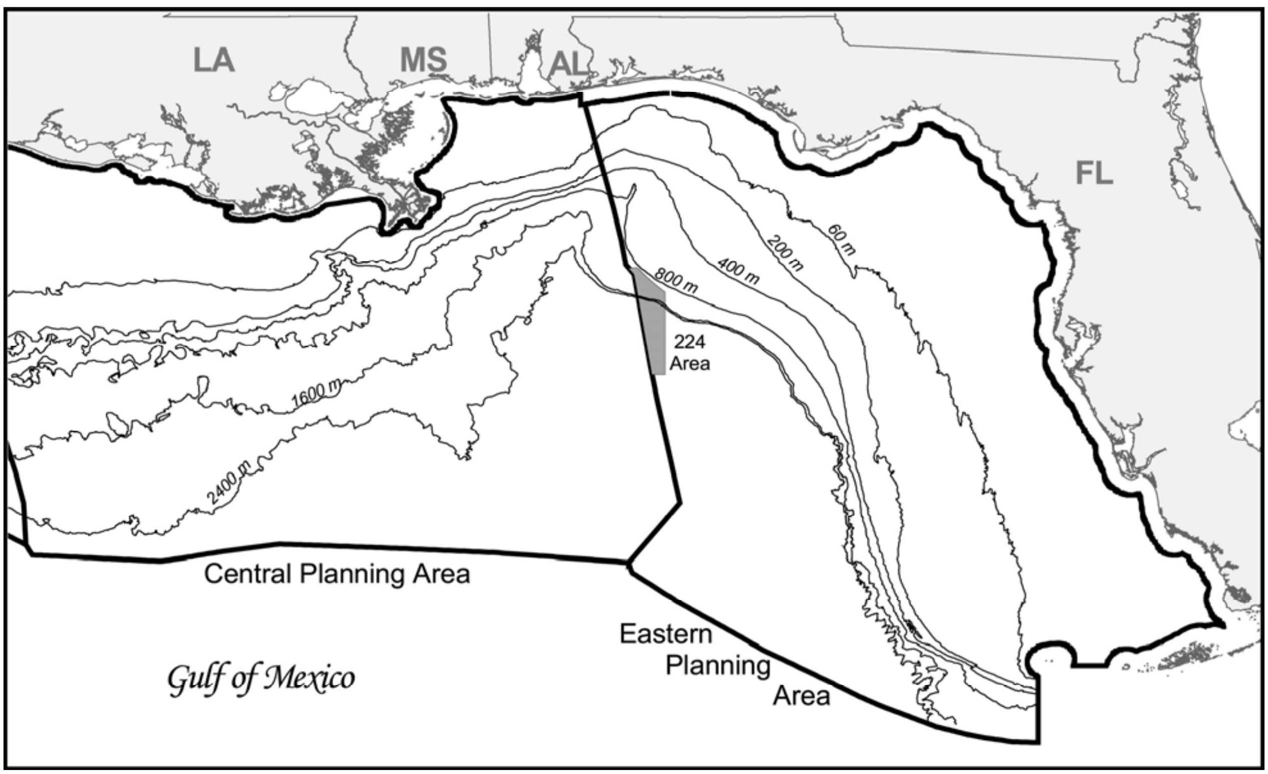
OCS EIS/EA
MMS 2007-060

Gulf of Mexico OCS Oil and Gas Lease Sale 224

Eastern Planning Area

Final Supplemental Environmental Impact Statement



MMS
U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region

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REGIONAL DIRECTOR'S NOTE

On December 20, 2006, President Bush signed into law the Gulf of Mexico Energy Security Act (GOMESA), which makes available two new areas in the Gulf of Mexico for leasing (the Lease Sale 224 and the "181 South" Areas). One oil and gas lease sale, within an area previously known as the "181 Area," is scheduled for the Eastern Planning Area. Lease Sale 224 will offer all blocks in the proposed lease sale area that may contain economically recoverable oil and gas via one lease sale, as authorized under GOMESA. Proposed Lease Sale 224 is scheduled to be held in March 2008. The Minerals Management Service (MMS) has prepared the *Gulf of Mexico OCS Oil and Gas Lease Sale 224: Eastern Planning Area, Final Supplemental Environmental Impact Statement* (EIS) for the proposed sale. At the completion of the EIS process, a decision will be made for Lease Sale 224.

The Department of the Interior has been conducting environmental analyses of the effects of Outer Continental Shelf (OCS) oil and gas development in the Gulf of Mexico since the inception of the National Environmental Policy Act (NEPA) 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
Acting Regional Director
Minerals Management Service
Gulf of Mexico OCS Region

COVER SHEET

Supplemental Environmental Impact Statement for Proposed Eastern Gulf of Mexico OCS Oil and Gas Lease Sale 224

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

Area of Potential Impact: Offshore Marine Environment and Coastal Parishes/Counties of Louisiana, Mississippi, Alabama, and northwestern Florida

Agency:	**Headquarters' Contact:**	**Region Contacts:**
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ABSTRACT

This Final Supplemental Environmental Impact Statement (SEIS) covers the proposed 2008 Eastern Gulf of Mexico OCS oil and gas Lease Sale 224. The proposed action is a major Federal action requiring an SEIS (reference **Chapter 1.1**). 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 alternative, description of the affected environment, and an analysis of the potential environmental impacts of the proposed action, the alternative, 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 a proposed action is adopted. Activities and disturbances associated with a proposed action on biological, physical, and socioeconomic resources are considered in the analyses.

Additional copies of this SEIS and the referenced MMS publications and visuals may be obtained from the MMS, 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

This supplemental environmental impact statement (SEIS) addresses one proposed Federal action that offers for lease in the Eastern Planning Area (EPA) an area on the Gulf of Mexico (GOM) Outer Continental Shelf (OCS) that may contain economically recoverable oil and gas resources (**Figure 1-1**). On December 20, 2006, President Bush signed into law the Gulf of Mexico Energy Security Act of 2006 (GOMESA), which makes available two new areas in the GOM for leasing (portions of the “181 Area” and the “181 South Area” (**Figure 1-2**)), places a moratorium on other areas in the GOM, and increases the distribution of offshore oil and gas revenues to coastal States. The proposed Lease Sale 224 area is contained within the area designated as “181 Area” by GOMESA. Federal regulations allow for the preparation of supplements to either a draft or final EIS if an agency makes substantial changes in the proposed action or if there are new significant circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts (40 CFR 1502.9(c)). At the completion of this SEIS process, decisions will be made only for proposed Lease Sale 224 in the EPA. 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 SEIS. To obtain the proper perspective and context of the potential environmental and socioeconomic impacts discussed, it is necessary to read the analyses in their entirety. Relevant discussions can be found in the chapters of this SEIS as described below. This single volume SEIS contains **Chapters 1 through 8,** the **figures and tables,** and the **Appendices**, which are listed below, and provides more in-depth information and analyses.

- **Chapter 1**, the Proposed Action, describes the purpose of and need for the proposed lease sale. **Chapter 1** also provides summaries of the major applicable Federal laws and regulations, and describes the prelease process, postlease activities; and other OCS-related activities.
- **Chapter 2**, Alternatives Including the Proposed Action, describes the proposed lease sale and alternatives, and summarizes the environmental and socioeconomic effects. Also discussed are potential mitigation measures to avoid or minimize impacts.
- **Chapter 3**, Description of the Affected Environment, describes the environment that would potentially be affected by the proposed action and the alternative. Also described are existing offshore and coastal infrastructure, which supports OCS oil and gas activities. The description of the affected environment includes impacts from recent major hurricanes to the physical environmental, biological environment, and socioeconomic activities and OCS-related infrastructure. These baseline data are considered in the assessment of impacts from the proposed lease sale to these resources and the environment.
- **Chapter 4**, Environmental and Socioeconomic Consequences, describes the scenario and impact-producing factors (IPF’s) associated with the proposed lease sale and alternatives, and the potential impacts on the environmental and socioeconomic resources described in **Chapter 3**.
  - **Chapter 4.1**, Impact-Producing Factors and Scenario—Routine Operations, describes the offshore infrastructure and activities (IPF’s) associated with the proposed lease sale that could potentially affect the biological, physical, and socioeconomic resources of the GOM.
  - **Chapter 4.2**, 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 the proposed lease sale.
  - **Chapter 4.3**, Environmental and Socioeconomic Impacts of the Proposed Sale and Alternatives—Routine, Accidental, and Cumulative Analyses,

discusses and considers the environmental and socioeconomic impacts that may result from the routine and accidental analyses as well as the incremental impact of a proposed lease sale when added to all past, present, and reasonably foreseeable future human activities, including OCS activities and non-OCS activities.

— **Chapter 4.4**, Unavoidable Adverse Impacts of the Proposed Action.

— **Chapter 4.5**, Irreversible and Irretrievable Commitment of Resources.

— **Chapter 4.6**, 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 SEIS.
- **Chapter 6**, References, is a list of literature cited throughout this SEIS.
- **Chapter 7**, Preparers, is a list of names of persons who were primarily responsible for preparing and reviewing this SEIS.
- **Chapter 8**, Glossary, is a list of definitions of selected terms used in this SEIS.
- The **Appendices** contain material prepared in connection with this SEIS that support description or analyses in this SEIS.

Proposed Action and Alternatives

Alternative A (Preferred Alternative)—The Proposed Action: This alternative would offer for lease all blocks within the Sale 224 Area for oil and gas operations.

The Lease Sale 224 Area encompasses about 134 unleased, whole and partial blocks covering approximately 584,000 acres (ac) in that portion of the "181 Area" that is west of the Military Mission Line and more than 125 miles (mi) (200 kilometers (km)) from Florida **(Figure 1-2)**. The estimated amount of resources projected to be developed as a result of proposed Lease Sale 224 is 0.1-0.14 billion barrels of oil (BBO) and 0.16-0.34 trillion cubic feet (Tcf) of gas.

Alternative A has been identified as the Agency's (Minerals Management Service's) preferred alternative; however, this does not mean that the other alternative may not be selected in the Record of Decision.

Alternative B—No Action: This is the cancellation of proposed EPA Lease Sale 224. The opportunity for development of the 0.1-0.14 BBO and 0.16-0.34 Tcf of gas that could have resulted from the proposed EPA lease sale would be precluded or postponed. Any potential environmental impacts resulting from the proposed lease sale would not occur or would be postponed.

Proposed Mitigating Measures Analyzed

The potential mitigating measures included for analysis in this SEIS were developed as the result of scoping efforts over a number of years for the continuing OCS Program in the GOM. Four lease stipulations are proposed for the EPA sale—the Protected Species Stipulation, Military Areas Stipulation, the Evacuation Stipulation, and the Coordination Stipulation. These measures will be considered for adoption by the Assistant Secretary of the Interior for Land and Minerals (ASLM). Any stipulations or mitigation requirements to be included in Lease Sale 224 will be described in the Final Notice of Sale for this lease sale. Mitigation 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 this lease sale, will undergo a National Environmental Policy Act (NEPA) review, and additional project-specific mitigations may be applied as conditions of plan approval. The MMS 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.

Endangered Species Act Section 7 Consultations, performed with the National Marine Fisheries Service (NMFS) and Fish and Wildlife Service (FWS) for Lease Sale 181, apply for the proposed lease sale. All specific protective measures developed as a result of those consultations and included in previous lease sales, such as the Marine Protected Species Stipulation, remain in effect for this proposed action.

Application of lease stipulations will be considered by the ASLM. The analysis of the stipulations as part 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 this lease sale will be described in the Final Notice of Sale for this lease 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. The MMS's GOM 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 an assumed range of activities (for example, 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 4.3**) considers environmental and socioeconomic impacts that may result from the incremental addition of the lease sale when added to all past, present, and reasonably foreseeable future human activities, including non-OCS activities such as import tankering and commercial fishing. The cumulative analysis includes all activities that are projected to occur from past, proposed, and future lease sales during the 40-year analysis period (2008-2047). 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 SEIS 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 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, tourism, aesthetic interference, cultural impacts, environmental justice, and consistency with State coastal zone management programs. Environmental resources and activities determined to warrant environmental analyses are water and air quality, sensitive coastal environments (coastal barrier beaches and associated dunes, wetlands, and seagrass communities), sensitive offshore resources, marine mammals, sea turtles, beach mice, endangered and threatened fish, coastal and marine birds, fisheries, recreational fishing, recreational resources, archaeological resources, and socioeconomic conditions.

Non-OCS issues included impacts 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 GOM oil and gas activities have been impacted by several major hurricanes. Hurricanes Lili (2002), Ivan (2004), Katrina (2005), and Rita (2005) are discussed in **Chapters 3 and 4**. The description of the affected environment (**Chapter 3**) includes impacts from these storms 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)**.

Impact Conclusions

A summary of the potential impacts on each environmental and socioeconomic resource and the conclusions of the analyses can be found in **Chapter 2.1.3**. The full analyses are presented in **Chapter 4.3** (impacts of routine, accidental, and cumulative activities from proposed Lease Sale 224).

Air Quality: Emissions of pollutants into the atmosphere from routine activities associated with the proposed action are projected to have minimal impacts on onshore air quality, including emissions within the National Ambient Air Quality Standards (NAAQS). Increases in onshore annual average concentrations of NO_x, SO_x, and PM_{10} as a result of the proposed action will be less than the maximum increases allowed in the Prevention of Significant Deterioration (PSD) Class II areas. However, accidents as a result of the proposed action may involve high concentrations of H_2S that could result in deaths as well as environmental damage. Other emissions of pollutants from accidental events as a result of the proposed action are not expected to have concentrations that would change onshore air quality classifications.

Coastal Waters: The impacts to coastal water quality from routine activities associated with a proposed action should be minimal as long as all existing regulatory requirements are met. Accidental events associated with the proposed action could temporarily impact coastal water quality. More extensive impacts may result if the oil is trapped and released from sand on the beach or wetlands. However, the distance of the proposed action from shore and the likely small nature of nearshore spills will minimize the chance of oil soaking into sediments.

Marine Waters: Regulations limit the levels of contaminants in discharges of drilling fluids and cuttings from exploratory activities and produced water and supply-vessel discharges during production activities. Therefore, the impacts to marine water quality from routine activities associated with the proposed action should be minimal as long as regulatory requirements are followed. Large spills as a result of accidental events associated with the proposed action could impact water quality. However, the distance of the proposed action from shore and the likely small nature of nearshore spills will minimize the chance of long-term nearshore impacts on water quality. Chemical spills, the accidental release of synthetic-based fluids (SBF), and blowouts are expected to have temporary localized impacts on water quality.

Coastal Barrier Beaches and Associated Dunes: Effects to coastal barrier beaches and associated dunes from routine activities (navigation channel use and dredging, and continued use of infrastructure) associated with the proposed action are expected to be restricted to temporary and localized disturbances. No significant impacts to the physical shape and structure of barrier beaches and associated dunes are expected to occur as a result of accidental events associated with the proposed action. Should a spill contact a barrier beach, oiling is expected to be light and sand removal during cleanup activities minimized. However, the distance of the proposed action from shore and the likely small nature of nearshore spills will minimize the chance of a spill contacting barrier beaches.

Wetlands: Impacts to wetlands from routine activities associated with the proposed action are expected to be low and could be further reduced through mitigation. The proposed action is expected to contribute minimally to the need for maintenance dredging of navigation channels and canals. Alternative dredged-material disposal methods can be used to enhance and create coastal wetlands. Vessel traffic associated with the proposed action is expected to contribute minimally to the erosion and widening of navigation channels and canals.

Offshore oil spills resulting from the proposed action are not expected to damage significantly any wetlands along the Gulf Coast due to the distance from shore of any large spill. However, if an inland oil spill related to the proposed action occurs, some impact to wetland habitat would be expected. Although the impact may occur generally over coastal regions, the impact has the highest probability of occurring in and around Plaquemines Parish, Louisiana, in the Central Planning Area (CPA). Impacts to wetland habitats from an oil spill associated with activities related to the proposed action would be expected to be low and temporary. Although the probability of occurrence is low, the greatest threat to wetland habitat is from an inland spill resulting from a vessel accident or pipeline rupture. While a resulting slick may cause minor impacts to wetland habitat and surrounding seagrass communities, 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 avoid or minimize those impacts.

Seagrass Communities: Very little, if any, damage would occur as a result of typical channel traffic associated with the proposed action. Maintenance dredging will not have a substantial impact on existing seagrass habitat given that no new channels are expected to be dredged as a result of the proposed action, and increased dredging is not projected as a result of the proposed lease sale. No permanent loss of seagrass is projected to result from oil contact unless an unusually low tidal event allows direct contact between the slick and vegetation. The greatest danger under the more probable circumstances is a reduction of the diversity or population of epifauna and benthic fauna found in seagrass beds. Some fauna are more susceptible to oil impacts than others. It could take as much as 5-10 years of community succession before faunal composition resembles pre-impact conditions, although recovery from small spills (more likely inshore) would be much quicker.

Chemosynthetic Deepwater Benthic Communities: Routine activities or 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. The rarer, widely scattered, high-density, Bush Hill-type chemosynthetic communities could experience very minor (if any) impacts from drilling discharges or resuspended sediments located at more than 1,500 ft (457 m) away as required by NTL 2000-G20.

Nonchemosynthetic Deepwater Benthic Communities: Routine activities or accidental events associated with the proposed action are expected to cause little damage to the ecological function or biological productivity of the widespread, typical deep-sea benthic communities. Impacts to other hard-bottom communities are expected to be avoided as a consequence of the application of the existing NTL 2000-G20 for chemosynthetic communities. The same geophysical conditions associated with the potential presence of chemosynthetic communities also results in hard carbonate substrate that is generally avoided.

Marine Mammals: Routine activities associated with the proposed action, particularly when mitigated as required by MMS, 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 GOM. Accidental blowouts, oil spills, and spill-response activities resulting from the proposed action have the potential to impact marine mammals in the GOM. Exposure to hydrocarbons persisting in the sea following the dispersal of an oil slick is likely to result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity; and increased vulnerability to disease) to marine mammals.

Sea Turtles: While routine activities associated with the proposed action have the potential to harm sea turtles, they are unlikely to have significant adverse effects on the size and recovery of any sea turtle species or population in the GOM. Most routine OCS activities are expected to have sublethal effects. Although lethal effects may occur from chance collisions with OCS service vessels or ingestion of plastic materials, a large body of laws and regulations decreases the risk of spills occurring and ensures quick response for cleanup actions. Accidental blowouts, oil spills, and spill-response activities associated with the proposed action 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. In most foreseeable cases, exposure to hydrocarbons persisting in the sea following the dispersal of an oil slick will result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity; 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 by would likely be fatal.

Alabama, Choctawhatchee, St. Andrew and Perdido Key Beach Mice, and Florida Salt Marsh Vole: Due to the restricted distributions of these species, the nature of their habitats, and the distance from shore of the Lease Sale 224 activities, impacts on the Alabama, Choctawhatchee, St. Andrew and Perdido Key beach mice, and the Florida salt marsh vole is possible but unlikely. Impact may result from consumption of beach trash and debris. Efforts undertaken for the removal of marine debris or for beach restoration, such as sand replenishment, may temporarily scare away beach mice, destroy their food resources, or collapse the tops of their burrows. Given the low probability of a large (≥1,000 bbl) spill occurring, direct impacts of oil spills on beach mice from the proposed action are highly unlikely. Oil-spill response and cleanup activities could have a significant impact on the beach mice and their habitat, if not properly regulated.

Coastal and Marine Birds: The majority of effects resulting from routine activities associated with the proposed action on endangered/threatened and nonendangered/nonthreatened coastal and marine birds are expected to be sublethal behavioral effects, sublethal exposure to or intake of OCS-related contaminants or discarded debris, temporary disturbances, and displacement of localized groups from impacted habitats. Nocturnal circulation around platforms may create acute sublethal stress from energy loss, while stopovers on platforms would reduce energy loss. No significant habitat impacts are expected to occur directly from routine activities associated with the proposed action. Oil spills from the proposed action pose the greatest potential for direct and indirect impacts to coastal and marine birds. Birds that are heavily oiled are usually killed. Lightly oiled birds can sustain tissue and organ damage from oil ingested during feeding and grooming or from oil that is inhaled. Low levels of oil could stress birds by interfering with food detection, feeding impulses, predator avoidance, territory definition, homing of migratory species, susceptibility to physiological disorders, disease resistance, growth rates, reproduction, and respiration. The air, vehicle, and foot traffic that takes place during shoreline cleanup activity can disturb nesting populations and degrade or destroy habitat if not properly regulated. Impacts to birds as a result of the proposed action are expected to be minor in scope and short term in duration.

Gulf Sturgeon: Routine activities resulting from the proposed action are expected to have negligible potential effects on Gulf sturgeon and their designated critical habitat. The Gulf sturgeon could be impacted by oil spills resulting from the proposed action since contact with spilled oil could have detrimental physiological effects. However, several factors influence the probability of spilled oil contact with Gulf sturgeon or their critical habitat. The distance of the proposed action from shore, the likely small nature of nearshore spills, and projected cleanup measures will greatly reduce the likelihood of spill occurrence and subsequent contact with, or impact on, Gulf sturgeon and/or designated critical habitat.

Fish Resources and Essential Fish Habitat: Routine activities associated with the proposed action are expected to result in an immeasurably small decrease in fish resources and/or standing stocks or in essential fish habitat (EFH). It would require one generation for fish resources to recover from 99 percent of the impacts. The effect of proposed-action-related oil spills on fish resources is expected to cause less than a 1 percent decrease in standing stocks of any population, commercial fishing efforts, landings, or value of those landings. At the expected level of impact, the resultant influence on fish populations from the proposed action would be negligible and indistinguishable from variations due to natural causes. It is expected that coastal environmental degradation from the proposed action would have little effect on fish resources or EFH; however, wetland loss could occur due to a petroleum spill contacting inland areas.

Commercial Fishing: Routine activities associated with the proposed action, such as seismic survey, will cause negligible impacts and will not deleteriously affect commercial fishing activities in the sale area more than 125 mi (200 km) offshore. The proposed action is expected to result in an immeasurably small decrease in activities, in pounds landed, or in the value of landings. It will require less than 6 months for fishing activity to recover from any impacts. The effect of proposed-action-related oil spills on commercial fishing is expected to cause less than a 1 percent decrease in standing stocks of any population, commercial fishing efforts, landings, or value of those landings. Any affected commercial fishing activity would recover within 6 months. At the expected level of impact, the resultant influence on commercial fishing activities from the proposed action would be negligible and indistinguishable from variations due to natural causes. It is expected that coastal environmental degradation from the proposed action would have little effect on fish resources or EFH; however, wetland loss could occur due to a petroleum spill contacting inland areas.

Recreational Fishing: The development of oil and gas in the proposed lease sale area is not likely to attract additional recreational fishing activity to structures installed on productive leases due to the long distances from shore. Impacts on recreational fishing because of OCS-related vessel wakes would be minor because, on average, vessel use associated with the proposed action would represent less than 1 percent of total vessel use. Potential impacts on recreational fisheries due to accidental events as a result of the proposed action would be minor. Based on the sizes of oil spills assumed for the proposed action, only localized and short-term disruption of recreational fishing activity might result (minor impact).

Recreational Resources: The proposed action is not expected to result in nearshore operations that may adversely affect the enjoyment of some Gulf Coast beach uses. The impact of marine debris on Gulf Coast recreational beaches is expected to be minimal. The incremental increase in helicopter and vessel traffic is expected to add very little additional noise that may affect beach users. It is unlikely that a spill would be a major threat to recreational beaches because any impacts would be short term and localized.

Historic Archaeological Resources: Offshore oil and gas activities resulting from the proposed action could contact a shipwreck because of incomplete knowledge on the location of shipwrecks in the Gulf. Although this occurrence is not probable, such an event would result in the disturbance or destruction of important historic archaeological information. Other factors associated with the proposed action are not expected to affect historic archaeological resources. Impacts to a historic archaeological resource could occur as a result of an accidental spill. The major effect from an oil-spill impact would be visual contamination of a historic coastal site, such as a historic fort or lighthouse. Since historic 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 to historic archaeological resources. These impacts would be temporary and reversible.

Prehistoric Archaeological Resources: The proposed action is not expected to result in impacts to prehistoric archaeological sites due to the distance from shore and the depth of the actions that may result from the lease sale.

Land Use and Coastal Infrastructure: There is no projected new construction due to the proposed action. Existing infrastructure is projected to be adequate to handle the proposed action. Accidental events such as oil or chemical spills, blowouts, and vessel collisions would have no effects on land use. Coastal or nearshore spills could have short-term adverse effects on coastal infrastructure, requiring cleanup of any oil or chemicals spilled.

Demographics: Routine activities relating to the proposed action are expected to minimally affect the analysis area's land use, infrastructure, and demography. These impacts are projected to mirror employment effects that are estimated to be negligible to any one economic impact area (EIA). Baseline patterns and distributions of these factors are expected to maintain the same level. Changes in land use throughout the analysis area are expected to be contained and minimal. Accidental events such as oil or chemical spills, blowouts, and vessel collisions would have no effects on the demographic characteristics of the Gulf coastal communities.

Economic Factors: There would be only minor economic changes in the Louisiana, Mississippi, Alabama, and Florida EIA's as the result of the proposed action. The proposed action is expected to generate less than a 1 percent increase in employment in any of the EIA's. The short-term social and economic consequences for the Gulf coastal region should a spill ≥1,000 bbl occur includes opportunity cost of employment and expenditures that could have gone to production or consumption rather than spill cleanup efforts. Non-market 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 an oil 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.

Environmental Justice: The effects of the proposed action are expected to be widely distributed and little felt. Impacts related to the 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 proposed action is not expected to have a disproportionate effect on minority or low-income people. Routine activities or accidental events associated with the proposed action are not expected to have disproportionate high/adverse environmental or health effects on minority or low-income people.

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ABBREVIATIONS AND ACRONYMS

°C	degree Celsius
°F	degree Fahrenheit
µg	micrograms
µm	
^{210}Pb	lead 210
2D	two-dimensional
3D	three-dimensional
4C	multicomponent
4D	four-dimensional
AAPA	American Association of Port Authorities
ac	acre
ACP	Area Contingency Plans
ADEM	Alabama Department of Environmental Management
AGA	American Gaming Association
AHTS	anchor-handling towing supply/mooring vessels
AL	Alabama
AMSA	Australian Maritime Safety Authority
ANPR	Advance Notice of Proposed Rulemaking
APD	Application for Permit to Drill
API	American Petroleum Institute
AQRV	air quality related values
Area ID	Area Identification
ASLM	Assistant Secretary of the Interior for Land and Minerals
atm	atmosphere
B.P.	before present
BACT	best available control technology
BAST	best available and safest technology
bbl	barrel
BBO	billion barrels of oil
Bcf	billion cubic feet
Bcf/d	billion cubic feet per day
BiO	Biological Opinion
BNWA	Breton National Wildlife Refuge and National Wilderness Area
BOD	biochemical oxygen demand
BOE	barrels of oil equivalent
BOP	blowout preventer
CAA	Clean Air Act of 1970
CAAA	Clean Air Act Amendments of 1990
Call	Call for Information and Nominations
CBO	Congressional Budget Office
CBRA	Coastal Barrier Resources Act
CBRS	Coastal Barrier Resource System
CCA	Coastal Coordination Act (Texas)
CCMP	Comprehensive Conservation and Management Plan
CD	Consistency Determination
CDP	common-depth-point (seismic surveying)
CEE	controlled exposure experiment
CEI	Coastal Environments, Inc.
CEQ	Council on Environmental Quality
CER	categorical exclusion review
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CES	Center for Energy Studies
cf.	compare, see
CFR	Code of Federal Regulations
CIAP	Coastal Impact Assistance Program
CID	Conservation Information Document
CIS	corrosion inhibiting substance
cm	centimeter
CMI	Coastal Marine Institute
CMP	Coastal Management Plans
CNG	compressed natural gas
CNRA	Coastal Natural Resources Area
CO	carbon monoxide
CO_2	carbon dioxide
COE	Corps of Engineers (U.S. Army) (also: USACE)
COF	covered offshore facilities
CPA	Central Planning Area
CPRA	Coastal Protection and Restoration Authority
CPS	coastal political subdivisions
CRE	Center for Regulatory Effectiveness
CRS	Congressional Research Service
CSA	Continental Shelf Associates
CWA	Clean Water Act
CWPPRA	Coastal Wetlands Protection, Planning & Restoration Act
CZARA	Coastal Zone Act Reauthorization Amendments of 1990
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act

CZMP Coastal Zone Management Program
CZPA Coastal Zone Protection Act of 1996
dB re-1μPa-m decibels, reference pressure 1 micropascal, reference range 1 meter
dB decibel
DDT dichloro-diphenyl-trichloroethane
DGoMB Deep Gulf of Mexico Benthos
DOC Department of Commerce (U.S.) (also: USDOC)
DOD Department of Defense (U.S.)
DOE Department of Energy (U.S.) (also: USDOE)
DOI Department of the Interior (U.S.) (also: USDOI)
DOS Department of State
DOT Department of Transportation (U.S.) (also: USDOT)
DOTD Department of Transportation and Development
DP dynamically positioned
DPP development and production plan
DSV downhole safety valves
DWOP deepwater operations plan
DWPA Deepwater Ports Act of 1974
DWT dead weight tonnage
E&P exploration and production
e.g. for example
EA environmental assessment
EDP exploration, development, and production
EEZ Exclusive Economic Zone
EFH Essential Fish Habitat
EH oxidation reduction potential
EIA Economic Impact Area
EIA Energy Information Administration (USDOE)
EIS environmental impact statement
EP exploration plan
EPA Eastern Planning Area
EROS explosive removal of structure
ERS Economic Research Service
ESA Endangered Species Act of 1973
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
FAD fish attracting device
FCF Fishermen's Contingency Fund
FDA Food and Drug Administration
FDEP Florida Department of Environmental Protection
FEIS final environmental impact statement
FEMA Federal Emergency Management Agency
FERC Federal Energy Regulatory Commission
FGB Flower Garden Banks
FGBNMS Flower Garden Banks National Marine Sanctuary
FL Florida
FLM Federal Land Manager
FMC Fishery Management Council
FMP Fishery Management Plan
FNOS Final Notice of Sale
FO Field Operations
FONSI Finding of No Significant Impact
FOSC Federal On-Scene Coordinator
FPS floating production system
FPSO floating production, storage, and offloading system
FR Federal Register
ft feet
FWPCA Federal Water Pollution Control Act of 1972
FWS Fish and Wildlife Service (U.S.)
FY fiscal year
g gram
G&G geological and geophysical
gal gallon
GIS geographical information system
GIWW Gulf Intracoastal Waterway
GLO General Land Office
GLPC Greater Lafourche Port Commission
GMAQS Gulf of Mexico Air Quality Study
GMFMC Gulf of Mexico Fishery Management Council
GOM Gulf of Mexico
GOMESA Gulf of Mexico Energy Security Act of 2006
GOMR Gulf of Mexico Region
GOOMEX Gulf Mexico Offshore Operations Monitoring Experiment
GS Geological Survey (U.S.) (also: USGS)
GT gross tons
H_2S hydrogen sulfide

ha	hectare
HAPC	Habitat Areas of Particular Concern
HCl	hydrochloric
HIPPS	high-integrity pressure protection system
HMS	highly migratory species
HPHT	high-pressure, high-temperature
hr	hour
Hz	hertz
i.e.	specifically
IADC	International Association of Drilling Contractors
ICC	International Beach Cleanup
ICCAT	International Commission for the Conservation of Atlantic Tunas
in	inch
IPCC	Intergovernmental Panel Climate Change
IPF	impact-producing factor
ISPS	International Ship and Port Facility Security Code
IT	incidental take
ITOPF	International Tanker Owners Pollution Federation Limited
ITS	Incidental Take Statement
IUCN	International Union for the Conservation of Nature
IWC	International Whaling Commission
kg	kilogram
kHz	kilohertz
kJ	kilojoule
km	kilometer
kn	knot
L	liter
LA	Louisiana
LA Hwy 1	Louisiana Highway 1
LADEQ	Louisiana Department of Environmental Quality
LADNR	Louisiana Department of Natural Resources
LATEX	Texas-Louisiana Shelf Circulation and Transport Process Program (MMS-funded study)
lb	pound
LC_{50}	lethal concentration, 50% mortality
LMA	labor market area
LNG	liquefied natural gas
LOOP	Louisiana Offshore Oil Port
LPG	liquefied petroleum gas
LSNWR	Lower Suwannee National Wildlife Refuge
LSU	Louisiana State University
LTL	Letters to Lessees
LWC	loss of well control
LWCF	Land and Water Conservation Fund
m	meter
ml	milliliter
m/sec	meters/second
m/yr	meters per year
MAFLA	Mississippi, Alabama, and Florida
MAMES	Mississippi-Alabama Marine Ecosystem Study
MARAD	U.S. Department of Transportation Maritime Administration
MARPOL	International Convention for the Prevention of Pollution from Ships
MBOPD	millions of barrels of oil per day
MDP	Marine Debris Monitoring Program
MFCMA	Magnuson Fishery Conservation and Management Act of 1976
mg	milligram
mg/l	milligrams per liter
MHHW	mean higher high water
mi	mile
MLLW	mean lower low water
mm	millimeter
mm/yr	millimeter/year
MMB	Marine Minerals Branch
MMbbl	million barrels
MMbbl/day	million barrels per day
MMBtu	million British thermal units
MMC	Marine Mammal Commission
MMcfd	million cubic feet per day
MMPA	Marine Mammal Protection Act of 1972
MMS	Minerals Management Service
MOA	Memorandum of Agreement
MODU	mobile offshore drilling unit
MOU	Memorandum of Understanding
MPA	Marine Protected Area
MPD	managed pressure drilling
mph	miles per hour
MPPRCA	Marine Plastic Pollution Research and Control Act of 1987
MPRSA	Marine Protection, Research, and Sanctuaries Act of 1972
MPSV	multi-purpose supply vessels

MRFSS	Marine Recreational Fisheries Statistics Survey
MRGO	Mississippi River Gulf Outlet
MS	Mississippi
MSA	Metropolitan Statistical Area
MSD	marine sanitation device
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act of 1976
MSL	mean sea level
MSRC	Marine Spill Response Corporation
MSW	municipal solid waste
MSY	maximum sustainable yield
MTBE	methyl tertiary butyl ether
MTSA	Maritime Transportation Act of 2002
MW	megawatts
N.	north
NAAQS	National Ambient Air Quality Standards
NACE	National Association of Corrosion Engineers
NACOSH	National Advisory Committee on Occupational Safety and Health
NARP	National Artificial Reef Plan
NEGOM	northeastern GOM
NEP	National Estuary Program
NEPA	National Environmental Policy Act
NERBC	New England River Basins Commission
ng	nanogram (one-billionth of a gram)
NHPA	National Historic Preservation Act
NHPF	National Historic Preservation Fund
NHS	National Highway System
NIOSH	National Institute for Occupational Safety and Health
NMFS	National Marine Fisheries Service
nmi	nautical mile
NO_2	nitrogen dioxide
NO_x	nitrogen oxide
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent to Prepare an EIS
NORM	naturally occurring radioactive material
NOS	National Ocean Service
NOSAC	National Offshore Safety Advisory Committee
NOW	nonhazardous oil-field waste
NPDES	National Pollutant and Discharge Elimination System
NPFC	National Pollution Funds Center
NPS	National Park Service
NRC	National Research Council
NRDA	Natural Resource Damage Assessment
NSRE	National Survey on Recreation and the Environment
NSTC	National Science and Technology Council
NTL	Notice to Lessees and Operators
NUT	new or unusual technology
NWR	National Wildlife Refuge
O_3	ozone
OBC	ocean bottom cables
OBF	oil-based drilling fluids
OCD	Offshore and Coastal Dispersion Model
OCRM	Office of Ocean and Coastal Resource Management
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OGP	Oil and Gas Producers
OPA	Oil Pollution Act of 1990
ORV	open rack vaporizer
OSC	On-Scene Coordinator
OSCP	Oil Spill Contingency Plan
OSFR	oil-spill financial responsibility
OSHA	Occupational Safety and Health Administration
OSLTF	Oil Spill Liability Trust Fund
OSM	Office of Safety Management
OSRA	Oil Spill Risk Analysis
OSRO	Oil Spill Removal Organization
OSRP	oil-spill response plans
OSV	offshore supply/service vessels
P.L.	Public Law
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
pCi/l	picoCuries/liter
PEA	programmatic environmental assessment
pH	potential of hydrogen
PINC	Potential Incident of Noncompliance
PINS	Padre Island National Seashore
PM	particulate matter

PM_{10}	particulate matter smaller than 10 microns in size
$PM_{2.5}$	particulate matter smaller than 2.5 microns in size
PNOS	Proposed Notice of Sale
ppb	part per billion
ppm	parts per million
ppt	parts per thousand
PSD	Prevention of Significant Deterioration
psi	pounds per square inch
PSV	platform supply vessel
R&D	research and development
RCRA	Resource Conservation and Recovery Act
RD	Regional Director
RFG	reformulated motor gasoline
ROTAC	Regional Operations Technology Assessment Committee
ROV	remotely operated vehicle
ROW	right-of-way
RP	Recommended Practice
RRC	Railroad Commission
RRT	Regional Response Team
RS	Regional Supervisor
RS-FO	Regional Supervisor for Field Operations
RTR	Rigs-to-Reef
S.	south
SAIC	Science Application International Corporation
SARA	Superfund Amendments and Reauthorization Act
SBF	synthetic-based drilling fluid
SCRS	Standing Committee for Research and Science
SEAMAP	Southeastern Area Monitoring and Assessment Program
SEIS	supplemental environmental impact statement
SIP	State implementation plan
SITP	shut-in tubing pressure
SO_2	sulphur dioxide
SO_x	sulphur oxides
sp.	species
spp.	multiple species
SPR	spawning potential ratio
SSSV	subsurface safety valves
Stat.	Statutes
SUSIO	State University System of Florida Institute of Oceanography
SWSS	Sperm Whale Seismic Study
TA&R	Technical Assessment & Research Program (MMS)
TCEQ	Texas Commission on Environmental Quality
Tcf	trillion cubic feet
TED	turtle excluder device
TL	total length
TLP	tension leg platform
TMDL	total maximum daily load
TOC	total organic carbon
TSS	traffic separation schemes
TVD	true vertical depth
TWC	treatment, workover, and completion
TX	Texas
U.S.	United States
U.S.C.	United States Code
U.S.V.I.	U.S. Virgin Islands
USACE	U.S. Dept. of the Army, Corps of Engineers
USCG	U.S. Coast Guard
USDOC	U.S. Department of Commerce (also: DOC)
USDOD	U.S. Department of Defense (also: DOD)
USDOE	U.S. Department of Energy (also: DOE)
USDOI	U.S. Department of the Interior (also: DOI)
USDOT	U.S. Department of Transportation (also: DOT)
USEPA	U.S. Environmental Protection Agency
USGS	United States Geological Survey (also: GS)
VOC	volatile organic compounds
VSP	vertical seismic profiling
W.	west
WBF	water-based drilling fluids
WPA	Western Planning Area
yd	yard

CONVERSION CHART

To convert from	To	Multiply by
millimeter (mm)	inch (in)	0.03937
centimeter (cm)	inch (in)	0.3937
meter (m)	foot (ft)	3.281
kilometer (km)	mile (mi)	0.6214
meter^2 (m^2)	foot^2 (ft^2)	10.76
	yard^2 (yd^2)	1.196
	acre (ac)	0.0002471
hectare (ha)	acre (ac)	2.47
kilometer^2 (km^2)	mile^2 (mi^2)	0.3861
meter^3 (m^3)	foot^3 (ft^3)	35.31
	yard^3 (yd^3)	1.308
liter (l)	gallons (gal)	0.2642
degree Celsius (°C)	degree Fahrenheit (°F)	°F = (1.8 x °C) + 32

CHAPTER 1

THE PROPOSED ACTION

1. THE PROPOSED ACTION

1.1. PURPOSE OF AND NEED FOR THE PROPOSED ACTION

The proposed Federal action addressed in this supplemental environmental impact statement (SEIS) is proposed Outer Continental Shelf (OCS) Lease Sale 224 in the Eastern Planning Area (EPA) of the Gulf of Mexico (GOM) (**Figure 1-1**). On December 20, 2006, President Bush signed into law the Gulf of Mexico Energy Security Act of 2006 (GOMESA), which makes available two new areas in the GOM for leasing (the Lease Sale 224 and the "181 South Area" (**Figure 1-2**)), places a moratorium on other areas in the GOM, and increases the distribution of offshore oil and gas revenues to coastal States. The purpose of the proposed Federal action is to offer for lease certain blocks within the EPA known as the 181 Area (**Figure 1-1**) that may contain economically recoverable oil and gas resources. The proposed lease sale, EPA Lease Sale 224, will provide qualified bidders the opportunity to bid upon lease acreage in the GOM OCS in order to explore, develop, and produce oil and natural gas. This SEIS analyzes the potential impacts of the proposed action on the marine, coastal, and human environments, and will be the only National Environmental Policy Act (NEPA) document prepared for proposed Lease Sale 224 in the EPA. At the completion of the NEPA process a decision will be made for proposed Lease Sale 224. This SEIS supplements the *Gulf of Mexico OCS Oil and Gas Lease Sale 181, Eastern Planning Area, Final Environmental Impact Statement* (Lease Sale 181 FEIS) (USDOI, MMS, 2001a). Pertinent material is summarized and incorporated by reference from the Lease Sale 181 FEIS and from 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; Volumes I and II* (Final Multisale EIS) (USDOI, MMS, 2007a).

According to the Council on Environmental Quality (CEQ), a supplement to a final environmental impact statement (FEIS) shall be prepared if there are significant new information relevant to environmental concerns and bearing on the proposed action or its impacts. This document is being prepared as an SEIS because significant new scientific information relevant to environmental resources has been discovered since completion of the Lease Sale 181 FEIS in 2001. These environmental resources include sensitive coastal environments and offshore benthic resources, marine mammals, sea turtles, endangered and threatened species, and fisheries. In 2004 and 2005, several hurricanes impacted the Gulf of Mexico region. These hurricanes resulted in significant short-term and long-term impacts to the environment and to the oil and gas industry. The new scientific information, as well as impacts resulting from hurricanes, requires further evaluation and are described in this SEIS.

The Outer Continental Shelf Lands Act (OCSLA) of 1953 (67 Stat. 462), as amended (43 U.S.C. 1331 *et seq*. (1988)), established Federal jurisdiction over submerged lands on the OCS seaward of the 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 Minerals Management Service (MMS) as the administrative agency responsible for the mineral leasing of submerged OCS lands and for the supervision of offshore operations after lease issuance.

The Gulf of Mexico constitutes one of the world's major oil and gas producing areas, and has proved a steady and reliable source of crude oil and natural gas for more than 50 years (Figure 1-3). Oil from the GOM can help reduce the Nation's need for oil imports and reduce the environmental risks associated with oil tankering. Natural gas is generally considered to be an environmentally preferable alternative to oil, both in terms of the production and consumption.

1.2. Description of the Proposed Action

The proposed action is to offer for lease all blocks in the proposed lease sale area that may contain economically recoverable oil and natural gas via one oil and gas lease sale (Lease Sale 224) as authorized under GOMESA.

Proposed EPA Lease Sale 224 is scheduled to be held in March 2008. The EPA sale area encompasses about 134 whole and partial blocks covering approximately 584,000 acres (ac) of that portion of the 181 Area that is west of the Military Mission Line (86°41'30"W. longitude). All areas under consideration for leasing are more than 125 miles (mi; 200 kilometers (km)) from Florida (**Figure 1-2**).

The estimated amount of resources projected to be developed as a result of this proposed EPA lease sale is 0.10-0.14 billion barrels of oil (BBO) and 0.16-0.34 trillion cubic feet (Tcf) of gas. The proposed EPA lease sale includes proposed lease stipulations designed to reduce environmental risks; the stipulations are discussed in **Chapter 2.2**.

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., National Environmental Policy Act). Several Federal regulations establish specific consultation and coordination processes with Federal, State, and local agencies (i.e., Coastal Zone Management Act, Endangered Species Act, the Magnuson-Stevens Fishery Conservation and Management Act, and the Marine Mammal Protection Act). In addition, the OCS leasing process and all activities and operations on the OCS must comply with other Federal, State, and local laws and regulations. On December 20, 2006, President Bush signed into law the Gulf of Mexico Energy Security Act of 2006 (GOMESA), which makes available two new areas in the GOM for leasing, places a moratorium on other areas in the GOM, and increases the distribution of offshore oil and gas revenues to coastal States. The following are summaries of the major, applicable, Federal laws and regulations.

Outer Continental Shelf Lands Act

The OCSLA of 1953 (43 U.S.C. 1331 *et seq*.), as amended, established Federal jurisdiction over submerged lands on the OCS seaward of State boundaries. The Act, as amended, provides guidelines for implementing an OCS oil and gas exploration and development program. The basic goals of the Act include the following:

- to establish policies and procedures for managing the oil and natural gas resources of the OCS that are intended to result in expedited exploration and development of the OCS in order to achieve national economic and energy policy goals, assure national security, reduce dependence on foreign sources, and maintain a favorable balance of payments in world trade;
- to preserve, protect, and develop oil and natural gas resources of the OCS in a manner that is consistent with the need;
  - — to make such resources available to meet the Nation's energy needs as rapidly as possible;
  - — to balance orderly resource development with protection of the human, marine, and coastal environments;
  - — to ensure the public a fair and equitable return on the resources of the OCS; and
  - — to preserve and maintain free enterprise competition; and
- to encourage development of new and improved technology for energy resource production, which will eliminate or minimize the risk of damage to the human, marine, and coastal environments.

Under the OCSLA, the Secretary of the Interior is responsible for the administration of mineral exploration and development of the OCS. Within the DOI, MMS is charged with the responsibility of managing and regulating the development of OCS oil and gas resources in accordance with the provisions of the OCSLA. The MMS operating regulations are in Chapter 30, Code of Federal Regulations, Part 250 (30 CFR 250); 30 CFR 251; and 30 CFR 254.

Enacted August 8, 2005, the Energy Policy Act amended Section 8 of the OCSLA to authorize DOI to grant leases, easements, or rights-of-way on the OCS for the development and support of energy resources from sources other than oil and gas and to allow for alternate uses of existing facilities on the OCS.

Under Section 20 of the OCSLA, the Secretary shall ". . . conduct such additional studies to establish environmental information as he deems necessary and shall monitor the human, marine, and coastal environments of such area or region in a manner designed to provide time-series and data trend information that can be used for comparison with any previously collected data for the purpose of identifying any significant changes in the quality and productivity of such environments, for establishing trends in the area studied and monitored, and for designing experiments to identify the causes of such changes." Through the Environmental Studies Program (ESP), MMS conducts studies designed to provide information on the current status of resources of concern and notable changes, if any, resulting from OCS Program activities.

In addition, the OCSLA provides a statutory foundation for coordination with the affected States and, to a more limited extent, local governments. At each step of the procedures that lead to lease issuance, participation from the affected States and other interested parties is encouraged and sought.

National Environmental Policy Act

The NEPA of 1969 (42 U.S.C. 4321 *et seq*.) provides a national policy that encourages "productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man . . . ." The NEPA requires that all Federal agencies use a systematic, interdisciplinary approach to protection of the human environment; this approach will ensure the integrated use of the natural and social sciences in any planning and decisionmaking that may have an impact upon the environment. The NEPA also requires the preparation of a detailed EIS on any major Federal action that may have a significant impact on the environment. This Lease Sale 224 SEIS must address any adverse environmental effects that cannot be avoided or mitigated, alternatives to the proposed action, the relationship between short-term uses and long-term productivity of the environment, and any irreversible and irretrievable commitments of resources involved in the project.

In 1979, the Council on Environmental Quality (CEQ) established uniform guidelines for implementing the procedural provisions of NEPA. These regulations (40 CFR 1500 to 1508) provide for the use of the NEPA process to identify and assess the reasonable alternatives to the proposed action that avoid or minimize adverse effects of these actions upon the quality of the human environment. "Scoping" is used to identify the scope and significance of important environmental issues associated with the proposed Federal action through coordination with Federal, State, and local agencies; the public; and any interested individual or organization prior to the development of an impact statement. The process is also intended to identify and eliminate, from further detailed study, issues that are not significant or that have been covered by prior environmental review.

The following Federal regulations establish specific consultation and coordination processes with Federal, State, and local agencies.

Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) (16 U.S.C. 1451 *et seq*.) was enacted by Congress in 1972 to develop a national coastal management program that comprehensively manages and balances competing uses of and impacts to any coastal use or resource. The national coastal management program is implemented by individual State coastal management programs in partnership with the Federal Government. The CZMA Federal consistency regulations require that Federal activities (e.g., OCS lease sales) be consistent to the maximum extent practicable with the enforceable policies of a State's coastal management program. The Federal consistency regulations also require that other federally approved activities (e.g., activities requiring Federal permits, such as activities described in OCS plans) be consistent with a State's federally approved coastal management program. The Federal consistency requirement is an important mechanism to address coastal effects, to ensure adequate Federal consideration of State coastal management programs, and to avoid conflicts between State and Federal agencies. The Coastal Zone Act Reauthorization Amendments of 1990 (CZARA), enacted November 5, 1990, as well as the Coastal Zone Protection Act of 1996 (CZPA), amended and reauthorized the CZMA. The CZMA is administered by the Office of Ocean and Coastal Resource Management (OCRM) within the National Oceanographic Atmospheric Administration's (NOAA's) National Ocean Service (NOS). The NOAA's implementing regulations are found at 15 CFR 930, with the latest revision published in the *Federal Register* on January 5, 2006.

The Endangered Species Act

The Endangered Species Act (ESA) (16 U.S.C. 1631 *et seq*.) of 1973, as amended (43 U.S.C. 1331 *et seq*.), establishes a national policy designed to protect and conserve threatened and endangered species and the ecosystems upon which they depend. The ESA is administered by the U.S. Fish and Wildlife Service (FWS) and NOAA's National Marine Fisheries Service (NMFS). Section 7 of the ESA governs interagency cooperation and consultation. Under Section 7, MMS consults with both NMFS and FWS to ensure that activities on the OCS under MMS jurisdiction do not jeopardize the continued existence of threatened or endangered species and/or result in adverse modification or destruction of their critical habitat.

Through a biological assessment or an informal consultation, NMFS and FWS determine the effect of the proposed action on a listed species or critical habitat. If either agency determines the proposed action would be likely to affect adversely either a listed species or critical habitat, a formal consultation is initiated. The formal consultation process commences with MMS's written request for consultation and concludes with NMFS and FWS each issuing a Biological Opinion (BiO).

In their BiO's, NMFS and FWS make recommendations on the modification of oil and gas operations to minimize adverse impacts, although it remains the responsibility of MMS to ensure that proposed OCS activities do not impact threatened and endangered species. If an unauthorized taking occurs or if the authorized level of incidental take is exceeded, reinitiation of formal consultation is likely required.

In 1988, MMS requested a "generic" consultation from NMFS pursuant to Section 7 of the ESA concerning potential impacts on endangered and threatened species associated with explosive-severance activities conducted during structure-removal operations. Much like the programmatic environmental assessment (PEA), the consultation's "generic" BiO was limited to the best scientific information available and concentrated primarily on the majority of structure removals (water depths <200 m or 656 feet (ft)). The Incidental Take Statement (ITS) was therefore limited to the five species of sea turtle found on the shallow shelf. Reporting guidelines and specific mitigation measures are outlined in the ITS and include (1) the use of a qualified NMFS observer, (2) aerial surveys, (3) detonation delay radii, (4) nighttime blast restrictions, (5) charge staggering and grouping, and (6) possible diver survey requirements.

Emphasizing a continued need for an incentive to keep explosive weights low, MMS formally requested that NMFS amend the 1988 BiO to establish a minimum charge size of 5 pounds (lb). The NMFS Southeast Regional Office subsequently addressed explosive charges ≤5 lb in a separate, informal BiO. The October 2003 "de-minimus" BiO waives several mitigative measures of the "generic" 1988 BiO (i.e., aerial observations, 48-hr pre-detonation observer coverage, onsite NOAA personnel, etc.), reduces the potential impact zone from 3,000 ft to 700 ft (914 m to 213 m), and gives the operators/ severing contractors the opportunity to conduct their own observation work.

The MMS recently prepared a new PEA, *Structure-Removal Operations on the Gulf of Mexico Outer Continental Shelf* (USDOI, MMS, 2005a), to evaluate the full range of potential environmental impacts of structure-removal activities in all water depths in the Central Planning Area (CPA) and Western Planning Area (WPA) and the Sale 181/189 area in the EPA of the Gulf of Mexico. On February 28, 2005, MMS submitted the new structure-removal PEA and a petition for new Incidental-Take Regulations under the Marine Mammal Protection Act (MMPA) to the National Marine Fisheries Service (NMFS). After review of the petition and PEA, NMFS published a notice of receipt of MMS's petition in the *Federal Register* on August 24, 2005. On April 7, 2006, NMFS published the proposed rule for the incidental take of marine mammals under the MMPA in the *Federal Register*. The subsequent public comment period ended May 22, 2006, and MMS expects the Final Rule to be published in the *Federal Register* in spring 2007. An ESA, Section 7 consultation was also conducted with the MMPA rulemaking efforts. The BiO and ITS were finalized and submitted to MMS in August 2006, and the terms and conditions contained within are similar to the mitigation discussed in Appendix F of the MMS PEA (USDOI, MMS, 2005a) and should mirror what is promulgated by NMFS in the final MMPA take-regulations.

By letters dated June 8, 2001, and June 15, 2001, FWS and NMFS, respectively, concluded formal consultation by providing biological opinions of Lease Sale 181 on threatened and endangered species. Both agencies concurred with MMS that implementation of the proposed lease sale was not likely to jeopardize the continued existence of any threatened or endangered species under the agencies' purview, or any areas proposed as critical habitat. The Lease Sale 224 area is encompassed within the Lease Sale 181 area. The MMS has made a determination that no additional impacts would trigger a re-initiation of consultation with NMFS or FWS. The MMS contacted FWS and NMFS on September 20 and September 21, 2007, respectively, requesting concurrence that conditions of the 2001 Biological Opinions remain in effect for proposed Lease Sale 224.

The Magnuson Fishery Conservation and Management Act

The Magnuson Fishery Conservation and Management Act (MFCMA) of 1976 (16 U.S.C. 1251 *et seq*.) established and delineated an area from the States' seaward boundary outward 200 nautical miles (nmi) as a fisheries conservation zone for the U.S. and its possessions. The Act established national standards for fishery conservation and management. It is now named the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA).

Congress amended and reauthorized the MSFCMA through passage of the Sustainable Fisheries Act of 1996. The Act, as amended, established eight Regional Fishery Management Councils (FMC's) to exercise sound judgment in the stewardship of fishery resources through the preparation, monitoring, and revision of fishery management plans (FMP's). An FMP is based upon the best available scientific and economic data. The reauthorization also promotes domestic commercial and recreational fishing under sound conservation and management principles, including the promotion and catch and release programs in recreational fishing and encouraging the development of currently underutilized fisheries. The reauthorization requires that the FMC's identify Essential Fish Habitat (EFH). To promote the protection of EFH, Federal agencies are required to consult on activities that may adversely affect EFH designated in the FMP's. The Act was reauthorized on January 12, 2007, with the President's signature of the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act that will authorize appropriations through 2013. The bill includes extensive provisions on individual fishing quotas and is intended to end overfishing, help replenish the Nation's fish stocks, and advance international cooperation and ocean stewardship.

Essential Fish Habitat

There are FMP's in the GOM OCS region for shrimp, red drum, reef fishes, coastal migratory pelagics, stone crabs, spiny lobsters, coral and coral reefs, billfish, and highly migratory species (HMS). The Gulf of Mexico Fishery Management Council's (GMFMC) *Generic Amendment for Addressing Essential Fish Habitat Requirements* (GMFMC, 1998) amends the first seven FMP's listed above, identifying estuarine/inshore and marine/offshore EFH for over 450 managed species (about 400 in the Coral FMP). Although not part of the GMFMC's FMP's, separate FMP's have been finalized by NMFS for Atlantic tunas, swordfish and sharks, and the Atlantic billfish fishery (USDOC, NMFS, 1999a and b).

The GMFMC's *Generic Amendment for Addressing Essential Fish Habitat Requirements* identifies threats to EFH and makes a number of general and specific habitat preservation recommendations for pipelines and oil and gas exploration and production activities within State waters and OCS areas (**Chapter 3.2.8.2**, Essential Fish Habitat). In 2005, a new amendment to the original EFH Generic Amendment was finalized (GMFMC, 2005). The purpose of this action was to amend each of the seven GOM FMP's to (1) describe and identify EFH for the fisheries, (2) minimize to the extent practicable the adverse effects of fishing on such EFH; and (3) encourage the conservation and enhancement of such EFH. This is pursuant to the mandate contained in Section 303(a)(7) of the MSFCMA. To support the description and identification of EFH and to address adverse fishing impacts for all managed GOM species, the GMFMC undertook, over a two-year period, a detailed analysis of the GOM's physical environment; oceanographic features; estuarine, nearshore, and offshore habitats; all fishery resources; and marine mammals and protected species. The analysis resulted in a Final EFH Environmental Impact Statement (EIS) (GMFMC, 2004a) for the seven FMP's. As a result of analyses from this Final EIS, the GMFMC proposed actions to describe and identify EFH, to establish habitat areas of particular concern (HAPC), and to address adverse effects of fishing on EFH. The NMFS approved these revisions, and the rule implementing the changes became effective January 23, 2006. One of the most significant proposed changes in this amendment will reduce the extent of EFH relative to the 1998 Generic Amendment by removing EFH description and identification from waters between 100 fathoms and the seaward limit of the Exclusive Economic Zone (EEZ).

Prior to this EIS, the Lease Sale 181 FEIS (USDOI, MMS, 2001a) requested and received an EFH consultation for the originally proposed larger Sale 181 area that included all of the proposed Lease Sale 224 area. The EFH conservation measures previously recommended by NMFS for the Lease Sale 181 FEIS serve the purpose of protecting EFH and include avoidance distances from topographic feature's No Activity Zones and live-bottom pinnacle features (although none occur in or near this lease area). These agreements, including avoidance distances from topographic feature's No Activity Zones and live-bottom pinnacle features appear in Notice to Lessees and Operators (NTL) 2004-G05. There were no EFH conservation recommendations relating to the proposed Lease Sale 224 area that had not been previously established by MMS or adopted through the original Programmatic Consultation Agreement with NMFS. By letter dated July 19, 2007 (Appendix E), NMFS has no objection to amending the agencies' current EFH agreement to add the proposed Lease Sale 224 area to the Programmatic Consultation package previously comprising only areas in the Central and Western Planning Areas.

Essential Fish Habitat Consultation

This SEIS includes the required components of an EFH assessment that represents a submission to NMFS in request of an EFH consultation. Each of these required components are outlined below, together with the associated chapters of this EIS where EFH discussion and other related material can be located.

1. A description of the proposed action:

   Chapters 1.2 and 2.2.1. Description of the environment appears throughout **Chapter 3** with specific sections on fishery resources and EFH in **Chapter 3.2.8.**

2. An analysis of the effects, including cumulative effects, of the proposed action on EFH:

   Routine operations, accidental events, and cumulative impacts are found in **Chapter 4.3.**

3. The MMS's views regarding the effects of an action on EFH:

   Summary and conclusion statements are included with each impact discussion outlined under Item 2 above. Summaries of impacts also appear in **Chapter 2.2.**

4. Proposed mitigations:

   Mitigations are presented in **Chapter 2.1.2.** Additional mitigating measures include lease stipulations, discussed in **Chapters 2.2.1.3.**

The Marine Mammal Protection Act

Under the Marine Mammal Protection Act (MMPA) of 1972 (16 U.S.C. 1361 *et seq.*), the Secretary of Commerce is responsible for all cetaceans and pinnipeds, except walruses. Authority for implementing the Act is delegated to NMFS. The Secretary of the Interior is responsible for walruses, polar bears, sea otters, manatees, and dugongs, and authority is delegated to FWS. The Act established the Marine Mammal Commission (MMC) and its Committee of Scientific Advisors on Marine Mammals to provide oversight and advice to the responsible regulatory agencies on all Federal actions bearing upon the conservation and protection of marine mammals.

The MMPA established a moratorium on the taking of marine mammals in waters under U.S. jurisdiction. The MMPA defines "take" to mean "to harass, harm, shoot, wound, trap, hunt, capture, or kill, or attempt to engage in any such conduct (including actions that induce stress, adversely impact critical habitat, or result in adverse secondary or cumulative impacts)." Potential "takes" that are likely to be associated with the OCS Program activities would be limited to harassment. The moratorium may be waived when the affected species or population stock is within its optimum sustainable population range and will not be disadvantaged by an authorized taking (e.g., will not be reduced below its maximum net productivity level, which is the lower limit of the optimum sustainable population range). The Act directs that the Secretary, upon request, authorize the unintentional taking of small numbers of marine mammals incidental to activities other than commercial fishing (e.g., offshore oil and gas exploration and development) when, after notice and opportunity for public comment, the Secretary finds that the total of such taking during the 5-year (or less) period will have a negligible impact on the affected species. The MMPA also specifies that the Secretary shall withdraw, or suspend, permission to unintentionally take marine mammals incidental to activities such as oil and gas development if, after notice and opportunity for public comment, the Secretary finds (1) that the applicable regulations regarding methods of taking, monitoring, or reporting are not being complied with or (2) the taking is, or may be, having more than a negligible impact on the affected species or stock.

In 1994, a subparagraph (D) was added to the MMPA to simplify the process for obtaining "small take" exemptions when unintentional taking incidental to activities such as offshore oil and gas development is by harassment only. Specifically, incidental take (IT) by harassment can now be authorized by permit for periods of up to one year (as opposed to the lengthy regulation/Letter of Authorization process that was formerly in effect). The new language also sets a 120-day time limit for processing harassment IT authorizations. In 1989, the American Petroleum Institute (API) petitioned NMFS under Subpart A of the MMPA regulations for the incidental take of spotted and bottlenose dolphins during structure-removal operations (i.e., for either explosive- or nonexplosive-severance activities). The Incidental Take Authorization regulations were promulgated by NMFS in October 1995 (60 FR 53139, October 12, 1995), and on April 10, 1996 (61 FR 15884), the regulations were moved to Subpart M (50 CFR 216.141 *et seq*.). Effective for 5 years, the regulations detailed conditions, reporting requirements, and mitigative measures similar to those listed in the 1988 ESA Consultation requirements for sea turtles. After the regulations expired in November 2000, NMFS and MMS advised operators to continue following the guidelines and mitigative measures of the lapsed subpart pending a new petition and subsequent regulations. At industry's prompting, NMFS released Interim regulations in August 2002, which expired on February 2, 2004. Operators have continued to follow the Interim conditions until NMFS promulgates new regulations.

The MMS recently prepared a new PEA, *Structure-Removal Operations on the Gulf of Mexico Outer Continental Shelf* (USDOI, MMS, 2005a), to evaluate the full range of potential environmental impacts of structure-removal activities in all water depths in the CPA and WPA and the Sale 181/189 area in the EPA of the Gulf of Mexico. On February 28, 2005, MMS submitted the new structure-removal PEA and a petition for new Incidental-Take Regulations under the MMPA to NMFS. After review of the petition and PEA, NMFS published a notice of receipt of MMS's petition in the *Federal Register* on August 24, 2005. On April 7, 2006, NMFS published the proposed rule for the incidental take of marine mammals under the MMPA in the *Federal Register*. The subsequent public comment period ended May 22, 2006, and MMS expects the Final Rule to be published in the *Federal Register* in spring 2007.

The Clean Air Act

The 1970 Clean Air Act (CAA) (42 U.S.C. 7401 *et seq.*) established the National Ambient Air Quality Standards (NAAQS) and required the promulgation of national primary and secondary standards. The primary NAAQS standards were established to protect public health and the secondary standards to protect public welfare. Under the CAA, the U.S. Environmental Protection Agency (USEPA) sets limits on how much of a pollutant can be in the air anywhere in the U.S. Although the CAA is a Federal law covering the entire Nation, the States do much of the work to implement the Act. The law allows individual states to have more stringent pollution controls, but the States are not allowed to have less stringent pollution controls than those for the rest of the U.S. The law recognizes that states should take the lead in carrying out the CAA because pollution control problems often require an in-depth understanding of local; meteorology, industries, geography, housing patterns, etc.

States may be required to develop state implementation plans (SIP's) that explain how they will comply with, or remain in compliance with, the CAA. The States must involve the public, through hearings and opportunities to comment, in the development of the SIP. The USEPA must approve the SIP, and if the SIP is not acceptable, USEPA can take over enforcing the CAA in that state. The U.S. Government, through USEPA, assists the states with air quality compliance by providing scientific research, expert studies, engineering designs, and money to support clean air programs.

The CAA established the Prevention of Significant Deterioration (PSD) program to preserve, protect, and enhance the air quality in special regions of the U.S. Under the PSD program, these special air quality regions were designated as Class I areas. Class I areas are areas of special national or regional natural, scenic, recreational, or historic value for which the PSD regulations provide special protection. The Federal Land Manager (FLM) for a Class I area is responsible for defining specific Air Quality Related Values (AQRV) for the area and for establishing the criteria to determine any adverse impact on the area's AQRV. If a FLM determines that a source will adversely impact AQRV in a Class I area, the FLM may recommend that the permitting agency deny issuance of the permit; however, the permitting authority has the final decision to issue or deny the permit. In the GOM OCS Region, the Fish and Wildlife Service is the FLM for the Breton, St. Marks, Okefenokee, and Chassahowitzka Class I areas and the National Park Service (NPS) is the FLM for the Everglades Class I area.

The CAA also delineates GOM air quality jurisdictional boundaries between the USEPA and DOI. Operations on the GOM OCS, east of 87.5° W. longitude are subject to USEPA air quality regulations and those west of 87.5° W. longitude are regulated by MMS (**Figure 1-4**). In the OCS areas under MMS jurisdiction, MMS regulations at 30 CFR 250 apply.

The 1990 Clean Air Act Amendments (CAAA) (Public Law No. 101-549) required MMS to conduct a study to evaluate cumulative, onshore, air quality nonattainment area impacts from OCS petroleum resource development in the GOM. Subsequent to the completion of the air quality impacts study in 1995, the DOI Secretary consulted with the USEPA Administrator and determined no new air quality requirements were necessary for the area under MMS jurisdiction.

The MMS air quality regulations are codified in 30 CFR 250 Subpart C. These regulations are used to assess and control OCS emissions that may impact air quality in onshore areas. In accordance with MMS air quality regulations, MMS applies defined criteria to determine which OCS plans require an air quality review and performs an impact-based analysis, on the selected plans, to determine whether the emission source would potentially cause a significant onshore impact. Should the emission source be deemed significant, requiring air quality modeling, the USEPA preferred model, the steady-state Gaussian, Offshore and Coastal Dispersion (OCD) model should be used.

The Clean Water Act

The Clean Water Act (CWA) is a 1977 amendment to the Federal Water Pollution Control Act of 1972. The CWA establishes the basic structure for regulating discharges of pollutants to waters of the U.S. Under the CWA, it is unlawful for any person to discharge any pollutant from a point source into navigable waters without a National Pollution Discharge Elimination System (NPDES) permit. Under Sections 301 and 304 of the CWA, USEPA issues technology-based effluent guidelines that establish discharge standards based on treatment technologies that are available and economically achievable. Permits that meet or exceed the guidelines and standards are issued. Initially, the CWA targeted point-source discharges from industrial and municipal sources. More recently, efforts to address watershed issues and nonpoint-source discharges such as urban and agricultural runoff have been implemented.

All waste streams generated from offshore oil and gas activities are regulated by the USEPA, primarily by general permits. The USEPA may not issue a permit for a discharge into ocean waters unless the discharge complies with the guidelines established under Section 403(c) of the CWA. These guidelines are intended to prevent degradation of the marine environment and require an assessment of the effect of the proposed discharges on sensitive biological communities and aesthetic, recreational, and economic values. The most recent effluent guidelines for the oil and gas extraction point-source category were published in 1993. The USEPA also published new guidelines for the discharge of synthetic-based drilling fluids (SBF) on January 22, 2001.

Within the GOM, USEPA Region 6 has jurisdiction over the all of the WPA and the majority of the CPA. The USEPA Region 4 has jurisdiction over the eastern portion of the GOM, including all of the EPA and part of the CPA off the coasts of Alabama and Mississippi. The EPA Lease Sale 224 area is entirely within the jurisdiction of the USEPA Region 4. Each region has promulgated general permits for discharges that incorporate the 1993 effluent guidelines as a minimum. In some instances, a site-specific permit is required.

Discharges to the GOM must meet the requirements of the permit that is in effect. In USEPA Region 6, the permit (GMG290000) became effective on November 6, 2004, and will expire on November 5, 2007. A three-year permit was written so that any new information that could assist in the reduction of the hypoxic zone could be included. In USEPA Region 4, the new permit (GMG460000) became effective on January 1, 2005, and will expire on December 31, 2009.

Other sections of the CWA also apply to offshore oil and gas activities. Section 404 of the CWA requires a Corps of Engineers (COE) permit for the discharge or deposition of dredged or fill material in all the waters of the U.S. Approval by COE, with consultation from other Federal and State agencies, is also required for installing and maintaining pipelines in coastal areas of the GOM. Section 303 of the CWA provides for the establishment of water quality standards that identify a designated use for waters (e.g., fishing/swimming). States have adopted water quality standards for ocean waters within their jurisdiction (waters of the territorial sea that extend out to 3 nmi off Louisiana, Mississippi, and Alabama, and 3 leagues off Texas and Florida). Section 316(b) of the CWA requires NPDES permits to ensure that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available to minimize adverse environmental impact from impingement and entrainment of aquatic organisms. Final regulations for Phase III facilities were published in June 2006 and apply to new offshore oil and gas facilities designed to use more than 2 MGD, of which at least 25 percent is for cooling. The USEPA estimated 21 platforms and 103 mobile offshore drilling units (MODU's) would be affected nationally. The requirements will be incorporated into each USEPA region's permit when it is reissued. The liquefied natural gas (LNG) facilities that utilize seawater for warming rather than cooling are not included in Phase III.

Harmful Algal Bloom and Hypoxia Research and Control Act

The Harmful Algal Bloom and Hypoxia Research and Control Act (P.L. 105-383) was passed in 1998 in response to a surge in blooms nationwide, which resulted in fish kills, beach and shellfish bed closures, and manatee deaths. The 2004 amendments include a periodic review to evaluate program effectiveness. The Act required an assessment of the causes and consequences of hypoxia in the GOM and the development of a plan to reduce hypoxia. Six reports commissioned by the White House Committee on Environment and Natural Resources comprise the assessment. The Mississippi River GOM Watershed Nutrient Task Force developed the Action Plan with the goal to halve the size of the hypoxic zone in 15 years. The goal, as stated in the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force's January 2001 Action Plan, is as follows: "By the year 2015, subject to the availability of additional resources, reduce the 5-year running average areal extent of the GOM hypoxic zone to less than 5,000 square kilometers through implementation of specific, practical, and cost effective voluntary actions by all States, Tribes, and all categories of sources and removals within the Mississippi/Atchafalaya River Basin to reduce the annual discharge of nitrogen into the Gulf" (Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, 2001).

Recently, the contribution of phosphorous has received additional attention. As upstream industrial and urban and agricultural sources are quantified and as remedial programs are discussed, produced-water discharges from offshore oil and gas have also been suggested as a possible source of nutrients that require further investigation.

The Oil Pollution Act

The Oil Pollution Act of 1990 (OPA or OPA 90) (33 U.S.C. 2701 *et seq.*) is comprehensive legislation that includes, in part, provisions to (1) improve oil-spill prevention, preparedness, and response capability; (2) establish limitations on liability for damages resulting from oil pollution; and (3) implement a fund for the payment of compensation for such damages.

The OPA, in part, revised Section 311 of the CWA to expand Federal spill-response authority; increase penalties for spills; establish U.S. Coast Guard (USCG), prepositioned, oil-spill response equipment sites; require vessel and facility response plans; and provide for interagency contingency plans. Many of the statutory changes required corresponding revisions to the National Oil and Hazardous Substances Pollution Contingency Plan.

If a spill or substantial threat of a spill of oil or a hazardous substance from a vessel, offshore facility, or onshore facility is considered to be of such a size or character to be a substantial threat to the public health or welfare of the U.S., under provisions of the Act, the President (through USCG) now has the authority to direct all Federal, State, and private actions to remove a spill or to mitigate or prevent the threat of the spill. Potential impacts from spills of oil or a hazardous substance to fish, shellfish, wildlife, other natural resources, or the public and private beaches of the U.S. would be an example of the degree or type of threat considered to be of such a size or character to be a substantial threat to the U.S. public health or welfare. In addition, USCG's authority to investigate marine accidents involving foreign tankers was expanded to include accidents in the Exclusive Economic Zone (EEZ). The Act also established USCG oil-spill, district response groups (including equipment and personnel) in each of the 10 USCG districts, with a national response unit, the National Strike Force Coordination Center, located in Elizabeth City, North Carolina.

The OPA strengthened spill planning and prevention activities by providing for the establishment of interagency spill contingency plans for areas of the U.S. To achieve this goal, Area Committees composed of qualified Federal, State, and local officials were created to develop Area Contingency Plans. The OPA mandates that contingency plans address the response to a "worst case" oil spill or a substantial threat of such a spill. It also required that vessels and both onshore and offshore facilities have response plans approved by the President. These plans were required to adhere to specified requirements, including the demonstration that they had contracted with private parties to provide the personnel and equipment necessary to respond to or mitigate a "worst case" spill. In addition, the Act provided for increased penalties for violations of statutes related to oil spills, including payment of triple costs by persons who fail to follow contingency plan requirements.

The Act further specifies that vessel owners, not cargo owners, are liable for spills and raises the liability limits from $150 (dollars) per gross ton to $1,200 per gross ton for vessels. The maximum liability for offshore facilities is set at $75 million plus unlimited removal costs; liability for onshore facilities or a deepwater port is set at $350 million. Willful misconduct, violation of any Federal operating or safety standard, failure to report an incident, or refusal to participate in a cleanup subjects the spiller to unlimited liability under provisions of the Act.

Pursuant to the Act, double hulls are required on all newly constructed tankers. Double hulls or double containment systems are required on all tank vessels less than 5,000 gross tons (i.e., barges). Since 1995, existing single-hull tankers are being phased out based on size and age.

An Interagency Coordinating Committee on Oil Pollution Research was established by the provisions of the Act and tasked with submitting a plan for the implementation of an oil-pollution research, development, and demonstration program to Congress. The plan was submitted to Congress in April 1992. This program addressed, in part, an identification of important oil-pollution research gaps, an establishment of research priorities and goals, and an estimate of the resources and timetables necessary to accomplish the identified research tasks. In 1992, the program plan was also provided to the Marine Board of the National Research Council for review and comment as required by OPA 90. Upon review, the Marine Board recommended that the plan be revised using a framework that addresses spill prevention, human factors, and field testing demonstration of developed response technology. This was accomplished in April 1997.

In October 1991, Executive Order 12777 delegated the provisions of OPA to various departments and agencies within the U.S. Government, including the USCG, USEPA, U.S. Department of Transportation (USDOT or DOT), and DOI. The Secretary was delegated Federal Water Pollution Control Act authority over offshore facilities and associated pipelines (except deepwater ports) for all Federal and State waters. The Secretary's functions under the Executive Order include spill prevention, Oil Spill Contingency Plans (OSCP's), equipment, financial responsibility certification, and civil penalties.

The Oil Spill Liability Trust Fund (OSLTF), authorized under OPA and administered by USCG, is available to pay for removal costs and damages not recovered from responsible parties. The Fund provides up to $1 billion per incident for cleanup costs and other damages. The OSLTF was originally established under Section 9509 of the Internal Revenue Code of 1986. It was one of several similar Federal trust funds funded by various levies set up to provide for the costs of water pollution. The OPA generally consolidated the liability and compensation schemes of these prior, Federal oil-pollution laws and authorized the use of the OSLTF, which consolidated the funds supporting those regimes. Those prior laws included the Federal Water Pollution Control Act, Trans-Alaska Pipeline Authorization Act, Deepwater Port Act, and OCSLA. On February 20, 1991, the National Pollution Funds Center (NPFC) was commissioned to serve as fiduciary agent for the OSLTF.

The OPA 90 provides that parties responsible for offshore facilities demonstrate, establish, and maintain oil-spill financial responsibility (OSFR) for those facilities. The OPA 90 replaced and rescinded the OCSLA OSFR requirements. Executive Order 12777 assigned the OSFR certification function to DOI; the Secretary, in turn, delegated this function to MMS.

The minimum amount of OSFR that must be demonstrated is $35 million for covered offshore facilities (COF's) located on the OCS and $10 million for COF's located in State waters. A COF is any structure and all of its components, 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 for, drilling for, or producing oil or for transporting oil from such facilities. The regulation provides an exemption for persons responsible for facilities having a potential worst-case oil spill of 1,000 barrels (bbl) or less, unless the risks posed by a facility justify a lower threshold volume.

The Secretary of Transportation has authority for vessel oil-pollution financial responsibility, and USCG regulates the oil-spill financial responsibility program for vessels. An MODU is classified as a vessel. However, a well drilled from a MODU is classified as an offshore facility under this rule.

Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (42 U.S.C. 9601 *et seq*.), modified by the 1986 Superfund Amendments and Reauthorization Act (SARA) and Section 1006 of OPA 90, requires the promulgation of regulations for the assessment of natural resource damages from oil spills and hazardous substances. These Acts provide for the designation of trustees who determine resource injuries, assess natural resource damages (including the costs of assessing damages), present claims, recover damages, and develop and implement plans for the restoration, rehabilitation, replacement, or acquisition of the equivalent of the injured natural resources under the trusteeship.

The DOI was given the authority under CERCLA to develop regulations and procedures for the assessment of damages for natural resource injuries resulting from the release of a hazardous substance or oil spills (Natural Resource Damage Assessment (NRDA) regulations). These rulemakings are all codified at 43 CFR 11. The CERCLA specified two types of procedures to be developed: type "A" procedures for simplified, standard assessments requiring minimal field observations in cases of minor spills or releases in certain environments; and type "B" site-specific procedures for detailed assessments for individual cases.

The Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) (42 U.S.C. 6901 *et seq*.) provides a framework for the safe disposal and management of hazardous and solid wastes. The OCS wastes taken to shore are regulated under RCRA. The USEPA has exempted many oil and gas wastes from coverage under the hazardous wastes regulations of RCRA. Exempt wastes (exploration and production (E&P) waste) include those generally coming from an activity directly associated with the exploration, drilling, production, or processing of a hydrocarbon product. Therefore, most oil and gas wastes taken onshore are not regulated by the Federal Government but by various Gulf States' programs. It is occasionally possible for a RCRA exempt E&P waste to fail a State's E&P waste disposal regulations. If wastes generated on the OCS are not exempt and are hazardous, the wastes must be transported to shore for disposal at a hazardous waste facility.

Marine Plastic Pollution Research and Control Act

The Marine Plastic Pollution Research and Control Act of 1987 (MPPRCA) (33 U.S.C. 1901 *et seq*.) implements Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL). Under provisions of the law, all ships and watercraft, including all commercial and recreational fishing vessels, are prohibited from dumping plastics at sea. The law also severely restricts the legality of dumping other vessel-generated garbage and solid-waste items both at sea and in U.S. navigable waters. The USCG is responsible for enforcing the provisions of this law and has developed final rules for its implementation (33 CFR 151, 155, and 158), calling for adequate trash reception facilities at all ports, docks, marinas, and boat-launching facilities.

The GOM has received "Special Area" status under MARPOL, thereby prohibiting the disposal of all solid waste into the marine environment. Fixed and floating platforms, drilling rigs, manned production platforms, and support vessels operating under a Federal oil and gas lease are required to develop waste management plans and to post placards reflecting discharge limitations and restrictions.

Waste Management Plans require oil and gas operators to describe procedures for collecting, processing, storing, and discharging garbage and to designate the person who is in charge of carrying out the plan. The MMS regulations 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. These rules also apply to all oceangoing ships of 12 m (39 ft) or more in length that are documented under the laws of the U.S. or numbered by a State and that are equipped with a galley and berthing. Placards noting discharge limitations and restrictions, as well as penalties for noncompliance, apply to all boats and ships 8 m (26 ft) or more in length. Furthermore, the Shore Protection Act of 1988 (33 U.S.C. 2601 *et seq*.) requires ships transporting garbage and refuse to assure that the garbage and refuse is properly contained on-board so that it will not be lost in the water from inclement wind or weather conditions.

National Fishing Enhancement Act

The National Fishing Enhancement Act of 1984 (33 U.S.C. 2601 *et seq*.), also known as the Artificial Reef Act, establishes broad artificial reef development standards and a national policy to encourage the development of artificial reefs that will enhance fishery resources and commercial and recreational fishing. It mandated that a long-term artificial reef plan be developed. The Secretary of Commerce provided leadership in developing the National Artificial Reef Plan (NARP), which identifies the roles of Federal, State, local and private agencies in the development of artificial reefs. It provides national guidelines on the siting, materials, design, regulatory requirements, construction, management, and liability of artificial reefs. It cites key documents, provides the best existing information, and lists future research needs. The Secretary of the Army issues permits under Section 10 of the River and Harbors Act to responsible applicants for reef development projects in accordance with the NARP, as well as regional, State, and local criteria and plans. The law also limits the liability of reef developers complying with permit requirements and includes the availability of all surplus Federal ships for consideration as reef development materials.

Fishermen's Contingency Fund

Final regulations for the implementation of Title IV of the OCSLA, as amended (43 U.S.C. 1841-1846), were published in the *Federal Register* on January 24, 1980 (50 CFR 296). The OCSLA, as amended, established the Fishermen's Contingency Fund (not to exceed $2 million) to compensate commercial fishermen for actual and consequential damages, including loss of profit due to damage or loss of fishing gear by various materials and items associated with oil and gas exploration, development, or production on the OCS. This Fund, administered by the Financial Services Division of NMFS, mitigates most losses suffered by commercial fishermen due to OCS oil and gas activities.

As required in the OCSLA, nine area accounts have been established—five in the GOM, one in the Pacific, one in Alaska, and two in the Atlantic. The five Gulf accounts cover the same areas as the five MMS GOM OCS Region Districts. Each area account is initially funded at $100,000 and cannot exceed this amount. The accounts are initiated and maintained by assessing holders of leases, pipeline rights-of-way and easements, and exploration permits. These assessments cannot exceed $5,000 per operator in any calendar year.

The claims eligible for compensation are generally contingent upon the following: (1) damages or losses must be suffered by a commercial fisherman; and (2) any actual or consequential damages, including loss of profit, must be due to damages or losses of fishing gear by items or obstructions related to OCS oil and gas activities. Damages or losses that occur in non-OCS waters may be eligible for compensation if the item(s) causing damages or losses are associated with OCS oil and gas activities.

Ineligible claims for compensation are generally (1) damages or losses caused by items that are attributable to a financially responsible party; (2) damages or losses caused by negligence or fault of the commercial fishermen; (3) occurrences before September 18, 1978; (4) claims of damages to, or losses of, fishing gear exceeding the replacement value of the fishing gear; (5) claims for loss of profits in excess of 6 months, unless supported by records of the claimant's profits during the previous 12 months; (6) claims or any portions of damages or losses claimed that will be compensated by insurance; (7) claims not filed within 60 days of the event of the damages or losses; and (8) damages or losses caused by natural obstructions or obstructions unrelated to OCS oil and gas activities.

There are several requirements for filing claims, including one that a report stating, among other things, the location of the obstruction, must be made within 5 days after the event of the damages or losses; this 5-day report is required to gain presumption of causation. A detailed claim form must be filed within 60 days of the event of the damages or losses. The specifics of this claim are contained in 50 CFR 296. The claimant has the burden of establishing all the facts demonstrating eligibility for compensation, including the identity or nature of the item that caused the damages or losses and its association with OCS oil and gas activity.

Damages or losses are presumed to be caused by items associated with OCS oil and gas activities provided the claimant establishes that (1) the commercial fishing vessel was being used for commercial fishing and was located in an area affected by OCS oil and gas activities; (2) the 5-day report was filed; (3) there is no record in the most recent Department of Commerce's National Oceanic and Atmospheric Administration/National Ocean Service (NOAA/NOS) nautical charts or weekly USCG Notice to Mariners of an obstruction in the immediate vicinity; and (4) no proper surface marker or lighted buoy marked the obstruction. Damages or losses occurring within a one-quarter-mile radius of obstructions recorded on charts, listed in the Notice to Mariners, or properly marked are presumed to involve the recorded obstruction.

Ports and Waterways Safety Act

The Ports and Waterways Safety Act (33 U.S.C. 1223) of 1972 authorizes the USCG to designate safety fairways, fairway anchorages, and traffic separation schemes (TSS's) to provide unobstructed approaches through oil fields for vessels using GOM ports. The USCG provides listings of designated fairways, anchorages, and TSS's in 33 CFR 166 and 167, along with special conditions related to oil and gas production in the GOM. In general, no fixed structures, such as platforms, are allowed in fairways. Temporary underwater obstacles such as anchors and attendant cables or chains attached to floating or semisubmersible drilling rigs may be placed in a fairway under certain conditions. Fixed structures may be placed in anchorages, but the number of structures is limited by spacing.

A TSS is a designated routing measure that is aimed at the separation of opposing streams of traffic by appropriate means and by the establishment of traffic lanes (33 CFR 167.5). The Galveston Bay TSS and precautionary areas is the only TSS established in the GOM. There is no TSS in the CPA or EPA.

Marine and Estuarine Protection Acts

The Sanctuaries and Reserves Division, NOS, NOAA, of the Department of Commerce (DOC), administers the National Marine Sanctuary and National Estuarine Research Reserve programs. The marine sanctuary program was established by the Marine Protection, Research, and Sanctuaries Act of

1972 (MPRSA), and the estuarine research reserve program was established by the Coastal Zone Management Act of 1972.

Marine sanctuaries and estuarine research reserves are designed and managed to meet the following goals, among others:

- enhance resource protection through the implementation of a comprehensive, long-term management plan tailored to the specific resources;
- promote and coordinate research to expand scientific knowledge of sensitive marine resources and improve management decision making;
- enhance public awareness, understanding, and wise use of the marine environment through public interpretive and recreational programs; and
- provide for optimum compatible public and private use of special marine areas.

The Congress declared that ocean dumping in the territorial seas or the contiguous zone of the U.S. would be regulated under MPRSA (33 U.S.C. 1401 *et seq*.). Under 40 CFR 228, pursuant to Section 103 of the MPRSA, sites and times for ocean dumping of dredged and nondredged materials were designated by USEPA after a determination that such dumping will not unreasonably degrade or endanger human health, welfare, or the marine environment. The EIS's on these disposal sites describe impacts that are expected to occur over a period of 25 years. Under 33 U.S.C. 1413 (33 CFR 324), COE reviews applications for permits to transport dredged and nondredged materials for the purpose of dumping it in ocean waters. On December 31, 1981, 33 U.S.C. 1412a mandated the termination of ocean dumping of sewage sludge and industrial waste.

Marine Protection, Research, and Sanctuaries Act

The MPRSA of 1972 established the National Marine Sanctuary Program, which is administered by NOAA of the DOC. The Flower Garden Banks National Marine Sanctuary (FGBNMS), which was designated in 1992, is the only sanctuary that exists in the northern GOM. The DOI has taken action to protect the biological resources of the sanctuary from damage due to oil and gas exploration and development activities. The MMS has established a "No Activity Zone" around the sanctuary and has established other operational restrictions as described in the Topographic Features Stipulation. Stetson Bank was added to the FGBNMS in 1996 and is protected from oil and gas activities by a "No Activity Zone." Whole blocks and portions of blocks that lie within the boundaries of FGBNMS at the East and West Flower Garden Banks and Stetson Bank are excluded from leasing.

National Estuarine Research Reserves

The National Estuarine Research Reserve System is a network of protected areas established for long-term research, education, and stewardship. This partnership program between NOAA and coastal states has established five reserves (Grand Bay National Estuarine Research Reserve in Mississippi, Weeks Bay National Estuarine Research Reserve in Alabama, Rookery Bay National Estuarine Research Reserve and Apalachicola National Estuarine Research Reserve in Florida, and Mission-Aransas Reserve in Texas) in the GOM.

Grand Bay National Estuarine Research Reserve covers about 8,400 ac (7,470 hectares (ha)) in Jackson County, Mississippi. Located between Pascagoula and the Alabama State line, it contains diverse habitats that support several rare or endangered plants and animals. The reserve's fishery resources include oysters, fish, and shrimp. The area also has recreational resources and archaeological sites.

Weeks Bay National Estuarine Research Reserve covers a small estuary of approximately 3,000 ac (1,215 ha) in Baldwin County, Alabama. Weeks Bay is a shallow open bay with an average depth of less than 4.9 ft (1.5 m) and extensive vegetated wetland areas. The bay receives waters from the spring-fed Fish and Magnolia Rivers and connects with Mobile Bay through a narrow opening.

Rookery Bay National Estuarine Research Reserve, at more than 8,500 ac (3,440 ha), preserves a large mangrove-filled bay and two creeks, along with their drainage corridors. Management of the sanctuary is performed by the Florida Department of Environmental Protection, The Nature Conservancy, and the National Audubon Society. This unique management structure was created when the two private organizations granted a dollar-per-year, 99-year lease of the land to the State. Federal and State funds will add additional key acreage to the existing core area. The diversity of the area's fauna can be recognized by the porpoises that feed there and the bald eagles and white-tailed deer that make Rookery Bay their permanent residence. Within the Sanctuary is a marine laboratory, which, even before the establishment of the sanctuary, provided data used in important coastal management decisions—a primary objective of Congress in establishing the estuarine research-reserve program.

At about 190,000 ac (76,890 ha), the Apalachicola National Estuarine Research Reserve is one of the largest remaining naturally functioning ecosystems in the Nation, and it is also the first sanctuary on the mouth of a major navigable river. Its establishment served to promote improved cooperation concerning river navigation among the States of Florida, Alabama, and Georgia. The major business activity of Apalachicola, which is adjacent to the sanctuary, centers around the oyster industry. It is expected that the sanctuary will benefit this and other fishing industries by protecting the environment and by providing research information that will help assure the continued productivity of the bay/river ecosystem. A FWS refuge and a State park, representing a unique cooperative effort at ecosystem protection, exist within the boundaries of the reserve.

The Mission-Aransas Reserve was designated on May 3, 2006, and covers 185,708 ac (75,153 ha) in Aransas and Refugio Counties, Texas. It is a contiguous complex of wetland, terrestrial, and marine environments. The land is mostly coastal prairie with unique oak motte habitats. The wetlands include riparian habitat and fresh and saltwater marshes. Within the water areas, the bays are large, open, and include extensive tidal flats, seagrass meadows, mangroves, and oyster reefs. These unique and diverse estuarine habitats in the Western GOM support a host of endangered and threatened species, including the endangered whooping crane.

The National Estuary Program

In 1987, an amendment to the Clean Water Act, known as the Water Quality Act (P.L. 100-4), established the National Estuary Program (NEP). The purpose of the NEP is to identify nationally important estuaries, to protect and improve their water quality, and to enhance their living resources. The NEP is administered by USEPA. The governor of a State may nominate an estuary for inclusion in the NEP. Once accepted, a Comprehensive Conservation and Management Plan (CCMP) is developed. Representatives from Federal, State, and interstate agencies; academic and scientific institutions; and industry and citizen groups work during a 3- to 5-year period to define objectives for protecting the estuary, to select the chief problems to be addressed in the Plan, and to ratify a pollution control and resource management strategy to meet each objective. Strong public support and subsequent political commitments are needed to accomplish the actions called for in the Plan; hence, the 3- to 5-year time period to develop the strategies. There are a total of 28 NEP's, 7 of which are in the GOM: Sarasota Bay, Charlotte Harbor, and Tampa Bay in Florida; Mobile Bay in Alabama; the Barataria-Terrebonne Estuarine Complex in Louisiana; and Galveston Bay and Coastal Bend Bay and Estuaries in Texas.

Executive Order 11990 (May 24, 1977), Protection of Wetlands

Executive Order 11990 establishes that each Federal agency shall provide leadership and take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities. The Executive Order applies to the following Federal activities: managing and disposing of Federal lands and facilities; providing federally undertaken, financed, or assisted construction and improvements; and conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

Coastal Barrier Resources Act

The Coastal Barrier Resources Act (CBRA) (16 U.S.C. 3501 *et seq.*) of 1982 established that undeveloped coastal barriers, per the Act's definition, may be included in a Coastal Barrier Resource System (CBRS).

The CBRA prohibits all new Federal expenditures and financial assistance within the CBRS, with certain specific exceptions, including energy development. The purpose of this legislation was to end the Federal Government's encouragement for development on barrier islands by withholding Federal flood insurance for new construction of or substantial improvements to structures on undeveloped coastal barriers.

The National Historic Preservation Act

The National Historic Preservation Act (NHPA) of 1966, as amended (16 U.S.C. 470 *et seq*.), states that any Federal agency, before approving federally permitted or federally funded undertakings, must take into consideration the effect of that undertaking on any property listed on, or eligible for, the National Register of Historic Places. Implied in this legislation and Executive Order 11593 is that an effort be made to locate such sites before development of an area. Section 101(b)(4) of NEPA states that it is the continuing responsibility of the Federal Government to preserve important historic and cultural aspects of our natural heritage. In addition, Section 11(g)(3) of the OCSLA, as amended, states that "exploration (oil and gas) will not . . . disturb any site, structure, or object of historical or archaeological significance."

The NHPA provides for a National Register of Historic Places to include districts, sites, buildings, structures, and objects noteworthy in American history, architecture, archaeology, and culture. These items may bear National, State, or local significance. The NHPA provides funding for the State Historic Preservation Officer and his staff to conduct surveys and comprehensive preservation planning, establishes standards for State programs, and requires States to establish mechanisms for certifying local governments to participate in the National Register nomination and funding programs.

Section 106 of the Act requires that Federal agencies having direct or indirect jurisdiction over the proposed Federal, federally assisted, or federally licensed undertaking, prior to approval of the expenditure of funds or the issuance of a license, take into account the effect of the undertaking on any district, site, building, structure, or object included in or eligible for inclusion in the National Register of Historic Places, and afford the Advisory Council on Historic Preservation a reasonable opportunity to comment with regard to the undertaking. This Council, appointed by the President, has implemented procedures to facilitate compliance with this provision at 36 CFR 800.

Section 110 of the NHPA directs the heads of all Federal agencies to assume responsibility for the preservation of National Register listed or eligible historic properties owned or controlled by their agency as well as those not under agency jurisdiction and control but are potentially affected by agency actions. Federal agencies are directed to locate, inventory, and nominate properties to the National Register, to exercise caution to protect such properties, and to use such properties to the maximum extent feasible. Other major provisions of Section 110 include documentation of properties adversely affected by Federal undertakings, the establishment of trained Federal preservation officers in each agency, and the inclusion of the costs of preservation activities as eligible agency project costs.

A Section 106 review refers to the Federal review process designed to ensure that historic properties are considered during Federal project planning and execution. The review process is administered by the Advisory Council on Historic Preservation, an independent Federal agency, together with the State Historic Preservation Office.

Rivers and Harbors Act

Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 401 *et seq*.) prohibits the unauthorized obstruction or alteration of any navigable water of the U.S. The construction of any structure in or over any navigable water of the U.S., the excavating from or depositing of dredged material or refuse in such waters, or the accomplishment of any other work affecting the course, location, condition, or capacity of such waters is unlawful without prior approval from COE. The legislative authority to prevent inappropriate obstructions to navigation was extended to installations and devices located on the seabed to the seaward limit of the OCS by Section 4(e) of the OCSLA of 1953, as amended.

Executive Order 12898: Environmental Justice

The environmental justice policy, based on Executive Order 12898 of February 11, 1994, requires agencies to incorporate analysis of the environmental and health effects of their proposed programs on minorities and low-income populations and communities into NEPA documents. The MMS's existing NEPA process invites participation by all groups and communities in the development of its proposed action, alternatives, and potential mitigation measures. Scoping and review for the EIS is an open process that provides an opportunity for all participants, including minority and low-income populations, to raise new expressions of concern that can be addressed in the EIS. Impacts to socioeconomic conditions, commercial fisheries, air quality, and water quality are considered in the analysis of effects of the proposed action on local populations or resources used by local groups including minority and low-income groups.

Occupational Safety and Health Act

The Occupational Safety and Health Act of 1970 (29 U.S.C. 651-678) was enacted to assure, to the extent possible, safe and healthful working conditions and to preserve our human resources. The Act encourages employers and employees to reduce occupational safety and health hazards in their places of employment and stimulates the institution of new programs and the perfection of existing programs for providing safe and healthful working conditions. The Act established the National Institute for Occupational Safety and Health (NIOSH), the Occupational Safety and Health Administration (OSHA), and the National Advisory Committee on Occupational Safety and Health (NACOSH). The NIOSH is responsible for conducting research and making recommendations for the prevention of work-related injury and illness. The OSHA is responsible for developing and enforcing workplace safety and health regulations. The NACOSH advises the Secretaries of Labor and Health and Human Services on occupational safety and health programs and policies.

The Act empowers the Secretary of Labor or his representative to enter any factory, plant, establishment, workplace, or environment where work is performed by employees and to inspect and investigate during regular working hours and at other reasonable times any such place of employment and all pertinent conditions and equipment therein. If, upon inspection, the Secretary of Labor or authorized representative believes that an employer has violated provisions of the Act, the employer shall be issued a citation and given 15 days to contest the citation or proposed assessment of penalty.

Energy Policy Act of 2005

The Energy Policy Act of 2005 (P.L. 109-58) encourages increased domestic production of oil and natural gas, grants MMS new authority for Federal offshore alternate energy uses, and requires a comprehensive inventory of oil and gas resources on the OCS.

The Act grants MMS new responsibilities over Federal offshore renewable energy and related uses on the OCS. Section 388 of the Act provides an initiative to facilitate increased renewable energy production on the OCS.

Section 388 gives the Secretary the authority to

- grant leases, easements, or rights-of way for renewable energy-related uses on Federal OCS lands,
- act as a lead agency for coordinating the permitting process with other Federal agencies,
- monitor and regulate those facilities used for renewable energy production and energy support services; and
- establish an interagency comprehensive digital mapping effort to assist in decisionmaking related to renewable energy activity.

Section 388 clarifies the Secretary's authority to allow an offshore oil and gas structure, previously permitted under the OCSLA, to remain in place after oil and gas activities have ceased in order to allow the use of the structure for other energy and marine-related activities. This authority provides opportunities to extend the life of facilities for non-oil and gas purposes, such as research, renewable energy production, aquaculture, etc., before being removed.

Section 388 does not authorize any leasing, exploration, or development activities for oil or natural gas. Congressional moratoria and administrative withdrawals in effect remain unchanged.

The Energy Policy Act created the Coastal Impact Assistance Program (CIAP) by amending Section 31 of the OCSLA. Under the provisions of the Act, the authority and responsibility for the management of CIAP is vested in the Secretary of DOI. The Secretary has delegated this authority and responsibility to MMS.

Under Section 384, MMS shall disburse $250 million for each fiscal year (FY) 2007 through 2010 to eligible producing States and coastal political subdivisions (CPS's). The MMS shall determine CIAP funding allocations to States and CPS's using the formulas mandated by the Act (Section 31(b)), which requires a minimum annual allocation of 1 percent to each State and provides that 35 percent of each State's share shall be allocated directly to its CPS's. The funds allocated to each State are based on the proportion of qualified OCS revenues offshore the individual State to the total qualified OCS revenues to all States. States eligible to receive funding are Alabama, Alaska, California, Louisiana, Mississippi, and Texas; 67 CPS's are eligible to receive CIAP funding:

- Alabama Counties—Baldwin and Mobile;
- Alaska Boroughs—Anchorage, Bristol Bay, Kenai Peninsula, Kodiak Island, Lake and Peninsula, Matanuska-Susitna, North Slope, and Northwest Arctic;
- California Counties—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;
- Louisiana Parishes—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;
- Mississippi Counties—Hancock, Harrison, and Jackson; and
- Texas Counties—Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Harris, Jackson, Jefferson, Kenedy, Kleberg, Matagorda, Nueces, Orange, Refugio, San Patricio, Victoria, and Willacy.

The Energy Policy Act (Section 31(d)(1)) stipulates that a State or CPS shall use CIAP funds only for one or more of the following authorized uses:

- projects and activities for the conservation, protection, or restoration of coastal areas, including wetland;
- mitigation of damage to fish, wildlife, or natural resources;
- planning assistance and the administrative costs of complying with CIAP;
- implementation of a federally-approved marine, coastal, or comprehensive conservation management plan; and
- mitigation of the impact of OCS activities through funding of onshore infrastructure projects and public service needs.

In order to receive CIAP funds, States are required to submit a coastal impact assistance plan (Plan) that MMS must approve prior to disbursing any funds; all funds shall be disbursed through a grant process. Pursuant to the Act, a State must submit its Plan no later than July 1, 2008.

Section 357 of the Act, entitled "Comprehensive Inventory of OCS Oil and Natural Gas Resources," calls for MMS to conduct a comprehensive inventory of the estimated oil and natural gas resources on the OCS, including moratoria areas. The Act requires the use of "any available technology, except drilling, but including 3-D seismic surveys." The first report to Congress was required to be submitted within 6 months of enactment and will be publicly available and updated at least every 5 years. To respond to this statutory directive, MMS published *Report to Congress: Comprehensive Inventory of U.S. OCS Oil and Natural Gas Resources* in February 2006 (USDOI, MMS, 2006a).

Gulf of Mexico Energy Security Act of 2006

On December 20, 2006, President Bush signed into law the Gulf of Mexico Energy Security Act of 2006. The GOMESA makes available two new areas in the GOM for leasing (**Figure 1-2**), places a moratorium on other areas in the GOM, and increases the distribution of offshore oil and gas revenues to coastal States.

The first area GOMESA makes available for leasing is referred to as the 181 Area. Approximately 2 million ac of what is known as the 181 Area are located in the CPA. Because this portion was not previously under moratorium, it was included in the CPA proposed actions analyzed in the Final Multisale EIS (USDOI, MMS, 2007a). This area would be available for lease starting with proposed CPA Lease Sale 205, tentatively scheduled for October 2007. The remaining portion of the 181 Area (which would be offered as Sale 224) is located in the EPA (**Figure 1-2**), more than 125 mi (200 km) from Florida and west of the Military Mission Line. This portion of the 181 Area is approximately 584,800 ac, contains 134 whole and partial blocks, and is tentatively scheduled to be offered in Lease Sale 224 in March 2008. On February 14, 2007, MMS announced in the *Federal Register* its intent to prepare an SEIS for Lease Sale 224.

The second area GOMESA makes available for leasing is referred to as the 181 South Area (**Figure 1-2**). This area is located in the CPA and is approximately 5.8 million ac. Future CPA lease sales would be expanded to include the 181 South Area. The MMS has not yet decided which proposed CPA lease sale would be the first to include the 181 South Area. Because of the limited geological and geophysical (G&G) data available to industry for the 181 South Area, MMS believes that it would be premature to include the 181 South Area in at least the first two proposed CPA lease sales (Sale 205 in 2007 and Sale 206 in 2008). Prior to GOMESA, the 181 South Area was under moratorium. Once a decision is made to offer the 181 South Area, MMS will conduct a separate environmental review to reevaluate the expanded CPA sale area. This will most likely be in the form of an SEIS to the Final Multisale EIS (USDOI, MMS, 2007a).

The GOMESA establishes a moratorium on leasing, preleasing, and other activities in the following areas until June 30, 2022, on the following areas:

- the area within 125 mi (200 km) of the State of Florida in the EPA;
- the 181 Area in the CPA that is within 100 mi (161 km) of the State of Florida; and
- the area east of the Military Mission Line (at 86°41'30" W. longitude).

The GOMESA also mandates MMS provide an option to exchange existing leases located in the unavailable areas listed above for leases in the available areas of the GOM.

Prior to GOMESA, affected States received recurring annual disbursements of 27 percent of royalty, rent, and bonus revenues received within each State's 8(g) zone. Beginning in FY 2007, and thereafter, Gulf producing States (i.e., Texas, Louisiana, Mississippi, and Alabama) will receive 37.5 percent of revenue from new leases issued in the 181 Area and 181 South Area. Beginning in FY 2016, and thereafter, Gulf producing States will receive 37.5 percent from new leases in the existing areas available for leasing. The remaining 50 percent and 12.5 percent of the total revenues would be distributed to the U.S. Treasury and the Land and Water Conservation Fund (LWCF), respectively. **Chapter 3.3.5.2**, How OCS Development Has Affected the Analysis Area, discusses the distribution of Federal offshore revenues to States in more detail.

Marine Debris Research, Prevention, and Reduction Act

The Marine Debris Research, Prevention, and Reduction Act (P.L l09-449) was enacted in December 2006. The purposes of this Act are (1) to help identify, determine sources of, assess, reduce, and prevent marine debris and its adverse impacts on the marine environment and navigation safety; (2) to reactivate the Interagency Marine Debris Coordinating Committee; and (3) to develop a Federal marine debris information clearinghouse. The Act established, within NOAA, a Marine Debris Prevention and Removal Program to reduce and prevent the occurrence and adverse impacts of marine debris on the marine environment and navigation safety.

Under the program, the Administrator shall (1) in consultation with relevant Federal agencies, undertake marine debris mapping, identification, impact assessment, prevention, and removal efforts, with a focus on marine debris posing a threat to living marine resources and navigation safety; (2) improve efforts to reduce adverse impacts of lost and discarded fishing gear on living marine resources and navigation safety; (3) undertake outreach and education of the public and other stakeholders, such as the fishing industry, fishing gear manufacturers, and other marine-dependent industries, and the plastic and waste management industries, on sources of marine debris, threats associated with marine debris and approaches to identify, determine sources of, assess, reduce, and prevent marine debris and its adverse impacts on the marine environment and navigational safety, including outreach and education activities through public-private initiatives; and (4) acting through the Program, enter into cooperative agreements and contracts and provide financial assistance in the form of grants for projects to accomplish the purpose set forth in the Act.

As stated in Section 8, nothing in this Act supersedes, or limits the authority of the Secretary of the Interior under, the OCSLA (43 U.S.C. 1331 *et seq*.).

1.4. PRELEASE PROCESS

Scoping for this SEIS was conducted in accordance with CEQ regulations implementing NEPA. Scoping provides those with an interest in the OCS Program an opportunity to provide comments on the proposed action(s). In addition, scoping provides MMS an opportunity to update the GOM OCS Region's environmental and socioeconomic information base. The scoping process officially commenced on February 14, 2007, with the publication of the Notice of Intent (NOI) to Prepare an SEIS and Scoping Meetings in the *Federal Register*. Additional public notices were distributed via local newspapers, the U.S. Postal Service, and the Internet. A 30-day comment period, which closed on March 16, 2007, was provided. Federal, State, and local governments, along with other interested parties, were invited to send written comments to the GOM OCS Region on the scope of the SEIS. Formal scoping meetings were held during March 2007 in Pensacola, Florida, and Larose, Louisiana. Comments were received in response to the NOI and two scoping meetings from Federal, State, local government agencies, interest groups, industry, businesses, and the general public on the scope of the SEIS, significant issues that should be addressed, alternatives that should be considered, and mitigation measures. All scoping comments received were considered in the preparation of the Draft SEIS. The comments (both verbal and written) have been summarized in **Chapter 5.3**, Development of the Draft SEIS.

The MMS 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 SEIS. Key agencies and organizations included NMFS, FWS, U.S. Department of Defense (USDOD or DOD), USCG, USEPA, State Governors' offices, and industry groups.

Although the scoping process was formally initiated on February 14, 2007, with the publication of the NOI in the *Federal Register*, scoping efforts and other coordination meetings have proceeded and will continue to proceed throughout this NEPA process. Scoping and coordination opportunities are available during MMS's requests for information, comments, input, and review on other MMS NEPA documents.

The Area Identification (Area ID) is normally an early step in the prelease process leading up the preparation of the NEPA documentation. Congress effectively made the decision by passage of the Gulf of Mexico Energy Security Act of 2006. The Area ID is an administrative prelease step that describes the geographical area of the proposed actions (proposed lease sale areas). While Congress mandated the region to be analyzed, this SEIS identifies the alternatives, mitigating measures, and issues to be analyzed. As mandated by NEPA, this SEIS analyzes the potential impacts of the proposed actions on the marine, coastal, and human environments.

The MMS sent copies of the Draft SEIS 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 SEIS, MMS published a Notice of Availability (NOA) in the *Federal Register* on June 29, 2007. Additionally, public notices were mailed with the Draft SEIS and placed on the MMS Internet website (http://www.gomr.mms.gov). In accordance with 30 CFR 256.26, MMS held public hearings to solicit comments on the Draft SEIS. 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 MMS 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, MMS reviews each State's Coastal Zone Management Program (CZMP) and analyzes the potential impacts as outlined in this SEIS, new information, and applicable studies as they pertain to the enforceable policies of each CZMP. Based on the analyses, the MMS Director makes an assessment of consistency, which is then sent to each State with the Proposed Notice of Sale (PNOS). If a State disagrees with MMS's CD, the State is required to do the following under CZMA: (1) indicate how the MMS presale proposal is inconsistent with their CZMP; (2) suggest alternative measures to bring the MMS proposal into consistency with their CZMP; or (3) describe the need for additional information that would allow a determination of consistency. 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. Either MMS or the State may request mediation. Mediation is voluntary and the DOC would serve as the mediator. Whether there is mediation or not, the final CD is made by DOI and is the final administrative action for the presale consistency process.

The Final SEIS will be published approximately 5 months prior to the proposed sale, EPA Lease Sale 224, which is tentatively scheduled for March 2008. To initiate the public review and 30-day minimum comment period on the Final SEIS, MMS will publish a NOA in the *Federal Register*. The MMS will send copies of the Final SEIS for review and comment to public and private agencies, interest groups, and local libraries. Additionally, public notices will be mailed with the Final SEIS and placed on the MMS Internet website (http://www.gomr.mms.gov).

A PNOS will become available to the public 4-5 months prior to the proposed sale. A notice announcing the availability of the PNOS 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 Notice of Sale (FNOS), including 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 sale, a FNOS will be published in its entirety in the *Federal Register* at least 30 days prior to the sale date, as required by the OCSLA.

1.5. POSTLEASE ACTIVITIES

The MMS 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 mitigate 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. Mitigating measures address concerns such as endangered and threatened species, geologic and manmade hazards, military warning and ordnance disposal areas, 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 GOM OCS include, but are not limited to;

- avoidance of potentially significant archaeological and biological features;
- requiring placement of explosive charges at least 15 ft 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 MMS issues NTL's to provide clarification, description, or interpretation of a regulation; provide guidelines on the implementation of a special lease stipulation or regional requirement; or convey administrative information. A detailed listing of current GOM OCS Region NTL's is available through the MMS, GOM OCS Region's Internet website at http://www.gomr.mms.gov/homepg/regulate/regs/ntls/ntl_lst.html or through the Region's Public Information Office at (504) 736-2519 or 1-800-200-GULF.

Conditions of approval are mechanisms to control or mitigate potential safety or environmental problems associated with proposed operations. Conditions of approval are based on MMS 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 MMS-identified mitigation measures are implemented through cooperative agreements or efforts with the oil and gas industry and Federal and State agencies. These measures include the NMFS 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 EPA.

Geological and Geophysical Activities

A geological and geophysical (G&G) permit must be obtained from MMS 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 explorations 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. The MMS issued NTL 2006-G12 to provide guidance and clarification on conducting ancillary activities in the MMS GOM Region (GOMR). Issued June 2, 2006, with an effective date of July 3, 2006, this NTL supersedes Letters to Lessees (LTL's) dated November 8, 1990, and June 21, 1991, regarding preliminary activities.

Per NTL 2006-G12, operators must notify the MMS GOMR Regional Supervisor (RS), Field Operations (FO) in writing before conducting any of the following ancillary activities: a G&G exploration; a development G&G activity; a geophysical survey of any type in water depths 200 m (656 ft) or greater, or in the EPA of the GOM in any water depth where an airgun or airgun array is the seismic source; a geophysical survey of any type, independent of water depth, where explosives will be used as the energy source; a geotechnical evaluation involving piston or gravity coring or the recovery of sediment specimens by grab-sampling or similar technique; and any dredging or other geological or geophysical activity that disturbs the seafloor. This NTL also details the information requirements for each type of ancillary activity, the type and level of MMS 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.

The MMS has completed the PEA *Geological and Geophysical Exploration for Mineral Resources on the Gulf of Mexico Outer Continental Shelf* (USDOI, MMS, 2004). Upon receiving a complete G&G permit application, MMS conducts a categorical exclusion review (CER), an EA, or an EIS in accordance with the G&G PEA's conclusions, NEPA guidelines, and other applicable MMS policies. When required under an approved coastal zone management program, proposed G&G permit activities must receive State concurrence prior to MMS permit approval.

Exploration and Development Plans

To ensure conformance with the OCSLA, other laws, applicable regulations, and lease provisions, and to enable MMS 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 MMS 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 MMS may require additional specific supporting information to aid in the evaluation of the potential environmental impacts of the proposed activities. The MMS can require amendment of an OCS plan based on inadequate or inaccurate supporting information. The latest 30 CFR 250 Subpart B regulations were published in the *Federal Register* on August 30, 2005 (70 FR 167).

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, MMS operating regulations, and other requirements. Federal agencies, including the FWS, NMFS, 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 MMS, GOM OCS Region's Public Information Office.

In response to increasing deepwater activities in the GOM, MMS 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 EA, MMS 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).

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

On, January 23, 2003, MMS issued NTL 2003-G03, "Remotely Operated Vehicle (ROV) Surveys in Deepwater." The NTL requires ROV surveys and reports in water depths greater than 400 m (1,312 ft). Eighteen grid areas were 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 sale area, CPA sale area, and portions of the EPA.

Operators must submit a ROV survey plan with each exploration plan (EP) submitted in each grid area and with the development and production plan (DPP) 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 of 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—prespudding (survey performed from the facility) and postdrilling (prior to facility removal).

A minimum of five surveys will be required for each grid area. The MMS 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.

Exploration Plans

An EP must be submitted to MMS 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, 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 further explained in NTL's 2006-G14 and 2006-G15. The NTL 2006-G14 provides guidance on information requirements and establishes the contents for OCS plans required by 30 CFR 250 Subpart B. This NTL, along with NTL 2006-G15, supersedes NTL 2003-G17. In the revised final Subpart B regulations, the contents of an EP are given. The NTL 2006-G15 provides guidance for submitting OCS plans to the MMS GOMR.

After receiving an EP, MMS performs technical and environmental reviews. The MMS 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 in support of the NEPA 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 (for selected plans under provisions of a DOI agreement), NMFS, and/or internal MMS offices. As part of the review process, most EP's and supporting environmental information are sent to the affected State(s) for consistency certification review and concurrence under the States' approved Coastal Management Plans (CMP's).

After EP approval 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, MMS formed an internal Deepwater Task Force to address technical issues and regulatory concerns relating to deepwater (greater than 1,000 ft or 305 m) operations and projects utilizing subsea technology. Based on the Deepwater Task Force's recommendation, an NTL (2000-N06) was developed, which 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 the MMS 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 MMS regulatory framework, and it is intended to initiate an early dialogue between MMS and industry before major capital expenditures on deepwater and subsea projects are committed. Deepwater technology has been evolving faster than MMS's ability to revise OCS regulations; the DWOP was established through the NTL process, which provides for a more timely and flexible approach to keep pace with the expanding deepwater operations and subsea technology. On August 30, 2005, the DWOP requirements were incorporated into MMS operating regulations via revisions to 30 CFR 250 Subpart B.

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 MMS 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 MMS operating regulations at 30 CFR 250. The MMS 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); stationkeeping (includes mooring system); wellbore, completion, and riser systems; safety systems; offtake; and hazards and operability of the production system. The DWOP provides MMS 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 MMS the opportunity to assure that the production system is suitable for the conditions in which it will operate.

The MMS 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 (stationkeeping), and hazard analysis. The MMS is in the process of incorporating these recommended practices into the existing regulations. Hazard analyses allow MMS to be assured that the operator has anticipated emergencies and is prepared to address such, either through their design or through the operation of the equipment in question.

Conservation Reviews

One of MMS'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 are required to submit the necessary information as part of their EP, initial and supplemental DPP, and Conservation Information Document (CID). Conservation reviews are performed to ensure that economic reserves are fully developed and produced, and are managed in a manner to maximize resources recovered from reservoirs.

Development and Production Plans

A development and production plan (DPP) must be submitted to MMS for review and decision before any development operations can begin on a lease in the Eastern Gulf of Mexico. Eastern Gulf of Mexico means all OCS areas in the Gulf of Mexico adjacent to the State of Florida, as described in the OCSLA (43 U.S.C. 1333(a)(2)). The DPP's describe the proposed development activities, drilling activities, platforms or other facilities, proposed production operations, environmental monitoring plans, and other relevant information, and include a proposed schedule of development and production activities. Requirements for lessees and operators submitting a DPP are addressed in 30 CFR 250, Subpart B.

After receiving a DPP, MMS performs technical and environmental reviews. The MMS 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, coastal resources, and other uses (e.g., military operations) of the OCS. The DPP is reviewed for compliance with all applicable laws and regulations.

An EA and/or EIS is prepared in support of the NEPA environmental review for every DPP. The EA and/or EIS 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 (for selected plans under provisions of a DOI agreement), NMFS, and/or internal MMS offices.

As part of the review process, the DPP and supporting environmental information are sent to the affected State(s) for consistency certification review and determination under the States' approved CZM programs. The OCSLA (43 U.S.C. 1345(a) through (d) and 43 U.S.C. 1351(a)(3)) provides for this coordination and consultation with the affected State and local governments concerning a DPP.

New or Unusual Technologies

Technologies continue to evolve to meet the technical, environmental, and economic challenges of deepwater development. The MMS prepared a PEA to evaluate potential effects of deepwater technologies and operations (USDOI, MMS, 2000). As a supplement to the EA, MMS prepared a series of technical papers that provides a profile of the different types of development and production structures that may be employed in the GOM deep water (Regg et al., 2000). The EA and technical papers were used in the preparation of this SEIS.

New or unusual technologies (NUT's) are required to be identified by the operator in its EP, DWOP, and DPP or through MMS'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 MMS for alternative compliance or departures that may trigger additional engineering, technological, or 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 in how they function or interface with the environment. These include equipment or procedures that have not been installed or used in GOM OCS waters. Having no operational history, they have not been assessed by MMS through technical and environmental reviews. New technologies may be outside the framework established by MMS regulations and, thus, their performance (safety, environmental protection, efficiency, etc.) has not been addressed by MMS. 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 MMS 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 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 MMS does not have sufficient information to determine its potential impacts to the environment. In this later case, MMS 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 MMS'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 MMS 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 MMS regulation must be fully described and justified before it would be approved for use. For MMS 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 MMS uses to assess the adequacy of protection provided by alternative technology or operations. Actual operational experience is necessary with alternative compliance measures before MMS would consider them as proven technology.

Emergency Plans

Criteria, models, and procedures for shutdown operations and the orderly evacuation for a pending hurricane have been in place in the GOM OCS for more than 30 years. Operating experience from extensive drilling activities and more than 4,000 platforms during the 30-plus years of the GOM 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) is to formulate the exact time needed to secure the wells/production facility and to abandon as necessary. Operators will develop site-specific curtailment/securing/evacuation plans that will 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/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 terrorist attack.

Neither MMS 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.

In less than one month in 2005, two Category 5 hurricanes, Katrina and Rita, impacted OCS activities in the GOM. As stated in **Chapter 3.3.5.7.3**, Damage to Offshore Infrastructure from Recent Hurricanes, the damage to structures and pipelines was minimal considering that three-quarters of the structures and two-thirds of the pipelines were in the direct path of either Hurricane Katrina or Hurricane Rita.

Although this demonstrates the effectiveness of existing regulations, MMS is working to further minimize potential damage in future hurricane seasons. Two separate MMS-funded studies are currently assessing damage from Hurricanes Katrina and Rita to pipelines and fixed offshore platforms, and the studies should be completed in 2007. Meanwhile, interim guidelines were issued for drilling rigs for the 2007 Hurricane Season (NTL's 2007-G18 and 2007-G19), which adopted new API standards. Work is currently underway to revise the design standards of platform structures.

Beginning in the 1980's, MMS established comprehensive pollution prevention requirements that include redundant safety systems, as well as inspection and testing requirements to confirm that these devices are working properly (**Chapter 1.5).** An overall reduction in spill volume has occurred over the past 40 years, while oil production has generally increased. The MMS attributes this improvement to MMS operational requirements, ongoing efforts by the oil and gas industry to enhance safety and pollution prevention, and the evolution and improvement of offshore technology. Part of those safety systems are subsurface safety valves (SSSV) and downhole safety valves (DSV). Should a platform be damaged, these valves "shut-in" production flow to prevent pollution events until the production can be safely reestablished. During Hurricanes Ivan, Katrina, and Rita, these valves performed successfully (U.S. Senate, Committee on Energy and Natural Resources, 2005).

Permits and Applications

After EP or DPP approval, the operator submits applications for specific activities to MMS 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 MMS 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 evaluation of operational safety and pollution-prevention measures. The APD is reviewed for conformance with the engineering requirements and other technical considerations.

The MMS 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. Compliance includes requirements for state-of-the-art drilling technology, production safety systems, completion of oil and gas wells, oil-spill contingency plans, pollution-control equipment, H_2S contingency plans, and specifications for platform/structure designs. These safety, technical, and engineering reviews involve risk assessment and a thorough analysis of the hazards involved. Safety systems used for drilling, workover, and production operations 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. Specific requirements for sundry notices for well workovers, completions, and abandonments are detailed in 30 CFR 250 Subparts F, E, and Q, respectively.

The MMS 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 below the mudline. All plugs must be tested in accordance with the regulations. If a well were found to be leaking, MMS 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 MMS with an annual report summarizing plans to permanently abandon the well or to bring the well into production. Part of the annual report for a temporarily abandoned well is a survey of the well location to ensure the temporary abandonment is intact and adequately restricting any reservoir fluids from migrating out of the well. All equipment such as wellheads, production trees, casing, manifolds, etc., must be designed to withstand the maximum pressures that they may experience. These designs are verified by MMS through multiple levels of engineering safety reviews prior to the equipment being placed into service.

Platforms and Structures

The MMS does a technical and safety review of all proposed structure designs and installation procedures. All proposed facilities are reviewed for structural integrity. These detailed classical engineering reviews entail an intense 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 and MMS 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 MMS 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, DOT, COE, the Federal Energy Regulatory Commission (FERC), and 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 or affecting interstate commerce of 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 MMS is responsible for regulatory oversight of the design, installation, and maintenance of OCS producer-operated oil and gas pipelines. The MMS 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 DPP’s. Pipeline applications may be for on-lease pipelines or right-of-way for pipelines that cross other lessees’ leases or unleased areas of the OCS. Pipeline permit applications to MMS 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 DOI has regulatory responsibility for all producer-operated pipelines. The DOI’s responsibility extends downstream from the first production well to the last valve and associated safety equipment on the last OCS-related production system along the pipeline. The DOT’s regulatory responsibility extends shoreward from the last valve on the last OCS-related production facility.

The MMS 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 MMS prepares an EA on all pipeline rights-of-way (ROW) that go ashore. For Federal consistency, applicants must comply with the requirements of NTL 2002-G15. All Gulf States require consistency review of ROW pipeline applications as described in the subject 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 (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 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, 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 as specified in a Letter to Lessees and Operators (LTL) dated April 18, 1991.

Applications for pipeline decommissioning must also be submitted for MMS 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 MMS 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 an MMS 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 platform, safety-system components.

The inspectors follow the guidelines as established by the regulations, API Recommended Practices (RP) 14C, and the specific MMS-approved plan. The MMS 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 MMS 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 MMS 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 GOM Region 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 MMS 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 provided for critical safety devices that will shut off flow from the well if loss of control is encountered.

In addition, MMS regulations at 30 CFR 250.500, 250.600, and 250.800 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, MMS incorporates 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, MMS regulations at 30 CFR 250.1000 require that pipelines and associated valves, flanges, and fittings be designed, installed, operated, maintained, and abandoned to provide safe and pollution-free transportation of fluids in a manner that does not unduly interfere with other uses on the OCS.

The MMS 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 a pollution event is required. All hydrocarbon-handling equipment for testing and production, such as separators, tanks, and treaters, are required to be designed, installed, and operated to prevent pollution. Maintenance and repairs that are necessary to prevent pollution is required to be taken immediately. Drilling and production facilities are required to be inspected daily or at intervals approved or prescribed by the MMS 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 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 NPDES program. The MMS 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 MMS District Supervisor.

Oil-Spill Response Plans

The MMS's responsibilities under OPA 90 include spill prevention, review, and approval of oil-spill response plans (OSRP); 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 MMS 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) that is used for one or more of the following purposes: exploring for, drilling for, producing, storing, handling, transferring, processing, or transporting oil. An 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 MMS can grant an exception to this requirement during the MMS 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 MMS 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 MMS-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 MMS GOM Region. Although Regional OSRP's have not been allowed for facilities subject to the State of Florida consistency review in the past, MMS has recently initiated a new policy accepting subregional plans for this area. 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 MMS 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 MMS-required OSRP. In accordance with 30 CFR 254.23, 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 response removal 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 worse-case discharge scenario, contractual agreements, and training and drills. 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 MMS-approved OSRP's must be reviewed at least every two years. In addition, revisions must be submitted to MMS 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.

Financial Responsibility

The responsible party for COF's may have to demonstrate OSFR as required by regulation at 30 CFR 253. These regulations implement the OSFR requirements of Title I of OPA 90, as amended. Penalties for noncompliance with these requirements are covered at 30 CFR 250.51 and in NTL 99-N01, "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 MMS 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 NAAQS, pursuant to the 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 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 Outer Continental Shelf (OCS) areas of the Pacific, Atlantic, Arctic, and eastward of 87.5^{o} W. longitude in the GOM. Air quality in the OCS area westward of 87.5^{o} W. longitude, in the Gulf, is under MMS jurisdiction.

For OCS air emission sources located east of 87.5^{o} 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. For air emission sources located east of 87.5^{o} 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 proposed sale area falls east of 87.5^{o} W. longitude, where the CAA assigns air quality jurisdiction to USEPA. Operators with actions that affect air quality in this area must comply with USEPA air quality regulations and submit air permit applications to USEPA for approval. 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.

To comply with the CAAA, MMS adjusted regulations in 30 CFR 250 Subpart C to apply regulatory authority to only those OCS air emission sources west of 87.5^{o} W. longitude. The regulated pollutants include carbon monoxide, suspended particulates, sulphur dioxide, nitrogen oxides, total hydrocarbons, and volatile organic compounds (VOC's). All new or supplemental EP's and DPP's must include air emissions information sufficient to perform an air quality review. The MMS regulations require a review of air quality emissions to determine if the projected emissions from a facility result in onshore ambient air concentrations above MMS 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 MMS so that affected States can determine potential air quality impacts on its air quality.

The MMS 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 MMS 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 OCD model. The results from the OCD model, the modeled potential onshore impacts, are compared with MMS 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 non-attainment, further emission reductions or offsets may be required. Projected contributions to onshore pollutant concentrations are also subject to the same limits as the 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, to provide sufficient reservoir data for the operator to evaluate reservoir development options, during unloading/testing operations, and/or in emergency situations. The MMS regulates flaring/venting to minimize the loss of revenue producing natural gas resources. The MMS regulations (30 CFR 250) allow, without prior MMS 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 MMS. Records must always be prepared by the operator for all flaring/venting and justification must be provided for flaring/venting not expressly authorized by MMS regulations.

Hydrogen Sulfide Contingency Plans

The operator of a lease must request an MMS area classification for the presence of hydrogen sulfide (H_2S) gas. The MMS 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 (ppm) are required to file an H_2S contingency plan with MMS. This plan must include the 30 CFR 250 requirements, intended to ensure workers safety at the production facility and contingencies for simultaneous drilling, well-completion, well-workovers, and production operations. The NTL 98-16, "Hydrogen Sulfide (H_2S) Requirements," provides clarification, guidance, and information regarding MMS's H_2S regulations at 30 CFR 250.

Archaeological Resources Regulation

The archaeological resources regulation at 30 CFR 250.194 grants specific authority to each MMS Regional Director to require archaeological resource surveys and reports where deemed necessary. The technical requirements of the archaeological resource surveys and reports are detailed in NTL 2005-G07. Specific lease blocks that require an archaeological survey and assessment are identified in NTL 2006-G07. Both of these NTL's are issued by the MMS's GOM OCS Region. The regulations at 30 CFR 250.227(b)(6) and 30 CFR 250.261(b)(6) require the lessee to include an archaeological report with an EP or DPP. If the evidence 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 MMS Regional Supervisor, Office of Leasing and Environment, within 48 hours of its discovery.

Coastal Zone Management Consistency Review and Appeals for Plans

The 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 MMS 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 program and that such activities will be conducted in a manner consistent with the program (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 information begins when the State receives the OCS plan, consistency certification, and required necessary data and information. Only missing information can be used to delay the commencement of State agency review, and a request for information and data in addition to that required by 15 CFR 930.76 will not extend the date of commencement of review (15 CFR 930.58). The information requirements for CZM purposes are found at 30 CFR 250.226 and 250.260 and are discussed in NTL's 2006-G14 and 2006-G15. Under the CZMA, each State with an approved CZM plan may require information that is different than that specifically outlined in these regulations. All of the Gulf States have approved CZM programs. Requirements for the CZM consistency information for Texas, Louisiana, Mississippi, Alabama, and Florida are given in NTL's 2006-G14 and 2006-G15. In accordance with the requirements of 15 CFR 930.76, the MMS, GOM OCS Region sends copies of an OCS plan, including the consistency certification and other necessary information, to the designated State CZM agency by receipted mail or other approved communication. If no State-agency objection is submitted by the end of the consistency review period, MMS shall presume consistency concurrence by the State (15 CFR 930.78 (b)). The MMS can require modification of a plan if the operator has agreed to certain requirements requested by the State.

If MMS receives a written consistency objection from the State, MMS 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 (30 CFR 250.107(c) and (d)). Conformance to the standards, codes, and practices referenced in 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, completion of oil and gas wells, oil-spill response plans, pollution-control equipment, and specifications for platform/structure designs. The MMS 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 MMS 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 BAST feature would not be feasible.

The BAST concept is addressed in the MMS, GOM OCS Region by a continuous effort to locate and evaluate the latest technologies for safety and effectiveness, and to report on these advances at periodic Regional Operations Technology Assessment Committee (ROTAC) meetings. A part of the MMS staff has an ongoing function to evaluate 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 MMS district personnel at ROTAC meetings. Awareness by both MMS 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 enhanced safety 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. Another example of a BAST-required equipment change would be the requirement to replace subsurface-controlled, subsurface safety valves with surface-controlled, subsurface safety-valve systems, which incorporate a more positive closure design and operation.

Production Facilities

The MMS'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 separators, treaters, 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, MMS 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 MMS 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, MMS 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 (OSM) created the MMS 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 is often required to be embedded into or placed onto the seafloor around activity areas. In compliance with Section 22 of MMS'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 one 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.

In 1988, MMS requested a "generic" consultation from NMFS pursuant to Section 7 of the ESA concerning potential impacts on endangered and threatened species associated with explosive severance activities conducted during the structure-removal operations. The consultation's BiO concentrated primarily on structure removals in water depths <200 m (656 ft); therefore, the ITS was limited to the five species of sea turtle found on the shallow shelf. Reporting guidelines and specific mitigation measures are outlined in the ITS and include (1) the use of a qualified NMFS observer, (2) aerial surveys, (3) detonation delay radii, (4) nighttime blast restrictions, (5) charge staggering and grouping, and (6) possible diver survey requirements.

In 1989, API petitioned NMFS under the MMPA regulations for the incidental take of spotted and bottlenose dolphins during structure-removal operations. The Incidental Take Authorization regulations were promulgated by NMFS in October 1995 (60 FR 53139, October 12, 1995), and on April 10, 1996 (61 FR 15884), the regulations were moved to Subpart M (50 CFR 216.141 *et seq*.) of the MMPA regulations. Effective for 5 years, the regulations detailed conditions, reporting requirements, and mitigative measures similar to those listed in the 1988 ESA Consultation requirements for sea turtles. After the regulations expired in November 2000, NMFS and MMS advised operators to continue following the guidelines and mitigative measures of the lapsed subpart pending a new petition and subsequent regulations. At industry's prompting, NMFS released interim regulations in August 2002, which expired on February 2, 2004. Operators continue to follow the interim conditions until NMFS promulgates new regulations.

Emphasizing a continued need for an incentive to keep explosive weights low, MMS formally requested that NMFS amend the 1988 BiO to establish a minimum charge size of 5 lb. The NMFS subsequently addressed explosive charges ≤5 lb in a separate, informal BiO. The October 2003 "de minimus" BiO waives several mitigative measures of the 1988 BiO (i.e., aerial observations, 48-hr pre-detonation observer coverage, onsite NOAA personnel, etc.), reduces the potential impact zone from 3,000 ft to 700 ft (914 m to 213 m), and gives the operators/severing contractors the opportunity to conduct their own observation work. All of the current terms and conditions of structure and well removal activities are covered in NTL 2004-G06, "Structure Removal Operations."

The MMS has prepared a PEA (USDOI, MMS, 2005a) that assesses the potential impacts of all decommissioning activities and related salvage operations on the GOM. The PEA and its associated Finding of No Significant Impact (FONSI) were published in March 2005. Topics of primary concern addressed in the PEA include pre-severance operations, severance technologies, industry needs related to water depth and location, and the potential impacts of decommissioning operations on the marine environment. Information from the PEA was used to prepare a new petition for rulemaking by the NMFS for incidental take regulations under Subpart I of the MMPA. The MMS has also requested initiation of a new formal consultation for explosive severance activities under Section 7 of the ESA using information from the PEA. Work is currently proceeding on both the MMPA and ESA efforts, and MMS expects to have new take regulations and the consultation finalized by the end of 2006.

Once the bottom-founded components are severed and the structures/wells are removed, operators must verify that the seafloor is clear of obstructions and the site is returned to prelease conditions. The NTL 98-26, dated November 30, 1998, establishes site clearance verification procedures that include sonar surveys and/or trawling the cleared site by a licensed "shrimp" trawler to ensure that no "hangs" exist. The MMS requires operators to submit a procedural plan for site clearance verification, and once the sonar or trawling activities are completed, they are required to file reports on the results of their site clearance activities.

Marine Protected Species NTL's

The Marine Protected Species Stipulations are now embodied in NTL 2007-G02, "Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program," NTL 2007-G04, "Vessel Strike Avoidance and Injured/Dead Protected Species Reporting," and NTL 2007-G03, "Marine Trash and Debris Awareness and Elimination." The requirements of these NTL's apply to all existing and future oil and gas operations in the GOM OCS.

The NTL 2007 G-02, "Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program," clarifies the implementation of mitigation features to minimize impacts to protected species during seismic surveys. Seismic operators must comply with certain ramp-up procedures, including measures to minimize sound source levels. The NTL also outlines the requirements of the Protected Species Observer Program, including training, monitoring methods, and reporting. The seismic operators are also encouraged to participate in an experimental program by including passive acoustic monitoring as part of the protected species observer program.

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 their own vessel that collided with a protected species, MMS must be notified within 24 hours of the strike.

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 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 2003-G11 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 given in the NTL) and (2) receiving an explanation from the lessee company's management that emphasizes their commitment to the message of this NTL. 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 MMS by January 31 of each year.

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 also 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 RTR plans for their respective States. 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 to run the State's artificial reef program. Since the inception of the RTR plans, more than 240 retired platforms have been donated and used for reefs in the GOM.

1.6. Other OCS-Related Activities

The MMS 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 actives, and regulatory enforcement. The MMS also participates in industry research efforts and forums.

Environmental Studies Program

The 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 GOM OCS Region has funded more than 350 completed or ongoing environmental studies (see Appendix A for recent GOM Region 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.

Studies completed since 1974 are available on the MMS Internet website at http://www.gomr.mms.gov/homepg/regulate/environ/techsumm/rec_pubs.html. The MMS's Environmental Studies Program Information System (ESPIS) provides immediate access to all completed MMS ESP studies (http://mmspub.mms.gov:81/search.html). 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 MMS ESP report. Studies that focus on the Eastern GOM can be found at http://www.gomr.mms.gov/homepg/offshore/egom/cmp_stud.html. A complete description of all ongoing GOM OCS Region studies is available at http://www.gomr.mms.gov/homepg/regulate/environ/ongoing_studies/gom.html. 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 web sites.

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 MMS's GOM OCS Region analysts to prepare this document. While not all of the MMS's GOM OCS Region studies are specifically referenced in this document, they were used by analysts as input into their analysis. The information in ESP studies is also used by decisionmakers to manage and regulate exploration, development, and production activities on the OCS.

Technical Assessment & Research Program

The Technical 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 MMS regulations, rules, and operational guidelines ensure the use of BAST (**Chapter 1.5**).
- 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

Memorandum 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 a Memorandum of Understanding (MOU), previously called a Cooperating Agency Agreement. The Agreement details the responsibilities of each participating agency. The MMS, as lead agency, has requested other Federal agencies to become cooperating agencies while other agencies have requested MMS 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 EIS. No requests were received for cooperating agency status.

Memorandum of Understanding and Memoranda of Agreements Between MMS and the Coast Guard

Since the MMS 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 OCSLA, as amended, and OPA 90. 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 MMS and USCG, dated September 30, 2004, further clarifies the technical and process section of the MMS/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, MMS has established a full-time position within the Office of Offshore Regulatory Programs to provide liaison between the agencies.

Generally, the MOU identifies MMS 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 the USCG. These include, among others, design of vessels, their seakeeping 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, MMS 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 the MMS), OSFR (i.e., MMS determines and provides OSFR-related information to the USCG upon request), oil-spill preparedness and response planning (i.e., MMS requires responsible parties to maintain approved oil-spill-response plans consistent with Area Contingency Plans and the National Contingency Plan;

personnel receive training and response equipment is inspected; jointly approve floating oil storage facilities; and advise MMS of spill-response activities), 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., MMS and USCG responsible for investigating and preparing report of fires, spillage, injury, fatality, blowouts, and collisions and allisions), and offshore facility system/subsystem responsibility matrix (identifies lead agency responsible for MODU, fixed, and floating systems and subsystem and coordinates with other agencies as appropriate).

On April 18, 2005, MMS 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 was approved on September 12, 2006. The Oil-Spill Planning MOA has been drafted and is under legal counsel review with USCG and DOI. The Incident Investigation MOA has undergone regional review and is proceeding toward finalization.

Deepwater Port Agreement

The MMS is among several other Federal agencies that are a part of a MOU for licensing deepwater ports. The MOU emphasizes the importance of the lead agencies, USCG and the Maritime Administration, to receive specific information from subject matter experts in other participating agencies. The MOU establishes that agencies will work together with applicants and stakeholders, identify and resolve issues, attempt to build consensus among governmental agencies, and expedite environmental reviews required for licensing associated with deepwater ports. The MMS is responsible for issuing and enforcing regulations to promote safe operations and activities on the OCS, including leasing and minerals royalty programs, overseeing facility permitting, conducting NEPA analyses, granting pipeline rights-of-way, performing facility and operations inspection, and engaging appropriate engineering and oil-spill research. Other participating agencies include the NMFS, NOS, COE, Office of Fossil Energy (U.S. Department of Energy (DOE)), FWS, Department of State (DOS), U.S. Department of Transportation Maritime Administration (MARAD), USEPA, FERC, and CEQ. The MMS has a Cooperating Agency Agreement with the USCG regarding deepwater ports and NEPA. Under the OCSLA, MMS has the authority to manage the exploration, development, and production of mineral resources located in the OCS. The MMS will designate a primary point of contact, provide a listing of subject matter experts available to assist in NEPA activities, participate in pre-application meetings, perform completeness and adequacy reviews, participate in scoping meetings, provide written comments and recommendations of all draft and interim final versions of NEPA documents prepared by USCG or its contractors, assist in the development of information and preparation of environmental analyses, and recommend mitigations to avoid or reduce impacts to environmental resources.

Marine Minerals Branch

The Marine Minerals Branch (MMB) manages the MMS's nonenergy minerals program in the GOM. Nonenergy minerals include sand, shell, and gravel. The MMB develops and procures contracts to assist in the acquisition of environmental data and information that would facilitate a NEPA analysis or add to the general knowledge base. The MMB offers and can enter into a noncompetitive lease (P.L. 103-426) for sand, shell, or gravel resources for certain types of projects funded in whole or part by or authorized by the Federal Government. The Shore Protection Provisions of the Water Resource Development Act of 1999 amended P.L. 103-426 by prohibiting charging State and local governments a fee for using OCS sand. For all other uses, a competitive bidding process is required under Section 8(k)(1) of the OCSLA.

CHAPTER 2

ALTERNATIVES INCLUDING THE PROPOSED ACTION

2. ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1. ALTERNATIVES, MITIGATING MEASURES, AND ISSUES

2.1.1. Alternatives for Proposed Eastern Gulf Sale 224

Alternative A—The Proposed Action: This alternative would offer for lease all blocks within the Sale 224 area for oil and gas operations as mandated by the Gulf of Mexico Energy Security Act of 2006 (**Figure 1-1**).

The Sale 224 area encompasses about 134 unleased blocks covering approximately 584,000 ac in that portion of the "181 Area" that is west of the Military Mission Line and more than 125 mi (200 km) from Florida **(Figure 1-2)**. The estimated amount of resources projected to be developed as a result of the proposed Lease Sale 224 is 0.1-0.14 BBO and 0.16-0.34 Tcf of gas.

Alternative B—No Action: This is the cancellation of proposed EPA Lease Sale 224. The opportunity for development of the 0.1-0.14 BBO and 0.16-0.34 Tcf of gas that could have resulted from the proposed EPA lease sale would be precluded or postponed. Any potential environmental impacts resulting from the proposed lease sale would not occur or would be postponed.

2.1.2. Mitigating Measures

In 1978, Section 1508.20 of CEQ defined mitigation as follows:

- Avoidance—The avoidance of an impact altogether by not taking a certain action or part of an action.
- Minimization—The minimizing of impacts by limiting the degree or magnitude of the action and its implementation.
- Restoration—The rectifying of the impact by repairing, rehabilitation, or restoring the affected environment.
- Maintenance—The reducing or eliminating of the impact over time by preservation and maintenance operations during the life of the action.
- Compensation—The compensation for the impact by replacing or providing substitute resources or environments.

2.1.2.1. Proposed Mitigating Measures Analyzed

The potential mitigating measures included for analysis in this EIS were developed as the result of scoping efforts over a number of years for the continuing OCS Program in the GOM. Four lease stipulations are proposed for the EPA sale—the Protected Species Stipulation, Military Areas Stipulation, the Evacuation Stipulation, and the Coordination Stipulation. These measures will be considered for adoption by the Assistant Secretary of the Interior for Land and Minerals (ASLM). The analysis of any stipulations as part of 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 Lease Sale 224 will be described in the Final Notice of Sale for that lease sale. Mitigation 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 a lease sale, will undergo a NEPA review, and additional project-specific mitigations may be applied as conditions of plan approval. The MMS 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.

2.1.2.2. Existing Mitigating Measures

This section discusses mitigation measures that would be applied by MMS. Mitigating measures have been proposed, identified, evaluated, or developed through previous MMS 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 MMS review and approval to ensure compliance with established laws and regulations. Existing mitigating measures must be incorporated and documented in plans submitted to MMS. Operational compliance of these mitigating measures is enforced through the MMS onsite inspection program.

Mitigating measures that are a standard part of the MMS program ensure that the operations are always conducted in an environmentally sound manner (with a zero tolerance of pollution and with every regulatory effort to minimize any adverse impact of routine operations to the environment). For example, mitigating measures ensure site clearance procedures eliminate potential snags to commercial fishing nets and require surveys to detect and avoid archaeological sites and biologically-sensitive areas such as pinnacles, topographic features, and chemosynthetic communities.

Some MMS-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 accidental debris loss, development of methods of pipeline landfall to eliminate impacts to barrier beaches, and semiannual beach cleanup events.

Site-specific mitigating measures are also applied by MMS during plan reviews. The MMS 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 MMS 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, 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, reminders, and safety precautions. In addition to standard mitigations, MMS may also apply nonrecurring mitigating measures that are developed on a case-by-case basis.

The MMS is continually revising applicable mitigations to allow the GOMR 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 currently tracked by MMS (e.g., end of operations reports for plans, construction reports for pipelines, and removal reports for structure removals).

2.1.3. 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 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 (IPF) associated with the OCS Program; a reasonable probability of an interaction between the resource/activity and IPF should exist; or
- information that indicates a need to evaluate the potential impacts to a resource/activity has become available.

2.1.3.1. Issues to be Analyzed

The following issues relate to potential IPF's and the resources and activities that could be affected by OCS exploration, development, production, and transportation activities.

Accidental Events: Concerns were raised related to the potential impact of oil spills on the marine and coastal environments specifically regarding the potential effects of oil spills on tourism, emergency response capabilities, spill prevention, effect of winds and currents on the transport of oil spills, accidental discharges from both deepwater blowouts and pipeline ruptures, and oil spills resulting from past and future hurricanes. Other concerns raised over the years of scoping were the fate and behavior of oil spills, availability and adequacy of oil-spill containment and cleanup technologies, oil-spill cleanup strategies, impacts of various oil-spill cleanup methods, effects of weathering on oil spills, toxicological effects of fresh and weathered oil, air pollution associated with spilled oil, and short-term and long-term impacts of oil on wetlands.

Drilling Fluids and Cuttings: Specific concerns related to drilling fluids include mercury, SBF's and large volumes of industrial chemicals necessary for deepwater drilling operations, and potential for persistence of drilling muds and cuttings. Other concerns raised over the years of scoping were potential smothering of benthic communities by offshore disposal of drilling fluids and cuttings, the use and disposal of drilling fluids include potential spills of oil-based drilling fluids (OBF's), onshore disposal of OBF's, the fate and effects of SBF's in the marine environment, and the potential toxic effects or bioaccumulation of trace metals in drilling fluids discharged into the marine environment.

Air Emissions: The potential effects of emissions of combustion gases from platforms, drill rigs, service vessels, and helicopters have been raised as an issue over the years of scoping. Also under consideration are the flaring of produced gases during extended well testing and the potential impacts of transport of production with associated H_2S.

Water Quality Degradation: Issues related to water quality degradation raised over the years of scoping most often were associated with operational discharges of drilling muds and cuttings, produced waters, and domestic wastes. Water quality issues also included concerns related to impacts from sediment disturbance, petroleum spills and blowouts, and discharges from service vessels.

Other Wastes: Other concerns raised over the years of scoping include storage and disposal of trash and debris, and trash and debris on recreational beaches.

Structure and Pipeline Emplacement: Some of the issues raised over the years of scoping related to structure and pipeline emplacement are bottom area disturbances from bottom-founded structures or anchoring, sediment displacement related to pipeline burial, space-use conflicts, and the vulnerability of offshore pipelines to damage that could result in hydrocarbon spills or H_2S leaks.

Platform Removals: Concerns raised over the years of scoping about the abandonment of operations include how a platform is removed, potential impacts of explosive removals on marine organisms, remaining operational debris snagging fishing nets, and site clearance procedures.

OCS-Related Support Services, Activities, and Infrastructure: Specific issues were damage to coastal infrastructure by Hurricanes Katrina and Rita, and the vulnerability of coastal infrastructure to damage from future hurricanes. Concerns raised over the years of scoping include activities related to the shore-base support of the Development and Production Plan include vessel and helicopter traffic and emissions, construction or expansion of navigation channels or onshore infrastructure, maintenance and use of navigation channels and ports, and deepening of ports.

Sociocultural and Socioeconomic: Many concerns have focused on the potential impacts to coastal communities including demands on public services and tourism. Issues raised over the years of scoping include impacts on employment, population fluctuations, effects on land use impacts to low-income or minority populations, and cultural impacts.

OCS Oil and Gas Infrastructure: Specific issues were damage to offshore infrastructure by Hurricanes Katrina and Rita, and the vulnerability of offshore infrastructure to damage from future hurricanes.

Other Issues: Many other issues have been identified. Several of these issues are subsets or variations of the issues listed above. All are taken under advisement and are considered in the analyses, if appropriate. Additional issues raised during the years of scoping are new and unusual technologies, noise from platforms, vessels, helicopters, and seismic surveys; turbidity as a result of seafloor disturbance or discharges; mechanical damage to biota and habitats; and multiple-use conflicts.

Resource Topics Analyzed in the EIS: The analyses in **Chapter 4.3** address the issues and concerns identified above under the following resource topics:

- Air Quality
- Alabama, Choctawhatchee, St. Andrew, and Perdido Key Beach Mice, Florida Salt Marsh Vole
- Archaeological Resources (Historic and Prehistoric)
- Coastal Barrier Beaches and Associated Dunes
- Coastal and Marine Birds
- Commercial Fisheries
- Continental Slope and Deepwater Resources (Chemosynthetic and Nonchemosynthetic Communities)
- Fish Resources and Essential Fish Habitat
- Gulf Sturgeon
- Human Resources and Land Use
- Marine Mammals
- Recreational Fishing
- Recreational Resources (Beach Use, Visual Aesthetics, and Tourism)
- Sea Turtles
- Seagrasses
- Water Quality (Coastal and Marine)
- Wetlands

2.1.3.2. Issues Considered but Not Analyzed

As previously noted, CEQ’s 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 the 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 EIS for the proposed EPA lease sale. 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 DOI and/or MMS, 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. Programmatic issues including global warming, administrative boundaries, expansion of sale area, port usage fees, alternative energies, and royalty relief have been considered in the preparation of the EIS for the 5-Year Program (USDOI, MMS, 2007e).

Revenue Sharing

A number of comments were received 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 DOI, and their guiding regulations, statutes, and laws.

The MMS 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**.

With the enactment of GOMESA, the Gulf producing States (i.e., Texas, Louisiana, Mississippi, and Alabama) will receive an increased share of offshore oil and gas revenue. Beginning in FY 2007, and thereafter, Gulf producing States will receive 37.5 percent of revenue from new leases issued in the 181 Area and 181 South Area. Beginning in FY 2016, and thereafter, Gulf producing States will receive 37.5 percent from new leases in the existing areas available for leasing. The remaining 50 percent and 12.5 percent of the total revenues would be distributed to the U.S. Treasury and LWCF, respectively. The socioeconomic benefits and impacts to local communities are analyzed in **Chapter 3.3** of this SEIS.

Additionally, there are a number of resources that MMS routinely analyzes in the NEPA documents prepared to support the offshore lease sales. However, proposed Lease Sale 224 is more than 125 mi (200 km) offshore, a very small area is under consideration, the water depth ranges from 800 to 3,200 m (2,625 to 10,500 ft), the scenario projects a single platform, no pipelines to shore, few exploration and development wells, and a relatively small amount of resources to be recovered. Due to the limited nature of this proposed lease sale and the distance from shore, some topics and potential impact-producing factors have been eliminated from detailed analyses in this SEIS. These topics were fully analyzed in the 181 Lease Sale EIS.

- **Aesthetics** are normally considered as the potential visual impacts from a proposed activity on the general population of an area. Due to the distance of more than 125 mi (200 km) from the shore, visual impacts are not considered to have a potential impact.
- **Topographic Features** are naturally occurring banks and regions of high topographic relief in the Gulf of Mexico. These banks occur in the central and western portions of the GOM, well outside the region for potential impacts from the proposed lease sale.
- The **Pinnacle Trend** is a region of naturally occurring, high-relief and low-relief banks in a restricted area off Alabama. No leases are being offered in the vicinity of the pinnacles and the only potential impacting factor would be pipeline installations. New pipeline installations will be restricted to tie-ins to existing pipelines in deeper waters than where the pinnacles are found.
- **Low-relief Live Bottoms** are hard-bottom regions of the north-central GOM that provide habitat for shallow-water organisms. The only potential impacting factor would be pipeline installations, and those will be restricted to deep waters where tie-ins to existing pipelines will be made.

2.2. PROPOSED EASTERN GULF LEASE SALE 224

2.2.1. Alternative A—The Proposed Action

2.2.1.1. Description

Alternative A would offer for lease all blocks within the EPA Lease Sale 224 area for oil and gas operations as mandated by GOMESA (**Figure 1-1**).

The EPA encompasses about 63.2 million ac, with approximately 584,817 ac, or less than 1 percent offered for lease under this proposed action. The estimated amount of resources projected to be developed as a result of proposed EPA Lease Sale 224 is 0.1-0.14 BBO and 0.16-0.34 Tcf of gas.

The analyses of impacts summarized below and described in detail in **Chapters 4.3** 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 **Chapters 4.1 and 4.2**.

2.2.1.2. Summary of Impacts

Air Quality (Chapter 4.3.1)

Emissions of pollutants into the atmosphere from the routine activities associated with the proposed action in the EPA 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. The proposed action would have only a very small effect on ozone levels in the onshore areas and would not interfere with the States' schedule for compliance with the NAAQS. The impacts of OCS emissions on onshore O_3 levels were very small in the EPA. 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 I areas.

Accidents involving high concentrations of H_2S could result in deaths as well as environmental damage. Other emissions of pollutants into the atmosphere from accidental events as a result of a proposed action in the EPA are not projected to have significant 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.

Water Quality

Coastal Waters (Chapter 4.3.2.1)

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. The impacts to coastal water quality from the proposed action should be minimal as long as all existing regulatory requirements are met.

The ability of coastal waters to assimilate spilled oil is affected by the shallowness of the environment. Large volumes of water are not available to dilute suspended oil droplets and dissolved constituents. 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 contains toxic aromatic compounds such as benzene, toluene, xylenes, naphthalenes, and polynuclear aromatic hydrocarbons, which are soluble to some extent in water. The effect of these compounds on water quality depends on the circulation in the coastal environment, the composition of the spilled oil, and the length of time the oil is in contact with the water. 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. Smaller spills (<1,000 bbl) are not expected to significantly impact water quality in coastal waters. Larger spills, however, could impact water quality in coastal waters.

Marine Waters (Chapter 4.3.2.2)

During exploratory activities, the primary impacting sources to marine water quality are discharges of drilling fluids and cuttings. 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. Impacts to marine waters from the proposed action should be minimal as long as regulatory requirements are followed.

Smaller spills (<1,000 bbl) are not expected to significantly impact water quality in marine waters. Larger spills, however, could impact water quality. Chemical spills, the accidental release of SBF, and blowouts are expected to have temporary localized impacts on water quality.

Sensitive Coastal Environments

Coastal Barrier Beaches and Associated Dunes (Chapter 4.3.3.1)

In summary, effects to coastal barrier beaches and associated dunes from navigation channel use and dredging, and construction or continued use of infrastructure in support of the proposed action are expected to be restricted to temporary and localized disturbances. There is no new construction expected on barrier beaches due to the proposed action. Existing facilities originally built inland may, through natural erosion and shoreline recession, 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 very localized impacts on adjacent barrier beaches downdrift of the channel due to sediment deprivation. The worst of these situations is found on the sediment-starved coasts of Louisiana, where sediments are largely organic. Based on use, the proposed action would account for a very small percentage of these impacts, which would occur whether the proposed action is implemented or not.

In conclusion, the 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. The proposed action may extend the life and presence of facilities in eroding areas, which can accelerate erosion there. Strategic placement of dredged material from channel maintenance, channel deepening, and related actions can mitigate adverse impacts upon those localized areas.

Should a spill contact a barrier beach, oiling is expected to be light and sand removal during cleanup activities minimized. No significant impacts to the physical shape and structure of barrier beaches and associated dunes are expected to occur as a result of the proposed action.

Wetlands (Chapter 4.3.3.2)

In summary, effects to coastal wetlands from the primary impact-producing factors associated with the proposed action in the EPA are expected to be minimal. The proposed action is expected to contribute minimally to the need for ongoing routine maintenance dredging of navigation channels and canals, and impacts associated with this dredging related to the proposed project are expected to be minor. Alternative dredged-material disposal methods can be used to enhance and create coastal wetlands. There is an expected minor increase in the use of existing channels by vessel traffic resulting from the proposed action, and this use is expected to contribute minimally to the erosion and widening of navigation channels and canals. Overall, impacts from these sources are expected to be low and could be further reduced through mitigation.

Offshore oil spills resulting from the proposed action are not expected to damage significantly any inland wetlands; however, if an inland oil spill related to the proposed action occurs, some impact to wetland habitat would be expected. Although the impact may occur generally over coastal regions, the impact has the highest probability of occurring in and around Plaquemines and St. Bernard Parishes, Louisiana, in the CPA.

Although the probability of occurrence is low, the greatest threat to wetland habitat is from an inland spill resulting from a vessel accident or pipeline rupture. While a resulting slick may cause minor impacts to wetland habitat and surrounding seagrass communities, 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 avoid or minimize those impacts. Overall, impacts to wetland habitats from an oil spill associated with activities related to the proposed action would be expected to be low and temporary.

Seagrass Communities (Chapter 4.3.3.3)

Most seagrass communities located between the Southwest Pass of the Mississippi River and Cape San Blas, Florida, are inland of the barrier shorelines. Because of the location of most seagrass communities, inshore oil spills pose the greatest threat (**Chapters 4.2.1.7 and 4.3.3.3**).

Such spills may result from either vessel collisions that release fuel and lubricants or from pipelines that rupture. If an oil slick settles into a protective embayment where seagrass beds are found, shading may cause reduced chlorophyll production; shading for more than about 2 weeks could cause thinning of leaf density. Under certain conditions, a slick could reduce dissolved oxygen in an embayment and cause stress to the bed and associated organisms due to reduced oxygen conditions. These light and oxygen problems can correct themselves once the slick largely vacates the embayment, and light and oxygen levels are returned to pre-slick conditions.

Increased water turbulence due to storms or vessel traffic will break apart the surface sheen and disperse some oil into the water column, as well as increase suspended particle concentration, which will adsorb to the dispersed oil. Typically, these situations will not cause long-term or permanent damage to the seagrass beds, although some dieback of leaves is projected for one growing season. No permanent loss of seagrass is projected to result from oil contact, unless an unusually low tidal event allows direct contact between the slick and vegetation. The greatest danger under the more probable circumstances is a reduction of the diversity or population of epifauna and benthic fauna found in seagrass beds. Seagrass stands usually recover from oil impacts in about a year with subsequent rapid colonization by fauna. However, it may take as much as 5-10 years of community succession before faunal composition resembles pre-impact conditions (Chan, 1977; Zieman et al., 1984; NRC, 1985 and 2003; Proffitt and Roscigno, 1996).

Although the probability of their occurrence is low, the greatest threat to inland, seagrass communities would be from an inland spill resulting from a vessel accident or pipeline rupture. Although a resulting slick may cause minor impacts to the bed, equipment and personnel used to clean up a slick over shallow seagrass beds may generate the greatest direct impacts to the area. Associated foot traffic may work oil farther into the sediment than would otherwise occur. Scarring may occur if an oil slick is cleaned up over a shallow submerged aquatic vegetation bed where vessels, booms, anchors, and personnel on foot would be used and scar the bed. Close monitoring and restrictions on the use of bottom-disturbing equipment would be needed to avoid or minimize those impacts.

Sensitive Offshore Benthic Resources (Chapter 4.3.4)

Chemosynthetic Deepwater Benthic Communities

Chemosynthetic communities are susceptible to physical impacts from structure placement (including templates or subsea completions), anchoring, and pipeline installation. The provisions of NTL 2000-G20 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 impacting activities.

If the presence of a high-density community were missed using existing procedures, potentially severe or catastrophic impacts could occur due to contact or raking of the sea bottom by anchors and anchor chains and partial or complete burial by muds and cuttings including those associated with pre-riser discharges or some types of riserless drilling. Variations in the dispersal and toxicity of synthetic-based drilling fluids may contribute to the potential extent of these impacts. The severity of such an impact is such that there would be incremental losses of productivity, reproduction, community relationships, and overall ecological functions of the community, and incremental damage to ecological relationships with the surrounding benthos.

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), 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 would permanently prevent reestablishment in the same locations.

The proposed action in the EPA is expected to cause no damage to the ecological function or biological productivity of either low-density chemosynthetic communities or the rarer, widely scattered, high-density, Bush Hill-type chemosynthetic communities as there is no expected suitable chemosynthetic community habitat located in the Sale 224 area.

Nonchemosynthetic Deepwater Benthic Communities

Accidental events resulting from the proposed action are expected to cause little damage to the ecological function or biological productivity of the 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. Even in situations where substantial burial of typical benthic communities occurred, recolonization from populations from neighboring substrate would be expected over a relatively short period of time for all size ranges of organisms, in a matter of hours to days for bacteria and probably less than one year for most all macrofauna species.

Deepwater coral habitats and other potential hard-bottom communities not associated with chemosynthetic communities will likely be avoided due to the geological hazards in the proximity of the escarpment where some hard substrate could be exposed.

Accidental events from the proposed action are expected to cause little damage to the ecological function or biological productivity of the widespread, typical, deep-sea benthic communities.

Marine Mammals (Chapter 4.3.5)

Small numbers of marine mammals could be killed or injured by a chance collision with a service vessel; however, current MMS requirements and guidelines for vessel operation in the vicinity of protected species should minimize this risk (the proposed Protected Species Stipulation and NTL 2003-G10).

Marine mammal ingestion of industry-generated debris is a concern. Sperm whales may be particularly at risk because of their suspected feeding behavior involving cruising along the bottom with their mouth open. Entanglement in debris could have serious consequences. A sperm whale could suffer diminished feeding and reproductive success, and potential injury, infection, and death from entanglement in discarded packing materials or debris. Industry has made good progress in debris management on vessels and offshore structures in the last several years. The debris awareness training, instruction, and placards required by the proposed Protected Species Stipulation and NTL 2003-G11 should greatly minimize the amount of debris that is accidentally lost overboard by offshore personnel.

There is no conclusive evidence whether anthropogenic noise has or has not caused long-term displacements of, or reductions in, marine mammal populations. Noise associated with the proposed action, including drilling noise, aircraft, and vessels may affect marine mammals by eliciting a startle response or masking other sounds. However, many of the industry-related sounds are believed to be out of, or on the limits of, marine mammal hearing, and the sounds are also generally temporary. The continued presence of sperm whales in close proximity to some of the deepwater structures in the GOM tends to rule out concerns of permanent displacement from disturbance.

Seismic operations have the potential to harm marine mammals in close proximity to firing airgun arrays. The proposed protected species stipulation and the several mitigations, including onboard observers and airgun shut-downs for whales in the exclusion zone, included in NTL 2004-G01 ("Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program") minimize the potential of harm from seismic operations to marine mammals.

Marine mammal death or injury is not expected from explosive structure-removal operations. Existing mitigations and those recently developed for structures placed in oceanic waters should continue to minimize adverse effects to marine mammals from these activities.

Contaminants in waste discharges and drilling muds might indirectly affect marine mammals through food-chain biomagnification. Although the scope and magnitude of such effects are not known, direct or indirect effects are not expected to be lethal.

Routine activities related to the proposed action, particularly when mitigated as required by MMS, 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 GOM.

Accidental blowouts, oil spills, and spill-response activities resulting from the proposed action have the potential to impact marine mammals in the GOM. 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. Populations of marine mammals in the northern Gulf will be exposed to residuals of oils spilled as a result of the proposed action during their lifetimes. Chronic or acute exposure may result in harassment, harm, or mortality to marine mammals occurring in the northern Gulf. Marine mammals made no apparent attempt to avoid spilled oil in some cases (e.g., Smultea and Würsig, 1995); however, marine mammals have been observed apparently detecting and avoiding slicks in other reports (e.g., Geraci and St. Aubin, 1987). Exposure to hydrocarbons persisting in the sea following the dispersal of an oil slick is likely to result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity; and increased vulnerability to disease) to marine mammals.

Sea Turtles (Chapter 4.3.6)

Routine activities resulting from the proposed action have the potential to harm sea turtles. These animals could be impacted by the degradation of water quality resulting from operational discharges; noise generated by seismic exploration, helicopter and vessel traffic, platforms, and drillships; vessel collisions; and marine debris generated by service vessels and OCS facilities. Lethal effects are most likely to be from chance collisions with OCS service vessels and ingestion of plastic materials. Most OCS activities are expected to have sublethal effects.

Contaminants in waste discharges and drilling muds might indirectly affect sea turtles through food-chain biomagnification, but there is uncertainty concerning the possible effects. Rapid dilution of the discharges should minimize impact. Chronic sublethal effects (e.g., stress) resulting in persistent physiological or behavioral changes and/or avoidance of impacted areas from noise disturbance could cause declines in survival or fecundity and result in population declines; however, such declines are not expected. The required seismic operation mitigations, particularly clearance of the impact area of sea turtles and marine mammals prior to ramp-up, and the subsequent gradual ramping up of the airguns should minimize the impact of rapid onset of, and close proximity to, very loud noise. Vessel traffic is a serious threat to sea turtles. Diligence on the part of vessel operators as encouraged by the vessel strike mitigations should minimize vessel/sea turtle collisions. 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 and minimizing the devastating effects on sea turtles. The routine activities of the proposed action are unlikely to have significant adverse effects on the size and recovery of any sea turtle species or population in the GOM.

Accidental blowouts, oil spills, and spill-response activities resulting from the proposed action 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. Populations of sea turtles in the northern Gulf will 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 sea turtles occurring in the northern Gulf. In most foreseeable cases, exposure to hydrocarbons persisting in the sea following the dispersal of an oil slick will result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity; 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.

Alabama, Choctawhatchee, St. Andrew, and Perdido Key Beach Mice and the Florida Salt Marsh Vole (Chapter 4.3.7)

An impact from the proposed action on the Alabama, Choctawhatchee, St. Andrew, and Perdido Key beach mice, and the Florida salt marsh vole is possible but unlikely. Impact may result from consumption of accidentally released beach trash and debris. The proposed action would deposit only a small portion of the total debris that reach the habitat. Efforts undertaken for the removal of marine debris or for beach restoration, such as sand replenishment, may temporarily scare away beach mice, destroy their food resources, or collapse the tops of their burrows.

Given the low probability of a large (≥1,000 bbl) spill occurring, direct impacts of oil spills on beach mice from the proposed action are highly unlikely. Oil-spill response and cleanup activities could have significant impact to the beach mice and their habitat, if not properly implemented.

Coastal and Marine Birds (Chapter 4.3.8)

The majority of effects resulting from the proposed action in the EPA on endangered/threatened and nonendangered/nonthreatened coastal and marine birds are expected to be sublethal: behavioral effects, sublethal exposure to or intake of OCS-related contaminants or accidentally discarded debris, temporary disturbances, and displacement of localized groups from impacted habitats. Chronic sublethal stress, however, is often undetectable in birds. As a result of stress, individuals may weaken, facilitating infection and disease. Nocturnal circulation around platforms may create acute sublethal stress from energy loss, while stopovers on platforms would reduce energy loss. No significant impacts to habitat are expected to occur directly from routine activities resulting from the proposed action. Secondary impacts from pipeline and navigation canals to coastal habitats will occur over the long term and may ultimately displace species from traditional sites to alternative sites.

Oil spills from the proposed action pose the greatest potential direct and indirect impacts to coastal and marine birds. Mortality usually results for birds that are heavily oiled. 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. Small coastal spills, pipeline spills, and spills from accidents in navigated waterways can contact and affect the different groups of coastal and marine birds, most commonly marsh birds, waders, waterfowl, and certain shorebirds. Lightly oiled birds can sustain tissue and organ damage from oil ingested during feeding and grooming or from oil that is inhaled. Stress, trauma, and shock enhance the effects of exposure and poisoning. Low levels of oil could stress birds by interfering with food detection, feeding impulses, predator avoidance, territory definition, homing of migratory species, susceptibility to physiological disorders, disease resistance, growth rates, reproduction, and respiration. Reproductive success can be affected by the toxins in oil. Indirect effects occur by the fouling of nesting habitat and by the displacement of individuals, breeding pairs, or populations to less favorable habitats. Competition with resident avian populations may displace refugee seabirds from all habitats.

New research, experience, and testing will help efficacy of the rehabilitation of oiled birds and probably improve scare methods that will keep birds away from an unlikely and accidental oil slick. Rehabilitation can be significant to the survival of threatened and endangered bird species.

Dispersants used in spill cleanup activity can have toxic effects similar to oil on the reproductive success of coastal and marine birds. The, air, vehicle, and foot traffic that takes place during shoreline cleanup activity can disturb nesting populations and degrade or destroy habitat if not properly regulated.

Endangered and Threatened Fish (Chapter 4.3.9)

Gulf Sturgeon

Potential impacts on Gulf sturgeon and the designated critical habitat may occur from drilling and produced-water discharges, degradation of estuarine and marine water quality by non-point runoff from estuarine OCS-related facilities, vessel traffic, explosive removal of structures, and pipeline installation. The dilution and low toxicity of this pollution is expected to result in negligible impact of the proposed action on Gulf sturgeon. Vessel traffic will generally only pose a risk to Gulf sturgeon when leaving and returning to port. Major navigation channels are excluded from critical habitat. The Gulf sturgeon characteristics of bottom-feeding and general avoidance of disturbance make the probability of vessel strike extremely remote. Explosive removal of structures as a result of the proposed action will occur well offshore of Gulf sturgeon critical habitat and the riverine, estuarine, and shallow Gulf habitats where sturgeon are generally located. Environmental permit requirements and recent techniques for locating pipelines will result in very minimal impact to Gulf sturgeon critical habitat if any pipeline is installed nearshore due to the proposed action. Impacts from routine activities resulting from the proposed action in the EPA are expected to have negligible effects on Gulf sturgeon and their designated critical habitat.

The Gulf sturgeon could be impacted by oil spills resulting from the proposed action. However, the juvenile and subadult Gulf sturgeon, at a minimum, seasonally use the nearshore coastal waters and could potentially be at risk from both coastal and offshore spills. Contact with spilled oil could have detrimental physiological effects. However, several factors influence the probability of spilled oil contact with Gulf sturgeon or their critical habitat. The likelihood of spill occurrence and subsequent contact with, or impact to, Gulf sturgeon and/or designated critical habitat is extremely low.

Fish Resources, Essential Fish Habitat, and Commercial Fishing (Chapter 4.3.10)

Law and Hellou (1999) make a clear summary stating, “Accidents and spillages are an inevitable consequence of the worldwide transport of crude oil and refined petroleum products by sea.” They also add that the number of major spills occurring each year has decreased since the 1970’s. Accidental events resulting from oil and gas development in the proposed action area of the EPA have the potential to cause some detrimental effects on fisheries and commercial fishing practices. A subsurface blowout would have a negligible effect on GOM fish resources or commercial fishing. 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 shellfish to avoid a spill, to metabolize hydrocarbons, and to excrete both metabolites and parent compounds. The effect of proposed-action-related oil spills on fish resources and commercial fishing is expected to cause less than a 1 percent decrease in standing stocks of any population, commercial fishing efforts, landings, or value of those landings. Historically, there have been no oil spills of any size that have had a long-term impact on fishery populations. Any affected commercial fishing activity (long lining in the southern portion of the sale area) would recover within 3 months. There is no evidence at this time that commercial fisheries in the GOM have been adversely affected on a regional population level by spills or chronic contamination.

At the expected level of impact, the resultant influence on fish populations and commercial fishing activities from the proposed action would be negligible and indistinguishable from variations due to natural causes. It is expected that coastal environmental degradation from the proposed action would have little effect on fish resources or EFH; however, wetland loss could occur due to a petroleum spill contacting inland areas, although contact probabilities are extremely low.

Recreational Fishing (Chapter 4.3.11)

The development of oil and gas in the proposed lease sale area is too far from shore to attract additional recreational fishing activity. Each structure placed in the GOM to produce oil or gas functions as a *de facto* artificial reef by attracting sport fish and improving fishing prospects in the immediate vicinity of the platforms. The single platform expected from the proposed activity will most likely have a minimal impact on recreational fishing in the area. This impact would last for the life of the structure, until the structure is removed from the location and the marine environment. The proposed action would have a beneficial effect on offshore and deep-sea recreational fishing within developed leases accessible to fishermen. These effects would last until the production structures are removed from the marine environment. Short-term, space-use conflict could occur during the time that any pipeline is being installed. Impacts on recreational fishing because of OCS-related vessel wakes would be minor because, on average, vessel use associated with the proposed action would represent less than 1 percent of total vessel use.

The estimated number and size of potential spills associated with the proposed action’s activities are unlikely to decrease recreational fishing activity but may divert the location or timing of a few planned fishing trips. Potential recreational fisheries due to accidental events as a result of the proposed action would be minor to moderate. Based on the sizes of oil spills assumed for the proposed action, only localized and short-term disruption of recreational fishing activity might result (minor impact).

Recreational Resources (Chapter 4.3.12)

Marine debris will be lost from time to time from operations resulting from the proposed action. The impact on Gulf Coast recreational beaches is expected to be minimal. The incremental increase in helicopter and vessel traffic is expected to add very little additional noise that may affect beach users. The proposed action is expected to result in nearshore operations that may adversely affect the enjoyment of some Gulf Coast beach uses; however, these will have little effect on the number of beach users.

It is unlikely that a spill would be a major threat to recreational beaches because any impacts would be short term and localized. Should a spill contact a recreational beach, short-term displacement of recreational activity from the areas directly affected would occur. Beaches directly impacted would be expected to close for periods of 2-6 weeks or until the cleanup operations were complete. Should a spill result in a large volume of oil contacting a beach or a large recreational area visitation to the area could be reduced by as much as 5-15 percent for as long as one season, but such an event should have no long-term effect on tourism. Tarballs can lessen the enjoyment of the recreational beaches but should have no long-term effect on the overall use of beaches.

Archaeological Resources (Chapter 4.3.13)

The impact-producing factors associated with development and production of the Lease Sale 224 area that could affect archaeological resources include direct physical contact from drilling rig and platform emplacement, pipeline installation and trenching, anchoring, dredging activity, oil spills, and ferromagnetic debris. The specific locations of archaeological sites cannot be known without first conducting a remote-sensing survey of the seabed and near-surface sediments. The MMS, by virtue of operational regulations under 30 CFR 250.194, requires that an archaeological survey be conducted prior to development of leases within the high-probability zones for historic and prehistoric archaeological resources.

An Archaeological Resources Stipulation was included in all GOM lease sales from 1973 through 1994. The stipulation has been incorporated into operational regulations, which can be found at 30 CFR 250.194. All protective measures offered in the stipulation have been adopted in this regulation. The current NTL for archaeological resource surveys and reports—NTL 2005-G07, effective July 01, 2005—supersedes all other archaeological NTL's and LTL's, and updates requirements to reflect current technology. The list of lease blocks requiring an archaeological survey and assessment are identified in NTL 2006-G07.

The proposed action includes the potential drilling of 5-15 exploration wells and 15-20 development wells over the 40-year life of the proposed action. Approximately 15,000-20,000 service-vessel trips (**Table 4-2**) are estimated under the proposed action; this is a rate of 375-500 service-vessel trips annually.

Lease blocks with a high probability for prehistoric archaeological resources may only be found landward of a line that roughly follows the 60-m (200-ft) water depth as the seaward extent of prehistoric archaeological potential on the OCS. The water depth in the Lease Sale 224 area ranges from 800 to 3,200 m (2,625 to 10,499 ft). Based on the extreme water depth, there is no potential for prehistoric archaeological resources; therefore, no impacts can occur.

There are areas of the northern GOM that are considered by MMS to have a high probability for historic period shipwrecks (Garrison et al., 1989; Pearson et al., 2003). Statistical analysis of shipwreck location data identified two specific types of high-probability areas: (1) within 10 km (6 mi) of the shoreline and (2) proximal to historic ports, barrier islands, and other loss traps. In addition, MMS has created high-probability search polygons associated with individual shipwrecks to afford protection to wrecks located outside the two high-probability areas. Of the 134 unleased blocks in proposed Lease Sale 224, no blocks fall within the GOM Region's high-probability area for historic resources and no historic shipwrecks are reported within this area. However, three historic shipwrecks have been reported within 15 mi (24 km) of the Lease Sale 224 area.

Several OCS-related, impact-producing factors may cause adverse impacts to unknown historic archaeological resources. Offshore development activities that could result in the most severe impacts to an unknown historic shipwreck would be contact with an installation barge or TLP anchors and mooring chains, and the installation of subsea production infrastructure, such as manifolds, flowlines, production risers, and pipeline tie-backs. Direct physical contact with a shipwreck site could destroy fragile remains, such as the hull and wooden or ceramic artifacts, and could disturb the site context. The result would be the loss of archaeological data on ship construction, cargo, and the social organization of the vessel's crew, as well as the loss of information on maritime culture for the time period from which the ship dates. The likelihood of impacts on a historic archaeological resource from any permitted actions within the Lease Sale 224 area is considered to be extremely small.

Offshore operations can introduce tons of ferromagnetic structures, components, and debris onto water that if dropped or accidentally lost without recovery have the potential to mask the magnetic signatures of historic shipwrecks. However, the water depths that occur within the Lease Sale 224 area exceed the requirement for magnetometer surveys and, therefore, would not be a factor in identifying historic shipwrecks.

No onshore development in support of the proposed action is expected; therefore, no impact to onshore historic sites, such as forts, lighthouses, cemeteries, or buildings, from any onshore development in support of operations in the Lease Sale 224 area would be expected. Cumulative impacts may occur, however. Should spilled oil contact a coastal historic site, such as a fort or a lighthouse, oil would be in a weathered and degraded state. The major impact would be visual petroleum contamination of the site and surroundings. Impacts to coastal historic sites are not expected to occur and, if a spill does occur, impacts would be temporary and reversible.

Human Resources and Land Use

Land Use and Coastal Infrastructure (Chapter 4.3.14.1)

The proposed action would not require additional coastal infrastructure and would not alter the current land use of the analysis area. Accidental events such as oil or chemical spills, blowouts, and vessel collisions would have no effects on land use. Coastal or nearshore spills could have short-term adverse effects on coastal infrastructure, requiring clean up of any oil or chemicals spilled.

Demographics (Chapter 4.3.14.2)

Activities relating to the proposed lease sale are expected to affect minimally the analysis area's land use, infrastructure, and demography. These impacts are projected to mirror employment effects that are estimated to be negligible to any one economic impact area (EIA). Baseline patterns and distributions of these factors, as described in **Chapter 3.3.5.4**, are expected to approximately maintain the same level. Changes in land use throughout the analysis area are expected to be contained and minimal. The OCS-related infrastructure is in place and will not change as a result of the proposed action. Current baseline estimates of population growth for the analysis area show a continuation of growth, but at a slower rate. Accidental events such as oil or chemical spills, blowouts, and vessel collisions should have no effect on the demographic characteristics of the Gulf coastal communities.

Economic Factors (Chapter 4.3.14.3)

Should the proposed lease sale occur, there would be only minor economic changes in the Texas, Louisiana, Mississippi, Alabama, and Florida EIA's. The proposed action is expected to generate less than a 1 percent increase in employment in any of these subareas. This demand will be met primarily with the existing population and available labor force for reasons discussed above. Accidental events such as oil or chemical spills, blowouts, and vessel collisions would have no effects on the demographic characteristics of the Gulf coastal communities. Accidental events such as oil or chemical spills, blowouts, and vessel collisions as a result of the proposed action should have no effect on the economics of the Gulf coastal communities.

Environmental Justice (Chapter 4.3.14.4)

Because of the existing extensive and widespread support system for OCS-related industry and associated labor force, the effects of the proposed action in the EPA are expected to be widely distributed and little felt. In general, who will be hired and where new infrastructure might be located is impossible to predict. Impacts related to the proposed action are expected to be economic and 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 proposed action is not expected to have a disproportionate effect on these populations.

Lafourche Parish will experience the most concentrated effects of the proposed action; however, because the parish is not heavily low-income or minority, the Houma Indians are not residentially segregated, and the effects of road traffic and port expansion will not occur in areas of low-income or minority concentration, these groups will not be affected differently. In general, the effects in Lafourche Parish are expected to be mostly economic and positive. The proposed action would help to maintain ongoing levels of activity rather than expand them. Future changes in activity levels will most likely be caused by fluctuations in oil prices and imports, and not by activities related to the proposed action. The proposed action is not expected to have disproportionate high/adverse environmental or health effects on minority or low-income people.

Considering the low likelihood of an oil spill and the heterogeneous population distribution along the GOM region, accidental spill events associated with the proposed action are not expected to have disproportionate adverse environmental or health effects on minority or low-income people.

2.2.1.3. Mitigating Measures

2.2.1.3.1. Protected Species Stipulation

A protected species stipulation has been applied to all blocks leased in the GOM since 2001. This stipulation would be a part of any lease resulting from the proposed action, i.e., Lease Sale 224. The stipulation reads as follows:

Protected Species Stipulation

The Outer Continental Shelf Lands Act (OCSLA) at 43 U.S.C. 1333 extends the laws of the United States to the subsoil and seabed of the Outer Continental Shelf and to all artificial islands, and all installations and other devices erected thereon for the purpose of exploring for, developing, producing resources, or transporting such resources. The laws of the U.S. include the Endangered Species Act and the Marine Mammal Protection Act designed to protect threatened and endangered species and marine mammals. The OCSLA at 43 U.S.C. 1332 also requires expeditious and orderly development of the Outer Continental Shelf, subject to environmental safeguards. The MMS implements those laws in 30 CFR 250, Subpart A (250.101, 250.106) and Subpart B Plans and Information (implementing regulations).

In response to MMS implementing regulations you and your operators must:

(a) collect and remove flotsam resulting from activities related to exploration, development, and production of this lease;

(b) post signs in prominent places on all vessels and platforms used as a result of activities related to exploration, development, and production of this lease detailing the reasons (legal and ecological) why release of debris must be eliminated;

(c) observe for marine mammals and sea turtles while on vessels, reduce vessel speed to 10 knots or less when assemblages of cetaceans are observed and maintain a distance of 90 meters or greater from whales, and a distance of 45 meters or greater from small cetaceans and sea turtles;

(d) employ mandatory mitigation measures for all seismic surveys including the use of an "exclusion zone" based upon the appropriate water depth, ramp-up and shut-down procedures, visual monitoring, and reporting;

(e) immediately report all sightings and locations of injured or dead protected species (marine mammals and sea turtles) to the appropriate stranding network. If oil and gas industry activity is responsible for the injured or dead animals (e.g., because of a vessel strike), the responsible parties should remain available to assist the stranding network. If the injury or death was caused by a collision with your vessel, you must notify MMS within 24 hours of the strike; and

(f) identify important habitats, including designated critical habitat, used by listed species (e.g., sea turtle nesting beaches, piping plover critical habitat), in oil spill contingency planning and require the strategic placement of spill cleanup equipment to be used only by personnel trained in less-intrusive cleanup techniques on beach and bay shores.

You, your operators, and personnel are responsible for carrying out the specific mitigation measures outlined in the most current MMS Notices to Lessees, which interpret requirements in the above-mentioned implementing regulations.

Effectiveness of the Lease Stipulation

This stipulation was developed in consultation with NMFS and FWS, and is designed to minimize or avoid potential adverse impacts to federally protected species.

2.2.1.3.2. Military Areas Stipulation

A standard military warning areas stipulation has been applied to all blocks leased in military areas in the GOM since 1977. **Figure 2-1** shows the military warning areas in the GOM. This stipulation would be a part of any lease resulting from the proposed action, i.e., Lease Sale 224. The stipulation reads as follows:

Military Areas Stipulation

(a) Hold and Save Harmless

Whether compensation for such damage or injury might be due under a theory of strict or absolute liability or otherwise, the lessee assumes all risks of damage or injury to persons or property, which occur in, on, or above the OCS, to any persons or to any property of any person or persons who are agents, employees, or invitees of the lessee, its agents, independent contractors, or subcontractors doing business with the lessee in connection with any activities being performed by the lessee in, on, or above the OCS, if such injury or damage to such person or property occurs by reason of the activities of any agency of the United States Government, its contractors or subcontractors, or any of its officers, agents or employees, being conducted as a part of, or in connection with, the programs and activities of the command headquarters listed at the end of this stipulation.

Notwithstanding any limitation of the lessee's liability in Section 14 of the lease, the lessee assumes this risk whether such injury or damage is caused in whole or in part by any act or omission, regardless of negligence or fault, of the United States, its contractors or subcontractors, or any of its officers, agents, or employees. The lessee further agrees to indemnify and save harmless the United States against all claims for loss, damage, or injury sustained by the lessee, or to indemnify and save harmless the United States against all claims for loss, damage, or injury sustained by the agents, employees, or invitees of the lessee, its agents, or any independent contractors or subcontractors doing business with the lessee in connection with the programs and activities of the aforementioned military installation, whether the same be caused in whole or in part by the negligence or fault of the United States, its contractors, or subcontractors, or any of its officers, agents, or employees and whether such claims might be sustained under a theory of strict or absolute liability or otherwise.

(b) Electromagnetic Emissions

The lessee agrees to control its own electromagnetic emissions and those of its agents, employees, invitees, independent contractors or subcontractors emanating from individual designated defense warning areas in accordance with requirements specified by the commander of the command headquarters to the degree necessary to prevent damage to, or unacceptable interference with, Department of Defense flight, testing, or operational activities, conducted within individual designated warning areas. Necessary monitoring control, and coordination with the lessee, its agents, employees, invitees, independent contractors or subcontractors, will be effected by the commander of the appropriate onshore military installation conducting operations in the particular warning area; provided, however, that control of such electromagnetic emissions shall in no instance prohibit all manner of electromagnetic communication during any period of time between a lessee, its agents, employees, invitees, independent contractors or subcontractors and onshore facilities.

(c) Operational

The lessee, when operating or causing to be operated on its behalf, boat, ship, or aircraft traffic into the individual designated warning areas, shall enter into an agreement with the commander of the individual command headquarters listed in the following list, upon utilizing an individual designated warning area prior to commencing such traffic. Such an agreement will provide for positive control of boats, ships, and aircraft operating into the warning areas at all times.

Effectiveness of the Lease Stipulation

The hold harmless section of the military stipulation serves to protect the U.S. Government from liability in the event of an accident involving the lessee and military activities. The actual operations of the military and the lessee and its agents will not be affected.

The electromagnetic emissions section of the stipulation requires the lessee and its agents to reduce and curtail the use of radio, CB, or other equipment emitting electromagnetic energy within some areas. This serves to reduce the impact of oil and gas activity on the communications of military missions and reduces the possible effects of electromagnetic energy transmissions on missile testing, tracking, and detonation.

The operational section requires notification to the military of oil and gas activity to take place within a military use area. This allows the base commander to plan military missions and maneuvers that will avoid the areas where oil and gas activities are taking place or to schedule around these activities. Prior notification helps reduce the potential impacts associated with vessels and helicopters traveling unannounced through areas where military activities are underway.

This stipulation reduces potential impacts, particularly in regards to safety, but does not reduce or eliminate the actual physical presence of oil and gas operations in areas where military operations are conducted. The reduction in potential impacts resulting from this stipulation makes multiple-use conflicts most unlikely. Without the stipulation, some potential conflict 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.

2.2.1.3.3. Evacuation Stipulation

This stipulation would be a part of any lease resulting from the proposed action, i.e., Lease Sale 224. An evacuation stipulation has been applied to all blocks leased in this area since 2001. The stipulation reads as follows:

Evacuation Stipulation

(a) The lessee, recognizing that oil and gas resource exploration, exploitation, development, production, abandonment, and site cleanup operations on the leased area of submerged lands may occasionally interfere with tactical military operations, hereby recognizes and agrees that the United States reserves and has the right to temporarily suspend operations and/or require evacuation on this lease in the interest of national security. Such suspensions are considered unlikely in this area. Every effort will be made by the appropriate military agency to provide as much advance notice as possible of the need to suspend operations and/or evacuate. Advance notice of fourteen (14) days shall normally be given before requiring a suspension or evacuation, but in no event will the notice be less than four (4) days. Temporary suspension of operations may include the evacuation of personnel, and appropriate sheltering of personnel not evacuated. Appropriate shelter shall mean the protection of all lessee personnel for the entire duration of any Department of Defense activity from flying or falling objects or substances and will be implemented by a written order from the MMS Regional Supervisor for Field Operations (RS-FO), after consultation with the appropriate command headquarters or other appropriate military agency, or higher authority. The appropriate command headquarters, military agency or higher authority shall provide information to allow the lessee to assess the degree of risk to, and provide sufficient protection for, lessee's personnel and property. Such suspensions or evacuations for national security reasons will not normally exceed seventy-two (72) hours; however, any such suspension may be extended by order of the RS-FO. During such periods, equipment may remain in place, but all production, if any, shall cease for the duration of the temporary suspension if so directed by the RS-FO. Upon cessation of any temporary suspension, the RS-FO will immediately notify the lessee such suspension has terminated and operations on the leased area can resume.

(b) The lessee shall inform the MMS of the persons/offices to be notified to implement the terms of this stipulation.

(c) The lessee is encouraged to establish and maintain early contact and coordination with the appropriate command headquarters, in order to avoid or minimize the effects of conflicts with potentially hazardous military operations.

(d) The lessee shall not be entitled to reimbursement for any costs or expenses associated with the suspension of operations or activities or the evacuation of property or personnel in fulfillment of the military mission in accordance with subsections (a) through (c) above.

(e) Notwithstanding subsection (d), the lessee reserves the right to seek reimbursement from appropriate parties for the suspension of operations or activities or the evacuation of property or personnel associated with conflicting commercial operations.

Effectiveness of the Lease Stipulation

This stipulation would provide for evacuation of personnel and shut-in of operations during any events conducted by the military that could pose a danger to ongoing oil and gas operations. It is expected that the invocation of these evacuation requirements will be extremely rare.

It is expected that these measures will serve to eliminate dangerous conflicts between oil and gas operations and military operations. Continued close coordination between MMS and the military may result in improvements in the wording and implementation of these stipulations.

2.2.1.3.4. Coordination Stipulation

This stipulation would be a part of any lease resulting from the proposed action, i.e., Lease Sale 224. A coordination stipulation has been applied to all blocks leased in this area since 2001. The stipulation reads as follows:

Coordination Stipulation

(a) The placement, location, and planned periods of operation of surface structures on this lease during the exploration stage are subject to approval by the MMS Regional Director (RD) after the review of an operator's EP. Prior to approval of the EP, the lessee shall consult with the appropriate command headquarters regarding the location, density, and the planned periods of operation of such structures, and to maximize exploration while minimizing conflicts with Department of Defense activities. When determined necessary by the appropriate command headquarters, the lessee will enter a formal Operating Agreement with such command headquarters, that delineates the specific requirements and operating parameters for the lessee's Final activities in accordance with the military stipulation clauses contained herein. If it is determined that the Final operations will result in interference with scheduled military missions in such a manner as to possibly jeopardize the national defense or to pose unacceptable risks to life and property, then the RD may approve the EP with conditions, disapprove it, or require modification in accordance with 30 CFR 250. The RD will notify the lessee in writing of the conditions associated with plan approval, or the reason(s) for disapproval or required modifications. Moreover, if there is a serious threat of harm or damage to life or property, or if it is in the interest of national security or defense, pending or approved operations may be suspended in accordance with 30 CFR 250. Such a suspension will extend the term of a lease by an amount equal to the length of the suspension, except as provided in 30 CFR 250.169(b). The RD will attempt to minimize such suspensions within the confine of related military requirements. It is recognized that the issuance of a lease conveys the right to the lessee as provided in section 8(b)(4) of the Outer Continental Shelf Lands Act to engage in exploration, development, and production activities conditioned upon other statutory and regulatory requirements.

(b) The lessee is encouraged to establish and maintain early contact and coordination with the appropriate command headquarters, in order to avoid or minimize the effects of conflicts with potentially hazardous military operations.

(c) If national security interests are likely to be in continuing conflict with an existing operating agreement, the RD will direct the lessee to modify any existing operating agreement or to enter into a new operating agreement to implement measures to avoid or minimize the identified potential conflicts, subject to the terms and conditions and obligations of the legal requirements of the lease.

Effectiveness of the Lease Stipulation

This stipulation would provide for review of pending oil and gas operations by military authorities and could result in delaying oil and gas operations if military activities have been scheduled in the area that may put the oil and gas operations and personnel at risk.

2.2.2. Alternative B—No Action

2.2.2.1. Description

Alternative B is the cancellation of the proposed EPA lease sale. The opportunity for development of the estimated 0.1-0.14 BBO and 0.16-0.34 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.

2.2.2.2. Summary of Impacts

If Alternative B is selected, all positive and negative impacts associated with the proposed lease sale would be eliminated. This alternative would therefore result in no effect on the sensitive resources and activities discussed in **Chapter 4.3**. The incremental contribution of the proposed lease sale to cumulative effects would also be foregone, but effects from other activities, including other OCS lease sale, would remain.

Strategies that could provide replacement resources for lost domestic OCS oil and gas production include a combination of energy conservation; onshore domestic oil and gas supplies; alternative energy sources; and imports of oil, natural gas, and liquefied natural gas. Market forces are assumed to be the predominant factor in determining substitutes for OCS oil and gas. Based on this, increased imports of foreign oil are assumed to be the largest replacement source. Much of this imported oil would enter the U.S. through the GOM, thus increasing the probability of tanker spills, which are usually closer to shore and can be larger in volume. This is analyzed in the Final EIS for the 5-Year Program.

CHAPTER 3

DESCRIPTION OF THE AFFECTED ENVIRONMENT

3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1. PHYSICAL ENVIRONMENT

3.1.1. Air Quality

The Lease Sale 181 FEIS (USDOI, MMS, 2001a) and the Final Multisale EIS (USDOI, MMS, 2007a) discusses the CAA that established the NAAQS. The primary standards are to protect public health and the secondary standards are to protect public welfare. The current NAAQS are shown in **Table 3-1**. The Clean Air Act Amendments of 1990 established classification designations based on regional monitored levels of ambient air quality. These designations impose mandated timetables based on the seriousness of the regional air quality problem and other requirements necessary for attaining and maintaining healthful air quality in the U.S. 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. There are five classifications of nonattainment status: marginal, moderate, serious, severe, and extreme (Clean Air Act Amendments, 1990).

The Federal OCS waters attainment status is unclassified. The OCS areas are not classified because there is no 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 either attainment, nonattainment, or unclassifiable. Operations west of 87.5° W. longitude fall under MMS jurisdiction for enforcement of the CAA. The OCS waters east of 87.5° W. longitude are under the jurisdiction of USEPA; thus, the entire area and plans received as a result of proposed Lease Sale 224 will fall under the air quality jurisdiction of USEPA. As of November 2005, the new 8-hr ozone standard NAAQS of 0.085 ppm has been fully implemented.

At the time the Lease Sale 181 FEIS was published:

- None of the coastal counties/parishes of Florida, Mississippi, and Alabama were classified as nonattainment areas. Louisiana was in attainment for all pollutants except ozone. There were four Louisiana coastal zone parishes that had been tentatively designated as nonattainment for ozone: Ascension, Iberville, Lafourche, and Livingston. Lafourche Parish is no longer designated as nonattainment (Louisiana Dept. of Environmental Quality (LADEQ), 2004).

- According to the *2002 Louisiana Environmental Inventory Report* (LADEQ, 2004), there are five parishes (Ascension, East Baton Rouge, Iberville, Livingston, and West Baton Rouge) in the Baton Rouge Area that are in nonattainment for ozone (LADEQ, 2004). In the last two decades, there has been a steady decline in ozone in the nonattainment areas over the past two decades as 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.

- Air quality data for 2007 from Mississippi, Alabama, and Florida show all states in attainment of the NAAQS for all criteria pollutants (USEPA, 2007a).

- The PSD Class I air quality areas, designated under the CAA, are afforded the greatest degree of air quality protection and are protected by stringent air quality standards that allow for very little deterioration of their air quality. The PSD maximum allowable pollutant increase for Class I areas are as follows: 2.5 $\mu g/m^3$ annual increment for NO_2; 25 $\mu g/m^3$ 3-hr increment, 5 $\mu g/m^3$ 24-hr increment, and 2 $\mu g/m^3$ annual increment for SO_2; and 8 $\mu g/m^3$ 24-hr increment and 4 $\mu g/m^3$ annual increment for PM_{10}. The Breton National Wildlife Refuge and National Wilderness Area (BNWA) south of Mississippi is designated as a PSD Class I area. The FWS has responsibility for protecting wildlife, vegetation, visibility, and other sensitive resources called air-quality-related values in this area. The FWS has expressed concern that the NO_2 and SO_2 increments for the BNWA have been consumed. The

> MMS is addressing FWS concerns with scientific study, now underway, to determine the pollutant increment status at BNWA. The initial results show that the NO_2 and SO_2 increments for BMWA are well below the PSD maximum allowable increments.

Ambient air quality is directly related to population in association with resulting economic development, transportation, and energy policies of the region. 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 effects of hurricanes on air quality are investigated by LDEQ and USEPA (2007b). They have conducted extensive air sampling in the area impacted by Hurricane Katrina. This effort includes continuous criteria pollutant monitoring at Kenner (Louisiana) for ozone, nitrogen oxides (NO_x), sulfur dioxide (SO_2), hydrogen sulfide (H_2S), carbon monoxide (CO), and particulate.

All of the results collected to date for ambient air quality samples appear to be typical for this region of the state and are below any levels of health concern. A review of $PM_{2.5}$ (fine particulate) data shows concentrations below levels of concern. All concentrations of the toxic air pollutants are below the USEPA one-year screening levels and below the Louisiana ambient air standards.

3.1.2. Water Quality

For the purposes of this 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 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 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 marine waters for the following discussion. Coastal waters, as defined by MMS, include all the bays and estuaries. Marine water as defined in this document 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.

3.1.2.1. Coastal Waters

The Lease Sale 181 FEIS describes the variables affecting the water quality of the GOM estuaries. The effects of salinity, turbidity, pH, temperature, and tides are all considered. The coastal systems, broken down by State and the physical properties of, as well as types of and sources of pollution, to each major bay and estuary from St. Andrews Bay in Florida through the Atchafalaya/Vermilion Bays in Louisiana are presented.

The Gulf of Mexico Alliance was organized in 2005 as a collaborative means to solve regional problems to implement the U.S. Ocean Action Plan. The priority water quality issues identified by the Alliance are bacterial-related beach and shellfish bed closures, estuarine hypoxia, harmful algal blooms, and seafood, particularly mercury, contamination. Nutrient loading was also identified as a regional action item (Gulf of Mexico Alliance, 2005).

Gulf Coast water quality was given a fair rating in the National Coastal Condition Report II (USEPA, 2004a). Five factors—dissolved oxygen, dissolved inorganic nitrogen, dissolved inorganic phosphorus, chlorophyll *a,* and water clarity—were used to rate water quality. Dissolved oxygen is essential for aquatic life, and low levels can result in mortality to benthic organisms and other organisms that cannot escape. The nutrients, nitrogen and phosphorous, are necessary in small amounts but can stimulate excessive phytoplankton growth. Chlorophyll *a* is a measurement of phytoplankton productivity. Water with greater clarity can support more submerged aquatic vegetation, which stabilizes the shoreline from erosion, reduces the impact of nonpoint source pollution, and provides habitat for many species.

Along the Gulf Coast lies one of the most extensive estuary systems in the world. Estuaries represent a transition zone between the freshwater of rivers and the higher salinity waters offshore. These bodies of water are influenced by freshwater and sediment influx from rivers and the tidal actions of the oceans. The primary variables that influence coastal water quality are water temperature, total dissolved solids (salinity), suspended solids (turbidity), and nutrients. An estuary's salinity and temperature structure is determined by hydrodynamic mechanisms governed by the interaction of marine and terrestrial influences, including tides, nearshore circulation, freshwater discharges from rivers, and local precipitation. Gulf Coast estuaries exhibit a general east to west trend in selected attributes of water quality associated with changes in regional geology, sediment loading, and freshwater inflow.

Estuaries provide habitat for plants, animals, and humans. Marshes, mangroves, and seagrasses surround the Gulf Coast estuaries and provide food and shelter for shorebirds, migratory waterfowl, fish, invertebrates (e.g., shrimp, crabs, and oysters), reptiles, and mammals. Estuarine-dependent species constitute more than 95 percent of the commercial fishery harvests from the GOM. Estuarine ecosystems are impacted by humans, primarily via upstream usage of water for agricultural, industrial, and domestic purposes; contamination by industrial and sewage discharges, agricultural runoff carrying pesticides and herbicides, and urban and suburban runoff carrying oils, chemicals, and nutrients; and habitat alterations (e.g., construction and dredge and fill operations). When runoff flows through the surrounding coastal wetlands (**Chapter 3.2.1.2**), suspended particulate material is trapped and nutrients are incorporated into vegetation, resulting in improved water quality.

Population growth in coastal areas can impact water quality. Since 1960 the population of the coastal counties of the Gulf Coast States has increased by more than 100 percent. From 2000 to 2004 the population expanded by 6.7 percent. Population growth results in additional clearing of the land, excavation, construction, expansion of paved surface areas, and drainage controls (U.S. Commission on Ocean Policy, 2004a and b). These activities alter the quantity, quality, and timing of freshwater runoff. Storm-water runoff, which flows across impervious surfaces such as parking lots, is more likely to be warmer and to transport contaminants associated with urbanization. These include suspended solids, heavy metals and pesticides, oil and grease, and nutrients.

Hypoxia is also found in most of the Gulf of Mexico estuaries (Ning et al., 2003). Areas of hypoxia form east of the Mississippi River Delta in Chandeleur and Breton Sounds, Mississippi Sound, and Mobile Bay. These periods of hypoxia also result from eutrophic conditions but occur independently of the large and well-known zone west of the Mississippi River outflow. Estuaries with a poor water quality rating comprised 9 percent of the Gulf Coast estuaries, while those ranked fair to poor comprised 55 percent. In Louisiana, estuaries that received a poor water quality rating in the report had low water clarity and high dissolved inorganic phosphorus in comparison to levels expected for that region. In Florida and Mississippi estuaries, the factors that contributed to a poor water quality rating were low water clarity and high chlorophyll relative to expected levels. Chlorophyll is one of several symptoms of eutrophic conditions. Dissolved oxygen levels in Gulf Coast estuaries are good, and less than 1 percent of bottom waters exhibit hypoxia (dissolved oxygen below 2 milligrams per liter (mg/L)).

Sediments can serve as a sink for contaminants that were originally transported via water in either dissolved or particulate form or via atmospheric deposition. Sediments may contain pesticides, metals, and organics. The sediments of Gulf Coast estuaries were ranked as fair. Metals were the type of sediment contamination found to most frequently exceed toxicity guidance.

The passage of a hurricane serves to mix and transport waters. Winds can transport coastal waters to the inner shelf or force waters with higher salinity inland. Winds and waves resuspend bottom sediments, resulting in temporarily elevated levels of suspended solids in the water column. Contaminants sequestered in sediments, for example tributylin, may be redistributed. Similarly, nutrients in sediments may be re-introduced into the water column and result in increased phytoplankton activity.

Hurricane Ivan traveled across the shelf and through the waters of the Mississippi River Delta as a Category 4 hurricane prior to landfall at Gulf Shores, Alabama, in 2004. This area is the most susceptible to underwater mudslides in the GOM. The MMS estimates that 150 platforms and 10,000 mi (16,000 km) of pipeline were in the direct path of Hurricane Ivan. Seven platforms were destroyed and 24 others had major damage. More than 10 percent of GOM production was interrupted for at least 4 months due to pipeline and platform damages.

Little information was available regarding water quality impacts following Hurricane Ivan. Hagy et al. (2006) presented data showing hypoxia present in several coastal bays and estuaries following Hurricane Ivan. Most remarkable was a decrease in NO_2^- and NO_3^- in Pensacola Bay as a probable result of surge flushing and a nearly two-fold increase in bottomwater NH_4^+ in upper Escambia Bay. The increase in NH_4^+ was due to the enrichment of bay sediments with storm-related organic debris.

Hurricanes Katrina and Rita in 2005 caused extensive flooding and damage to industrial and municipal waste facilities and to residential and commercial structures. Industrial and agricultural chemicals, household chemicals, sewage, oil, and nutrients contained in the flood waters had the potential to degrade water quality in coastal areas. The flood waters of New Orleans contained elevated bacterial levels and were oxygen depleted, but it was generally typical of storm water when pumped into Lake Pontchartrain (Pardue et al., 2005). With the passage of days to a few months, the number of bacteria colonies associated with sewage decreased below the USEPA criteria of 200 fecal coliforms/100 ml (USEPA, 2006a), the suspended load settled, and the water quality in the coastal areas recovered. Recovery in areas with hotspots of contamination, such as those surrounding the oil spills or with greatly increased salinity, face a longer recovery or may not return to their original condition. Testing following the storm identified low levels of fecal coliform in Mississippi Sound and Louisiana coastal waters. Very few toxics were detected in estuarine or coastal waters resulting from the hurricanes (USEPA, 2006a). The hurricanes also caused the loss of diesel fuel tanks and chemical products from the damaged or destroyed offshore platforms.

3.1.2.2. Marine Waters

The marine water, within the area of interest, can be divided into three regions: the continental shelf west of the Mississippi River, the continental shelf east of the Mississippi River, and deep water (>400 m; >1,312 ft). In the Lease Sale 181 FEIS, the deepwater environment was considered to begin at depths greater than 300 m (984 ft). For this discussion, the continental shelf includes the upper slope to a water depth of 400 m (1,312 ft). While the various parameters measured to evaluate water quality do vary in marine waters, one parameter, pH, does not. The buffering capacity of the marine system is controlled by carbonate and bicarbonate, which maintain the pH at 8.2.

Continental Shelf West of the Mississippi River

The Mississippi and Atchafalaya Rivers are the primary sources of freshwater, sediment, and pollutants to the continental shelf west of the Mississippi (Murray, 1997). The drainage basin that feeds the rivers covers 55 percent of the contiguous U.S. While the average river discharge from the Mississippi River exceeds the input of all other rivers along the Texas-Louisiana coast by a factor of 10, during low-flow periods, the Mississippi River can have a flow less than all the other rivers combined (Nowlin et al., 1998). This area is highly influenced by input of sediment and nutrients from the Mississippi and Atchafalaya Rivers. A turbid surface layer of suspended particles is associated with the freshwater plume from these rivers. A nepheloid layer composed of suspended clay material from the underlying sediment is always present on the shelf. The river system supplies nitrate, phosphate, and silicate to the shelf. During summer months, the low-salinity water from the Mississippi River spreads out over the shelf, resulting in a stratified water column. While surface oxygen concentrations are at or near saturation, hypoxia (dissolved oxygen O_2 less than 2 mg/L), is observed in bottom waters during the summer months.

The Lease Sale 181 FEIS summarized data from the *Texas-Louisiana Shelf Circulation and Transport Process Study* (LATEX A; Nowlin et al., 1998). This study looked at surface and bottom water temperatures, oxygen, and salinity throughout the GOM. Surface temperatures were influenced by the atmospheric temperature and ranged from 20 to 30°C (68 to 86°F), while bottom temperatures were from 16 to 28°C (61 to 84°F), decreasing with increasing depth. Salinity was as high as 36.6 parts per thousand (ppt), but there is a freshening near the coast to <30 ppt due to the influence of rivers and run-off.

The zone of hypoxia on the Louisiana-Texas shelf is one of the largest areas of low oxygen in the world's coastal waters (Murray, 1997). The oxygen-depleted bottom waters occur seasonally and are affected by the timing of the Mississippi and Atchafalaya Rivers' discharges carrying nutrients to the surface waters. This, in turn, increases the carbon flux to the bottom, which, under stratified conditions, results in oxygen depletion to the point of hypoxia. The hypoxic conditions last until local wind-driven circulation mixes the water again. The average size of the hypoxic zone increased from 2.1 million ac (0.8 million ha, 8,300 km^2) during 1985-1992 to over 4 million ac (1.6 million ha, 16,000 km^2) during 1993-2001. The largest year measured was 2002 when the hypoxic zone occupied 5.4 million ac (2.2 million ha, 22,000 km^2) (Rabalais, 2005). Increased nutrient loading since the turn of the 19th century correlates with the increased extent of hypoxic events (Eadie et al., 1994), supporting the theory that hypoxia is related to the nutrient input from the Mississippi and Atchafalaya River systems. Phosphorus may play a larger role than originally suspected (USEPA, 2005).

Shelf waters or sediments off the coast of Louisiana may contain trace levels of organic pollutants including polynuclear aromatic hydrocarbons (PAH), herbicides such as Atrazine, chlorinated pesticides, and polychlorinated biphenyls (PCB), and trace inorganic (metals) pollutants, for example, mercury. The concentrations of chlorinated pesticides and PCB's, which are associated with suspended particulates and sediment, continue to decline since their use has been discontinued. The source of these contaminants is the river water that feeds into the area.

Continental Shelf East of the Mississippi River

Water quality on the continental shelf from the Mississippi River Delta to Tampa Bay is influenced by river discharge, run-off from the coast, and eddies from the Loop Current. The Mississippi River accounts for 72 percent of the total discharge onto the shelf (SUSIO, 1975). The outflow of the Mississippi River generally extends only 45 mi (75 km) to the east of the river mouth (Vittor and Associates, Inc., 1985) except under extreme flow conditions. The Loop Current intrudes in irregular intervals onto the shelf, and the water column can change from well mixed to highly stratified very rapidly. Discharges from the Mississippi River can be easily entrained in the Loop Current. The flood of 1993 provided an infusion of freshwater to the entire northeastern GOM shelf, with some Mississippi River water transported to the Atlantic Ocean through the Florida Straits (Dowgiallo, 1994). Hypoxia is rarely observed on the Mississippi-Alabama shelf, although low dissolved oxygen values of 2.93-2.99 mg/L were observed during the MAMES and NEGOM cruises (Brooks, 1991; Jochens et al., 2002). In the summer the lowest dissolved oxygen in bottom waters was associated with greater vertical stability (Jochens, 2002).

The Mississippi-Alabama shelf sediments are strongly influenced by fine sediments and nutrients discharged from the Mississippi River. The shelf area is characterized by a bottom nepheloid layer and surface lenses of suspended particulates that originate from river outflow. The West Florida Shelf has very little sediment input with primarily high-carbonate sands offshore and quartz sands nearshore. The water clarity is higher towards Florida, where the influence of the Mississippi River outflow is rarely observed.

A three-year, large-scale marine environmental baseline study conducted from 1974 to 1977 in the Eastern GOM resulted in an overview of the Mississippi, Alabama, and Florida (MAFLA) OCS environment to 200 m (656 ft) (SUSIO, 1977; Dames and Moore, 1979). Analysis of water, sediments, and biota for hydrocarbons indicated that the MAFLA area is pristine, with some influence of anthropogenic and petrogenic hydrocarbons from river sources. Analysis of trace metal contamination for the nine trace metals analyzed (barium, cadmium, chromium, copper, iron, lead, nickel, vanadium, and zinc) also indicated no contamination. A decade later, the continental shelf off Mississippi and Alabama was revisited (Brooks, 1991). Bottom sediments were analyzed for high-molecular-weight hydrocarbons and heavy metals. High-molecular-weight hydrocarbons can come from natural petroleum seeps at the seafloor or recent biological production as well as input from anthropogenic sources. In the case of the Mississippi-Alabama shelf, the source of petroleum hydrocarbons and terrestrial plant material is the Mississippi River. Higher levels of hydrocarbons were observed in the late spring, which coincides with increased river influx. The sediments, however, are washed away later in the year, as evidenced by low hydrocarbon values in winter months. Contamination from trace metals was not observed (Brooks, 1991).

The Science Applications International Corporation (SAIC, 1997) summarized information about water quality on the shelf from DeSoto Canyon to Tarpon Springs and from the coast to 200-m (656-ft) water depth. Several small rivers and the Loop Current are the primary influences on water quality in this region. Because there is relatively little onshore development in this area, the waters and surface sediments are uncontaminated. The Loop Current flushes the area with clear, low-nutrient water.

The NEGOM chemical oceanography and hydrography study (1997-2000) noted that interannual variation in the parameters measured outweighed seasonal variation due to the influence of offshelf circulation features and interannual variation in wind (Jochens et al., 2002). The average water-column, particulate matter mass on the Florida shelf remained within a narrow range and was half of that measured on the Mississippi and Alabama shelf. The cruise average particulate matter in the bottom nepheloid layer over the Florida shelf was similarly both lower and less variable than on the Mississippi and Alabama shelf. The highest chlorophyll *a* amounts measured in near-surface water were located in the areas influenced by the Mississippi and Apalachicola Rivers. The dissolved oxygen in bottom waters over the west Florida shelf was higher than the Mississippi and Alabama shelf waters at comparable isobaths. Hypoxia was not observed on the shelf during the 3 years of the study.

The Deep Gulf of Mexico Benthos (DGoMB) study (Rowe and Kennicutt, 2007) was designed to provide a better understanding of biological communities. The study observed variability in near-surface salinity values related to circulation features adjacent to the Mississippi River mouth that transported shelf water, diluted by mixing with river water, to the slope region (Rowe and Kennicutt, 2007).

The DGoMB study included measurement of metals and PAH's in sediments (Rowe and Kennicutt, 2007). Samples were collected along transects from 300- to 3,000-m (984-9,842 ft) water depths. The samples collected from the "S" transect stations are the easternmost stations and several survey stations are representative of the Sale 224 area. Over the entire sample area, the concentrations of most of the elements measured, Be, Co, Cr, Fe, Si, Tl, V, and Zn, co-varied with the amount of Mississippi River delta sediment present as represented by the iron or aluminum concentration. On the slope, Ni, Pb, Cd, As, and Cu were enriched by 20-50 percent in comparison with Mississippi River Delta sediment. The enrichment is likely due to natural processes rather than human activity. The mean PAH concentration (including biogenic perylene) in sediment was 100-300 nanogram/gram (ng/g) at S36 (upper end DeSoto Canyon) and less than 100 ng/g in all other locations east of the Mississippi River outflow.

Deep Water

Limited information is available on the deepwater environment. Water at depths greater than 1,400 m (4,593 ft) is relatively homogeneous with respect to temperature, salinity, and oxygen (Nowlin, 1972; Pequegnat, 1983; Gallaway et al., 1988). Of importance, as pointed out by Pequegnat (1983), is the flushing time of the GOM. Oxygen in deep water must originate from the surface and be mixed into the deep water by some mechanism. The major source of oxygen in deep waters is the transport of oxygen-rich water through the Yucatan Channel. Available data indicate that oxygen replenishment is adequate to balance oxygen consumption in deep waters; however, localized areas of depleted oxygen could exist as the result of natural conditions or anthropogenic activities such as the discharge from oil and gas activities (Jochens et al., 2005).

Limited analyses of trace metals and hydrocarbons for the water column and sediments exist (Trefry, 1981; Gallaway et al., 1988). The MMS recently completed a field study of four drilling sites located in water depths of 1,033-1,125 m (3,389-3,691 ft) (CSA, 2006). 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. 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 prior to drilling, the average sediment barium concentration was 0.087-0.109 percent. The average sediment mercury and cadmium concentrations were 71 ng/g and 0.22-0.28 μg/g, respectively. Dissolved oxygen reached zero at 1.6- to 3.5-cm (0.6-1.4 in) (sediment depth and the average sediment total organic carbon (TOC) concentration was 1.44-1.54 percent. The range of total sediment PAH was 159-388 ng/g before drilling.

Samples collected during the DGoMB study include several sampling stations representative of baseline conditions in the proposed Lease Sale 224 area. Total PAHs, including biogenic perylene, were present at less than 100 ng/g. Barium was present at crustal concentrations. No drilling or discharge of drilling mud has occurred in the area to contribute to increases in sediment barium concentrations.

Hydrocarbon seeps are extensive throughout the continental slope and contribute hydrocarbons to the surface sediments and water column, especially in the Central GOM (Sassen et al., 1993a and b). MacDonald et al. (1993) observed 63 individual seeps using remote-sensing and submarine observations. Estimates of the total volume of seeping oil vary widely from 29,000 bbl/yr (MacDonald, 1998) to 520,000 bbl/yr (Mitchell et al., 1999). These estimates used satellite data and an assumed slick thickness. In addition to hydrocarbon seeps, other fluids leak from the underlying sediments into the bottom water along the slope. These fluids have been identified to have three origins: (1) seawater trapped during the settling of sediments; (2) dissolution of underlying salt diapirs; and (3) deep-seated formation waters (Fu and Aharon, 1998; Aharon et al., 2001). The first two fluids are the source of authigenic carbonate deposits while the third is rich in barium and radium and is the source of barite deposits such as chimneys.

3.2. Biological Resources

3.2.1. Sensitive Coastal Environments

The coastal environments discussed here are those barrier beaches, wetlands, and submerged vegetation that might be impacted by activities resulting from the proposed action. Geographically, the discussion covers coastal areas that range from Vermilion Parish, Louisiana, through the mouth of Tampa Bay, Florida. A detailed analysis of sensitive coastal environments can be found in the Gulf of Mexico OCS Oil and Gas Lease Sale 181 FEIS and the Final Multisale EIS.

Barrier features that are found along this coast can be divided into three groups: sand beaches, including barrier islands, which fringe most shores of the Gulf, the Mississippi River Deltaic complex and the marsh coast of the Big Bend area of Florida. Coastal Louisiana had about 1,430 ha (3,534 ac) of barrier beach in 1984 (Barras et al., 1990). Prior to Hurricane Katrina in 2005, Louisiana's Chandeleur Islands contained approximately 1,460 ha (3,600 ac) of land, most of which was beach and dune complex. Following Katrina the land mass of these islands (Chandeleurs) was reduced from 1,460 ha (3,600 ac) to 648 ha (1,600 ac) (Di Silvestro, 2006). In 1992, Hurricane Andrew stripped sand from 70 percent of the barrier islands leaving exposed old coastal marsh. More than 70 km (43 mi) of valuable dune habitat providing storm protection to estuaries, wetlands, and the coastal population were destroyed (USDOI, GS, 2004). Mississippi's 34 mi (54.6 km) of barrier beaches are on a series of offshore islands (USDOI, FWS, 1999). Coastal Alabama contained about 1,620 ha (4,003 ac) of dune and beach complex (Wallace, 1996). The Florida Game and Freshwater Fish Commission found about 3,560 ha (8,796 ac) of coastal strand within the area of interest in Florida during the winter of 1991-1992.

3.2.1.1. Coastal Barrier Beaches and Associated Dunes

The U.S. Gulf shorelines are usually comprised of barrier island and shoreline beach complexes that have a synergistic relationship with adjacent estuarine ecosystems (Mississippi River Deltaic Plain) and coastal wetland communities (Big Bend area of Florida). The dynamics of the formation and condition of these barrier landforms are also subject to other environmental stressors such as waves, currents, wind, and human activities.

Accumulation and movement of sediments that make up barrier landforms are often described in terms of transgressive and regressive sequences. A transgressive sequence moves the shore landward, allowing marine deposits to form over terrestrial sediments. The best examples of shorelines that have been transgressive for a long time include the Mississippi Deltaic Plain; the dunes of Panama City Beach, Florida, and Dauphin Island, Alabama. Some barriers have grown laterally as spits attached to the mainland shore (St. Joseph Peninsula, Florida; Bolivar Peninsula, Texas) and other barriers formed around an island core of older barrier deposits left over from a previous time when sea level was at about the same level as today (east Dauphin Island and Morgan Peninsula, Alabama). Still other barriers (Mississippi Sound barriers and Anclote Key, Florida) may have emerged from offshore sand shoals (Otvos, 1979; Davis and others 1985). This up-building of barriers occurs most commonly in shallow water where wave energy is low, where the slope of the continental shelf is very gentle, and where a rapid accumulation of sand deposited by storms can drastically alter nearshore currents and wave patterns.

These conditions are particularly applicable to the west coast of Florida. The west-central coast of Florida, extending from Anclote Key on the north to Cape Romano on the south and facing the Gulf of Mexico, is an estuarine, barrier-island/inlet system and may be morphologically the most complicated in the world in an environment with tidal ranges of <1 m (3.2 ft) and a mean wave height of 30-40 cm (11.8-15.7 in). This coast contains all barrier island and inlet types in a range of sizes and ages. Barriers include both wave-dominated and mixed-energy drumstick morphologies with lengths ranging from about 1.2 mi (2 km) to more than 18.6 mi (30 km). Inlets range from tide-dominated through mixed energy to wave-dominated. Two of the latter variety closed in the 1980's. Since the behavior of the coastline is weather and climate dependent, it is impossible to predict where the coastline will be in the coming few years, decades, or longer. However, based upon the recent past and certain geologic facts such as the lack of any new inputs of sand into the system, we can conclude that areas of critical coastal erosion will continue to be areas of concern.

Today, the highest barrier elevations and largest sand dunes are present on the sand-rich aggradational (upward building) and progradational (seaward building) barrier islands such as Central Padre Island, Texas; east Dauphin Island, Alabama; and St. Joseph Peninsula, Florida. Much of the coastal sand that was washed ashore as sea level reached its present position is stored in these high-profile barriers, and they typically have lower erosion rates because of the abundant sand. Migrating and landward retreating barriers, such as St. George Island, Florida; Chandeleur Islands, Louisiana; and South Padre Island, Texas, typically have higher erosion rates because they are located away from major sources of sand. High-profile barriers, such as Sanibel Island, Florida, Matagorda Island, Texas, and Central Padre Island, Texas, are the result of abundant sand supply for thousands of years. These barriers are typically wide and have continuous, well-vegetated dune ridges. The high elevations effectively block storm surges and prevent island overwash, even during the most severe storms. For high-profile barriers, enough sand is stored in the dunes that they are able to withstand prolonged erosion without being breached, which would allow flooding of the barrier core. However, flooding of high-profile barriers can occur from the lagoon side or from the ocean through artificial breaks in the dune ridge, such as beach access roads or areas where dunes have been destroyed by coastal construction.

A regressive sequence is one in which terrestrial sediments are deposited over marine deposits as the land builds out into the sea. An example of a regressive shoreline in this area is the deltaic formation occurring at the mouth of the Atchafalaya River and its Wax Lake Outlet in the Atchafalaya Bay, Louisiana. Smaller shoreline regressions also occur as a result of jetties located on the eastern end of Grand Isle, the western end of Caminada-Moreau Beach, Empire navigational canal, and elsewhere. Most barrier shorelines of the Mississippi River Delta in Louisiana are transgressive and trace the seaward remains of a series of five abandoned deltas. The Mississippi River is channelized through the Belize Delta, more commonly known as the Birdfoot Delta. Channelization isolated the river from most of this sixth delta, except near the distributary mouths. There, a small fraction of the river's sediment load is contributed to longshore currents for building and maintaining barrier shores.

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. Landform changes can be seasonal, cyclical and noncyclical and changes in landforms can be progressive, causing landform movement landward, seaward, or laterally along the coast. When Gulf waters are elevated by storms, larger waves can overwash lower coastal barriers, creating overwash fans or terraces behind and between the dunes. Boyd and Penland (1988) estimated that storms raise mean water levels 1.73-2.03 m (5.68-6.66 ft) above mean sea level 10-30 times per year. Under those conditions, barrier islands of the Mississippi River Delta complex experience severe overwash of up to 100 percent. With time, opportunistic plants will colonize on these flat, sand terraces, followed by the usual vegetative succession. 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.

The Chandeleur Islands of Louisiana, western Dauphin Island, Alabama, and St. George Island, Florida, are typically narrow and characterized by discontinuous frontal dunes that are lower than and inundated by extreme storm surges. This makes the entire barrier subject to frequent overwash during storms. Overwash also creates channels and fans that transfer sand from the ocean onto the barrier or into the adjacent lagoon. Barrier upbuilding is a response to a rise in relative sea level, and the transfer of sand from the ocean to the lagoon is how the barrier migrates landward and still retains its general shape and sand volume. Island migration is enhanced if there is a deficit in the sand supply or if there is a rapid rise in relative sea level. However, if the rate of sea-level rise is too great, then the barrier island is drowned in place and left as a submerged sand shoal on the continental shelf. 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. 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 of the barrier islands defining Mississippi Sound are relatively young, having formed some 3,000-4,000 years ago as a result of regressive shoal-bar accretion (Otvos, 1979). The barrier islands and capes of the Florida Panhandle also result from shoal-bar accretion and are generally regressive with high beach ridges and prominent sand dunes.

The increase or decrease of open-water areas of bays or sounds also has a significant effect on the deterioration or growth of barrier beaches and dunes flanking tidal passes. Interruptions of longshore sediment transport compound the problems of inadequate sand supply by causing localized accumulation of sediments on the up-drift side of an obstruction, causing an accretion or causing seaward building of the shoreline. Interruptions of sediment drift cause or accelerate shoreline retreat. Such manmade obstructions include jetties, groins, breakwaters, dredged channels, and bulkheads.

Subsidence, sea-level rise, and the loss of sediment input has transformed the Mississippi River Delta into an eroding (transgressive) headland that may soon be reworked by wave energy into flanking arcs of barrier sand spits and barrier islands. The bulk of river sediments are deposited in deep water, where they cannot be reworked and contribute to the longshore sediment drift. Regressive shorelines do occur in Louisiana's deltaic region. The diversion of the Red River and about 30 percent of the Mississippi River to the Atchafalaya River has allowed transport of large volumes of sediment into shallow Atchafalaya Bay. There, inland deltas are forming at the mouths of that river and Wax Lake Outlet. Most dune zones of the Mississippi River Delta contain low, single-line dune ridges that may be sparsely to heavily vegetated. Generally in this area, the vegetation on a dune ridge gets denser as the time between storms lengthens.

The past decade has seen an increase in tropical storm activity for the GOM. Hurricane Katrina (August 2005) caused severe erosion and landloss for the coastal barrier islands of the Deltaic Plain. The eye of Hurricane Katrina passed directly over the 50-mi (80-km) Chandeleur Island chain. Aerial surveys conducted by the U.S. Geological Survey (USGS or GS) on September 1, 2005, show that these islands were heavily damaged by the storm (USDOI, GS, 2006a). 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 major storms occur within a short time period. Hurricane Katrina was the fifth hurricane to impact the Chandeleur Island chain in the past 8 years. The other storms were Hurricanes Georges (1998), Lili (2002), Ivan (2004), and Dennis (2005). Landmass rebuilt since Hurricane Ivan was washed away by Hurricane Katrina. The Chandeleur Islands were reduced by Hurricane Katrina from 1,460 ha (3,600 ac) to 6,480 ha (16,000 ac) and then to 5,180 ha (12,800 ac) by Hurricane Rita (Di Silvestro, 2006).

Grand Isle was also heavily damaged by Katrina. Although Katrina made landfall more than 50 mi (80 km) to its east, Grand Isle received extremely high winds and a 12- to 20-ft (3.5- to 6-m) storm surge that caused tremendous structural damage to most of its camps, homes, and businesses (Louisiana Sea Grant, 2006a).

Coastal erosion is not a steady process; bursts of erosion occur during and after the passage of major cold fronts, tropical storms, and hurricanes. These major storms produce energetic overwash conditions that erode the beach and produce a lower-relief barrier landscape (Penland et al., 1992). Boyd and Penland (1988) estimated that storms raise mean water levels 1.73-2.03 m (5.68-6.66 ft) above mean sea level 10-30 times per year. Under those conditions, barrier islands of the Mississippi River Delta complex experience severe overwash of up to 100 percent.

Shell Key is an emerged barrier feature that varies greatly from the others around the Delta. It is located south of Marsh Island, Louisiana, at the mouth of Atchafalaya Bay, and is composed almost entirely of oyster-shell fragments. It is found amid extensive shell reefs, which are part of the Shell Keys National Wildlife Refuge. This dynamic, minimally vegetated island builds and wanes with passing storms. In 1992 and 1999, Hurricanes Andrew and Francis reduced the island to little more than a shoal that largely submerges under storm tides. The shallow, submerged shell reefs around Shell Key also serve as barrier features. Located on the other side of the bay's mouth and to the southeast, the Point au Far Shell Reefs were commercially dredged for shells and no longer exist (USDOI, FWS, 2001; Schales and Soileau, personal communication, 2001)

The Dog Keys define the Mississippi Sound of Mississippi and Alabama. Mississippi has about 33.9 mi (54.6 km) of barrier beaches on these islands (USDOI, FWS, 1999). Dauphin Island represents about another 7 mi (12 km). This relatively young group of islands was formed 3,000-4,000 years ago as a result of shoal-bar accretion (Otvos, 1979). They are separated by wide passes with deep channels. Shoals are typically adjacent to these barriers. Generally, these islands are regressive and stable in size as they migrate westwardly in response to the predominantly westward-moving longshore currents. These islands generally have high beach ridges and prominent sand dunes. Although overwash channels do not commonly occur, the islands may be overwashed during strong storms as was seen after Hurricanes Ivan (2004), Dennis (2005), and Katrina (2005). The islands are well vegetated among and behind the dunes and around ponds. Southern maritime climax forests of pine and palmetto are found behind some of their dune fields.

Dauphin Island, Alabama, is the exception to the above description. It is essentially a low-profile transgressive barrier island, except for a small, eroding, Pleistocene core at its eastern end. The western end is a Holocene spit that is characterized by small dunes and many washover fans, exposed marsh deposits, and tree stumps exposed in the surf zone. Dauphin Island experienced significant shoreline retreat and rollover after Hurricane Katrina, with overwash deposits forming in the sound.

In coastal Louisiana, heights of dune lines range from 1.3 to 4 ft (0.5 to 1.3 m) above mean high tide levels. An analysis of 37 years of tide-gauge data from Grand Isle, Louisiana, shows that the probability of water levels reaching lower sand-dune elevations ranges up to 16 percent. In Mississippi and Alabama, dune elevations exceed those in Louisiana. Florida dunes are typically even higher. The Dog Keys that define the Mississippi Sound barrier island complex are characterized by high dune ridges with protected lagoons and vegetated areas on the protected side. These islands are normally only overwashed during severe storm events. The Big Bend Coast of Florida is very different from the sandy coast around the rest of the Gulf. This shoreline and its associated continental shelf have a very low gradient, which gently slopes out into the Gulf. This gradient helps lower the wave energy and modifies the waves to a wide profile and low average breaker height. This topography would limit the area of affect by an oil spill incident and for all except major tropical storms would provide protection for the vegetation, wetland, and aquatic habitat on the protected side of the beach ridge.

Strong tropical storms have significantly impacted beaches and dunes along the Florida coast. Sallenger et al. (2006) described the impacts to Florida barrier islands from four hurricanes that battered the State of Florida in 2004 (i.e., Hurricanes Charley, Frances, Ivan, and Jeanne).

3.2.1.2. Wetlands

Wetland habitats found along the Central and Eastern Gulf Coast include fresh, intermediate, saline, marshes; mud and sand flats; and forested wetlands of mangrove swamps, cypress-tupelo swamps, 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. Sharply delineated botanical zones of either a single species or mixed communities of plants are found within wetlands. These zones are largely based upon elevations, chemical and physical characteristics of a wetland's sediments, and hydrological alterations caused by natural and manmade events.

The importance of coastal wetlands to the coastal environment has been well documented. Wetlands are characterized by high organic productivity. They are also very efficient at nutrient recycling. Wetlands provide habitat for a great number and wide diversity of invertebrates, fish, reptiles, birds, and mammals. The high detritus production and habitat diversity have rendered wetlands as particularly important nursery grounds for many fish and shellfish juveniles, which in turn support a thriving fishing industry.

Of the coastal states potentially affected by the proposed lease sale, Louisiana contains the greatest amount of salt marsh while the Florida coast accounts for the greatest amount of forested wetlands. Within the area of interest, the coastal counties of Florida contain about 2,448,725 ac (994,950 ha) of wetlands. Hardwood swamps represent the largest percentage (32.5%) of those wetlands. Hardwood swamps there are largely associated with the river deltas, such as those associated with Pensacola, Choctawatchee, and St. Andrews Bays. Estuarine wetlands, such as marsh and mangroves, represent 7.4 percent of that total (Florida Game and Freshwater Fish Commission, 1996). Florida also contains a significantly larger amount of fresh marsh and tidal flats than the other components of the study area (Kirlay, et al., 1990).

The deterioration of coastal wetlands is an issue of Federal, State, and local concern. Federal legislation that reflects this concern includes the Clean Water Act, the Coastal Zone Management Act, and the Coastal Wetlands Planning, Protection and Restoration Act. The National Environmental Policy Act is designed to identify and, where appropriate, analyze such issues of concern. The States of Louisiana, Mississippi, Alabama, and Florida have adopted Coastal Zone Management Programs and a variety of other laws that discourage wetland destruction. Many of the coastal parishes of Louisiana have also adopted coastal management programs and other permitting procedures to discourage wetland destruction.

Coastal Marshes

Coastal marshes of Mississippi and Alabama largely occur as discontinuous bands around bays, sounds, and streams. Mississippi has approximately 72,000 ac (113 mi^2) of designated crucial coastal wetland habitat (Mississippi Dept. of Marine Resource, 2006). Estuarine wetlands are the second-most common wetlands in Mississippi, including coastal marsh, estuarine, fresh, mud flats and cypress-tupelo gum swamp (estuarine forested wetlands). Estuarine marshes around Mississippi Sound and associated bays occur in discontinuous bands. Based on previous vegetation studies of the island beach complexes in the Mississippi Delta System (Mendelssohn, 1988), it was noted that vegetation communities present on barrier islands include (from Gulf to back bay) beach (foreshore and backshore), dune, swale, and/or barrier flat, shrub, forest, salt pan, marsh high and low, and subtidal flats (Mendelssohn et al., 1987). Factors influencing communities include soil moisture, salinity, nutrient status, salt spray, topography, site suitability, rainfall, and perturbations such as grazing, burning, and trampling (Mendelssohn et al., 1987). The barrier islands in the Mississippi Sound vary in vegetative types and distribution based on the elevation and exposure to the tidal variations and wave wash. Most of these islands have a broad beach backed by a dune system. On the sound side of the islands the beaches are interdispersed with intermittent patches of saline-to-brackish marshes backed by dunes. The broad beaches on the Gulf side are backed by dunes that in some cases provide sufficient height and elevation for maritime forest development. These maritime forests are characterized by scrubby live oak (*Quercus virginiana var. maritime*), myrtle oak (*Quercus myrtifolia*), seaside rosemary (*Ceratiola ericoides*), seaside balm (*Conradina canescens*), sand pine (*Pinus clausa*) (from eastern Alabama into Florida), slash pine (*Pinus eliottii*), red cedar (*Juniperus virginiana*), and saw palmetto (*Serenoa repens*) (USACE, 1984). Marshes along the sound side of the islands have been described as having three zones. The highest zone, 1 m above mean sea level (MSL), is a high marsh flooded only by the highest tides and dominated by saltmarsh fimbristylis and saltgrass. The next zone is a brackish marsh dominated by blackrush (*Juncus roemerianus*) and spikerush (*Eleocharis* spp.). The regularly flooded marshes are saline and consist of smooth cordgrass (USACE, 1984). In Mississippi, the most extensive marshes are located between the Pearl River and Clear Point, around St. Louis Bay, in the lower Pascagoula River delta and around Point aux Chenes Bay at the state's eastern border. These mainland marshes behind Mississippi Sound are discontinuous wetlands associated with estuarine systems receiving sediment and freshwater discharges. They are isolated from direct exposure to the Gulf by barrier islands, shoals, or protruding landmasses such as peninsulas or terraces (USACE, 1984). There are also extensive wetlands in the Grand Bay of the Mississippi Sound, which straddles the Mississippi-Alabama border.

The largest areas of marshland in Alabama are around Grand Bay (east of Point aux Chenes Bay), around Fowl River Bay to Heron Bay (north of Dauphin Island), and at the mouth of the Mobile River Delta. According to Wallace (1996), Alabama has 118,000 ac (47,752 ha) of coastal wetlands comprised of about 75,000 ac (30,375 ha) of forested wetlands, 4,400 ac (1,782 ha) of freshwater marsh, and 35,400 ac (14,337 ha) of estuarine marsh. Stout (1979) categorized Alabama coastal marshes into four types closely paralleling the Mississippi zones defined by Eleuterius (1973a): (1) Salt Marsh, dominated by oystergrass and blackrush; (2) Brackish Marsh I, dominated by blackrush, giant cordgrass, and wiregrass; (3) Brackish Marsh II, dominated by blackrush, wiregrass, and sawgrass; and (4) Fresh Marsh, represented by a large diversity of species such as alligatorweed, bulltongue (*Sagittaria falcata*), and cattails. The distribution, areal coverage, and species composition of Alabama's marshlands are dependent on several variables such as tidal range, shoreline elevation, topography, and salinity (Stout 1979). The limited extent of coastal marshes in Alabama seems to be a result of high shoreline elevations and extreme low tidal range (Stout 1979).

Mississippi's wetlands seem to be more stable than those in Louisiana and Alabama, perhaps reflecting the more stable substrate, more active and less disrupted sedimentation patterns in wetland areas, and the occurrence of only minor canal dredging and development. Urban and suburban growth are suggested as the greatest contributors to direct coastal wetland loss in Mississippi and Alabama (Moulton and Jacob, 2000).

Louisiana's coastal wetlands support more than two-thirds of the wintering waterfowl population of the Mississippi Flyway, including 20-25 percent of North America's puddle duck population. Louisiana's coastal region also supports the largest fur harvest in North America (Olds, 1984). The NMFS statistics for the last 20 years indicate that coastal Louisiana contributes about 20 percent of the Nation's total commercial fisheries harvest (Coast 2050 report).

Wetlands in general provide a means for naturally and effectively improving water quality, providing water recharge areas for potable aquifers, and act as storage areas for future water needs. These wetland attributes are especially important in Florida due to the urbanization and expansion of high density populations into or adjacent to sensitive wetland areas. These wetlands help to filter damaging nutrients and other pollutants from the water that passes through them. Other unique features of these wetlands is their ability to provide storage for floodwaters that can be used to later recharge groundwater and potable aquifers. Due to the vulnerable shoreline and low-lying populated areas of both Louisiana and Florida, these coastal wetlands also provide the benefit of buffering against streamside erosion while stabilizing shorelines and providing storm-surge protection, which in turn provides some degree of flood protection from storm surge (Florida Dept. of Environmental Protection (FDEP), 2007). These Florida wetlands, aside from providing habitat for waterfowl, provide refuge for various endangered species including the American bald eagle, Florida panther, and the snail kite. The survival of many commercially and recreationally important fish and shellfish, such as shrimp and crabs, depend upon healthy coastal wetland systems for their survival. The aesthetic attributes of these areas provide attractions for tourist and naturalist alike and therefore attract tourist dollars to the adjacent municipalities. The economic value of wetlands is indisputable. Acre-for-acre, wetlands are more productive than many agricultural lands. Florida's sports and commercial fisheries are dependent upon healthy wetland ecosystems. Wetlands bring in tourism dollars from hunters, fishermen, campers, and boaters, as well as from those who are passive users (e.g., photographers, birders, canoe tourists, hikers, etc).

During 1997, the area of interest in Louisiana contained about 1,750,915 ac (708,570 ha) of coastal wetlands. About 80,482 ac (32,570 ha) of this were freshwater marsh and forests; 433,818 ac (175,560 ha) were intermediate salinity marsh; and 512 595 ac (207,440 ha) were brackish marsh (Louisiana Dept. of Wildlife and Fisheries, 1997). Presumably, the remaining 724,018 ac (293,000 ha) were saline marsh. These wetlands largely occur as broad expanses. The most notable storm-related, storm-induced change was the 217 mi^2 (138,880 ac) of Louisiana's coastal lands that were transformed to water after Hurricanes Katrina and Rita (Barras, 2006). The change to density and concentration of the previously described coastal wetland types resulting from these two hurricanes will be determined after several growing seasons.

Mississippi River Delta Complex

The Mississippi River Delta Complex forms a plain that is composed of a series of overlapping riverine deltas that have extended onto the continental shelf over the past 6,000 years. Wetlands currently occupying this deltaic plain are characteristic of a deltaic system influenced by man-induced alterations of the historic hydrological and sedimentation patterns. The overall trend is the conversion of marsh wetlands to open-water habitat. Sparse stands of black mangrove are found in the highest salinity areas of the Barataria and Terrebonne Basins but occur at the northernmost part of their range and are subject to die-offs caused by severe cold weather events. Extensive salt and brackish marshes are found throughout the southern half of the plain and east of the Mississippi River. Intermediate and freshwater marshes are found farther inland. Coastal restoration projects, such as Caernarvon and Davis Pond Freshwater Diversion, has enhanced the recovery of intermediate and freshwater wetlands east of the Mississippi River and south of Lake Pontchartrain. In freshwater areas, cypress-tupelo swamps are found where hydro-period and water chemistry supports regeneration. Bottomland hardwoods are found on the numerous natural and manmade levees and in areas with an elevation and hydro-period conducive to regeneration.

Two active deltas are found within this region. The Red River and about 30 percent of the Mississippi River have been diverted to the Atchafalaya River, resulting in sediment accretion at the mouths of the Atchafalaya River and its distributary, Wax-lake Outlet. This system supports extensive freshwater marshes, swamps, and bottomland hardwoods. The less active delta is at the mouth of the Mississippi River, which is referred to as the Belize or Birdfoot Delta. The Mississippi River has been channelized and leveed through most of this delta, and its upper reaches have been transected by an extensive series of locks and dams. River channelization and levee construction help keep rivers within their banks, thereby excluding or reducing riverborne sediments from entering flanking deltaic wetlands. Farmland soil conservation efforts and dam construction have reduced the suspended-sediment load of the Mississippi River by about 70 percent since 1850 (Kesel, 1988). The combination of both has resulted in a greatly reduced volume of sediments available for delta formation.

In the aftermath of Hurricanes Katrina and Rita, scientists with State and Federal Government agencies, universities, and nongovernmental organizations have begun analyzing the losses to the coastal wetlands and barrier islands of the Gulf Coast. Louisiana in particular is highly susceptible to hurricanes. Although Louisiana's coastal marshes and barrier islands provide a front line of defense against storm surge, 90 percent of these wetlands are at or below sea-level elevation. Furthermore, Louisiana is historically prone to major storm events. According to the Louisiana State University (LSU) Hurricane Center, the central Louisiana coast has experienced landfall of more major hurricanes (Category 3 and above) than anywhere in the continental U.S. over the past century (LSU Hurricane Center, 1999).

The USGS National Wetlands Research Center reported a total of 217 mi^2 (138,880 ac) of Louisiana's coastal lands were transformed to water after Hurricanes Katrina and Rita (Barras, 2006). The permanency of this loss may not be known for several growing seasons as some of the shallow areas may recover rapidly while others may remain open ponds. According to a previous USGS report, the change from land to open water in all of coastal Louisiana east of the Mississippi River from 2004 to 2005 was 72.9 mi^2 (46,656 ac) (USDOI, GS, 2006b). The Louisiana Coastal Area Ecosystem Restoration Study (USACE, 2004c) projected only 60 mi^2 (38,400 ac) of landloss for this area for the 50-year period ending 2050.

In general, brackish and saline marshes appeared to have fared better than fresh and intermediate marshes. The greatest impacts were observed in the fresh and intermediate marshes of the Mississippi River Basin, upper Breton Sound Basin, and Pearl River Basin. A breakdown by basin shows the following:

- Breton Sound water area increased by 40.9 mi^2 (26,176 ac);
- Terrebonne basin water area increased by 19.4 mi^2 (12,416 ac);
- Pontchartrain basin water area increased by 19.1 mi^2 (12,224 ac);
- Mississippi River basin water area increased by 17.8 mi^2 (11,392 ac);
- Barataria basin water area increased by 17.6 mi^2 (11,264 ac);

- Pearl River basin water area increased by 4.4 mi^2 (2,816 ac); and
- Atchafalaya basin showed no change.

Mississippi and Alabama

Coastal marshes of Mississippi and Alabama largely occur as discontinuous bands around bays, sounds, and streams. The most extensive wetlands in this vicinity occur in the Eastern Pearl River and Pascagoula River deltas in Mississippi; the Mobile River and Tensaw River deltas in Alabama; and Grand Bay of Mississippi Sound, which straddles the Mississippi-Alabama border. Mississippi contains about 64,000 ac (25,920 ha) of vegetated, coastal wetlands (Coastal Preserves Program, 1999). According to Wallace (1996), Alabama has about 75,000 ac (30,375 ha) of forested wetlands, 4,400 ac (1,782 ha) of freshwater marsh, and 35,400 ac (14,337 ha) of estuarine marsh.

The marshes characteristic of the Mississippi Coast are primarily irregularly flooded marshes built on deltaic plain sediments deposited by a number of fairly large coalescing river systems (Hackney and de la Cruz, 1982). Soils are generally acidic, have an average organic content of 10 percent, and are composed of silt and clay. Although over 300 species of vascular plants have been found in the Mississippi marshes, communities are usually dominated by only a few plants (Eleuterius, 1973a). The saline marsh is composed of two major species: blackrush and smooth cordgrass. The brackish marsh is recognized by a reduction in smooth cordgrass, an increase in the number of plant species such as hogcane and wiregrass and a reduction in density of blackrush (Eleuterius, 1973b). The intermediate marsh marks the upper limit of blackrush and the dominance of brackish species such as bullwhip (*Scirpus californicus*), sawgrass (*Cladium jamaicens*e), and switchgrass (*Panicum virgatum*). The freshwater marshes are the smallest in areal extent and occur along the upper reaches of tidal rivers. Dominant species are spikerushes, lizard's tail (*Saururus cernuus*), arrow leaf (*Sagittaria lancifolia*), and three-square (*Scirpus americanus*). Eleuterius (1973a and b) attributes the zonation in Mississippi marshes to be primarily a function of salinity.

Mississippi's wetlands seem to be more stable than those in Louisiana and Alabama, perhaps reflecting the more stable substrate, more active and less disrupted sedimentation patterns in wetland areas, and the occurrence of only minor canal dredging and development. Urban and suburban growth are suggested as the greatest contributors to direct coastal wetland loss in Mississippi and Alabama (Moulton and Jacob, 2000). Most coastal wetlands in Alabama occur on the Mobile River delta or along the northern Mississippi Sound.

Florida

The coast of the Florida panhandle consists of narrow islands, spits, and bars, which are fronted by wide, white sand beaches subject to frequent storm overwash. Behind the beaches are a line of high, primary, often active dunes that range in elevation from an average low of 11.8 ft (3.6 m) on Perdido Key to a high of 29.5 ft (9 m) south of Choctawhatchee Bay. Vegetation on these dunes is similar to that previously described for the Alabama coast. Sea oats is the characteristic species on these dunes and is often associated with marshelder, sea grape (*Coccoloba uvifera*), seacoast bluestem, and sea rocket (*Cakile lanceolata*). Older, more stabilized dunes are frequently covered with rosemary, scrub oak, and sand live oak (*Quercus eminata*) (Duncan and Duncan, 1987). Similar vegetation is commonly found on the secondary dune fields, behind the fore dunes (Duncan and Duncan, 1987). Low-lying, sparsely vegetated, sand flats grade into tidal marshes on the backshore of some barrier islands and spits, such as Santa Rosa Island and Perdido Key. Slash pine is also common on the bay-sound side of the island above the tidal zone.

Furthermore, the Florida coastal area is so accessible and the beaches are so popular that the area has been and continues to be subjected to extensive development, which segments the vegetated habitats. Often, the only unimpacted native vegetation can be seen on military reservations such as Eglin Air Force Base or as set-asides enclosed by chain-link fences and located between condominiums. Even the natural vegetation in the small State parks and the Gulf Islands National Seashore on Santa Rosa Island can only preserve a semblence of the region's past appearances because of the heavy volume of human and vehicular traffic, especially off road recreational vehicles. Emergent wetlands have very limited distribution in the Florida panhandle. They are located as narrow, often discontinuous bands fringing the shore behind barrier islands and spits, near river mouths, and along some embayment shorelines. Most of these marshes are non-fresh and have species compositions comparable to those described for Alabama. In general, the wetlands from mean sea level to the highest tide line are dominated by smooth cordgrass, with blackrush dominating the next inland zone, followed by the least flooded zone being dominated by saltgrass and/or wiregrass (Darovec et al., 1975).

Within the area of interest, the coastal counties of Florida contain about 2,448,725 ac (994,950 ha) of wetlands. Hardwood swamps represent the largest percentage (32.5%) of those wetlands. Hardwood swamps there are largely associated with the river deltas, such as those associated with Pensacola, Choctawatchee, and St. Andrews Bays. Estuarine wetlands, such as marsh and mangroves, represent 7.4 percent of that total (Florida Game and Freshwater Fish Commission, 1996).

Tidal marshes of the Big Bend region of northwest Florida cover a 250-km (155-mi) stretch of coastline from Panacea to Tarpon Springs encompassing an area estimated at 16,062 ac (65,000 ha) (Raabe et al., 1996). This coastal reach is characterized by low wave energy, semi-diurnal tides, microtidal range, low relief, and sharp vegetation zones and ecotones. A typical marsh is prominently dominated by black needlerush, *Juncus roemerianus*, interspersed with barren sand flats, and bounded by cordgrass, *Spartina alterniflora,* on tidal creeks and flats at low elevations and a diverse, high marsh community at upper elevations along a forest ecotone. Marsh extent is usually no more than several kilometers wide, exhibiting a rather subtle elevation change of less than a meter rise from shore to coastal forest edge. Wave energy is classified as "zero" from St. Marks River east along the central Florida coastline to Cedar Key, Florida, and moderate from St. Marks River west to Apalachicola, Florida (Tanner, 1960). This coastal reach displays a low-relief topography of less than 1 percent (Coultas and Gross, 1975) that allows direct exchange of tidal ebb and flow. Tidal range is little more than 1 m (3 ft) between mean lower low water (MLLW) and mean higher high water (MHHW) at the mouth of the St. Marks River. Field surveys and model applications were conducted on aquatic and terrestrial habitats of St. Marks National Wildlife Refuge in the Big Bend region of northwest Florida. The refuge is situated approximately 20 mi (32 km) south of Tallahassee and covers parts of Wakulla, Jefferson, and Taylor counties. The total area of federally owned land encompasses 64,599 ac (26,142 ha). Of the total acreage, 31,500 ac (12,748 ha) are open water in Apalachee Bay and 32,082 ac (12,983 ha) are forest and marsh. The refuge is bordered by Apalachee Bay on the south, Ochlockonee Bay on the west, and the Aucilla River on the east. The reserve was purchased in 1929 and is one of the oldest refuges in the entire refuge system of FWS. The refuge landscape is characterized by a relatively low-elevation gradient that is intersected by several rivers and a number of freshwater springs and intertidal creeks. Upland pine sandhills drain into wet pine flatwoods and hardwood swamps within the freshwater zone and into tidal salt marsh and mudflats at bay's edge. Seagrass beds are abundant throughout Apalachee Bay, a shallow low-energy system open to the GOM. Elevations of these major habitat types ranges from below sea level for seagrass, 0-2 ft MSL for salt and fresh marsh, 2-4 ft MSL for coastal pine, palm, and hardwood hammocks, 4-6 ft MSL for bottomland hardwood and pine flatwoods, and above 6 ft MSL for pine sandhill and oak associations in the higher elevations approaching 40 ft MSL. The absence of relief contributes to the largely wetland composite of vegetation types.

In the coastal marshes of northern Florida and especially the Big Bend area, there is a notable zonation of plant species within these coastal wetlands, which provide a diversity of habitat types. St Marks National Wildlife Refuge (NWR) provides a stellar example of how the various gradations in coastal habitat base vary within a given ecotone whether it be forest or marsh. Based on the elevation, substrate and changing tidal and other hydrological dynamics within the area's various gradations in vegetation begin to occur. Zonation of low marsh habitat at St. Marks NWR is readily apparent with a narrow band of S*partina alterniflora* along tidal creeks and then a broad expanse dominated by *Juncus roemerianus*, which gives way to sand flats sparsely vegetated with succulent species, *Salicornia virginica* and *Batis maritima.* High marsh zonation above the sand flats is generally a diverse assemblage of brackish-tolerant graminoids in a fairly narrow band at the ecotone of lowland pine-palmetto forest. Plant height and biomass (*Juncus roemerianus* and *Spartina alterniflora*) varies with inundation and salinity exposure, tallest near tidal creeks and lowest on higher sand flats (Kruczynski et al., 1978). Coultas and Gross (1975) described the soil types and particle size relations in this marsh, which vary with elevation and vegetation from coarse-loamy Sulfaquents within low marsh grading to sandy Psammaquents and Haplaquodsx within high marsh habitats. Interspersed within the salt marsh zones are disjunct pine/palmetto islands from the coastal forest fringe. Island vegetation is a mix of stunted slash pine (*Pinus elliotti*), sabal palmetto (*Sabal palmetto*), saw palmetto (*Serenoa repens*), and associate shrub species. Remnant stumps of pine species and standing dead palmetto trunks are evident in high marsh zones and on small islands within the salt marsh zone. Jackson (1952) and Kurz and Wagner (1957) noted the threat of coastal erosion and sea-level rise on these same coastal wetlands of the northern Florida Gulf Coast, as evidenced from scoured beaches and remnant pine stumps in salt marsh and tidal flats. Their investigations focused on this coastal reach long before "climate change" was coined to describe the theory of human-induced factors of fossil fuel consumption and rising CO_2 that may accelerate or exacerbate global warming trends and sea-level rise. Several zonation and elevation studies have been conducted in this marsh setting, denoting the close association of tidal dynamics on vegetation distribution, soils, and growth forms (Jackson, 1952; Kurz and Wagner, 1957, Coultas and Gross, 1975, Kruczynski et al., 1978, Raabe et al., 1996; Cahoon et al., 1998; Doyle, 1998; Williams et al., 1999). Ramsey et al., (1998) used satellite and aircraft remote sensing tools to monitor dynamically the coastal flooding extent for specific tidal events to validate and relate surface topography to vegetation zonation. A review has been conducted on coastal marshes of the northern Gulf Coast by Stout (1984) that illustrates the strong correlation of marsh species zonation with tidal dynamics (Eleuterius, 1976 and 1979; Hackney and de la Cruz, 1982; Eleuterius, 1984). The goal of this case study was to develop a spatial simulation model to predict the effects of changing sea level based on IPCC (1996) climate change scenarios on coastal wetlands of the Gulf Coast region. A field study was conducted to elucidate vegetation relations with elevation for constructing and validating a digital elevation model of the land surface. A high-resolution model of surface topography was needed to predict the rate and fate of coastal inundation from sea-level rise over the next century. Land elevation and tidal inundation are key factors controlling habitat type and distribution in this coastal environment. Elevation surveys were conducted across the forest/marsh ecotone in various watersheds to test the vegetation-elevation relations under different freshwater and tidal forcing.

Tropical storms occurring along the Gulf Coast have the potential to significantly impact coastal wetlands. In 2004 and 2005, several major storms struck the State of Florida. Little published information is available regarding impacts of these storms on Florida wetlands. However, Hagey et al. (2006) notes that qualitative observations suggest that the impacts of Hurricane Ivan on salt marsh and other coastal wetlands in Pensacola Bay were minimal.

3.2.1.3. Seagrass Communities

Approximately 1.02 million ha (2.52 million ac) of submerged seagrass beds are estimated to exist in exposed, shallow coastal waters and embayments of the northern GOM. Over 80 percent of this is in Florida Bay and Florida coastal waters (Duke and Kruczynski, 1992; Zieman and Zieman, 1989). In the area from Mobile Bay to south Texas, seagrass occurs only in relatively small beds behind barrier islands.

Seagrass beds grow in shallow, relatively clear, and protected waters with predominantly sand bottoms. Their distribution depends on an interrelationship among a number of environmental factors that include temperature, water depth, turbidity, salinity, turbulence, and substrate suitability. Seagrasses provide important habitat for immature shrimp, black drum, spotted sea trout, juvenile southern flounder, and several other fish species; and they provide a food source for several species of wintering waterfowl. Beds of lower salinity vegetation provide important habitats for commercially important, although less diverse, communities of fish and shellfish.

In Louisiana, submerged vegetation primarily consists of freshwater and low salinity vegetation. Largely due to the turbid water conditions that are caused by the Mississippi and Atchafalaya Rivers, seagrass beds in Louisiana have very low densities and are rare, with the exception of beds in the vicinity of the Chandeleur Islands. About 100,442 ha (248,197 ac) of seagrass beds were found in the vicinity of these islands (USDOI, GS, 1998). Since 1998, the Chandeleur Island chain has been hit by six storms including Hurricane Georges, Tropical Storm Isadore, Hurricane Dennis, Hurricane Ivan, Hurricane Lilli, and Hurricane Katrina (Michot and Wells, 2005). 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. Landmass rebuilt since Hurricane Ivan was washed away by Hurricane Katrina. The Chandeleur Islands were reduced by Hurricane Katrina from

1,460 ha (3,600 ac) to 6,480 ha (16,000 ac) and then to 5,180 ha (12,800 ac) by Hurricane Rita (Di Silvestro, 2006). The influx of salt water in low salinity estuaries caused by Hurricanes Katrina and Rita may lead to an increase in colonization by *Ruppia maritima* and a decrease in abundance of freshwater species such as *Vallisineria americana* in upper bay areas. Such a fluctuation in community composition was documented for Lake Pontchartrain, Louisiana, by Poirrier and Cho (2002) after Hurricane Georges landfall at Biloxi, Mississippi, in September 1998.

In coastal Mississippi during 1973, about 8,100 ha (20,015 ac) of seagrass beds were reported. Currently, about 800 ha (2000 ac) are found in the state (Mississippi Museum of Natural Science, 2005). Vittor (2004) reported approximately 2,717 ha (6,714 ac) of submerged aquatic vegetation in Alabama coastal waters. Seagrass beds primarily occur in Mississippi Sound and associated bays to the north and along the islands to the south. A few beds are found along the shores of Mobile Bay and in the rivers and wetlands that feed into the bay. A survey of 44 stations in Alabama seagrass beds showed seagrasses still present in 86 percent of the stations after Hurricane Ivan's landfall at Mobile in September 2004. Seagrasses in Bayou la Batre, Alabama, exhibit reduced benthic and water-column production since Hurricane Katrina made landfall at the eastern border of Louisiana in August 2005 (Anton et al., 2006). Byron and Heck (2006) found 82 percent of Alabama seagrasses present in 2002 still present in November 2004. They also noted increases in *Ruppia maritima* and no loss of seagrasses resulting from Hurricane Katrina.

Over 300,000 ha (740,000 ac) of submerged vegetation were reported for central and northern Florida's Gulf coastal waters (Dawes et al., 2004; Sargent et al., 1995). For the Big Bend area, Sargent et al. (1995) documents dense seagrass out to 25 km (15.5 mi) from shore. Zieman and Zieman (1989) report stands of *Halophila decipiens* and *H. engelmanni* even farther, 112 km (70 mi) from shore. These species are reported at depths of over 20 m (66 ft) in the Big Bend area (Dawes et al., 2004; CSA, 1985) and *H. decipiens* has been documented at depths to 90 m (295 ft) near the Dry Tortugas (Zieman, 1982). Therefore, seagrass beds extend well into Federal waters of the northeastern Gulf of Mexico. Very little assessment has been done of hurricane impacts to seagrass in this area. Continental Shelf Associates (1987) studied the effects of four hurricanes that occurred during 1985 and found 116,554 ha (288,000 ac) of seagrass beds totally denuded in the Big Bend area. However, they reported complete recovery of the grassbeds the following season, supporting the contention that healthy communities are resilient to storm effects. Effects near shore appear more severe. Handley (2007) mentions Hurricane Frederick (1979) as partly responsible for the erosion of seagrass beds in Perdido Bay, Florida. Four years after the passage of Hurricane Andrew (1992), Tedesco et al. (2007) documented permanent losses of seagrass around sand blowouts and sand shoals stripped of seagrass cover in Biscayne Bay. Dawes et al. (2004) reports little direct impact except for erosion and deposition in some areas, as for Hurricane Andrew. Hagy et al. (2006) state that qualitative observations following Hurricane Ivan suggest that damage to seagrass beds in Pensacola Bay was minimal.

3.2.2. Sensitive Offshore Benthic Resources

The northern GOM is a geologically complex basin. It has been described as the most complex continental slope region in the world. 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 U.S. Coast and Geodetic Steamer, *Blake*, between 1877 and 1880. Rowe and Menzel (1971) reported that their deep GOM infauna data was 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 study funded by MMS 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 (984 and 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 and Benthic Ecology, is in preparation at the time of publication of this SEIS. This seven-year project spanned three field sampling years and included collections of benthos and/or 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, 2007).

The continental slope is a transitional environment influenced by processes of both the shelf and the abyssal (deep-sea) GOM (>975 m or >3,200 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 DeSoto Canyon region. In general, the Eastern GOM is more productive in the oceanic region than is the Western GOM. It is generally assumed that all the phytoplankton is consumed by the zooplankton, except for brief periods during major plankton blooms. The zooplankton then egests a high percentage of their food intake as feces that sink toward the bottom.

The general fauna, including macrofauna and fishes, when considered together, have been shown to group into major assemblages defined by depth including (1) upper slope, (2) mid-slope, (3) lower slope, and (4) abyssal plain (Rowe and Kennicutt, 2007). 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 off the bottom and the bottom itself constitutes 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). The seven zones 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. Similar to the continental slope in general, the proposed Lease Sale 224 area encompasses a range of habitats and water depths between 800 and 3,000 m (2,625 and 9,840 ft). The shallowest lease areas encompass the entirety of the upper slope, regardless of the depth criteria used to define the continental slope. The deepest portions extend nearly into the deepest part of the GOM at approximately 3,000 m (9,840 ft) south of the Florida Escarpment in the Eastern Gulf. This is not particularly deep for the rest of the world's oceans, but it is within about 800 m (2,625 ft) of the deepest point of the GOM at 3,840 m (12,598 ft), only accessible from Mexican waters of the southern Gulf.

A great number of publications have derived from the two major MMS-funded deep Gulf studies of Rowe and Kennicutt (2007) and Gallaway et al. (1988). Refer to these two studies for extensive background information on deepwater GOM habitat and biological communities. Several sampling stations from these two studies lie inside the boundaries of the proposed Lease Sale 224 area and numerous others are in close proximity (**Figure 3-1**). There are no remarkable biological characteristics of the benthic resources of this area other than the potential for attached communities associated with exposed carbonate material from the edge of the Florida Escarpment described below.

3.2.2.1. Chemosynthetic Communities

It should first be noted that no chemosynthetic communities have been discovered in the proposed Lease Sale 224 area to date (**Figure 3-2**). The geology of the lease area is remarkable because the northern portion of the area traverses across the Florida Escarpment. The seabed rises a total of 1,200 m (3,936 ft) from a depth of 2,800 m (9,184 ft) to 1,600 m (5,248 ft) across a horizontal distance of only 2 mi (3.2 km). The escarpment is a solid carbonate platform that appears to be exposed in some locations along the edge of this dramatic drop-off. Using the seabed surface amplitude reflectivity from 3D seismic data, high reflectivity areas can be seen at many locations just over the edge of the escarpment at a depth of around 1,600 m (5,248 ft). Interestingly, there is also an intermittent high reflectivity signal at the bottom of the escarpment. This likely represents an accumulation of carbonate talus that has detached and fallen from above, but there is also the possibility that chemosynthetic communities could exist here as well. The intersection of fine-grain sediments and the edge of the carbonate escarpment could possibly create an environment similar to the one located farther south along the base of the escarpment at about 26° N. latitude, where the first chemosynthetic community in the GOM was discovered in 1984 (Paull et al., 1984).

The nearest known chemosynthetic community to the proposed Lease Sale 224 area (and the farthest east of any known community) is located in Viosca Knoll Block 826 in water depths between 430 and

475 m (1,410 to 1,558 ft) approximately 80.7 mi (130 km) to the northwest of the proposed sale area boundary. Discoveries of chemosynthetic communities in other parts of the Gulf have historically been limited primarily by the diving depths of readily available research submersibles, but a recent MMS study partnering with NOAA Office of Ocean Exploration has utilized submergence facilities capable of diving to the full depth of the GOM and has been discovering numerous chemosynthetic communities between 1,000 and 3,000 m (3,280 and 9,840 ft). Using this constantly improving knowledge of the correlation of geophysical signatures available from 3D seismic data and the verified presence of chemosynthetic communities, there are likely no high-probability chemosynthetic community locations in the Sale 224 area.

A number of what appeared to be expulsion features were observed using older 2D data from the front of the escarpment inside the Sale 224 area. At first these appeared to be a long sequence of individual mud volcanoes averaging 500 ac (202.3 ha) in size. Using much more detailed 3D data from just outside the Sale 224 area to the northwest, the same kind of features were seen to be very obvious meanders of an ancient sediment flow. The appearance of the flow was exactly the same as that of a river on land. The sediment flow formed wide looping meanders and even "oxbows." The slices of 2D data represented individual sections of the flow patterns that appeared to be mud volcanoes, but were not.

Section III.C.3.a of the Lease Sale 181 FEIS and Chapter 3.2.2.2.1 of the Final Multisale EIS described chemosynthetic communities in detail, including the description, distribution, stability, biology, and detection.

All chemosynthetic communities in the GOM are located in water depths beyond the impact of severe storms, including hurricanes, and there would have been no alteration of these communities caused from surface storms, including the severe hurricane season of 2005.

3.2.2.2. Nonchemosynthetic Communities

More than chemosynthetic communities are found on the bottom of the deep GOM. In contrast to early theories of the deep sea, animal diversity, particularly the smaller forms living in bottom sediments, rivals that of the richest terrestrial environments such as rain forests. Other types of communities include the full spectrum of living organisms also found on the continental shelf or other areas of the marine environment. Major groups include bacteria and other microbenthos, meiofauna (0.063-0.3 millimeters (mm)), macrofauna (>0.3 mm), and megafauna (larger organisms such as crabs, sea pens, crinoids, and demersal fish). All of these groups are represented throughout the entire GOM—from the continental shelf to the deepest abyss at about 3,850 m (12,630 ft). Recent study results in Rowe and Kennicutt (2007) have indicated some unique areas near the Mississippi River Delta with substantially higher community biomass and carbon flux. Other areas of enhanced densities of nonchemosynthetic communities have also been reported in association with chemosynthetic communities (Carney, 1993). Some of these heterotrophic communities found at and near seep sites are a mixture of species unique to seeps and those that are a normal component from the surrounding environment.

There are also 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. Deepwater coral communities are now known to occur in numerous locations in the deep GOM; 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 (37 km) from the nearest known chemosynthetic community (likely in Viosca Knoll Block 906), a trawl collection from a depth of 421-512 m (1,381-1,680 ft) collected in 1955 retrieved more than 300 lb of the scleractinian coral *Lophelia prolifera*.

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 MMS used this location as a starting point and utilized the MMS in-house 3D seismic database depicting seafloor bathymetry and hard-bottom features in the region. Approximately 5 nmi (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 the 1960 paper. 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.

A large coral community (*L. pertusa*) was also discovered in Viosca Knoll Block 826 at a depth of 434 m (1,424 ft) by LGL Ecological Research Associates while doing a chemosynthetic community environmental survey for Oryx Energy in 1990 (LGL, 1990). Individual coral colonies at this site attain 1.5-2 m (5-7 ft) in height and width and up to 3-4 m (10-13 ft) in length. A large portion of the coral colonies are living. It was subsequently studied by submersible in the following years 1991 and 1992 as well as numerous occasions since and is described in detail in Schroeder (2002). These deepwater coral habitats have since been shown to be much more extensive and important to the support of diverse communities of associated fauna than previously known in the GOM. This community in VK Block 826 remains the largest and best developed *Lophelia* community known in the northern GOM. This type of unusual and unexpected community may exist in many other areas of the deep 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 MMS 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.

As described previously, hard substrate originating from the Florida Escarpment appears to be exposed both at the upper crest of the escarpment at a depth of 1,600 m (5,248 ft) as well as an accumulation of probable talus at the bottom of the escarpment at a depth of 2,800 m (9,184 ft). If these reflective targets from 3D seismic are indeed exposed hard substrate, they could very possible be colonized by a variety of deep-sea organisms including scleractinian corals. Although deeper than the high-density colonies of the upper slope, these depths are not prohibitive to a variety of coral development, including *Lophelia* and *Madrepora*. A relatively large accumulation of *Madrepora* was discovered during the recent MMS study "Chemo III" in Green Canyon Block 852 at a depth of 1,448 m (4,749 ft), very similar to the depth of the top of the escarpment.

Considering the depth of this resource, >400 m (1,312 ft), these deepwater communities would similarly 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 hurricane season of 2005.

Section III.C.3.b of the Lease Sale 181 FEIS and Chapter 3.2.2.2.2 of the Final Multisale EIS described nonchemosynthetic communities in detail. The following information is provided to supplement the information contained in the Lease Sale 181 FEIS.

Past Research

Texas A&M University, with numerous subcontractors, has recently completed the most detailed and comprehensive investigation of the deep GOM, titled *Northern Gulf of Mexico Continental Slope Habitat and Benthic Ecology*. These results are in final preparation at the time of this writing and are cited as Rowe and Kennicutt (2007). The final report should be available near the time of completion of the Final SEIS.

Microbiota

Less is known about the microbiota, primarily bacteria, in the GOM than the other size groups, especially in deep water. Very little is known about the microbiota group archaea in the deep sea. Environmental factors that control bacterial abundance in marine sediments remain poorly understood (Schmidt et al., 1998). While direct counts of bacteria 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 grams of carbon per square meter (g of C/m^2) for the shelf and slope combined, and 0.37 g of C/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. Counts of bacteria in marine sediments center around 10^9 bacteria per milliliter (ml) fluid volume; in other words, literally trillions per square meter (Schmidt et al., 1998).

In Rowe and Kennicutt (2007), bacteria abundance was measured at four depth horizons (0-1, 4-5, 9-10, and 14-15 cm) in triplicate cores at each of 59 stations ranging in depth from 19 to 3,732 m (62 to 12,244 ft). Results proved to be mixed, showing no significant difference in bacterial abundance between slope and abyssal sites, but there was a significant difference in terms of biomass over the full range of depth. Substantial additional bacterial biomass and abundance data is presented in Rowe and Kennicutt (2007).

Meiofauna

Rowe and Kennicutt (2007) reported meiofauna results from a total of 586 samples from 51 stations in the study, yielding 1.71×10^5 individuals from 21 meiofauna taxa. Overall mean abundance was 263,000 per m^{-2}, less than half of that reported by Gallaway et al. (1988). Exceptionally high abundance was found at stations in the northeast region at depths ranging from approximately 450 to 1,900 m (1,476 to 6,234 ft) with a maximum number of 946,000 per m^2. Meiofauna density in the Sale 224 area at Station S40 was moderate at 83,170 per m^2. Meiofauna biomass was dominated by the two dominant taxa, Nematoda and Harpacticoida. This final report (Rowe and Kennicutt, 2007) includes extensive analysis of diversity and biomass and a detailed section on harpacticoid copepod community structure.

Macrofauna

Rowe and Kennicutt (2007) also made extensive box core collections for macrofauna over the entire range of the continental slope and obtained higher numbers than Gallaway et al. (1988). Regressions of animal abundance as a function of depth for the entire dataset indicate that mean density declines from about 10,000 down to about 3,000 per m^2 at the base of the escarpment (near the Sale 224 area), with further declines out to less than 1,000 out on the abyssal plain. Maximum values were found near Mississippi Canyon. Three macrofauna groups were analyzed in detail because of their numerical importance: the polychaetes, bivalve molluscs, and isopod crustacea. When considered as a whole, the macrofauna displayed more or less the same patterns exhibited by the individual groups, as might be expected. The Central Gulf area, in close proximity to the Mississippi River, had highest densities, whereas the far western transect had the lowest densities, at any given depth. The central axis of DeSoto Canyon also had high densities. The highest densities were located at the Mississippi Canyon head and these also had the lowest diversity values. Both Gallaway et al. (1988) and Rowe and Kennicutt (2007) are referenced for extensive additional detail on macrofauna diversity and distribution.

Megafauna

The more recent Gulfwide study reported by Rowe and Kennicutt (2007) also included extensive megafauna sampling by both trawling techniques and benthic photography. A total of at least 185 species of megafaunal invertebrates (over 10 mm in greatest dimension, or attached to objects over 10 mm in size) were collected by trawl or trap during the study in 2000-2002. The amphipod *Eurythenes gryllus* was taken only in traps. Species richness was greatest in DeSoto Canyon at one station (S35) with 38 species. Four other stations resulted in more than 30 species, all in the eastern half of the GOM basin and one (S41) very near the boundary of the Sale 224 area. Stations on the Sigsbee Abyssal Plain had 20 or fewer species, as did stations of the Mississippi Trough.

Biomass was highest at stations of the DeSoto Canyon and a station in Mississippi Canyon, MT3. Much of the biomass was because of wet weight of holothuroids. Many species of echinoderms, sea anemones, and crustaceans were widespread in geographic distribution. The most common group of invertebrates was the Crustacea, with 58 species. Three of these were collected and identified for the first time in the GOM.

Megafaunal densities from photographs taken during the Rowe and Kennicutt (2007) and LGL/MMS (Gallaway et al., 1988) studies were compared with one another by site, transect, region, and program in Rowe and Kennicutt (2007). The ANOVA results indicate that megafaunal density numbers achieved during the latter work are not statistically different from those of the prior LGL/MMS work for any of these cases. Furthermore, the studies share four out of the top six taxa by density, and while LGL/MMS results list four more taxa groups than the latter work, these are all groups that are relatively rare with less than eight individuals/ha appearing study wide. Therefore, it would seem that the megafaunal populations of the northern GOM continental slope have not changed significantly in the past 15 years in terms of numbers and types of animals.

While the previous groups of sediment-dwelling organisms are considered immobile and unable to avoid disturbances caused by OCS activities, megafauna could be categorized into two groups: a nonmotile or very slow-moving group including many invertebrates and a motile group including fish, crustaceans, and some types of invertebrates, such as semipelagic sea cucumbers, that can readily move over substantial distances.

3.2.3. Marine Mammals

Twenty-nine species of marine mammals occur in the GOM (Davis et al., 2000). The GOM'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. Within the GOM, there are 28 species of cetaceans (7 mysticete and 21 odontocete species) and 1 sirenian species, the manatee (Jefferson et al., 1992) (**Table 3-2**).

3.2.3.1. Endangered and Threatened Species

Five baleen whales (the northern right, blue, fin, sei, and humpback), one toothed whale (the sperm whale), and one sirenian (the West Indian manatee) occur in the GOM and are listed as endangered under the ESA. The sperm whale is common in oceanic waters of the northern GOM and appears to be a resident species, while the baleen whales are considered rare or extralimital in the Gulf (Würsig et al., 2000). The West Indian manatee (*Trichechus manatus*) typically inhabits only coastal marine, brackish, and freshwater areas.

3.2.3.1.1. Cetaceans—Mysticetes

The species of endangered and threatened mysticetes reported in the GOM region are the northern right whale, blue whale, fin whale, sei whale, and humpback whale.

The northern right whale (*Eubalaena glacialis*) inhabits primarily temperate and subpolar waters. Right whales forage primarily on subsurface concentrations of zooplankton (Watkins and Schevill, 1976; Leatherwood and Reeves, 1983; Jefferson et al., 1993). Northern right whales range from wintering and calving grounds in coastal waters of the southeastern U.S. to summer feeding, nursery, and mating grounds in New England waters and northward to the Bay of Fundy and the Scotian Shelf. Five major congregation areas have been identified for the western North Atlantic right whale (southeastern U.S. coastal waters, Great South Channel, Cape Cod Bay, Bay of Fundy, and Scotian Shelf). This species is extralimital in the GOM (Würsig et al., 2000), and confirmed records in the GOM consist of a single stranding in Texas in 1972 (Schmidly et al., 1972), a sighting off Sarasota County, Florida, in 1963 (Moore and Clark, 1963; Schmidly, 1981), and sightings of a female and calf in April 2004 and January 2006. There are no abundance estimates for the northern right whale in the GOM.

The blue whale (*Balaenoptera musculus*) is the largest of all marine mammals. The blue whale occurs in all major oceans of the world; some blue whales are resident, some are migratory (Jefferson et al., 1993; USDOC, NMFS, 1998). Those that migrate move to feeding grounds in polar waters during spring and summer after wintering in subtropical and tropical waters (Yochem and Leatherwood, 1985). They feed almost exclusively on concentrations of zooplankton (Yochem and Leatherwood, 1985; Jefferson et al., 1993). They are considered extralimital in the GOM (Würsig et al., 2000), with the only records consisting of two strandings on the Texas coast (Lowery, 1974). There are no abundance estimates for the blue whale in the GOM.

The fin whale (*Balaenoptera physalus*) is an oceanic species that occurs worldwide and is most commonly sighted where deep water approaches the coast (Jefferson et al., 1993). Fin whales feed on concentrations of zooplankton, fishes, and cephalopods (Leatherwood and Reeves, 1983; Jefferson et al., 1993). The fin whale makes seasonal migrations between temperate waters, where it mates and calves, and polar feeding grounds that are occupied during summer months. Fin whale presence in the northern

GOM is considered rare (Würsig et al., 2000). There are only seven reliable reports of fin whales in the northern GOM, indicating that fin whales are not abundant in the GOM (Jefferson and Schiro, 1997).

The sei whale (*Balaenoptera borealis*) is an oceanic species that occurs in tropic to polar regions and is more common in the mid-latitude temperate zones. It is not often seen close to shore (Jefferson et al., 1993). Sei whales feed on concentrations of zooplankton, small fishes, and cephalopods (Gambell, 1985; Jefferson et al., 1993). They are considered rare in the GOM (Würsig et al., 2000), based on records of one stranding in the Florida Panhandle and three in eastern Louisiana (Jefferson and Schiro, 1997). There are no abundance estimates for the sei whale in the GOM.

The humpback whale (*Megaptera novaeangliae*) occurs in all oceans, feeding in higher latitudes during spring, summer, and autumn, and migrating to a winter range over shallow tropical banks, where they breed and calve (Jefferson et al., 1993). Humpback whales feed on concentrations of zooplankton and fishes using a variety of techniques that concentrate prey for easier feeding (Winn and Reichley, 1985; Jefferson et al., 1993). Humpback whales are considered rare in the GOM (Würsig et al., 2000) based on a few confirmed sightings and one stranding event. There are no abundance estimates for the humpback whale in the GOM.

3.2.3.1.2. Cetaceans—Odontocetes

The sperm whale (*Physeter macrocephalus*) is found worldwide in deep waters between approximately 60° N. and 60° S. latitude (Whitehead, 2002), although generally only large males venture to the extreme northern and southern portions of their range (Jefferson et al., 1993). As deep divers, sperm whales generally inhabit oceanic waters, but they do come close to shore where submarine canyons or other geophysical features bring deep water near the coast (Jefferson et al., 1993). Sperm whales prey on cephalopods, demersal fishes, and benthic invertebrates (Rice, 1989; Jefferson et al., 1993).

The sperm whale is the only great whale that is considered common in the northern GOM (Fritts et al., 1983a; Mullin et al., 1991; Davis and Fargion, 1996; Jefferson and Schiro, 1997). Aggregations of sperm whales are commonly found in waters over the shelf edge in the vicinity of the Mississippi River Delta in waters that are 500-2,000 m (1,641-6,562 ft) in depth (Mullin et al., 1994a; Davis and Fargion, 1996; Davis et al., 2000). They are often concentrated along the continental slope in or near cyclones and zones of confluence between cyclones and anticyclones (Davis et al., 2000). Consistent sightings and satellite tracking results indicate that sperm whales occupy the northern GOM throughout all seasons (Mullin et al., 1994a; Davis and Fargion, 1996; Sparks et al., 1996; Jefferson and Schiro, 1997; Davis et al., 2000; Jochens et al., 2006). For management purposes, sperm whales in the GOM are provisionally considered a separate stock from those in the Atlantic and Caribbean (Waring et al., 1997). Estimated abundance for sperm whales in the northern GOM is 1,349 individuals (Waring et al., 2004).

The life history and population dynamics of the sperm whale are described in detail in Chapter 3.2.3.1.2 of the Final Multisale EIS.

Sperm whales have been identified as species of concern in the GOM in relation to shipping, seismic surveys, and mineral production and the effects of these activities on the behavior of sperm whales have begun to be studied. Between 2002 and 2005, MMS conducted annual research cruises under the Sperm Whale Seismic Study (SWSS). The final year of the study, 2006, was devoted to data analysis and the publication of a synthesis report, including the various facets of SWSS. A detailed report of the research conducted from 2002 through 2004 has been published (Jochens et al., 2005). A summary of this report, along with supplemental information related to sperm whales is provided below.

Status and Distribution

Sperm whales are found throughout the world's oceans in deep waters between about 60°N. and 60°S. latitude (Leatherwood and Reeves, 1983; Rice, 1989). The primary factor for the population decline that precipitated ESA listing was commercial whaling in the 18th, 19th, and 20th centuries for ambergris and spermaceti. The International Whaling Commission (IWC) estimates that nearly 250,000 sperm whales were killed worldwide in whaling activities between 1800 and 1900. A commercial fishery for sperm whales operated in the GOM during the late 1700's to the early 1900's, but the exact number of whales taken is not known (Townsend, 1935). The overharvest of sperm whales resulted in their alarming decline in the last century. From 1910 to 1982, there were nearly 700,000 sperm whales killed worldwide from whaling activities (IWC Statistics, 1959-1983) (USDOC, NMFS, 2002a). Sperm whales have been protected from commercial harvest by the IWC since 1981, although the Japanese continued to harvest sperm whales in the North Pacific until 1988 (Reeves and Whitehead, 1997). Since the ban on nearly all hunting of sperm whales, there has been little evidence that direct effects of anthropogenic causes of mortality or injury are significantly affecting the recovery of sperm whale stocks (Perry et al., 1999), yet the effects of these activities on the behavior of sperm whales has just recently begun to be studied. Sperm whales are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the Marine Mammal Protection Act of 1972. At present, the global population of sperm whales is estimated to be at 32 percent of its pre-whaling number (Whitehead, 2002).

Since sperm whales were listed under the ESA, a concern for the effects of anthropogenic activities on the physiology and behavior of marine mammals has received much attention. Sperm whales have been identified as species of concern in the GOM in relation to shipping, seismic surveys, and mineral production (Jasny, 1999), although the studies of the effects of seismic pulses on sperm whales have been relatively few and have been largely inconclusive. The debate on the biological significance of certain reactions, or no reaction at all, makes any results difficult and sometimes contentious to interpret. However, many reported reactions to anthropogenic noise deserve special attention in assessing impacts to sperm whales and marine life in general. Sperm whale vocalization and audition are important for echolocation and feeding, social behavior and intragroup interactions, and maintaining social cohesion within the group. Anthropogenic sources from vessel noise, noise associated with oil production, seismic surveys, and other sources have the potential to impact sperm whales (e.g., behavioral alteration, communication, feeding ability, disruption of breeding and nursing, and avoidance of locales where audible sounds are being emitted).

Andrew et al. (2002) reported that, over a 33-year period, increases in shipping sound levels in the ocean may account for a 10-decibel (dB) increase in ambient noise between 20 and 80 hertz (Hz) and between 200 and 300 Hz, and a 3-dB increase in noise at 100 Hz on the continental slope off Point Sur, California. Although comparable data are not available for the GOM, it is likely that similar ambient noise increases have occurred. Much of the change is expected to be attributable to commercial shipping (greater numbers of ships in the Gulf and larger ship size are both factors). However, the expansion of oil and gas industry activities, including more structures, more exploration (seismic surveys) and drilling, a larger service boat fleet, and much greater distances to travel to deepwater installations, has also contributed to more sound in Gulf waters.

Documented takes of sperm whales primarily involve offshore fisheries such as the offshore lobster pot fishery and pelagic driftnet and longline fisheries. Sperm whales have learned to depredate sablefish from longline gear in the Gulf of Alaska and toothfish from longline operations in the south Atlantic Ocean. No direct injury or mortality has been recorded during hauling operations, but lines have had to be cut when whales were caught on them (Ashford et al., 1996). Because of their generally more offshore distribution and their benthic feeding habits, sperm whales are less subject to entanglement than are right or humpback whales. Sperm whales have been taken in the pelagic drift gillnet fishery for swordfish and could likewise be taken in the shark drift gillnet fishery on occasions when they may occur more nearshore, although this likely does not occur often. Although no interaction between sperm whales and the longline fishery have been recorded in the U.S. Atlantic, as noted above, such interactions have been documented elsewhere. The Southeast U.S. Marine Mammal Stranding Network received reports of 16 sperm whales that stranded along the GOM coastline from 1987 to 2001 in areas ranging from Pinellas County, Florida, to Matagorda County, Texas. One of these whales had deep, parallel cuts posterior to the dorsal ridge that were believed to be caused by the propeller of a large vessel; this trauma was assumed to be the proximate cause of the stranding.

Recent Research

Between 2002 and 2005, MMS conducted annual research cruises under the SWSS. The final year of the study, 2006, was devoted to data analysis and the preparation of a synthesis report, including the various facets of SWSS. A detailed report of the research conducted from 2002 through 2004 has been published (Jochens et al., 2005) and is summarized below. This report and others from the SWSS program are available online at http://seawater.tamu.edu/SWSS/.

Three objectives were identified for the SWSS program:

(1) establish the normal behavior of sperm whales in the northern GOM;

(2) characterize habitat use; and

(3) determine possible changes in the behavior of sperm whales when subjected to manmade noise, particularly from seismic airgun arrays.

Behavior

The intent of Objective 1 was to describe baseline sperm whale behavior. However, the long history in the GOM of human activity and human-generated sound, including in areas that sperm whales inhabit, makes the determination of baseline behavior of unexposed animals impossible. There may be some level of habituation of the GOM sperm whale population to such activities and the associated sounds.

Genetic analyses, coda vocalizations, and population structure support NMFS's provisional consideration of the northern GOM sperm whale stock as distinct from the U.S. Atlantic stock. Preliminary SWSS findings also indicate that GOM sperm whales are different from other populations. Significant genetic differences have been identified between northern GOM sperm whale population and the populations of sperm whales from the Mediterranean Sea, the North Sea, and the North Atlantic Ocean. The preliminary analyses of coda vocalizations of GOM sperm whales finds significant differences in these as compared with sperm whale populations in the rest of the Atlantic. The mixed group coda vocalizations in the GOM belong to an acoustic clan that is rare in other areas, and this leads researchers to believe that sperm whale groups from other clans rarely enter the northern GOM.

Population structure of sperm whale groups studied in the northern GOM between Mississippi Canyon and DeSoto Canyon showed variations from other populations studied in similar detail. The mean group size of the GOM sperm whales was 9-11 individuals, which is about half of the group size elsewhere. Whaling data from the GOM indicates that northern GOM sperm whales are smaller in length (1.5-2 m (5-7 ft) smaller) now than when those data were collected. The GOM sperm whales are also smaller than the whales in the Gulf of California, which have been studied using similar measurement techniques. The behavior and seasonality of large, mature males in the GOM is still a mystery as very few have been recorded and none were seen in 2004. The typical female/immature male mixed groups observed in the GOM have high site fidelity, which is not described elsewhere for females/immatures but is comparable to the site fidelity of bachelor males off New Zealand. No matches were found between the 185 individuals identified in the GOM and the 2,500+ individuals identified in the rest of the Atlantic (in the North Atlantic and Mediterranean Sperm Whale Catalog). These results suggest segregation between GOM sperm whales and those in the rest of the Atlantic that, based on the lack of matches and the differences in coda vocalizations, has likely spanned decades. All of these data support the management treatment of northern GOM sperm whales as a separate population.

The social organization of northern GOM sperm whales was examined by combining visual and acoustic observations and genetic analyses. A strong segregation in distribution between female/immatures groups and bachelor groups/lone males was found in at least 1 year of study. Female/immature groups were found south of the Mississippi River Delta and Mississippi Canyon and in the Western GOM, and these groups displayed high site fidelity for these areas. Bachelor groups and lone males were mainly found in DeSoto Canyon and along the Florida slope. Researchers point out that, although site fidelity is supported in most of the recent research, most of the research has focused on the Mississippi Canyon/DeSoto Canyon areas, and other portions of the GOM are not well represented in the study. The most recent calculation of first-year calves to group size was 11.5 percent, which is similar in magnitude to that in several areas of the South Pacific. Observations from the sailboat in 2004, which was a new addition to the SWSS project, found first-year calves in most groups of female/immature sperm whales that were visually tracked for at least 12 hours.

Sperm whale movement in the northern GOM was characterized using S-Tag data, visual and acoustic observation and tracking, and D-Tag data. S-Tags transmit the location of a tagged whale on the surface by satellite. S-Tags are expected to transmit for 6 months; however, several of the tags have continued to give whale positions for well over a year. Thirty-nine whales were tracked with S-Tags, and 2,826 locations were received between August 2001 and October 2004. Travel speeds ranged from 0.2 to 2.3 km/hr (1.4 mph) and averaged 0.7 km/hr (0.4 mph), with an average yearly distance traveled of 3,719 km (2,311 mi). S-Tagged females were not found over deeper water nearly as often as males, but rather tended to occupy the upper slope edge. Several males, conversely, moved offshore and traveled to the southern portions of the GOM. Tag data confirmed the importance of the Mississippi River Delta area as a year-round home range for whales tagged in that region. Data also indicated that males have a larger individual range than females, with emphasis over deeper waters.

In 2004, groups of sperm whales in the area south of the Mississippi River Delta were followed by a sailboat equipped for both visual and acoustic observation. Observation periods ranged between 12 and 50 hours. This study recorded an average horizontal daily displacement of 35 km (22 mi). Compared with sperm whales in other oceans, the GOM whales moved over a smaller area and stayed within a particular area for a longer period. Researchers noted that such a small horizontal displacement, along with the recorded small-scale movement patterns, suggested a high feeding success rate. This could indicate that the whales are feeding on small but dense patches of prey.

D-Tags are placed on sperm whales using suction cups and remain on the animal for several hours. During that time, the tag records very detailed data about the movements of the whale including orientation, depth, speed and other dive profile parameters. D-tagged sperm whales in the GOM dove to an average depth of 659 m (2,162 ft) (range of 326.8-972.0 m (1,072.2-3,189.0 ft)) as compared with an average depth of 966 m (3,169 ft) (range of 830.3-1,202.2 m (2,724.1-3,944.2ft)) for D-tagged sperm whales in the North Atlantic. In other dive-related behaviors, including bottom duration, number of "buzzes" per dive, and foraging phase duration, the GOM sperm whales and the North Atlantic sperm whales were similar. The foraging phase averaged 29 minutes and accounted for 60 percent of the dive duration. Whales spent an average of 11 minutes on the surface following a deep dive.

Habitat Use

The 2002-2004 SWSS cruises searched for whales mainly in the area between Mississippi Canyon and DeSoto Canyon. Surveys were generally run along the 1,000-m (3,281-ft) isobath, with water depths typically 800-1,200 m (2,625-3,937 ft). Researchers conducted *in-situ* measurements from the research vessel of several environmental parameters including, temperature, salinity, currents, and near-surface chlorophyll. Measurements were also gathered on sea-surface height and ocean color through remote sensing. These data were merged with the presence or absence of sperm whales within 5-10 km (3-6 mi) of the ship to address Objective 2. During the months when no cruises were in the field, remotely sensed data were matched with location data from S-tagged whales.

Researchers hypothesized that locally high chlorophyll features that persist for periods of months, particularly cyclonic eddies or eddy-induced off-margin flows, provide the sustained primary production needed for higher biological production that can be feeding grounds for sperm whales along the continental slope. Multiyear measurements demonstrated a very dynamic environment with striking year-to-year differences in the locations along the 1,000-m (3,281-ft) isobath where similar oceanographic features occurred. In the summers of 2002-2003, most sperm whale sightings occurred in regions of negative sea-surface height and/or higher-than-average surface chlorophyll. This was consistent with the feeding grounds hypothesis. However, 2004 proved to be a very different story. Few of the whale encounters were in areas of negative sea-surface height and/or higher-than-average surface chlorophyll. This finding was not only anomalous to the 2002-2003 SWSS results but also to those of the Sperm-Whale Acoustic Monitoring Program (SWAMP) cruises in 2000-2001 and the GulfCet II work in the late 1990's. Further analysis is anticipated.

The dynamic nature of the oceanography of the northern GOM slope occurred within the course of one season, as well as over annual periods. The Mississippi Canyon region has been an area of consistent sperm whale sightings over several years and research programs. A Loop Current eddy was located seaward but close to Mississippi Canyon in early summer 2003. The resultant water flow brought low-chlorophyll, low-nutrient Caribbean water into Mississippi Canyon from the Loop Current eddy. Researchers using both visual and acoustic surveys found sperm whales to be very uncharacteristically rare in the Mississippi Canyon region during this event. One month later, sperm whales were observed in the Canyon area, and remote-sensing fields showed that the eddy had moved farther seaward and away from the Canyon area. The more typical water flow had been reestablished.

Analyses of the spatial and temporal locations over time of 39 S-tagged whales produced some interesting results. Most of the tagged whales had been biopsied (30 of 39) and thus gender was known (24 females, 6 males). Significant differences were observed in the median bottom depth at locations for satellite-tracked males (1,171 m or 3,842 ft) and females (884 m or 2,900 ft). Although the depths overlapped, female sperm whales were located more frequently on the upper continental slope. Males were also found in this location but some males moved into the Central GOM and over the lower continental slope and the abyssal plain. Significant differences in habitat were also noted between meandering and transit behaviors. The median depth for meandering was 895 m (2,936 ft) and for transit was 968 m (3,176 ft). These two behaviors also had differing sea-surface height values (-3.9 cm (-1.5 in)) for meandering and 7.1 cm (2.8 ft) for transit). The fact that both of these height values are negative supports the hypothesis of a preference for regions of cyclonic circulation. Researchers suggest that the significant difference in mean sea height between meandering and transit movement types may indicate differential use of various areas of the GOM by sperm whales. A trend was noted for tracked whales to aggregate near the Mississippi Canyon and Mississippi River Delta areas in the summer. Some of the whales stayed in this region for several months and others dispersed in different directions the rest of the year. It should be noted that most of the whales were tagged in the Mississippi Canyon and Mississippi River Delta regions; thus, the site fidelity patterns shown by these whales may or may not be similar to whales from other areas in the GOM. The SWSS 2005 cruise tagged whales from areas farther west and perhaps those data will help address this issue.

Sperm Whales and Manmade Noise

Experiments for SWSS Objective 3 were designed to investigate the sound exposure level at which behavioral changes begin to occur. The primary tool for this investigation was the D-tag used in conjunction with seismic airgun controlled exposure experiments (CEE's) to quantify changes in the behavior of sperm whales throughout their dive cycle. Eight whales were tagged over two field seasons (2002-2003). The acoustic exposure and foraging behavior of these whales were recorded on the D-tag before, during, and after a 1- to 2-hr controlled sound exposure to typical airgun arrays. The maximum sound level exposures for the eight whales were between 130 and at least 162 dB re-1µPa-m (measurement of sound level in water) at ranges of 1.5-12.8 km (0.9-8.0 mi) from the sound source.

The whales showed no change to diving behavior or direction of movement during the gradual ramp-up or during the full-power sound exposures. There was no avoidance behavior toward the sound source. Foraging behavior was temporarily altered for the whale that was approached most closely. The surface resting period was prolonged hours longer than typical, but normal foraging behavior resumed immediately after the airguns ceased. The increased surface period may be a type of vertical avoidance to the sound source as the received sound level at the surface is expected to be less than farther down in the water column. There was a decrease of "buzzes" (distinctive echolocation sounds thought to be produced by sperm whales during prey capture attempts) in the foraging dives of the other exposed whales when compared with those of unexposed whales; however, the decrease was not statistically significant. Other analyses applied to these results led the researchers to suggest that a 20 percent decrease in foraging attempts at exposure levels ranging from <130 to 162 dB re-1µPa-m at distances of roughly 1-12 km (1-7 mi) from the sound source is more likely than no effect.

Whale locations from S-tags were compared with positions of active seismic vessels to determine whether tagged whales occurred less frequently than expected in areas of active seismic surveys in the GOM (potential vessel avoidance behavior). Chi-square testing and Monte Carlo simulations revealed no evidence that the data (whale locations) were nonrandomly distributed. However, the researchers caution that this apparent lack of avoidance to the seismic vessels is based on a very small sample size and cannot be used to refute a possible behavioral response. The sperm whale sightings of the visual team aboard the *Gyre* were also analyzed to investigate medium-term responses of whales to seismic surveys occurring in the area. No significant responses were observed in (1) the heading relative to the bearing to seismic surveys, (2) time spent at the surface, or (3) surfacing rate in the comparisons of matched pairs 2 hours before and 2 hours after line starts and line ends for survey lines within 100, 50, or 25 mi (or 161, 80.5, or 40.2 km).

The results of these three independent approaches suggest that sperm whales display no horizontal avoidance to seismic surveys in the GOM. However, these observations are based on very few exposures <160 dB re-1µPa-m. Also, these experiments were carried out in an area with substantial human activity, and the whales are not naive to human-generated sounds.

3.2.3.1.3. Sirenians

The West Indian manatee (*Trichechus manatus*) is the only sirenian occurring in tropical and subtropical coastal waters of the southeastern U.S., the GOM, and the Caribbean Sea (Jefferson et al., 1993; O'Shea et al., 1995). There are two subspecies of the West Indian manatee: the Florida manatee (*T. m. latirostris*), which ranges from the northern GOM to Virginia; and the Antillean manatee (*T. m. manatus*), which ranges from northern Mexico to eastern Brazil, including the islands of the Caribbean Sea.

Manatees are herbivores that feed opportunistically on a wide variety of submerged, floating, and emergent vegetation (USDOI, FWS, 2001). Manatees primarily use open coastal (shallow nearshore) areas, and estuaries, and they are also found far up in freshwater tributaries. Shallow grassbeds with access to deep channels are their preferred feeding areas in coastal and riverine habitats (near the mouths of coastal rivers and sloughs are used for feeding, resting, mating, and calving (USDOI, FWS, 2001).

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 are less common farther westward. In winter, the GOM 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. Crystal River in Citrus County is typically the northern limit of the manatee's winter range on the Gulf Coast. Manatees are uncommon west of the Suwannee River in Florida and are infrequently found as far west as Texas (Powell and Rathbun, 1984; Rathbun et al., 1990; Schiro et al., 1998). The Florida Gulf Coast population of manatees is estimated to be approximately 1,520 individuals (USDOI, FWS, 2001).

3.2.3.2. Nonendangered Species

3.2.3.2.1. Cetaceans—Mysticetes

The Bryde's whale (*Balaenoptera edeni*) is found in tropical and subtropical waters throughout the world. The Bryde's whale feeds on small pelagic fishes and invertebrates (Leatherwood and Reeves, 1983; Cummings, 1985; Jefferson et al., 1993). Bryde's whales in the northern GOM, with few exceptions, have been sighted along a narrow corridor near the 100-m (328-ft) isobath (Davis and Fargion, 1996; Davis et al., 2000). Most sightings have been made in the DeSoto Canyon region and off western Florida, although there have been some in the west-central portion of the northeastern GOM. The best estimate of abundance for Bryde's whales in the northern GOM is 40 individuals (Waring et al., 2004).

The minke whale (*Balaenoptera acutorostrata*) is the second smallest baleen whale and is found in all the world's oceans. They feed on a variety of marine invertebrates (copepods and squid) and fishes (Jefferson et al., 1993). At least three geographically isolated populations are recognized: North Pacific, North Atlantic, and Southern Hemisphere. The North Atlantic population migrates southward during the winter months to the Florida Keys and the Caribbean Sea. Minke whales are considered rare in the GOM, with the only confirmed records coming from stranding information (Würsig et al., 2000). Most records from the GOM have come from the Florida Keys, although strandings in western and northern Florida, Louisiana, and Texas have been reported (Jefferson and Schiro, 1997). There are no abundance estimates for minke whales in the GOM.

3.2.3.2.2. Cetaceans—Odontocetes

Family Kogiidae

The pygmy sperm whale (*Kogia breviceps*) has a worldwide distribution in temperate to tropical waters (Caldwell and Caldwell, 1989). They feed mainly on squid but will also eat crab, shrimp, and smaller fishes (Würsig et al., 2000). In the GOM, they occur primarily along the continental shelf edge and in deeper waters off the continental shelf (Mullin et al., 1991).

The dwarf sperm whale (*Kogia sima*) can also be found worldwide in temperate to tropical waters (Caldwell and Caldwell, 1989). It is believed that they feed on squid, fishes, and crustaceans (Würsig et al., 2000). In the GOM, they are found primarily along the continental shelf edge and over deeper waters off the continental shelf (Mullin et al., 1991).

At sea, it is difficult to differentiate dwarf from pygmy sperm whale, and sightings are often grouped together as "*Kogia* spp." The best estimate of abundance for dwarf and pygmy sperm whales combined in the northern GOM is 742 individuals (Waring et al., 2004).

Beaked Whales (Family Ziphiidae)

Beaked whales in the GOM are identified either as Cuvier's beaked whales or are grouped into an undifferentiated complex (*Mesoplodon* spp. and *Ziphius* spp.) because of the difficulty of at-sea identification. In the northern GOM, they are broadly distributed in waters greater than 1,000 m (3,281 ft) over lower slope and abyssal landscapes (Davis et al., 1998a and 2000). The abundance estimate for the Cuvier's beaked whale is 95 animals, and for the undifferentiated beaked whale complex in the northern GOM, it is 106 individuals (Waring et al., 2004).

The Sowerby's beaked whale (*Mesoplodon bidens*) occurs in cold temperate to subarctic waters of the North Atlantic and feeds on squid and small fishes (Würsig et al., 2000). It is represented in the GOM by only a single record, a stranding in Florida; this record is considered extralimital since this species normally occurs much farther north in the North Atlantic (Jefferson and Schiro, 1997). There are no abundance estimates for the GOM.

The Gervais' beaked whale (*Mesoplodon europaeus*) appears to be widely but sparsely distributed worldwide in temperate to tropical waters (Leatherwood and Reeves 1983). Little is known about their life history, but it is believed that they feed on squid (Würsig et al., 2000). Stranding records suggest that this is probably the most common mesoplodont in the northern GOM (Jefferson and Schiro, 1997).

The Blainville's beaked whale (*Mesoplodon densirostris*) is distributed throughout temperate and tropical waters worldwide, but it is not considered common (Würsig et al., 2000). Little life history is known about this secretive whale, but it is known to feed on squid and fish.

Cuvier's beaked whale (*Ziphius cavirorostris*) is widely (but sparsely) distributed throughout temperate and tropical waters worldwide (Würsig et al., 2000). Their diet consists of squid, fishes, crabs, and starfish. Sightings data indicate that Cuvier's beaked whale is probably the most common beaked whale in the GOM (Jefferson and Schiro, 1997; Davis et al., 1998a and 2000).

Dolphins (Family Delphinidae)

The Atlantic spotted dolphin (*Stenella frontalis*) is endemic to the Atlantic Ocean in tropical to temperate waters (Perrin et al., 1994a). They are known to feed on a wide variety of fishes, cephalopods, and benthic invertebrates (Leatherwood and Reeves, 1983; Jefferson et al., 1993; Perrin et al., 1994a). In the GOM they are commonly found in continental shelf waters less than 200 m (656 ft) in depth, primarily from 10 m (33 ft) on the shelf to up to 500 m (1,640 ft) on the slope. The abundance estimate for Atlantic spotted dolphins is 30,947 individuals (Waring et al., 2004).

The bottlenose dolphin (*Tursiops truncates*) is a common inhabitant of the continental shelf and upper slope waters of the northern GOM. Bottlenose dolphins are opportunistic feeders, taking a wide variety of fishes, cephalopods, and shrimp (Davis and Fargion, 1996; Jefferson and Schiro, 1997; Wells and Scott, 1999). There appears to be two ecotypes of bottlenose dolphins, a coastal form and an offshore form (Hersh and Duffield, 1990; Mead and Potter, 1990). The coastal or inshore stock(s) is genetically isolated from the offshore stock (Curry and Smith, 1997). In the northern GOM, bottlenose dolphins appear to have an almost bimodal distribution: shallow water (16-67 m or 52-220 ft) and a shelf break (about 250 m or 820 ft) region. These regions may represent the individual depth preferences of the coastal and offshore forms (Baumgartner, 1995). The best estimate of abundance for the northern GOM oceanic stock and the continental shelf stock of bottlenose dolphins in the GOM is 27,559 individuals (Waring et al., 2004).

The Clymene dolphin (*Stenella clymene*) is endemic to tropical and subtropical waters of the Atlantic Ocean (Perrin and Mead, 1994). This species is thought to feed on fishes and cephalopods (Leatherwood and Reeves, 1983; Jefferson et al., 1993; Mullin et al., 1994c). Data suggest that Clymene dolphins are widespread within deeper GOM waters (i.e., shelf edge and slope) (Davis et al., 2000; Würsig et al., 2000). The abundance estimate for the Clymene dolphin in the northern GOM is 17,355 individuals (Waring et al., 2004).

The Fraser's dolphin (*Lagenodelphis hosei*) has a worldwide distribution in tropical waters (Perrin et al., 1994b). Fraser's dolphins feed on fishes, cephalopods, and crustaceans (Leatherwood and Reeves, 1983; Jefferson et al., 1993; Jefferson and Schiro, 1997). In the GOM, they occur in deeper waters off the continental shelf. The abundance estimate for this species in the northern GOM is 726 individuals (Waring et al., 2004).

The pantropical spotted dolphin (*Stenella attenuata*) is distributed in tropical and subtropical waters worldwide (Perrin and Hohn, 1994). It feeds on epipelagic fishes and cephalopods (Leatherwood and Reeves, 1983; Jefferson et al., 1993). It is the most common cetacean in the oceanic northern GOM (Mullin et al., 1994b) and is found in the deeper waters off the continental shelf (Mullin et al., 1994c; Davis et al., 1998a and 2000). The abundance estimate for the pantropical spotted dolphin in the northern GOM is 91,321 individuals (Waring et al., 2004).

The Risso's dolphin (*Grampus griseus*) is distributed worldwide in tropical to warm temperate waters (Leatherwood and Reeves, 1983). They feed primarily on squid and secondarily on fishes and crustaceans (Leatherwood and Reeves, 1983; Jefferson et al., 1993). In the GOM, they occur primarily along the continental shelf and continental slope (Mullin and Fulling, 2004). The abundance estimate for the Risso's dolphin in the northern GOM is 2,169 individuals (Waring et al., 2004).

The rough-toothed dolphin (*Steno bredanensis*) occurs in tropical to warm temperate waters worldwide (Miyazaki and Perrin, 1994). This species feeds on cephalopods and fishes (Leatherwood and Reeves, 1983; Jefferson et al., 1993). In the GOM, they occur primarily over the deeper waters off the continental shelf (Mullin and Fulling, 2004). The abundance estimate for the rough-toothed dolphin in the northern GOM (both oceanic waters and the outer continental shelf) is 2,223 individuals (Waring et al., 2004).

The spinner dolphin (*Stenella longirostris*) occurs worldwide in tropical and warm temperate waters (Perrin and Gilpatrick, 1994; Jefferson and Schiro, 1997), primarily in offshore, deepwater environments. They feed on mesopelagic fishes and squid (Würsig et al., 2000). In the northern GOM, they occur in deeper waters off the continental shelf (Mullin and Fulling, 2004). The abundance estimated for the spinner dolphin in the northern GOM is 11,971 individuals (Waring et al., 2004).

The striped dolphin (*Stenella coeruleoalba*) occurs in tropical to temperate oceanic waters (Perrin et al., 1994c). They feed primarily on small, mid-water squid and fishes, especially lanternfish (myctophid). In the GOM, they occur in the deeper waters off the continental shelf (Mullin and Fulling, 2004). The abundance estimate for the striped dolphin in the northern GOM is 6,505 individuals (Waring et al., 2004).

The false killer whale (*Pseudorca crassidens*) occurs worldwide in tropical and temperate oceanic waters (Odell and McClune, 1999). False killer whales primarily eat fish and cephalopods, but they have been known to attack other toothed whales (Leatherwood and Reeves, 1983; Jefferson et al., 1993). In the GOM, most sightings occur in deeper waters off the continental shelf (Davis and Fargion, 1996). The abundance estimate for the false killer whale in the northern GOM is 1,038 individuals (Waring et al., 2004).

The killer whale (*Orcinus orca*) has a worldwide distribution from tropical to polar waters (Dahlheim and Heyning, 1999). They feed on marine mammals, marine birds, sea turtles, cartilaginous and bony fishes, and cephalopods (Leatherwood and Reeves, 1983; Jefferson et al., 1993). In the GOM, they occur primarily in the deeper waters off the continental shelf (Davis and Fargion, 1996). The abundance estimate for the killer whale in the northern GOM is 133 individuals (Waring et al., 2004).

The melon-headed whale (*Peponocephala electra*) has a worldwide distribution in subtropical to tropical waters (Jefferson et al., 1992), feeding on cephalopods and fishes (Mullin et al., 1994a; Jefferson and Schiro, 1997). In the GOM, they occur in the deeper waters off the continental shelf (Mullin et al., 1994b). The abundance estimated for the melon-headed whale in the northern GOM is 3,451 individuals (Waring et al., 2004).

The pygmy killer whale (*Feresa attenuata*) occurs worldwide in tropical and subtropical waters (Ross and Leatherwood, 1994). Its diet includes cephalopods and fishes, though reports of attacks on other dolphins have been reported (Leatherwood and Reeves, 1983; Jefferson et al., 1993). In the GOM, they occur primarily in deeper waters off the continental shelf (Mullin and Fulling, 2004). The abundance estimate for the pygmy killer whale in the northern GOM is 408 individuals (Waring et al., 2004).

The short-finned pilot whale (*Globicephala macrorhynchus*) is distributed worldwide in tropical to temperate waters (Leatherwood and Reeves, 1983). They feed predominately on squid, with fishes being consumed occasionally (Würsig et al., 2000). In the GOM, they are most frequently sighted along the continental shelf and continental slope. The abundance estimate for the northern GOM is 2,388 individuals (Waring et al., 2004).

3.2.3.3. Factors Influencing Cetacean Distribution and Abundance

The distribution and abundance of cetaceans within the northern GOM 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 river discharge. Beyond the shelf, mesoscale circulation is largely driven by the Loop Current in the eastern Gulf. 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. 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 GOM, 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 Mississippi River mouth 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. In either case, this input of nutrient-rich water leads to a localized deepwater environment with enhanced productivity and may explain the persistent presence of aggregations of sperm whales within 31 mi (50 km) of the Mississippi River Delta in the vicinity of the Mississippi Canyon.

Tropical Weather

Tropical storms and hurricanes are a normal occurrence in the Gulf and along the coast. Generally, the impacts are localized and infrequent. However, in recent years the GOM has been extremely hard hit by several very powerful hurricanes. Few areas of the coast did not suffer some damage in 2004 and 2005. In 2004, Hurricane Ivan took a large toll on oil and gas structures and operations in the Gulf and caused widespread damage to the Alabama-Florida Panhandle coast. Hurricanes Katrina, Rita, and Wilma (2005) reached Category 5 strength in the GOM. These storms caused damage in all five of the Gulf Coast States and caused massive damage to structures and operations both offshore and on land. The actual impacts of these storms on the marine mammals in the Gulf have not yet been determined and, for the most part, may remain very difficult to quantify. Examples of impacts that may have affected species include oil, gas, and chemical spills from damaged and destroyed structures and vessels (though no major oil spills were reported, many lesser spills are known to have occurred), increased trash and debris in both offshore and inshore habitats, and increased runoff and silting from wind and rain. These impacts are expected to be temporary. Generally, the offshore species and the offshore habitat are not expected to have been severely affected in the long term. However, the seasonal occurrence of impacts from hurricanes is impossible to predict.

3.2.4. Sea Turtles

Of the seven or eight extant species of sea turtles, five are known to inhabit the waters of the GOM (Pritchard, 1997): the leatherback, green turtle, hawksbill, Kemp's ridley, and loggerhead (Table 3-3). These five species are all highly migratory, and no individual members of any of the species are likely to be year-round residents of the analysis area. Individual animals will make migrations into nearshore waters as well as other areas of the North Atlantic Ocean, GOM, and the Caribbean Sea.

Natural disturbances such as hurricanes can cause significant destruction of nests and topography of nesting beaches (Pritchard, 1980; Ross and Barwani, 1982; Witherington, 1986). Tropical storms and hurricanes are a normal occurrence in the Gulf and along the coast. Generally, the impacts have been localized and infrequent. However, in the last two years the GOM has been extremely hard hit by very powerful hurricanes. Few areas of the coast have not suffered some damage in 2004-2005, and activities in the Gulf have also been severely impacted. In 2004, Hurricane Ivan took a large toll on oil and gas structures and operations in the Gulf and caused widespread damage to the Alabama-Florida Panhandle coast. In 2005, Hurricanes Katrina, Rita, and Wilma reached Category 5 strength in the GOM. These storms caused damage to all five of the Gulf Coast States. The actual impacts of these storms on the animals in the Gulf, and the listed species and critical habitat in particular, 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 will impact sea turtles that would have used those areas for nesting beaches.

3.2.4.1. Leatherback Sea Turtle

The leatherback is the most abundant sea turtle in waters over the northern GOM continental slope (Mullin and Hoggard, 2000). Leatherbacks appear to spatially use both continental shelf and slope habitats in the Gulf (Fritts et al., 1983b; Collard, 1990; Davis and Fargion, 1996). Recent surveys suggest that the region from Mississippi Canyon to DeSoto Canyon, especially near the shelf edge, appears to be an important habitat for leatherbacks (Mullin and Hoggard, 2000). Temporal variability and abundance suggest that specific areas may be important to this species, either seasonally or for short periods of time. Leatherbacks have been frequently sighted in the GOM during both summer and winter (Mullin and Hoggard, 2000).

Species/Critical Habitat Description

The leatherback sea turtle was listed as endangered on June 2, 1970 (35 FR 8491). Leatherback distribution and nesting grounds are found circumglobally and are found in waters of the Atlantic, Pacific, and Indian Oceans, the Caribbean Sea, and the GOM (Ernst et al., 1994). Adult leatherbacks forage in temperate and subpolar regions from 71°N. to 47°S. latitude in all oceans and undergo extensive migrations between 90°N. and 20°S. latitude to and from the tropical nesting beaches. In the Atlantic Ocean, leatherbacks have been recorded as far north as Newfoundland, Canada, and Norway, and as far south as Uruguay, Argentina, and South Africa (USDOC, NMFS, 2001a). Female leatherbacks nest from the southeastern U.S. to southern Brazil in the western Atlantic and from Mauritania to Angola in the eastern Atlantic. The most significant nesting beaches in the Atlantic, and perhaps in the world, are in French Guiana and Suriname (USDOC, NMFS, 2001a).

The leatherback is the largest and most pelagic of sea turtles. The average curved carapace length for adults is 155 cm (61 in) and weights from worldwide populations range from 200 to 700 kg (440 to 1540 lbs). Adults may attain weights up to and exceeding 1,000 kg (2,000 lbs) and reach lengths of 1.9 m (6.2 ft). The leatherback forages widely throughout the water column from the surface to great depths throughout tropical and temperate oceans of the world. An adult leatherback was reported, by extrapolation of data, to achieve a maximum dive of 1,300 m (4,265 ft) (Eckert et al., 1989). The distribution of leatherbacks appears to be dependent upon the distribution of their gelatinous prey (Leary, 1957), consisting mostly of scyphomedusae (jellyfish) and pelagic tunicates. Leatherbacks typically lay a clutch of approximately 100 eggs within a nest cavity, requiring approximately 60 days of incubation until pipping. Hatchlings average 61.3 mm (2.5 in) long and 44.4 g (1.5 oz) in mass. Neonate leatherbacks are the most active sea turtle species, crawling immediately across the beach to the sea upon emergence and swimming both day and night for at least 6 days after entering the surf (Wyneken and Salmon, 1992).

Critical habitat for the leatherback includes the waters adjacent to Sandy Point, St. Croix, U.S. Virgin Islands (U.S.V.I.). There is no critical habitat designation for the leatherback sea turtle in the GOM.

The life history and population dynamics of the Leatherback sea turtle are described in detail in Chapter 3.2.4.1 of the Final Multisale EIS.

Status and Distribution

Leatherback sea turtles are susceptible to ingestion of marine debris (Balazs, 1985; Fritts, 1982; Lutcavage et al., 1997; Mrosovsky, 1981; Shoop and Kenney, 1992). Poaching of eggs and animals still occurs. In the U.S.V.I., four of five strandings in St. Croix were the result of poaching (Boulon, 2000).

Leatherbacks may become entangled in longline gear (USDOC, NMFS, 2001a; Part III, Chapter 7), buoy lines, lobster pot lines (Prescott, 1988), and trawl fisheries (Marcano and Alio, 2000). During the period 1977-1987, 89 percent of the 57 stranded adult leatherbacks were the result of entanglement (Prescott, 1988), and during the period 1990-1996, 58 percent of the 59 stranded adult leatherbacks showed signs of entanglement. Leatherback sea turtles also are vulnerable to capture in gillnets (Goff et al., 1994; Castroviejo et al., 1994; Chevalier et al., 1999; Lagueux, 1998; Eckert and Lien, 1999).

Of the Atlantic turtle species, leatherback turtles seem to be the most susceptible to entanglement. This susceptibility may be the result of attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface, and perhaps to the lightsticks used to attract target species in the longline fishery. The observed take of leatherbacks by the Atlantic pelagic longline fishery during 1992 through 1999 was 263 turtles. When extrapolated for the entire Atlantic fishery, the estimated number of leatherbacks caught on longlines was 6,363 turtles. Most of the caught turtles were expected to be alive and released. Of the 6,363 estimated turtles caught, 88 (1.4%) were expected to be dead (USDOC, NMFS, 2001a).

According to observer records, an estimated 6,363 leatherback sea turtles were caught by the U.S. Atlantic tuna and swordfish longline fisheries between 1992 and 1999, of which 88 were discarded dead (USDOC, NMFS, 2001a). However, the U.S. fleet accounts for a small portion (5-8%) of the hooks fished in the Atlantic Ocean compared with other nations, including Taipei, Brazil, Trinidad, Morocco, Cyprus, Venezuela, Korea, Mexico, Cuba, United Kingdom, Bermuda, People's Republic of China, Grenada, Canada, Belize, France, and Ireland (Carocci and Majkowski, 1998). Reports of incidental takes of turtles are incomplete for many of these nations (USDOC, NMFS, 2001a; see Part II, Chapter 5, page 162 for a complete description of take records). Adding up the underrepresented observed takes per country per year of 23 actively fishing countries would likely result in estimates of thousands of sea turtles taken annually over different life stages.

3.2.4.2. Green Sea Turtle

The Florida breeding population of the green sea turtle is listed as endangered. Green sea turtles are found throughout the GOM. They occur in small numbers over seagrass beds along the south of Texas and the Florida Gulf Coast. Reports of green turtles nesting along the Gulf Coast are infrequent.

Species/Critical Habitat Description

Federal listing of the green sea turtle occurred on July 28, 1978 (43 FR 32808), with all populations listed as threatened except for the breeding populations of Florida and Pacific coast of Mexico, which are endangered. The complete nesting range of the green turtle within the NMFS, Southeast Region includes sandy beaches of mainland shores, barrier islands, coral islands, and volcanic islands between Texas and North Carolina and at the U.S.V.I. and Puerto Rico (USDOC, NMFS and USDOI, FWS, 1991a). Principal U.S. nesting areas for green turtles are in eastern Florida, predominantly Brevard through Broward Counties (Ehrhart and Witherington, 1992). Regular green turtle nesting also occurs on St Croix, U.S.V.I., and on Vieques, Culebra, Mona, and the main island of Puerto Rico (Mackay and Rebholz, 1996).

Critical habitat for the green sea turtle has been designated for the waters surrounding Isla Culebra, Puerto Rico, and its associated keys.

The life history and population dynamics of the green sea turtle are described in detail in Chapter 3.2.4.2 of the Final Multisale EIS.

Status and Distribution

The principal cause of past declines and extirpations of green turtle assemblages has been the over-exploitation of green turtles for food and other products. Adult green turtles and immatures are still exploited heavily on foraging grounds off Nicaragua and to a lesser extent off Colombia, Mexico, Panama, Venezuela, and the Tortuguero nesting beach (Carr et al., 1978; Nietschmann, 1982; Bass et al., 1998; Lagueux, 1998).

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). Hatchling sea turtles on land and in the water that are attracted to artificial light sources may suffer increased predation proportional to the increased time spent on the beach and in the predator-rich nearshore zone (Witherington and Martin, 2000).

Green turtles depend on shallow foraging grounds with sufficient benthic vegetation. Direct destruction of foraging areas because of dredging, boat anchorage, deposition of spoil, and siltation (Coston-Clements and Hoss, 1983; Williams, 1988) may have considerable effects on the distribution of foraging green turtles. Eutrophication, heavy metals, radioactive elements, and hydrocarbons all may reduce the extent, quality, and productivity of foraging grounds (Frazier, 1980).

Pollution also threatens the pelagic habitat of juvenile green turtles. Older juvenile green turtles have also been found dead after ingesting seaborne plastics (Balazs, 1985). A major threat from manmade debris is the entanglement of turtles in discarded monofilament fishing line and abandoned netting (Balazs, 1985).

The occurrence of green turtle fibropapillomatosis disease was originally reported in the 1930's, when it was thought to be rare (Smith and Coates, 1938). At present, this disease is cosmopolitan and has been found to affect large numbers of animals in some areas, including Hawaii and Florida (Herbst, 1994; Jacobson, 1990; Jacobson et al., 1991). The tumors are commonly found in the eyes, occluding sight; the turtles are often discovered entangled in debris and are frequently infected secondarily.

Predation on sea turtles by animals other than humans occurs principally during the egg and hatchling stage of development (Stancyk, 1982). Mortality because of predation of early stages appears to be relatively high naturally, and the reproductive strategy of the animal is structured to compensate for this loss (Bjorndal, 1980).

Green turtles are often captured and drowned in nets set to catch fishes. Gillnets, trawl nets, pound nets (Crouse, 1982; Hillestad et al., 1982; National Research Council, 1990), and abandoned nets of many types (Balazs, 1985; Ehrhart et al., 1990) are known to catch and kill sea turtles. Green turtles also are taken by hook and line fishing. Collisions with power boats and encounters with suction dredges have killed green turtles along the U.S. coast and may be common elsewhere where boating and dredging activities are frequent.

3.2.4.3. Hawksbill Sea Turtle

Long-term trends in hawksbill nesting in Florida are unknown, although there are a few historical reports of nesting in south Florida and the Keys (True, 1884; Audubon, 1926; DeSola, 1935). No nesting trends were evident in Florida from 1979 to 2000; between 0 and 4 nests are recorded annually. The hawksbill has been recorded in all of the Gulf States. Nesting on Gulf beaches is extremely rare and one nest was documented at Padre Island in 1998 (Mays and Shaver, 1998). 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 majority of hawksbill sightings are reported from the sea turtle stranding network. Strandings from 1972 to 1989 were concentrated at Port Aransas, Mustang Island, and near the headquarters of the Padre Island National Seashore, Texas (Amos, 1989). Live hawksbills are sometimes seen along the jetties at Aransas Pass Inlet. Other live sightings include a 24.7-cm (9.7-in) juvenile captured in a net at Mansfield Channel in May 1991 (Shaver, 1994) and periodic sightings of immature animals in the Flower Garden Banks National Marine Sanctuary.

Species/Critical Habitat Description

The hawksbill turtle was listed as endangered on June 2, 1970, and is considered critically endangered by the International Union for the Conservation of Nature (IUCN) based on global population declines of over 80 percent during the last three generations (105 years) (Meylan and Donnelly, 1999). In the western Atlantic, the largest hawksbill nesting population occurs in the Yucatán Peninsula of Mexico (Garduño-Andrade et al., 1999) with other important but significantly smaller nesting aggregations found in Puerto Rico, the U.S. Virgin Islands, Antigua, Barbados, Costa Rica, Cuba, and Jamaica (Meylan, 1999). The species occurs in all ocean basins, although it is relatively rare in the eastern Atlantic and eastern Pacific, and absent from the Mediterranean Sea. Hawksbills have been observed on the coral reefs south of Florida, but they are also found in other habitats including inlets, bays, and coastal lagoons. A surprisingly large number of small hawksbills have also been encountered in Texas. The diet is highly specialized and consists primarily of sponges (Meylan, 1988), although other food items have been documented to be important in some areas of the Caribbean (van Dam and Diez, 1997; Mayor et al.; 1998; Leon and Diez, 2000). The lack of sponge-covered reefs and the cold winters in the northern Gulf likely prevent hawksbills from establishing a strong population in this area.

Critical habitat for the hawksbill turtle includes Mona and Monito Islands, Puerto Rico, and the waters surrounding these islands, out to 3 nmi. Mona Island receives protection as a Natural Reserve under the administration of the Puerto Rico Department of Natural Resources and Environment. The coral reef habitat and cliffs around Mona Island and nearby Monito Island are an important feeding ground for all sizes of post-pelagic hawksbills. Genetic research has shown that this feeding population is not primarily composed of hawksbills that nest on Mona, but instead includes animals from at least six different nesting aggregations, particularly the U.S. Virgin Islands and the Yucatán Peninsula (Mexico) (Bowen et al., 1996; Bass, 1999). Genetic data indicate that some hawksbills hatched at Mona use feeding grounds in waters of other countries, including Cuba and Mexico. Hawksbills in Mona waters appear to have limited home ranges and may be resident for several years (van Dam and Diez, 1998).

The life history and population dynamics of the hawksbill sea turtle are described in detail in Chapter 3.2.4.3 of the Final Multisale EIS.

Status and Distribution

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). International trade in tortoiseshell is now prohibited among all signatories of the Convention on International Trade in Endangered Species; however, some illegal trade continues, as does trade between nonsignatories.

3.2.4.4. Kemp's Ridley

The nearshore waters of the GOM are believed to provide important developmental habitat for juvenile Kemp's ridley and loggerhead sea turtles. Ogren (1988) suggests that the Gulf Coast, from Port Aransas, Texas, through Cedar Key, Florida, represents the primary habitat for subadult ridleys in the northern GOM. Stomach contents of Kemp's ridleys along the lower Texas coast consisted of a predominance of nearshore crabs and mollusks, as well as fish, shrimp, and other foods considered to be shrimp fishery discards (Shaver, 1991). Analyses of stomach contents from sea turtles stranded on upper Texas beaches apparently suggest similar nearshore foraging behavior (Plotkin, 1995).

Species/Critical Habitat Description

The Kemp's ridley was listed as endangered on December 2, 1970. Internationally, the Kemp's ridley is considered the most endangered sea turtle. Kemp's ridleys nest in daytime aggregations known as arribadas, primarily at Rancho Nuevo, a stretch of beach in Mexico, Tamaulipas State. The species occurs mainly in coastal areas of the GOM and the northwestern Atlantic Ocean. Occasional individuals reach European waters. Adults of this species are usually confined to the GOM, although adult-sized individuals sometimes are found on the Eastern Seaboard of the U.S.

There is no designated critical habitat for the Kemp's ridley sea turtle.

The life history and population dynamics of the Kemp's ridley sea turtle are described in detail in Chapter 3.2.4.4 of the Final Multisale EIS.

Status and Distribution

The largest contributor to the decline of the ridley in the past was commercial and local exploitation, especially poaching of nests at the Rancho Nuevo site, as well as the GOM trawl fisheries. The advent of the Turtle Excluder Device (TED) regulations for trawlers and protections for the nesting beaches have allowed the species to begin to rebound. 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.

3.2.4.5. Loggerhead Sea Turtle

Loggerhead nesting along the Gulf Coast occurs primarily along the Florida Panhandle, although some nesting has been reported from Texas through Alabama as well (USDOC, NMFS and USDOI, FWS, 1991b). 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. Sightings of loggerheads in waters over the continental slope suggest that they may be in transit through these waters to distant foraging sites or while seeking warmer waters during the winter. Although loggerheads are widely distributed during both summer and winter, their abundance in surface waters over the slope was greater during winter than in summer (Mullin and Hoggard, 2000).

Species/Critical Habitat Description

The loggerhead sea turtle was listed as a threatened species on July 28, 1978 (43 FR 32800). This species inhabits the continental shelves and estuarine environments along the margins of the Atlantic, Pacific, and Indian Oceans, and within the continental U.S., and it nests from Louisiana to Virginia. The major nesting areas include coastal islands of Georgia, South Carolina, and North Carolina, and the Atlantic and Gulf Coasts of Florida, with the bulk of the nesting occurring on the Atlantic Coast of Florida. Developmental habitat for small juveniles is the pelagic waters of the North Atlantic and the Mediterranean Sea.

There is no critical habitat designated for the loggerhead sea turtle.

The life history and population dynamics of the loggerhead sea turtle are described in detail in Chapter 3.2.4.5 of the Final Multisale EIS.

Status and Distribution

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.

Loggerhead sea turtles face numerous threats from natural causes. The five known subpopulations of loggerhead sea turtles in the northwest Atlantic that nest in the southeastern U.S. are subject to fluctuations in the number of young produced annually because of natural phenomena, such as hurricanes, as well as human-related activities. There is a significant overlap between hurricane seasons in the Caribbean Sea and northwest Atlantic Ocean (June to November) and the loggerhead sea turtle nesting season (March to November). Hurricanes can have potentially disastrous effects on the survival of eggs in sea turtle nests. In 1992, Hurricane Andrew affected turtle nests over a 90-mi (145-km) length of coastal Florida. All of the eggs were destroyed by storm surges on beaches that were closest to the eye of this hurricane (Milton et al., 1994). On Fisher Island near Miami, Florida, 69 percent of the eggs did not hatch after Hurricane Andrew, likely because of an inhibition of gas exchange between the eggshell and the submerged nest environment resulting from the storm surge. Nests from the northern subpopulation were destroyed by hurricanes that made landfall in North Carolina in the mid- to late 1990's. Sand accretion and rainfall that result from these storms can appreciably reduce hatchling success. Recent, very active hurricane seasons, and particularly the 2004 and 2005 seasons that caused massive damage all along the Gulf Coast, have no doubt continued to greatly stress sea turtle populations in the area. These natural phenomena probably have significant, adverse effects on the size of specific year classes, particularly given the increasing frequency and intensity of hurricanes in the Caribbean Sea and northwest Atlantic Ocean.

3.2.5. Alabama, Choctawhatchee, St. Andrew, and Perdido Key Beach Mice, and the Florida Salt Marsh Vole

A detailed analysis of species characteristics and habitat requirements can be found in Section III.C.7 of the Lease Sale 181 FEIS and Chapter 3.2.5 of the Final Multisale EIS.

Hall (1981) recognizes 16 subspecies of field mouse (*Peromyscus polionotus*), eight of which are collectively known as beach mice. Of Gulf Coast subspecies, the Alabama, Choctawhatchee, St. Andrew, and Perdido Key beach mice occupy restricted habitats in the mature coastal dunes of Florida and Alabama. All four mice are listed as endangered: the Alabama subspecies in Alabama, and the Perdido Key, St. Andrew, and Choctawhatchee subspecies in Florida (USDOI, FWS, 1987). Populations have fallen to levels approaching extinction. The Alabama, Perdido Key, and Choctawhatchee beach mice were listed as endangered in the 1980's. The St. Andrew beach mouse was not listed as endangered until 1998; it is the only listed subspecies without designated critical habitat. Continued monitoring of populations of all subspecies along the Gulf Coast between 1985 and the present indicates that approximately 52 km (32.3 mi) of coastal dune habitat are now occupied by the four listed subspecies (1/3 of historic range). Beach mice were listed because of the loss of coastal habitat from human development. The reduced distribution and numbers of beach mice have continued because of multiple habitat threats over their entire range (coastal development and associated human activities, military activities, coastal erosion, and weather). The *Federal Register* (2006a) cites habitat loss as the primary cause for declines in populations of beach mice. Development of beachfront real estate along coastal areas and catastrophic alteration by hurricanes are the primary contributors to loss of habitat. Destruction of Gulf Coast sand dune ecosystems for commercial and residential development has destroyed about 60 percent of original beach mouse habitat (Holliman, 1983). Recent studies indicate that this continues to be a problem (Douglass et al., 1999; South Alabama Regional Planning Commission, 2001).

The inland extent of beach mouse habitat may vary depending on the configuration of the sand dune system and the vegetation present. There are commonly several rows of dunes paralleling the shoreline and within these rows there are generally three types of microhabitat. The first microhabitat is the frontal dunes, which are sparsely vegetated with widely scattered coarse grasses including sea oats (*Uniola paniculata*), bunch grass (*Andropogon maritimus*), and beach grass (*Panicum amarum* and *P. repens*), and with seaside rosemary (*Ceratiola ericoides*), beach morning glory (*Ipomoea stolonifera*), and railroad vine (*I. Pes-caprae*). The second microhabitat is the frontal dune grasses, a lesser component on the higher rear scrub dunes, which support growth of slash pine (*Pinus elliotti*), sand pine (*P. clausa*), and scrubby shrubs and oaks, including yaupon (*Ilex vomitoria*), marsh elder (*Iva sp.*), scrub oak (*Quercus myrtifolia*), and sand-live oak (*Q. virginiana* var. *maritima*). The third microhabitat is the interdunal areas, which contain sedges (*Cyperus sp.*), rushes (*Juncus scirpoides*), and salt grass (*Distichlis spicata)*.

Beach mice are restricted to the coastal barrier sand dunes along the Gulf. Optimal overall beach mouse habitat is currently thought to be comprised of a heterogeneous mix of interconnected habitats including primary dunes, secondary dunes, scrub dunes, and interdunal areas. Beach mice dig burrows mainly in the primary, secondary, and interior scrub dunes where the vegetation provides suitable cover. Most beach mouse surveys conducted prior to the mid-1990's were in primary and secondary dunes because the investigators assumed that these habitats are the preferred habitat of beach mice. A limited number of surveys in scrub dunes and other interior habitat resulted in less knowledge of the distribution and relative abundance there. In coastal environments, the terms "scrub" and "scrub dune" refer to habitat or vegetation communities adjacent to and landward of primary and secondary dune types where scrub oaks are visually dominant. Interior habitat can include vegetation types such as grass-like forbs (forbs are the herbs other than grasses). There is substantial variation in scrub oak density and cover within and among scrub dunes throughout ranges of beach mice. The variation, an ecological gradient, is represented by scrub oak woodland with a relatively closed canopy at one end of a continuum. At the other extreme of the gradient, scrub dunes are relatively open with patchy scrub ridges and intervening swales or interdunal flats dominated by herbaceous plants.

Beach mice feed nocturnally in the dunes and remain in burrows during the day. Their diets vary seasonally but consist mainly of seeds, fruits, and insects (Ehrhart, 1978; Moyers, 1996). Management practices designed to promote recovery of dune habitat, increase food sources, and enhance habitat heterogeneity may aid in recovery of beach mouse populations.

In wild populations, beach mice have an average life span of about9 months. Males and females reach adulthood and are able to reproduce at approximately 35 days of age. Females can nurse one litter while pregnant with another litter. From captive colonies we know that litter size is 1-8 with an average of four. Young are weaned in 2-3 weeks and are generally on their own 1-2 weeks later.

Hurricanes are a natural environmental phenomenon affecting the Gulf Coast, and beach mice have evolved and persisted in coastal dune habitats since the Pleistocene. Hurricanes are part of a repeated cycle of destruction, alteration, and recovery of dune habitat. The extensive coastal dune habitat that existed along the Gulf Coast before the fairly recent commerical and residential development allowed beach mice to survive even the most severe hurricane events to repopulate dune habitat as it recovered. Beach mice are affected by the passage of hurricanes along the northwest Florida and Alabama Gulf Coast. Since records on hurricane intensity began in 1885, a total of 32 hurricanes have struck northwest Florida within the historic ranges of the four Gulf Coast beach mouse subspecies (Williams and Duedall, 1997; Doering et al., 1994; Neumann et al., 1993). In addition, 22 hurricanes have made landfall along the coast of Alabama from 1851 to 2004 (USDOC, NOAA, National Hurricane Center, 2006).

Hurricanes generally produce damaging winds, storm tides and surges, and rain that erode barrier-island, peninsular, and mainland beaches and dunes. Following hurricanes, the dune system begins a slow natural repair process that may take 3-20 years, depending on the magnitude of dune loss (Salmon et al., 1982). During this period, sea oats and pioneer dune vegetation become established, collecting sand and building dunes. As the dunes grow and become stable, other successional dune vegetation colonizes the area (Gibson and Looney, 1994), and beach mouse food sources and habitats are reestablished. The rate of recovery of food supplies for beach mice is variable with some areas adversely affected for an extended period of time by hurricane and post-hurricane conditions.

Tropical storms periodically devastate Gulf Coast sand dune communities, dramatically altering or destroying habitat, and either drowning beach mice or forcing them to concentrate on high scrub dunes where they are exposed to predators. How a hurricane affects beach mice depends primarily on its characteristics (i.e., winds, storm surge, and rainfall), the time of year (midsummer is the worst), and where the eye crosses land (side of hurricane—clockwise or counterclockwise), population size, and storm impacts to habitat and food sources. The interior dunes and related access corridors may be essential habitats for beach mice following survival of a hurricane. For the three subspecies that have critical habitat areas (Alabama, Perdido Key, and Choctawhatchee beach mice), the major constituent elements that are known to require special management considerations or protection are dunes and interdunal areas and associated grasses and shrubs that provide food and cover (USDOI, FWS, 1985a and b).

Beach mice have existed in an environment subject to recurring hurricanes, but tropical storms and hurricanes are now considered to be a primary factor in the beach mouse's decline. It is only within the last 20-30 years that the combination of habitat loss due to beachfront development, isolation of remaining beach mouse habitat blocks and populations, and destruction of remaining habitat by hurricanes have increased the threat of extinction of several subspecies of beach mice.

The FWS reported considerable damage to 10 National Wildlife Refuges in Alabama, Mississippi, Louisiana, and the Panhandle of Florida caused by Hurricane Ivan in 2004 (USDOI, FWS, 2004a). Perdido Key, Florida, was hit hard by Hurricane Ivan, and beach mouse dune habitat and populations were greatly reduced. Dune habitat is recovering and tracking data have shown that the mice are slowly expanding back into their previous range (Haddad, 2005). Hurricane Ivan adversely impacted an estimated 90-95 percent of primary and secondary dune habitat throughout the range of the Alabama beach mouse (USDOI, FWS, 2004a). Trapping data indicate that mice may have been extirpated from these low-lying areas (USDOI, FWS, 2004a). The mice take refuge on higher ground during severe storms. Approximately 3,460 ha (1,400 ac) of higher elevation scrub habitat did not appear to be inundated by storm surge from either Hurricanes Ivan or Katrina (U.S. Army Corps of Engineers, 2001; USDOI, FWS, 2004a and b, 2005; ENSR Corporation, 2004) but received moderate damage from salt spray and wind (Boyd et al. 2003; USDOI, FWS, 2004a). The worst damage from Hurricane Ivan occurred in Alabama to Bon Secour National Wildlife Refuge located west of Gulf Shores, Alabama, along the Fort Morgan Peninsula. Major primary dunes at Bon Secour were almost completely destroyed and tons of debris washed up on the refuge.

Following Hurricane Opal in 1995, Swilling et al. (1998) reported higher Alabama beach mouse densities in the scrub than the foredunes nearly 1 year after the storm. As vegetation began to recover, however, the primary and secondary dunes were reoccupied by Alabama beach mice, and population densities surpassed those in the scrub in the fall and winter following the storm. Similar movement and habitat occupation patterns were observed following Hurricane Georges in 1998. Therefore, while Alabama beach mouse numbers and habitat quality in the frontal dunes ebb and flow in response to tropical storms, the higher elevation scrub habitat is important to mouse conservation as a more stable environment during and after storm events.

The Florida salt marsh vole (*Microtus pennsylvanicus dukecampbelli)* is of concern because of its extremely limited range, with only one known population and the threat of losing this population to a storm or other event. It is very difficult to determine the effects of hurricanes on baseline conditions of the vole due to the unreliable estimate of pre storm population levels and uncertain recovery times. In addition, determination of tropical storm effects are further complicated by the broad scope of the habitat changes in some areas combined with the short-term effect of the storms.

The Florida salt marsh vole was recently known from only one site in Waccasassa Bay, near Cedar Key, Levy County, Florida (**Figure 3-3**). However, additional searches for this species have recently revealed specimens (one female and two males) at the Lower Suwannee National Wildlife Refuge (LSNWR) (Brooks, personal communication, 2007). Due to the extreme limited range of this species, a single storm could drive the vole to extinction. With the exception of the LSNWR discovery, the vole is restricted to a salt marsh of Waccasassa Bay, Levy County, Florida. Woods et al. (1982) were able to trap only 31 individuals; subsequent trapping efforts at the site located only one individual (Woods, 1988). Trapping elsewhere in the coastal salt marshes of Citrus and Levy Counties have yielded no voles (Bentzien, 1989). Additionally, recent (1996) trapping efforts yielded five voles (all male) from the type locality.

The following is derived from information in Woods et al. (1982). The nearest known population of the meadow vole (*Microtus pennsylvanicus)* to the Florida salt marsh vole is located approximately 500 km (313 mi) to the north in Georgia. However, fossil *Microtus pennsylvanicus* have been found in late Pleistocene deposits at four sites in Alachua, Citrus, and Levy Counties, Florida, indicating a much more extensive ancestral range. The ages of these fossils may be from 8,000 to 30,000 years before present (B.P.). The Florida salt marsh vole probably is a relict population that has persisted at the Waccasassa Bay site after a prehistoric, long-term reduction in range. The range reduction has not been attributed to modern man at all. The Florida salt marsh vole is known to occur only at the type locality in a salt marsh habitat where the vegetation is dominated by salt grass (*Distichlis spicata*), with smooth cordgrass (*Spartina alterniflora*) and glasswort (*Salicornia* spp.) also present (Woods et al., 1982). This vegetation is some of the most salt tolerant in coastal wetlands.

3.2.6. Coastal and Marine Birds

The analysis below covers the portion of the area of proposed Lease Sale 224 that functions as bird habitat and as nesting area. This analysis includes only the birds that could be contacted by an oil spill associated with activities resulting from the proposed action.

3.2.6.1. Nonendangered and Nonthreatened Species

The GOM is populated by both resident and migratory species of coastal and marine birds. They are herein separated into seven major groups: diving birds, seabirds, shorebirds, Gulf passerine migrants, marsh and wading birds, waterfowl and raptors. Many species are mostly pelagic, and therefore rarely sighted nearshore. The remaining species are found within coastal and inshore habitats and are equally susceptible to potential deleterious effects resulting from OCS-related activities (Clapp et al., 1982). Site abandonment along the northern Gulf Coast has often been attributed to habitat alteration and excessive human disturbance (Martin and Lester, 1991).

Diving Birds

Diving birds are a diverse group. Diving birds comprise three main groups: cormorants (Pelecaniformes), loons (Gaviiformes), and grebes (Podicipediformes). Nesting diving birds in the Gulf include cormorants. The common diving birds in the northern Gulf are listed with their main features in **Table 3-4**.

Cormorants are streamlined, long-necked waterbirds with all toes joined by webs. They pursue their prey underwater. They live in freshwater, estuaries, and coastal marine waters. Cormorants are rather clumsy when walking because the legs are placed well back on the body. They sit rather low in the water because their bones are dense, with few air spaces, and their feathers are poorly oiled and not completely waterproof. The bill is thin and tubular, hooked at the tip, and lacking nostrils. The edges of the bill are serrated. The muscles for closing the bill on slippery fish prey are strong. All Gulf species are glossy blackish. Males are somewhat larger than females but otherwise look similar. Cormorants often breed in colonies. They build awkward stick-nests in trees or sometimes on cliff ledges. Both sexes incubate the eggs and rear the young. Sexual maturity is usually reached in 3 or 4 years. Anhingas live in estuaries and freshwater. They feed mostly on fish and the webbed feet are on legs placed well back on the body. They are strong swimmers and strong flyers.

Loons are all in one genus (*Gavia*) in an order all their own (Gaviiformes). They swim with their webbed feet and wings. They are awkward when walking because their legs are far back on the body. They can live to an age of 30 years. They prefer clear water to see prey, which they stab, scoop, or grasp with their pointed bills. Males and females build the nest and incubate the eggs together. Loon chicks are precocial and therefore able to swim immediately after hatching. They are fed by their parents at first. By 11 or 12 weeks they are almost independent.

Grebes compose a single family, Podicipedidae, in their own order, Podicipediformes. They have lobed and webbed feet and legs are placed far back on the body. Therefore, they are excellent swimmers but awkward on land. By pressing their feathers against their bodies, they can adjust their buoyancy and can lie low in the water with just their heads and necks exposed. Basic plumage is plain, dark browns and whites. Most species have ornate and distinctive breeding plumages.

Seabirds

Seabirds are a diverse group of birds that spend much of their lives on or over salt water. They 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). There are four main groups of seabirds, three of which are represented in the Gulf—the orders Procellariiformes (shearwaters, petrels, and storm petrels), Pelecaniformes (pelicans, gannets and boobies, tropicbirds, and frigate birds), and Charadriiformes (phalaropes, gulls, terns, noddies, and skimmers) (Clapp et al., 1982; Harrison, 1983). Seabirds typically aggregate in social groups called colonies; the degree of colony formation varies between species (Parnell et al., 1988). Nesting seabirds on the Gulf include pelicans, laughing gulls, eight species of terns, and black skimmers (Martin and Lester, 1991; Pashley, 1991). Seabirds obtain their food from the sea with a variety of behaviors including piracy, scavenging, dipping, plunging, and surface seizing.

Pelagic birds are susceptible to contact by oil that could be spilled from OCS activities associated with proposed Lease Sale 224.

Gulls, terns, noddies, jaegers, and black skimmers make up the gulls/terns group of seabirds. Gulls and terns are susceptible to contact by oil spilled from OCS activities in the proposed Sale 224 area. 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, personal communication, 2006).

Most of these species eat exclusively small fish and feed by plunge diving head-first from flight, often from a hovering position. Terns, like gannets and boobies (*Sula* spp.) and herons, are streamlined and have substantial size bills relative to prey size for "scooping," plunge diving, and (at least for the sulids and terns) underwater pursuit of fish. Exceptions to these feeding methods are the Sooty tern (*S. fuscata*) (the only tropical species in the group) and gull-billed tern (*S. nilotica*). The two species pluck food from the water's surface. Gull-billed terns also pluck food from mud, and they feed mostly on insects and crabs. Most seabirds are colonial nesting. Most land birds are not colonial nesters.

A discussion of colonial breeding of seabirds is pertinent to their possibly increased vulnerability to manmade disturbance. Almost all of the seabird species (98%, of about 260 species) are colonial nesting. Most land birds are not colonial nesting (Lack, 1968). On the basis of study of the seabird black-legged kittiwake, which is in the Gulf and sensitive to OCS-related activities, colonial birds may be able to adjust colony size upward. A breeder may disperse from a colony of low reproductive success (including the breeder's own low success) to a colony with more potential and remain there. Upward adjustment of colony size may control or at least track local schooling fish and pelagic invertebrate prey. Individuals would passively compete to exclude additional bird refugees from man-related disturbances (Danchin, 1998; Ainley et al., 2003). This ability to track or even control prey populations may be a reason for the evolution and maintenance of colonial breeding in birds (Danchin, 1998). Excluded refugees from OCS-related or other disturbances will not be able to breed in colonies and benefit from colonial mass predator mobbing, collective vigilance, or synchronized egg-laying for temporal swamping of the maximum predatory intake rate per unit time of local predator populations. The refugees would not be adapted to solo breeding and they would not breed at all.

Other hypotheses for the evolution of colonial breeding are much less supported or simply contradicted (Wittenberger and Hunt, 1985; Gottmark, 1990; Clode, 1993). An exception is Lack's (1968) hypothesis that many strong flyers live in colonies because they can move the extra foraging distances possibly required by location of a large group of birds breeding in just one place. However, such strong-winged birds do not include the seabirds considered here (Lack, 1968).

Colonial breeders usually have an additional character often found in many other birds including shorebirds and many waterfowl, which is collective feeding. Collective feeding makes seabirds, shorebirds, and other birds more robust at finding food to resist the stresses of OCS-related activities than birds that engage only in solo feeding. It particularly suits seabirds because they can use their senses of sight and sometimes smell over the large scales of the open sea to detect predators of all sorts (fish, marine mammals, and other birds that are often white-colored and therefore highly visible) feeding on surface schools of prey and locate their prey that way. The mere presence of other predators disrupts the protective adaptations of pelagic prey (Clode, 1993), increasing the capture rates of individual birds.

The small size of terns is a factor in their vulnerability to OCS-related activities and their general ecology. Terns are usually smaller than gulls, and tern refugees from colonies destroyed by humans may not be able to recolonize next to large gull colonies that are restricted to the same marsh and other such coastal habitats. Predation on tern eggs and chicks by the gulls is then often massive (Anderson and Devlin, 1999). However, smaller birds have more flight power and can fly farther to search successfully for suboptimal fishing grounds. Terns are smaller than other fish-eating seabirds and hence may be excluded from optimum feeding grounds by interference competition including food stealing (kleptoparasitism) (Ballance et al., 1997). However, for seabirds with similar wing feather patterns smaller birds like terns have more flight power and can fly farther (maximum foraging radius for breeding Sooty Terns, for example is about 460 mi (740 km) ; Flint, 1991) to search successfully for schools of prey that are suboptimal because they are harder to locate (Ballance et al., 1997).

Boobies and gannets have long, pointed wings and a characteristic cigar-shaped body. The neck is long and thick, with strong, well-developed muscles. The head is dominated by the stout, conical bill. The bare skin around the neck and bill is often brightly colored and plays an active role in ritual displays. The eyes are oriented towards the front, giving the bird excellent binocular vision, which is essential for active fishing from the air. Sulids typically plunge dive from great heights (up to 100 m (330 ft)). Like most fish-eating birds, boobies and gannets are mostly light colored in the underparts. The upper-parts, especially the wings, are most often dark. The light underparts blend in against the brighter sky, thus rendering the predator less visible to the prey fish. As a further adaptation to their specialized fishing technique, boobies and gannets have subcutaneous fat and well-developed air sacs, which act as cushions and protect the birds from the violent impact of crashing into the water. For the same reason, their external nostrils are closed. The short and stout legs are situated far back on their bodies, allowing the birds to swim well.

Tropicbirds are in only one genus (*Phaethon*) in their own family (Phaethontidae). They have two highly elongated central tail feathers that can be up to 21 in long. The short legs are placed far back on the body, making walking awkward. The feet are webbed. Males and females appear similar. When not breeding, they range widely in coastal and offshore tropical and warm-temperate waters. Tropicbirds make shallow plunge-dives, often from an impressive height. They usually search for food singly or in pairs, but they may also associate with large flocks of other seabirds. They often catch flying-fish above the surface. In areas where two species of tropicbirds occur, they partition food on the basis of bill size. The social courtship display includes groups of birds flying excitedly and noisily around the nesting site in undulating flight. During this display flight, the long tail feathers wave conspicuously up and down. The chick is fed by both parents.

Frigatebirds are in only one genus (*Fregata*) in their own family (Fregatidae). They attack and rob other seabirds of their food, like pirate frigates, hence the name frigatebird. They produce very little preening oil and hence they cannot swim. They land only to roost or breed on trees and cliffs; however, they can feed by snatching prey from the surface.

Shorebirds

Shorebirds are those members of the order Charadriiformes generally restricted to coastline margins (such as beaches and mudflats). The GOM shorebirds comprise five taxonomic families—Jacanidae (jacanas), Haematopodidae (oystercatchers), Recurvirostridae (stilts and avocets), Charadriidae (plovers), and Scolopacidae (sandpipers, snipes, and allies) (Hayman et al., 1986). 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 (Terres, 1991). Both spring and fall migrations take place in a series of “hops” to staging areas where birds spend time feeding heavily to store up fat for the sustained flight to the next staging area; many coastal habitats along the GOM are critical for such purposes. A recent study shows that all Arctic-breeding shorebirds (worldwide) avoid migration routes that require flying over barriers, including the Arctic Ocean itself, where landing and feeding cannot take place (Henningsson and Alerstam, 2005). Along the central Gulf Coast, 44 species of shorebirds have been recorded; only 6 nest in the area including willet, snowy plover, wilson’s plover, black-necked stilt, and killdeer; the remaining are wintering residents and/or staging migrants (Pashley, 1991).

Although variations occur between species, most shorebirds begin breeding at 1-2 years of age and generally lay 3-4 eggs per year. Life histories of shorebirds contrast sharply with seabirds, and differential life histories may have profound influence on sensitivity to pollution, offshore OCS activities, and other dangers. The eggs are camouflaged, laid in scrapes in the ground, and hatch into precocious birds that leave the nests immediately and forage for a while with their parent before flying and feeding on their own. Shorebirds are solitary nesters but often roost and feed in flocks, frequently with mixed species. Breeding shorebirds may be less susceptible to predators than offshore-breeding seabirds. Shorebirds feed on a variety of marine and freshwater invertebrates and fish, and small amounts of plant life.

In addition, many of the overwintering shorebird species remain within specific areas throughout the season and exhibit between-year wintering site tenacity, at least when not disturbed by humans. Birds are aerodynamically constrained to use more energy to initiate movement (take off) than most other vertebrates (Attenborough and Salisbury, 1998). They may prefer to stay in one place. These species may be especially susceptible to localized impacts resulting in habitat loss or degradation unless they move to more favorable habitats when disturbed by man.

However, at least some sandpipers are adapted to feed in many places on ubiquitous prey by their diverse feeding methods. They often peck for abundant aerobic harpacticoid copepods and cumaceans at the oxidized benthic surface (Sutherland et al., 2000), best done with a straight bill (Nebel et al., 2005). They also probe for infaunal polychaetes in the mud with low or no oxygen (Sutherland et al., 2000), best achieved with a curved bill (Nebel et al., 2005). They suck up the boundary film and its organisms from the surface of the mud. Finally, they even use surface tension to slightly open their long, thin bills and draw up drops of water containing small organisms into their mouths (Rubega, 1997; Rubega and Obst, 1993). Other forms of feeding in this group remain to be discovered.

Gulf Passerine Migrants

Passerine birds mostly migrate across the GOM each fall and spring and are protected along with other migrants under the Migratory Bird Treaty Act. A recent study of platforms as possible resting sites for birds crossing the Gulf was completed and is summarized as follows. Platforms for study were representative of the population of platforms at large, with respect to both structure and geography. Data suggest that the route for trans-Gulf migrants is influenced by the availability of tailwinds, with migrants attempting to minimize the time or energy expenditure required for crossing. Centers of offshore abundance as well as areas of eventual landfall varied in concert with synoptic weather. This pattern occurred despite the fact that synoptic weather was not necessarily without considerable variation along the trans-Gulf migration route and that not all birds of the same species conserve their migratory patterns. Very large flights (>25 million birds) occurred only in the 3-week period from April 22 to May 13, probably related to the need to reach breeding grounds quickly because of the high feeding costs for egg production and brooding. Considerable fall migration was over the Western Gulf, where flight direction usually had a westerly component. Death of migrants by starvation was fairly common in spring. In accord with this result, as mentioned below, a recent sophisticated statistical study shows that all Arctic-breeding shorebirds (worldwide) avoid migration routes that require flying over barriers, including the Arctic Ocean itself, where landing and feeding cannot take place (Henningsson and Alerstam, 2005). Platforms have three primary proximate impacts on migrant birds: (1) they provide habitat for resting and refueling; (2) they induce nocturnal circulations; and (3) they result in some mortality through collisions. Platforms appeared to be suitable stopover habitats for most species, and most of the migrants that stopped over on platforms did so in highly nonrandom ways and selected specific platform microhabitats (i.e., used alternative microhabitats nonrandomly) much in the same way that they select specific habitats during terrestrial stopovers. Preferred platform microhabitats were species specific and generally consistent between spring and fall. Platforms may facilitate the evolution of trans-Gulf migration strategies in certain species by providing “stepping stones” that allow incipient migrants to cross the Gulf successfully via a series of shorter flights. Cattle egrets colonized eastern North America only in the last half-century but have already become one of the most common species on platforms. Peregrine falcons are perhaps the most striking beneficiaries of platforms. This species, which formerly was near extinction, underwent a dramatic population recovery that was temporally coincident with the period of fastest expansion of the platform archipelago in the Gulf. 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 and result in non-useful expenditure of energy.

Marsh and Wading Birds

Collectively, the following families have representatives in the northern Gulf: Ardeidae (herons and egrets), Ciconiidae (storks), Threskiornithidae (ibises and spoonbills), Gruidae (cranes), and Rallidae (rails, moorhens, gallinules, and coots). The common wading birds in the northern GOM are listed with their main features in **Table 3-5**. Wading birds are those birds that have adapted to living in marshes and shallow water. They have long legs that allow them to forage by wading into shallow water, while they use their long necks and bills to probe underwater or to make long swift strokes to seize fish, frogs, aquatic insects, crustaceans, and other prey (Terres, 1991). Seventeen species of wading birds in the Order Ciconiiformes currently nest in the U.S., and all except the wood stork nest in the northern Gulf coastal region (Martin, 1991). Within the Gulf Coast region, Louisiana supports the majority of nesting wading birds. Typical herons and bitterns (Ardeidae) have large, sharply pointed bills, broad wings, and large moveable eyes. Large herons take to the air slowly, at first holding their heads out with legs dangling. Herons have a tall but narrow field of binocular vision. It is aimed forward and includes the zone under the bill down to the feet. Herons feed in shallow edges of the water, including areas of running water near banks. Tidal creeks, tidal mudflats and bars, tidal marshes, mangrove swamps, coastal lagoons, and beaches are all susceptible to oil spills and are all areas for feeding. In these waters, herons usually feed on the outgoing tide and therefore may feed at night. Reservoirs, farm ponds, ditches, rice fields, and other artificial habitats are also important for feeding. The cattle egret is largely terrestrial. Many heron species are colonial, nesting in bottomland hardwood forests on river floodplains in Louisiana and the rest of the southeastern United States. Great egrets are the most widespread nesting species in the Gulf region; they often occupy urban canals (Martin, 1991). Members of the Rallidae family are elusive and rarely seen within the low vegetation of fresh and saline marshes, swamps, and rice fields (Bent, 1926; National Geographic Society, 1983; Ripley and Beehler, 1985).

Coastal wading birds are susceptible to contact by oil spilled from OCS activities in the proposed Sale 224 area.

Waterfowl

Waterfowl belong to the taxonomic order Anseriformes and include swans, geese, and ducks. A total of 36 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 duck, wigeon, northern pintail, northern shoveler, blue-winged teal, cinnamon teal, and gadwall); 5 diving ducks (pochards, genus *Aythya*: redhead, canvasback, lesser scaup, greater scaup, and ring-necked duck*)*, and 14 others [including the wood duck (*Aix sponsa*), fulvous whistling duck (*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, 1983; Madge and Burn, 1988; Alsop, 2001). The common waterfowl in the northern GOM are listed with their main features in **Table 3-6**. Many species usually migrate from wintering grounds along the Gulf Coast to summer nesting grounds in the north. Duck drakes are especially brightly plumaged when part of a migratory population because of the limited time available for strong pair-bonding. Waterfowl migration pathways have traditionally been divided into four parallel north-south paths, or "flyways," across the North American continent. The Gulf Coast serves as the southern terminus of the Mississippi (Louisiana, Mississippi, and Alabama) flyway. Waterfowl have large, compact bodies, long or prominent necks, and full webbing between the three forward-pointing toes. They have a relatively large preen gland to keep their plumage waterproof. Waterfowl have a diverse array of feeding adaptations related to their habitat (Johnsgard, 1975). The lower mandible is flat and the upper is roughly conical tapering to a hard "nail" at the tip. With the exception of mergansers, they have horny plates along the interior of the bill near the cutting edges for sifting. The tongue acts as a suction piston, sucking muddy water through the tip of the bill and squeezing it out through the sifting plates along the sides. Most ducks breed when 1 year old, true geese when 3 years old, and swans when 4 or 5 years old. For most ducks, the pair-bond ends at egg-laying, but in swans and true geese the males permanently pair-bond and help lead the family after hatching. Many geese graze on land, gleaning fallen seeds and grain. Swans and surface-feeding ducks either swing their bills at the surface of the water or mud, sifting for small invertebrates and plant materials, or up-end and immerse their heads and necks while the rear of the body projects above the water so their bills can reach the shallow bottom. Most diving ducks use their feet for deep dives. Red-breasted and hooded mergansers use only their feet to remarkably twist and turn chasing fish. Plumage color varies from unpatterned white in most swans, through drab brown in many geese, to brightly contrasting and colored plumage of drakes of many northern ducks. A metallic luster is especially developed in the speculum (secondary flight feathers) of many ducks and aids in species recognition in mixed-species flocks when taking to the air. Female ducks and nonbreeding males are inconspicuous in drab brown and/or black. Waterfowl live in almost any kind of wetland, and the majority of species are extremely specialized and fussy about their environment. The common goldeneye, most mergansers, and the wood duck nest in tree-holes, which are hard for predators to attack. Most waterfowl are relatively solitary when nesting, but otherwise they are social. Large winter gatherings of geese and swans are composed of many family units that stay together for the first year of a young bird's life. Vocal communication is particularly important for these geese and swans. The young birds may learn the migration routes from their parents. Only a few hours after hatching, waterfowl young are greased by their mother's abdominal plumage, thereby becoming water repellent, and they feed independently. Ducks, however, are merely warmed and protected by their mothers until they are ready to fly (in about 40-70 days), while geese and swans lead their young until the following spring.

Coastal waterfowl are susceptible to contact by oil spilled that could be spilled from OCS activities associated with proposed Lease Sale 224.

Raptors

The American peregrine falcon was removed from the endangered species list on August 20, 1999. Although the final determination to delist removes the American peregrine falcon from ESA protection, the species is still protected under the Migratory Bird Treaty Act. The FWS will continue to monitor the falcon's status for 13 years to ensure it stays recovered. Peregrine falcons are perhaps the most striking beneficiaries of platforms. This species, which formerly was near extinction, underwent a dramatic population recovery that was temporally coincident with the period of fastest expansion of the platform archipelago in the Gulf.

Raptors typically have a sharply hooked bill. They have strong legs and feet with raptorial claws and an opposable hind claw. Almost all are carnivores, hunting by day or by twilight. Raptors are susceptible to contact by oil that could be spilled from OCS activities associated with the proposed Lease Sale 224.

Effects of Hurricanes Katrina, Rita, and Ivan

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. 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. The long-term effects of avian habitat loss because of these hurricanes is not known, and agencies such as 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. Invertebrate food for these birds (mostly insects and spiders) was sampled. Saltwater intrusion killed almost all crawfish being raised in ponds and killed freshwater vegetation there also; reptiles and especially amphibians were also killed by flooding saltwater moving inland (Fuller, personal communication, 2006; Harris, personal communication, 2006; Burrow, personal communication, 2006).

Shorebirds whose nests are affected by tropical storms (for example, Hurricane Ivan) will renest and actually seek washover passes as premium habitat created by the storms. Tropical storms generally benefit shorebirds nesting on the Gulf (Mitchell, personal communication, 2007) such as snowy plovers and Wilson's plovers.

3.2.6.2. Endangered and Threatened Species

The following coastal and marine bird species that inhabit or frequent the northern GOM coastal areas are recognized by FWS as either endangered or threatened: piping plover, bald eagle, and brown pelican. The southeastern snowy plover is a species of concern to the State of Florida. Least terns within 50 mi (80 km) of the Gulf Coast are not are listed as threatened or endangered and will not be further analyzed here. The roseate tern (*Sterna dougalli*) is not found in the northern GOM (USDOI, FWS, 1989). It will not be analyzed here.

Piping Plover

The piping plover (*Charadrius melodus*) is a migratory shorebird that is endemic to North America. The piping plover breeds on shores of the northern Great Plains, in the Great Lakes, and along the Atlantic Coast (Newfoundland to North Carolina); and winters on the Atlantic and Gulf Coasts from North Carolina to Mexico and in the Bahamas and West Indies. Critical habitat identifies specific areas that are essential to the conservation of a listed species and that may require special management consideration or protection. The primary constituent needs for the piping plover are those habitat components that are essential for the primary biological needs of foraging, sheltering, and roosting. The final rule on critical habitat of 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 lower low water and any densely vegetated habitat, which is not used by the piping plover.

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/or because the substrate coloration provides protection from aerial predators due to chromatic matching, or camouflage (Nicholls and Baldassarre, 1990). This species remains in a precarious state given its low population numbers, sparse distribution, and continued threats to habitat throughout its range. Of the birds located on the U.S. wintering grounds during censuses of 1991 and 1996, about 89 percent were found on the Gulf Coast and 8 percent on the Atlantic Coast. Along the Gulf Coast, the highest numbers of wintering plovers occurred along the Texas coast (1,333) (Haig and Plissner, 1993). During the winter (2001) census, 2,389 piping plovers were counted. Overall breeding census results in 2001 indicated an increase of only 0.2 percent since 1996 (Ferland and Haig, 2002). Piping plovers begin arriving on the wintering grounds in July and keep arriving through September. Behavioral observations of piping plovers on the wintering grounds suggest that they spend the majority of their time foraging. Primary prey for wintering plovers includes polychaete marine worms, various crustaceans, insects, and sometimes bivalve mollusks. They peck prey from on top of or just beneath the sediment. Foraging usually is on moist or wet sand, mud, or fine shell. In some cases, a mat of blue-green algae may cover this substrate. When not foraging, plovers can be found in aggressive encounters, roosting, preening, bathing, and moving among available habitat locations. The habitats used by wintering birds include beaches, mud flats, sand flats, algal flats, and washover passes (areas where storm-induced breaks in the sand dunes result in an inlet). In winter, piping plovers were found primarily on islands (73.4%), 15.8 percent were on the mainland, 7.1 percent were on sandbars, and the remainder was in unspecified sites. When habitats were specified, 36.3 percent were on mudflats, 33.2 percent were on sandy beaches, 23.1 percent were on sand/salt flats, 2.8 percent were on algal mats, 1 percent was on oyster reefs, and 0.1 percent was on gravel shores (Ferland and Haig, 2002).

Wintering plovers are dependent on a mosaic of habitat patches and move among these patches depending on local weather and tidal conditions. 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 migration of the piping plover is poorly understood. 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 encroachment of vegetation, which is usually kept under control by scour during high river flows. Vegetation imposes an extreme threat of predators on breeding adults. However, breeding in the open in temperate climates requires that parents may have to take turns brooding and soak themselves in water to avoid overheating; excessive heat will cause desertion. Females may renest soon after but males may take longer to renest if they do so at all (Szekely and Williams, 1995; Szekely et al., 1999). Shorebirds whose nests are affected by tropical storms (for example, Hurricane Ivan) will renest and actually seek washover passes as premium habitat created by the storms. Tropical storms generally benefit shorebirds nesting on the Gulf (Mitchell, personal communication, 2007).

Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*) is the only species of sea eagle that regularly occurs on the North American continent (USDOI, FWS, 1984). Its range extends from central Alaska and Canada to northern Mexico. The bulk of the bald eagle's diet is fish, though Bald Eagles will opportunistically take birds, reptiles, and mammals (USDOI, FWS, 1984). The general tendency is for winter breeding in the South, with a progressive shift toward spring breeding in northern locations. In the Southeast, nesting begins in early September; egg laying begins as early as late October and peaks in late December. The historical nesting range of the bald eagle within the southeastern United States included the entire coastal plain and shores of major rivers and lakes. There are certain general elements that seem to be consistent among selected nest sites. These estimates include (1) the proximity of water (usually within 0.5 mi) and a clear flight path to a close point on the water, (2) the largest living tree in a span, and (3) an open view of the surrounding area. The proximity of good perching trees may also be a factor in site selection. Bald eagles may not use an otherwise suitable site if there is excessive human activity in the area. The current range is limited, with most breeding pairs occurring in peninsular Florida and Louisiana, and some in South Carolina, Alabama, and east Texas. Sporadic breeding takes place in the rest of the southeastern states. In 1997, 120 nests were found in Louisiana; only 3 nests occurred within 5 mi (8 km) of the coast (Patrick, written communication, 1997). In 2007, about 300-400 nesting pairs were located in Louisiana. The majority of bald eagles are migratory and are only in Louisiana from about October 15 to about May 15 (Dunne, 2007).

The bald eagle was listed as endangered in 1967 in response to the declines due to DDT (dichloro-diphenyl-trichloroethane, an insecticide banned in the U.S. since 1972) and other organochlorines that affected the species' reproduction (USDOI, FWS, 1984). In July 1995, FWS reclassified the bald eagle from endangered to threatened in the lower 48 states (*Federal Register*, 1995a). The FWS is required to make a final determination on delisting the bald eagle by June 29, 2007. As of the time this NEPA document was printed, no decision has been made.

Brown Pelican

The brown pelican (*Pelicanus occidentalis*) is one of two pelican species in North America. It feeds entirely upon fishes captured by plunge diving in coastal waters. Organochlorine pesticide pollution apparently contributed to the endangerment of the brown pelican. In recent years, there has been a marked increase in brown pelican populations along its entire former range. In Louisiana in 2004, 16,501 nesting pairs produced an all-time high of 39,021 fledglings. Production decreased 35.2 percent in 2005 to 25,289 fledglings as a result of an oil spill at the West Breton Island colony caused by Tropical Storm Arlene, and the cumulative effects of Hurricanes Cindy, Dennis, Emily, Katrina, and Rita. Ninety-five percent of production occurred west of the Mississippi River. Young brown pelicans there had reached flight stage at the time of Hurricane Katrina with no direct mortality at colonies. Conversely, brown pelicans incubating eggs and caring for 5- to 6-week-old young east of the Mississippi River when Hurricane Katrina struck were impacted, as eggs and young were washed away. Colonies there were repeatedly flooded by Tropical Storm Arlene and hurricanes causing fledgling mortality. In addition, Hurricane Ivan in 2004 and Hurricanes Katrina and Rita in 2005 caused catastrophic destruction of barrier islands and brown pelican nesting colonies. Hurricane Katrina reduced the size of the Chandeleur Islands by 90 percent and completely washed away West Breton Island, Mitchell Island, and Grassy Island (Huntnfish.com, 2007). Other major causes of the decline of the brown pelican are colony site erosion, disease, and human disturbance (Boggs, written communication, 2007). The population of brown pelicans and their habitat in Alabama, Florida, Georgia, North and South Carolina, and points northward along the Atlantic Coast were removed from the endangered species list in 1985. Within the remainder of the range, which includes the coastal areas of Mississippi, where populations are not secure, the brown pelican remains listed as endangered (*Federal Register*, 1985). The brown pelican is not federally listed in Florida, but it is listed by the State as a species of special concern.

Effects of Hurricanes Katrina, Rita, and Ivan

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3.2.7. Endangered and Threatened Fish

3.2.7.1. Gulf Sturgeon

The Gulf sturgeon (*Acipenser oxyrinchus desotoi*), a subspecies of the Atlantic sturgeon (*A. o. oxyrhynchus*), has a subcylindrical body embedded with bony plates (scutes), a greatly extended snout, ventral mouth with four anterior chin barbels, and a heterocercal tail (Valdykov, 1955; Valdykov and Greeley, 1963). Adults range from 1.8 to 2.4 m (5.9 to 7.9 ft) in length, with females attaining a greater length and mass than males.

The NMFS and FWS listed the Gulf sturgeon as a threatened species on September 30, 1991. Subsequently, a recovery plan was developed to ensure the preservation and protection of Gulf sturgeon spawning habitat (USDOI, FWS and Gulf States Marine Fisheries Commission, 1995). Critical habitat was proposed June 6, 2002, in the *Federal Register* and was designated on April 18, 2003. Critical habitat is defined as specific geographic areas that are essential for the conservation of a threatened or endangered species and that may require special management consideration or protection. Fourteen geographic areas in the GOM rivers and tributaries were included in the critical habitat designation:

- Pearl and Bogue Chitto Rivers in Louisiana and Mississippi;
- Pascagoula, Leaf, Bowie (also referred to as Bouie), Big Black Creek, and Chickasawhay Rivers in Mississippi;
- Escambia, Conecuh, and Sepulga Rivers in Alabama and Florida;
- Yellow, Blackwater, and Shoal Rivers in Alabama and Florida;
- Choctawhatchee and Pea Rivers in Florida and Alabama;
- Apalachicola and Brothers Rivers in Florida; and
- Suwannee and Withlacoochee Rivers in Florida.

The critical habitat also includes portions of the following estuarine and marine areas:

- Lake Pontchartrain (east of the Lake Pontchartrain Causeway), Lake Catherine, Little Lake, The Rigolets, Lake Borgne, Pascagoula Bay, and Mississippi Sound systems in Louisiana and Mississippi, and sections of the adjacent State waters within the GOM;
- Pensacola Bay system in Florida;
- Santa Rosa Sound in Florida;
- nearshore GOM in Florida;
- Choctawhatchee Bay system in Florida;
- Apalachicola Bay system in Florida; and
- Suwannee Sound and adjacent State waters within the GOM in Florida.

The primary constituent elements of these designated areas that are considered essential for the conservation of the Gulf sturgeon include abundant food items; riverine spawning sites with appropriate substrates; riverine aggregation sites; a flow regime necessary for normal behavior, growth, and survival of all riverine life stages; water quality with the characteristics needed for normal behavior, growth, and viability of all life stages; sediment quality needed for normal behavior, growth, and viability of all life stages; and safe and unobstructed migratory pathways necessary for passage within and between riverine, estuarine, and marine habitats. The critical habitat for Gulf sturgeon encompasses approximately 1,730 river miles (2,783 river km) and 2,333 mi^2 (6,042 km^2) of estuarine and marine habitat. Major shipping channels have been excluded in the critical habitat units.

The Gulf sturgeon is anadromus, with immature and mature fish participating in freshwater migrations. Gill netting and biotelemetry have shown that subadults and adults spend 8-9 months each year in rivers and 3-4 of the coolest months in estuaries or Gulf waters. Subadult and adult Gulf sturgeon spend cool months (October or November through March or April) in estuarine areas, bays, or in the GOM (Odenkirk, 1989; Clugston et al., 1995). Adult Gulf sturgeon likely overwinter in the GOM but this is currently unknown for the majority of the population.

The adult fish tend to congregate in deeper waters of rivers with moderate currents and sand and rocky bottoms. Based on studies in the Choctawhatchee Bay river system and adjoining Gulf waters, it was noted that individual sturgeon move over an area until they encounter suitable prey type and density, and then stop to forage at these sites for extended periods of time (Mason and Clugston, 1993). This study further indicates that Gulf sturgeon seem to heavily utilize ghost shrimp as a forage item along with other benthics and do no frequent the local seagrass beds even though they may provide both more abundant and diverse invertebrate population. The mud and sand substrates appear to be important marine habitats, and the occasional use of sand flats have been noted where evidence of preferred benthic forage is available (ghost shrimp). Individuals are long-lived, some reaching at least 42 years in age (Huff, 1975). Females reach sexual maturity between the ages of 8 and 17 years, while males mature between the ages of 7 and 21 years (Huff, 1975).

Habitats used by Gulf sturgeon in the vicinity of the Mississippi Sound barrier islands tend to have a sand substrate and an average depth of 1.9-5.9 m (6.2-19.4 ft). Unvegetated estuary and bay habitats have a preponderance of sandy substrates that support burrowing crustaceans, such as ghost shrimp, small crabs, various polychaete worms, and small bivalve mollusks (Menzel, 1971; and Abele and Kim, 1986; American Fisheries Society, 1989). Gulf sturgeon are often located in these areas, and because their known prey items are present, it is assumed that Gulf sturgeon are foraging. Studies along the Florida coast indicates that Gulf sturgeon utilize shoreline areas between 2 and 4 m (6 and 13 ft) deep, characterized by low relief and sand substrate (Fox et al., 2002). These studies also noted the occasional use of depths deeper than 4 m (13 ft) but concluded that these deeper waters were used for movement between shoreline areas. Gulf sturgeon can move fairly long distances rapidly but the moves are generally localized and, in all cases, sturgeon that make localized move to deeper water but return to the optimum preferred shallow depth. Foraging areas for the Gulf sturgeon in the open GOM is unknown. Using telemetry studies as a basis, it has been hypothesized that a small percentage of the Gulf sturgeon population monitored may utilize the open Gulf for foraging, but this forage is still unknown. This conclusion is based on the absence of tagged sturgeon (relocated to deeper offshore waters) not being present in the nearshore samples, therefore, indicating that these fish did not return as other did to the nearshore waters (Parauka et al., 2001). Some adult Gulf sturgeon were noted to migrate >100 km (62 mi) into marine waters, although as previously noted the majority returned to shallow water quickly (Fox et al., 2002).

Gulf sturgeon eggs are demersal (sink to the bottom) and adhesive (Vladykov and Greeley, 1963). Spawning occurs in freshwater over relatively hard and sediment-free substrates such as limestone outcrops and cut limestone banks, exposed limestone bedrock or other exposed rock, large gravel or cobble beds, soapstone, or hard clay (Fox and Hightower, 1998; Marchent and Shutters, 1996; Sulak and Clugston, 1999). Although fry and juveniles feed in the riverine environment, subadults and adults do not (Mason and Clugston, 1993; Sulak and Clugston, 1999).

Evaluation of tagging data has identified several nearshore GOM feeding migrations but no offshore GOM feeding migrations. Telemetry data documented Gulf sturgeon from the Pearl River and Pascagoula River subpopulations migrating from their natal bay systems to Mississippi Sound and moving along the barrier islands on both the island passes (Ross et al., 2001). Based on recent population estimates for the Pearl River drainage (Rogillio and Kirk, personal communication, 2007), the annual populations of sturgeon varied from the 1996-2005 period of record from an annual low of 222 fish to a high of 536 fish captured. The acceptable range for annual mortality required to sustain the population in the Pearl River system was estimated to be in the range of 16 to 24 percent mortality. There was insufficient captures post-Hurricane Katrina to obtain an actual population number; however, a mortality rate of 38 percent was estimated. Based on this estimate of mortality, there is insufficient recruitment to maintain the current Pearl River population. Estimated annual populations of Gulf sturgeon in the Pascagoula River system is approximately 234, with an annual fish count that ranged from 142 to 394 fish per year over a period of record from 1999-2000 (Slack, personal communication, 2007). Based on this conversation, the 2005 annual population estimate for the Pascagoula system is 210 fish.

Gulf sturgeon from the Choctawhatchee, Yellow, and Apalachicola Rivers have been documented migrating in the nearshore GOM waters between Pensacola and Apalachicola Bay units (Fox et al., 2000). Telemetry data from the GOM mainly show sturgeon in depths of 6 m (19.8 ft) or less (Ross et al., 2001; Fox et al., 2000).

Gulf sturgeon occur in most major tributaries of the northeastern GOM from the Mississippi River east to Florida's Suwannee River, and in the Central and Eastern Gulf waters as far south as Charlotte Harbor (Wooley and Crateau, 1985). In Florida, Gulf sturgeon are still found in the Escambia, Yellow, Blackwater, Choctawhatchee, Apalachicola, Ochlockonee, and Suwannee Rivers (Reynolds, 1993). While little is known about the abundance of Gulf sturgeon throughout most of its range, population estimates have been calculated for the Apalachicola, Choctawhatchee, and Suwannee Rivers. The FWS calculated an average (from 1984 to 1993) 115 individuals (>45 cm (18 in) total length (TL)) over-summering in the Apalachicola River below Jim Woodruff Lock and Dam (USDOI, FWS, 1995). Preliminary estimates of the size of the Gulf sturgeon subpopulation in the Choctawhatchee River system are 2,000-3,000 fish over 61 cm (24 in) total length. The Suwannee River Gulf sturgeon population (i.e., fish >60 cm (24 in) TL and older than age 2) has been calculated recently at approximately 7,650 individuals (Sulak and Clugston, 1999). Although the size of the Suwannee River sturgeon population is considered stable, the population structure is highly dynamic as indicated by length frequency histograms (Sulak and Clugston, 1999). Strong and weak year-classes, coupled with the regular removal of larger fish, limit the growth of the Suwannee River population but stabilize the average population size (Sulak and Clugston, 1999).

The historic range of the Gulf sturgeon included nine major rivers and several smaller rivers from the Mississippi River in Louisiana to the Suwannee River in Florida, and the marine waters of the Central and Eastern GOM, south to Tampa Bay (Wooley and Crateau, 1985; USDOI, FWS, 1995). Its present range extends from Lake Pontchartrain and the Pearl River system in Louisiana and Mississippi east to the Suwannee River in Florida. Sporadic occurrences have been recorded as far west as the Rio Grande River between Texas and Mexico, and as far east and south as Florida Bay (Wooley and Crateau, 1985; Reynolds, 1993).

Five genetically-based stocks have been identified by NMFS and FWS: (1) Lake Pontchartrain and Pearl River; (2) Pascagoula River; (3) Escambia and Yellow Rivers; (4) Choctawhatchee River; and (5) Apalachicola, Ochlockonee, and Suwannee Rivers. Mitochondrial DNA analyses of individuals from subpopulations indicate that adults return to natal river areas for feeding as well as spawning (Stabile et al., 1996).

Until recently only two spawning sites were known, both in the Suwannee River in Florida. Eggs have now been discovered in six locations within the Choctawhatchee River system in Florida and Alabama (Fox and Hightower, 1998). Although fry and juveniles feed in the riverine environment, subadults and adults do not (Mason and Clugston, 1993; Sulak and Clugston, 1999).

In spring, large subadults and adults that migrate from the estuaries or the Gulf into major river passes feed primarily on lancelets, brachiopods, amphipods, polychaetes, and globular molluscs. Small sturgeon that remain in river passes during spring feed on amphipods, shrimp, isopods, oligochaetes, and aquatic insect larvae (Clugston, 1991). During the riverine stage, adults cease feeding, undergo gonadal maturation, and migrate upstream to spawn. Spawning occurs in freshwater reaches of the river, over coarse substrate in deep areas or holes with hard bottoms and where some current is present (Sulak and Clugston, 1998; Fox et al., 2000). Females lay large numbers of eggs. A large female was reported to have the capability of producing of 275,000-475,000 eggs (Chapman at al., 1993). These eggs are adhesive and will attach to rocks, vegetation, or other objects. They hatch in about 1 week depending upon the temperature of the water.

Fisheries scientists interrupt migrating Gulf sturgeon in the rivers and estuaries by capture with nets suspended from floats in the rivers and river mouths. Gill nets with mesh wide enough not to close the very large opercula are used. No capture or tracking is feasible in the open Gulf just when the fish migrate into it because cold fronts come every 2-3 days, with up to 9-ft (2.7 m) seas. Conditions are dangerous for the size of vessel required, and the paths traveled in the open Gulf cannot be followed beyond the estuaries. Thus, the offshore winter distribution of Gulf sturgeon relative to the location of the activities under the proposed action is unknown. However, there have been no reported catches of this species in Federal waters (Sulak, personal communication, 1997).

Sturgeon are bottom suction feeders that have ventrally located, highly extrusible mouths. The sturgeon head is dorsoventrally compressed with eyes dorsal so benthic food under the sturgeon's mouth will not be visible. However, they have taste barbels, like catfish, to detect prey. The barbels are also useful for feeding in high-order streams when they are muddy. However, Gulf sturgeon are common in clear water streams also. The barbels may locate food at night when visibility of prey is low from any direction. Fishes that forage by taste are opportunistic feeders because smell is much more discriminating than taste. Another adaptation of sturgeon to mainstem rivers and offshore waters is mobility (an adaptation to the large habitat scale). High fecundity (egg number) facilitates wide dispersal, a major adaptation to the high variance of habitat quality resulting from diverse habitats and dynamic nature of mainstems of watersheds.

The decline of the Gulf sturgeon is believed to be due to overfishing and habitat destruction, primarily the damming of coastal rivers and the degradation of water quality (Barkuloo, 1988). In the late 19th century and early 20th century, the Gulf sturgeon supported an important commercial fishery, providing eggs for caviar, flesh for smoked fish, and swim bladders for isinglass, a gelatin used in food products and glues (Carr, 1983). Dams and sill construction mostly after 1950 restricted access to historic spawning areas (Wooley and Crateau, 1985), exacerbating habitat loss; and overfishing resulted in the decline of the Gulf sturgeon throughout most of the 20th century. In several rivers throughout its range, dams have severely restricted sturgeon access to historic migration routes and spawning areas. Dredging and other navigation maintenance, possibly including lowering of river elevations and elimination of deep holes and altered rock substrates, may have adversely affected Gulf sturgeon habitats (Wooley and Crateau, 1985). Contaminants, both agricultural and industrial, may also be a factor in their decline. Organochlorines have been documented to cause reproductive failure in the Gulf sturgeon, reduced survival of young, or physiological alterations in other fish (White et al., 1983). In addition, Gulf sturgeon appear to be natal spawners with little, if any, spawning from other riverine populations.

Today, the greatest habitat threat to sturgeon is the damming of coastal rivers. Sturgeon cannot pass through the lock and dam systems to reach spawning areas. Dredging, desnagging, and spoil deposition associated with channel maintenance and improvement also present a threat to sturgeon spawning habitat. Poor water quality because of pesticide runoff, heavy metals, and industrial contamination may be affecting sturgeon populations. Habitat loss continues to pose major threats to the recovery of the species.

Natural phenomenon such as tropical storms and hurricanes occur along the Gulf Coast, with varying frequency and intensity between years. Although these are usually localized and sporadic, the 2004-2005 storm seasons brought major and repeated damage to the Gulf Coast area. The effects from Hurricane Katrina (2005) are still being assessed. The impacted area included a large portion of the designated critical habitat and known locations of Gulf sturgeon. The sturgeon are upstream in freshwater riverine habitats during the tropical weather season. This may give the estuarine and marine areas time to recover from hurricane impacts before the sturgeon move downstream. For instance, massive runoff due to flooding rains and swollen tributaries could cause a sharp increase in toxic contaminants in estuarine habitats. However, spreading and dilution should mitigate any threat to sturgeon very quickly. By the time the downstream migration occurs, conditions should have returned to near normal. The flooding and subsequent "unwatering" of New Orleans in the fall of 2005 created concern for any sturgeon that might have been in the areas of Lake Pontchartrain where those contaminated flood waters were pumped. The COE noted in their EA that temporary impacts to Gulf sturgeon may have resulted as a part of the unwatering activities related to the pumping of floodwaters into Lake Pontchartrain. Impacts due to the quantity and quality of the floodwaters may have caused some sturgeon to seek forage and resting areas in other more undisturbed locations of the lake. It was expected that any sturgeon displaced returned to the area once the unwatering activities ceased (USACE, 2005a). The COE also noted that the emergency procedures permitted in the Panama City, Florida, aftermath of Hurricane Ivan may have created temporary impacts to species including the Gulf sturgeon, but that the emergency procedures did not adversely impact the species (USACE, 2005b). After Hurricane Katrina, there were reports of fish kills and at least one confirmed report of a dead Gulf sturgeon due to low oxygen in the water from organic input from leaf litter and other sources such as raw sewage and untreated effluent (Cummins, 2005). Many municipalities or sources of discharges lost power and/or were flooded and were likely a source of contaminant discharge. The hurricane impacts have not yet been fully assessed for Gulf sturgeon but are generally believed to be temporary (Baker, personal communication, 2006).

3.2.8. Fisheries

3.2.8.1. Fish Resources

Ichthyoplankton

Most fishes inhabiting the GOM, whether benthic or pelagic as adults, have pelagic larval stages. For various lengths of time (10-100 days depending on the species), these pelagic eggs and larvae become part of the planktonic community. Variability in survival and transport of pelagic larval stages is thought to be an important determinant of future year-class strength in adult populations of fishes and invertebrates (Underwood and Fairweather, 1989; Doherty and Fowler, 1994). In general, the distribution of fish larvae depends on the spawning behavior of adults, hydrographic structure and transport at a variety of scales, duration of the pelagic period, behavior of larvae, and larval mortality and growth (Leis, 1991). Larval fishes are highly dependent on zooplankton until they can feed on larger prey.

Ichthyoplankton sampling at a regional scale in the GOM began in the early 1970's with routine surveys for king and Spanish mackerel larvae (Wollam, 1970; Dwinell and Futch, 1973). Houde et al. (1979) conducted major surveys of ichthyoplankton in the Eastern GOM from 1972 to 1974. Finucane et al. (1977) collected eggs and ichthyoplankton from areas off the Texas continental shelf over a 3-year period (1975-1977) as part of the South Texas Outer Continental Shelf studies. In 1982, the first comprehensive surveys of the Southeastern Area Monitoring and Assessment Program (SEAMAP) began collecting larval fishes in the GOM from a grid of sampling stations encompassing the entire northern GOM. Since SEAMAP's inception, the goal of plankton activities in the GOM has been to collect data on the early life stages of fishes and invertebrates that will complement and enhance the fishery independent data gathered on the adult lifestage. This continuing survey remains the only major effort to sample ichthyoplankton on a Gulfwide basis. Plankton samples are taken at stations arranged in a systematic grid across the GOM. An annual larval index for the Atlantic bluefin tuna is generated each year from the spring survey and is used by the International Commission for the Conservation of Atlantic Bluefin Tunas to estimate stock size. The objective of the fall survey is to collect ichthyoplankton samples with bongo and neuston gear for the purpose of estimating abundance and defining the distribution of eggs, larvae, and small juveniles of GOM fishes, particularly king and Spanish mackerel, lutjanids and sciaenids.

The accumulating SEAMAP data has not been synthesized on a regular basis. There are some examples of data synthesis for specific areas. Lyczkowski-Shultz et al. (2004) synthesized SEAMAP data between 1982 and 1999 for a localized area in the northeastern GOM (NEGOM) including DeSoto Canyon. This region is in the proximity of the Sale 224 area. Comparison of the NEGOM area with the overall SEAMAP survey area of the entire northern Gulf revealed that the larvae of 16 taxa occurred more frequently and were relatively more abundant in the NEGOM area than the entire SEAMAP survey area, while for other taxa, occurrence and relative abundance were comparable. These taxa represented fishes from mesopelagic, continental shelf, and reef assemblages, and the authors concluded that they reflected the wide diversity of habitats available in the NEGOM. Distinct distribution patterns were observed among larvae in the NEGOM study area; these patterns appear to be associated with the presence of DeSoto Canyon as well as the proximity to the influence of input from the Mississippi River.

Lyczkowski-Shultz et al. (2000) examined Gulf SEAMAP data from surveys in 1982 to 1995 for only young beryciform fishes, 1 of 42 orders of teleost fishes including the soldierfishes, squirrelfishes, roughies, flashlight fishes, and others. This analysis yielded new insights into the early life history of these unusual, rarely collected fishes. The squirrelfishes and soldierfishes (family Holocentridae) were the most numerous group. Nearly as numerous were the young of the bigscales (family Melamphaidae). Only a few specimens were observed in each of the remaining four families: Polymixiidae, Diretmidae, Trachichthyidae, and Gibberichthyidae.

Some independent ichthyoplankton studies have been conducted, focusing specifically on the influence of offshore platforms. The first comprehensive project was an MMS-funded study by Hernandez et al. (2001) that sampled three platforms as well as a nearshore rock jetty. A follow-on study also supported by MMS by Shaw et al. (2002) looked at several platforms both east and west of the

Mississippi River Delta. Both Hernandez et al. (2001) and Shaw et al. (2002) found highest taxonomic richness and diversity at mid-shelf platforms. Larval and juvenile fish assemblages seemed to be influenced by across-shelf gradients of increasing depth. Reef taxa were most abundant and diverse at the mid-shelf platforms, primarily because of the large numbers of larval and juvenile blenniids, pomacentrids, and lutjanids. This high abundance and diversity at mid-shelf could be attributed to the high concentration of platforms (i.e., more potential sources of larvae) and the favorable environmental conditions at mid-shelf (Gallaway, 1981; LGL Ecological Research Associates, Inc., and SAIC, 1998; Tolan, 2001). The only differences observed by Shaw et al. (2002) in the larval and juvenile fish assemblages across longitudinal gradients (i.e., east or west of the Delta) were differences in the abundance of certain taxa. Higher abundance of these taxa east or west of the Delta may, in turn, reflect differences in the hydrographic conditions and/or habitat availability. Despite the higher concentration of natural reef-type habitats east of the Delta, reef larvae were not more abundant at platforms in these areas.

Section III.C.9.a.1 of the Lease Sale 181 FEIS detailed ichthyoplankton diversity from some of the larger studies in the 1980's and 1990's. Some studies looked exclusively at the surf zone (Ruple, 1984) and others from specific depth zones or hydrographic features. Richards (1990) estimated that there are 200 families with more than 1,700 species whose early life stages may occur in the GOM. In addition to the resident fauna, many eggs, larvae, and juveniles may be advected into the Gulf from the Caribbean Sea via the Loop Current. Ditty et al. (1988) summarized information from over 80 ichthyoplankton studies from the northern GOM (north of 26º N. latitude) and reported 200 coastal and oceanic fishes from 61 families. The CSA (2000) also presents a good summary of all major ichthyoplankton collections throughout the GOM since the late 1950's.

The ichthyoplankton of DeSoto Canyon and of the West Florida Shelf were described in detail in Section III.C.9.a.1 of the Lease Sale 181 FEIS.

Recent work has focused on hydrographic features that appear to concentrate biomass of a variety of size scales from phytoplankton to megafauna. The combination of input of nutrients into the Gulf from river outflow and mesoscale circulation features enhances productivity, and thus the abundance. Biggs and Ressler (2002) describe deepwater "hot spots" of zooplankton, micronekton, and ichthyoplankton when primary production is enhanced by coarse to mesoscale eddies. Lamkin (1997) also showed that larval fish were associated with the Loop Current and periphery regions of companion cyclones and anticyclones, and Wormuth et al. (2000) documented that deepwater cyclones had locally higher standing stocks of zooplankton and micronekton but only in the upper 100 m (328 ft) of the water column.

Fishes

Finfish

The diversity of fish resources, as well as the life history of estuarine-dependent species is discussed in detail in Section III.C.9.a.2 of the Lease Sale 181 FEIS and Chapter 3.3.2.8.1 of the Final Multisale EIS.

The degradation of inshore water quality and loss of Gulf wetlands as nursery areas are considered significant threats to fish resources in the GOM (GMFMC, 2004a). Loss of wetland nursery areas in the north-central Gulf is believed to be the result of channelization, river control, and subsidence of wetlands (Turner and Cahoon, 1988). One major theory for the cause of coastal subsidence is the extraction of oil and gas from coastal areas (Morton et al., 2005). The idea that it causes subsidence has also been discounted, primarily because of the extreme depths of oil and gas reserves. In contrast, loss of wetland nursery areas in the far Western and Eastern Gulf is believed to be the result of urbanization and poor water management practices (USEPA, 1992).

Out to a depth of 40-50 m (131-165 ft), on muddy bottoms, the fish fauna is dominated by porgies (Sparidae), batfishes (Ogcocephalidae), sea-robins (Triglidae), sea basses (Serranidae), and left-eyed flounders (Bothidae). These species are also largely dependent on estuaries as nursery grounds. On shelly or hard bottoms in the same depth range (20-40 m (65-131 ft) or 50 m (165 ft)), a slightly different species group occurs dominated by snappers (Lutjanidae) and other spiny-rayed fishes with a preference for hard substrate (McEachran and Fechhelm, 1998). A number of important reef fish species share the common life history characteristics of offshore spawning and transport of larvae inshore to settle in estuaries and seagrass meadows where they spend an obligatory nursery phase before recruiting to adult stocks offshore. Among these fishes are both winter and summer spawners, with gag (*Mycteroperca* *micolepis*) and grey snapper (*Lutjanus griseus*), respectively, being good examples. Gags have become a particularly significant species in the Eastern Gulf where spawning aggregations have been studied over a significant period. Gags spawn in February and March in a defined area west of the Florida Middle Ground, and larvae are transported inshore to settle in seagrass meadows 30-50 days later. Two new reserves have been designated (described in **Chapter 3.3.1**) in this area where bottom-fishing activities have been prohibited. Juveniles remain in the seagrass nursery areas until October or November when they recruit to adult stocks offshore.

Other reef fish species are considered nonestuary dependent such as the red snapper, which remain close to an underwater structure for at least their early years. Recent research has shown that oil and gas platforms play a substantial role in providing habitat to red snapper through the first 2-5 years of life (Peabody and Wilson, 2006; Wilson et al., 2003). Red snapper feed along the bottom on fishes and benthic organisms such as crustaceans and mollusks. Peabody and Wilson (2006) clearly demonstrated the diurnal feeding movements of red snapper moving away from platforms at night to feed on surrounding bottom areas and then returning during the day. Juveniles feed on zooplankton, small fish, crustaceans, and mollusks (Bortone and Williams, 1986; USDOC, NOAA, 1986).

The OCS, ranging to a depth of approximately 200 m (656 ft), generally has a muddy or silty soft bottom. Fishes dominating this habitat include hakes (Phycidae), scorpionfishes (Scorpaenidae), and ogcocephalids (batfishes) (McEachran and Fechhelm, 1998). In this region where hard bottom occurs, some of the reef fish species that occur on the upper shelf can also be found. In addition, some species are particularly adapted for deeper hard-bottom areas including snowy grouper, warsaw grouper, yellowedge grouper, and gag. In the case of the warsaw and snowy grouper, their habitat has been documented to extend onto the upper continental slope to depths of 500 m (1,640 ft) on occasion (FishBase, 2006).

Deepwater demersal fishes below several hundred meters of depth (including all of the proposed Lease Sale 224 area) are better known than the deep pelagic species. Three major deep-sea studies have collected demersal fish throughout the depth range of the Gulf's continental slope between the 1960's and as recently as 2003. The first comprehensive look at the deeper part of the Gulf was by a long series of cruises by Pequegnat between 1964 and 1973 (Pequegnat, 1983). Pequegnat reported a total of 206 demersal fish species within 47 families. The Macrouridae (rattails) was the most speciose family, represented by 30 species, and was followed by Ophidiidae (cusk-eels) with 23 species. Gallaway et al. (1988) trawled 60 continental slope stations ranging in depth from 278 to nearly 3,000 m (900-9,842 ft), collecting a total of 5,400 fishes and 126 species. Only five species were represented by more than 300 specimens; the Atlantic batfish (*Dibranchus atlanticus*) was the most common. The other four most abundant included a hake (*Urophycis cirratus*), the flathead (*Bembrops gobiodes*), the cutthroat eel (*Synaphobranchus oregoni*), and the rattail (*Chlorophthalmus agassizi*). These same stations were also photographed by a still camera system; the two techniques showed significant differences indicating an undersampling by standard trawling techniques. Densities of fish determined from photography exceeded that estimated from trawling at all but one station by as much as one or two orders of magnitude. The mean density of fish determined from photography was 198.5 per hectare (1 ha = 10,000 m^2).

Most recently, a second large MMS-funded deepwater study was recently completed in 2006. Rowe and Kennicutt (2007) also sampled a wide range of depths throughout the northern GOM and also several stations in Mexican waters. Trawling for demersal fishes was conducted during 2000, 2001, and 2003 surveys of the study; however, the only comprehensive survey occurred in the 2000 survey. During the 2000 survey, fishes were captured at 31 of the 43 stations representing all of the DGoMB transects ranging in depths from 188 to 3,075 m (617 to 10,089 ft). A total of 1,065 individual demersal fishes, representing 119 species and 42 families, were collected in the 31 trawl collections. The families Macrouridae (grenadiers or rattails), with 21 species; Ophidiidae (cuskeels), with 15 species; and Alepocephalidae (slickheads), with eight species, dominated the samples. Cluster analyses resulted in four major assemblages. These consisted of an OCS assemblage between 188 and 216 m (617 and 709 ft), an upper slope assemblage between 315 and 785 m (1.033 and 2,575 ft), a mid-slope assemblage between 686 and 1,369 m (2,251 and 4,491 ft), and a deep assemblage between 1,533 and 3,075 m (5,030 and 10,089 ft). The abundance and species richness of fishes collected from stations located inside the proposed Lease Sale 224 area was low and not significantly different from collections at similar depths in other parts of the deep Gulf.

Recruitment is by far the most important, yet the least understood, factor contributing to changes in the numbers of harvestable Gulf fish. Natural phenomena such as weather, hypoxia, and red tides may reduce standing populations. Studies of abundance, growth, and mortality that affect recruitment have demonstrated the difficulty in making estimates over time or comparing different areas. As an example, Scharf (2000) examined red drum data from nine estuaries along the Texas Gulf Coast during a 20-year period and determined that estimates of abundance and mortality exhibited order-of-magnitude differences. Variations were also not related among estuaries, suggesting that factors affecting the survival of young red drum were specific to individual estuarine systems.

Recently, hurricanes have been a prominent impacting factor to Gulf resources and have affected fish resources by destroying oyster reefs and changing physical characteristics of inshore and, to a limited extent, offshore ecosystems. The intense storm season of 2005, including Hurricanes Katrina and Rita, did not affect the offshore fisheries as much as initially expected. It was initially believed that the 2005 hurricanes would have devastating effects on the health and numbers of offshore fish stocks in the GOM. Research results from NMFS have indicated that these expectations did not occur (USDOC, NMFS, 2005a). The NOAA's annual survey of shrimp and bottomfish (completed in November 2005) shows some species, such as the commercially valuable and overfished red snapper, had a higher population in 2005 than in 2004. The survey also found that the Atlantic croaker population doubled in 2005. Studies conducted in Barataria Bay, Louisiana, post-Katrina/Rita also indicated shrimp and fish abundance at near normal levels and water temperatures and salinities near normal. Thus, it appears that shrimp and finfish resources of the northern Gulf fared much better during and after the hurricanes than did the fishing infrastructure that uses them (Hogarth, 2005). The 2005 storms caused at least a four-fold increase in the loss of wetlands compared with average annual loss. While coastal wetland habitats are critical to almost every commercially important marine resource in the northern Gulf, the wetlands loss due to 2005 hurricanes was not reflected in offshore shrimp and finfish populations.

Pelagics

Pelagic fishes occur throughout the water column from the beach to the open ocean. Water-column structure (temperature, salinity, and turbidity) is the only partitioning of this vast habitat. On a broad scale, pelagic fishes recognize different watermasses based upon physical and biological characteristics. Some sources divide pelagic waters into three subdivisions by depth: the epipelagic from the surface to a depth of 200 m (656 ft); the mesopelagic from 200 to 1,000 m (656-3,281 ft); and the bathypelagic below 1,000 m (3,281 ft). The epipelagic is then divided into the coastal and oceanic, the first overlying the continental shelf and the oceanic representing the area seaward of the shelf (McEachran and Fechhelm 1998). Section III.C.9.a.2 of the Lease Sale 181 FEIS and Chapter 3.3.2.8.1 of the Final Multisale EIS described in detail the four ecological groups delineated by watermass:

- coastal pelagic species;
- oceanic pelagic species;
- mesopelagic species; and
- bathypelagics.

Invertebrates ("Shellfish" and Corals)

A number of invertebrate groups are considered "fisheries," including shrimp, crabs, oysters, and even corals. While none of these groups are fish resources, they are important prey species for fish resources and also comprise substantial commercial fisheries, and will be included in the following section dealing with essential fish habitat and fishery management plans. Invertebrates are described in detail in Section III.C.9.a.2 of the Lease Sale 181 FEIS and Chapter 3.2.8.1 of the Final Multisale EIS.

Estuarine and wetland habitats are vital to the life history of many invertebrate species. The severe storm season of 2005 severely impacted estuary habitat of Louisiana, Mississippi, and Alabama. Total wetlands loss from these storms has been conservatively estimated to be over 100 mi^2 (64,000 ac) in eastern Louisiana alone (Hogarth, 2005). By far, the worst resource devastation has occurred for oyster populations. According to Mississippi Department of Marine Resources estimates, approximately 90 percent of Mississippi's oyster beds were damaged and disrupted by Hurricane Katrina (Hogarth, 2005). Through early 2006, 100 percent of Mississippi's oyster fleet is out of work because of Hurricane Katrina. Oyster populations were similarly affected in parts of Louisiana. It was expected that the Gulf Coast shrimp population would have been severely impacted by the 2005 hurricanes, but the annual NOAA shrimp and bottomfish survey in the fall of 2005 indicated that shrimp abundance was the same or slightly higher than in the fall of 2004 and was widely distributed.

As described in **Chapter 3.2.2.1** above, there is a possibility for the presence of exposed ,carbonate hard bottom derived from the Florida Escarpment in some of the lease blocks located on or near the bottom of the escarpment. This hard substrate could be colonized by a variety of invertebrate megafauna including a variety of corals.

3.2.8.2. Essential Fish Habitat

The fishery habitat of the West Florida Shelf was described in detail in Section III.C.9.b of the Lease Sale 181 FEIS. The following information is provided to supplement the information contained in the Lease Sale 181 FEIS.

The Essential Fish Habitat Program in the Gulf of Mexico

As outlined in **Chapter 1.3,** the Magnuson-Stevens Fishery Conservation and Management Act of 1976 (MSFCMA), as amended through 1998 and 2006, places requirements on any Federal agency regarding essential fish habitat (EFH). The MMS must describe how actions under their jurisdiction may affect EFH. All Federal agencies are encouraged to include EFH information and assessments within NEPA documents.

Essential fish habitat is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, and growth to maturity. Because of the wide variation of habitat requirements for all life history stages of fish resources, EFH for the GOM previously included all estuarine and marine waters and substrates from the shoreline to the seaward limit of the U.S. EEZ. Although technically valid, this approach, for one example, failed to make any distinction between the vast deepwater areas of the northern GOM as compared with very different coastal and other more limited and important habitat areas of the continental shelf. Through extensive analysis in GMFMC (2004a), a new approach was adopted with Generic Amendment 3 to all GOM Fishery Management Plans. New EFH designated areas are now specific for each managed species. The proposed action in the Generic Amendment (GMFMC, 2005) will reduce the extent of EFH relative to the 1998 Generic Amendment by removing EFH description and identification from waters between 100 fathoms (183 m, 600 ft) and the seaward limit of the EEZ (as deep as 3,200 m (10,499 ft)). However, the habitats most important to managed species (i.e., those shallower than 100 fathoms (183 m, 600 ft)) will still be designated as EFH, and so the great majority of benefits to the biological environment will remain. The new Amendment also maintains the trigger for consultation and/or conservation recommendations for any Federal agency that proposes actions that may adversely affect EFH required under Sections 305(b)(2)-(4) of the MSFCMA. With this change in boundaries, the EFH designation was removed for all but highly migratory species (tuna, shark, swordfish, and marlin) in the proposed Lease Sale 224 area.

The EFH regulations also recommend that FMP's identify habitat areas of particular concern (HAPC's) within areas identified as EFH. The HAPC designation does not confer additional protection or restrictions upon an area, but it can help prioritize conservation efforts. The general types of HAPC include the following: nearshore areas of intertidal and estuarine habitats that may provide food and rearing for juvenile fish and shell fish managed by the Fishery Management Council; offshore areas with substrates of high habitat value or vertical relief, which serve as cover for fish and shell fish; and marine and estuary habitat used for migration, spawning, and rearing of fish and shellfish. Marine sanctuaries and national estuary reserves have been designated in the area managed by the GMFMC and are considered to be HAPC's that meet the above general guidelines.

In the original 1998 GMFMC Amendment, the HAPC's located within the area of the GOM considered in this SEIS were limited to the Weeks Bay National Estuarine Research Reserve and Grand Bay, Mississippi. Other areas designated HAPC by GMFMC (1998) included the Florida Middle Grounds, Apalachicola National Estuarine Research Reserve (southeast of Panama City, Florida), Rookery Bay National Estuarine Research Reserve (south of Naples, Florida), the Florida Keys National

Marine Sanctuary, and the Dry Tortugas. Amendment 3, finalized in 2005 (GMFMC, 2005), proposed additional HAPC's including the Madison-Swanson Marine Reserves, Tortugas North and South Ecological Reserves, Pulley Ridge, and several individual reefs and banks of the northwestern GOM in addition to the East and West Flower Garden Banks and Stetson Bank that comprise the FGBNMS. These additional banks are Sonnier Bank, MacNeil, 29 Fathom Bank, Rankin Bank, and Bright Bank (two Rankin Banks and Bright Bank were combined as a single entity although they are three separate features with some minor topography between them), Geyer Bank, McGrail Bank, Bouma Bank, Rezak-Sidner Banks, Alderdice Bank, and Jakkula Bank. The GMFMC Amendment lists these additional areas as a preferred alternative for new HAPC's. Of all the added HAPC's, only three are located relatively close to the Sale 224 area: the two grouper reserve areas, Madison-Swanson and Steamboat Lumps, and the Florida Middle Grounds. The Madison-Swanson marine reserve area is approximately 78 nmi (144 km) to the northeast of the Sale 224 area, Steamboat Lumps is about 100 nmi (185 km) to the east, and the Florida Middle Grounds are approximately 140 nmi to the east-northeast.

The two grouper reserve areas—the Madison and Swanson site (115 nmi^2 (97,468 ac)) south of Panama City, Florida, and Steamboat Lumps (104 nmi^2 (88,144 ac)) west of Tarpon Springs, Florida (**Figure 3-4**), on the west Florida shelf—continue to be closed to all fishing except for pelagics. These protected areas were officially created on June 19, 2000.

Essential Fish Habitat Assessment

As a Federal agency proposing future activities that may impact EFH, an EFH Assessment is required. The requirements for an EFH description and assessment are as follows: (1) description of the proposed action; (2) description of the action agency's approach to protection of EFH and proposed mitigation, if applicable; (3) description of EFH and managed and associated species in the vicinity of the proposed action; and (4) analysis of the effects of the proposed and cumulative actions on EFH, the managed species, and associated species. **Chapters 1 and 2** contain descriptions of the proposed action. **Chapters 1.3 and 2.2.1.3** discuss MMS's approach to the preservation of EFH with specific mitigations. **Chapter 3.2.1** details coastal areas that are considered EFH, including wetlands and areas of submerged vegetation. **Chapter 4.3.10** contains the routine, accidental, and cumulative impact analyses of the proposed action on EFH.

Managed Species

In the first Generic Amendment (GMFMC, 1998), the GOM Fishery Management Council described EFH for a number of species. The species managed by the GMFMC have been described in detail in Section III.C.9.b of the Lease Sale 181 FEIS and Chapter 3.2.8.2 of the Final Multisale EIS.

Addressing Essential Fish Habitat Requirements

Methods for addressing EFH, including the GMFMC's Generic Amendment for Addressing Essential Fish Habitat Requirements (GMFMC, 1998) as well as the Programmatic Consultation agreement with NMFS, are described in detail in Section III.C.9.b of the Lease Sale 181 FEIS and Chapter 3.2.8.2 of the Final Multisale EIS.

Since the publication of the Lease Sale 181 FEIS as well as the last Final Multisale EIS (USDOI, MMS, 2007a), a new NTL has been produced—NTL 2004-G05, "Biologically Sensitive Areas of the Gulf of Mexico." This new NTL combines the former Topographic Features Stipulation guidelines, the Live-Bottom (Pinnacle Trend) Stipulation, and the Live-Bottom (Low-Relief) Stipulation. It also created a new class of features not previously identified in stipulations or NTL's—the Potentially Sensitive Biological Feature. This is defined as not previously identified features of moderate to high relief that provide surface area for the growth of sessile invertebrates and attract large numbers of fish. This was an important new designation because these kinds of habitats are common outside named topographic features with their associated No Activity Zones and also outside of the 70 live-bottom (pinnacle trend) stipulated blocks. Although this new NTL would not apply to any part of the proposed Lease Sale 224 area, its foundational authority could be applied for the avoidance of hard-bottom substrate derived from the Florida Escarpment which could support significant sensitive biological communities.

The Final Multisale EIS (USDOI MMS 2007a) has completed the EFH consultation process for all of the CPA and WPA, which includes the entirety of the western boundary of the proposed Lease Sale 224 area. The response letter received from NMFS dated December 21, 2006, indicated that, with continued requirements for impact avoidance and accepted mitigation measures, there were "no comments or recommendations on the content of or analyses presented in the EIS" and no further consultation was required. Prior to this SEIS, the Lease Sale 181 FEIS (USDOI MMS 2001a) requested and received an EFH consultation for the originally proposed larger Sale 181 area that included all of the proposed Lease Sale 224 area. There were no EFH conservation recommendations relating to the proposed Lease Sale 224 area that had not been previously established by MMS or adopted through the original Programmatic Consultation Agreement with NMFS. A letter will be submitted to NMFS with the draft of this SEIS document to request the addition of the proposed Lease Sale 224 area to the Programmatic Consultation package, now comprising only areas in the CPA and WPA.

Mitigating Factors

Mitigating factors for impacts on EFH are described in Section III.C.9.b of the Lease Sale 181 FEIS and Chapter 3.2.8.2 of the Final Multisale EIS. These include the continued adherence to all MMS environmental regulatory policy, continued adherence to all EFH conservation recommendations provided to MMS by NMFS, and the continued program of converting decommissioned energy platforms into artificial reefs.

3.3. SOCIOECONOMIC ACTIVITIES

3.3.1. Commercial Fishing

Commercial fishing regulations are very 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 catch. As an example, a recent change in the allowable length for retention of vermilion snapper was effective July 8, 2005, with a new minimum size limit increased from 10 in to 11 in total length (both recreational and commercial). Federal fishing regulations are not always the same as State fishing regulations. The Gulf of Mexico Fishery Management Council provides the current information on commercial and recreational fishing rules for U.S. Federal waters of the GOM (GMFMC, 2006).

Section III.D.1 of the Lease Sale 181 FEIS and Section 3.3.1 of the Lease Sales 189 and 197 FEIS described in detail the commercial landings from the latest available 1999 data at that time (USDOC, NMFS, 2001a, and USDOC, NMFS, 2002, respectively). Data for Gulf Coast States were presented individually. In addition, information from a 1997 study characterizing recreational and commercial fishing east of the Mississippi Delta with emphasis on the Florida Panhandle region for the period 1983-1993 was detailed. A synopsis of the conclusions concerning commercial fisheries for the region from 1983 to 1993 was included (CSA, 1997a). Chapter 3.3.1 of the Final Multisale EIS also described in detail the commercial landings from the current NMFS database (USDOC, NMFS, 2006a). This Internet site makes all commercial landings data easily accessible. A brief summary of Gulfwide landings are presented here. The following information is derived from various simple analyses of the available data queries at this site. The most recent, complete information on landings and value of fisheries for the U.S. was compiled by NMFS for 2004.

During 2004, commercial landings of all fisheries in the GOM totaled nearly 1.4 billion pounds, valued at over $670 million (USDOC, NMFS, 2006a). The GOM provides over 34 percent of the commercial fish landings in the continental U.S. (excluding Alaska) on an annual basis.

Menhaden, with landings of about 1.02 billion pounds and valued at $44.9 million, was the most important GOM species in terms of quantity landed during 2004. Landings decreased by 261 million pounds (20%) in the Gulf Coast States compared with 2000. Shrimp, with landings of nearly 257 million pounds and valued at about $367 million, was the most important GOM species in terms of value landed during 2004. The 2004 GOM oyster fishery accounted for over 93 percent of the national total, with landings of 25 million pounds of meats valued at about $61 million. The GOM blue crab fishery accounted for 36 percent of the national total, with landings of 60 million pounds valued at about $41 million (USDOC, NMFS, 2006a).

Louisiana's total commercial landings in 2004 were 1.1 billion pounds valued at $275 million. Shrimp was the most important fishery landed, with about 134 million pounds valued at $139 million. In addition, during 2004, the following marine species each accounted for landings valued at over $2 million: Atlantic menhaden, black drum, blue crab, Eastern oyster, red snapper, yellowfin tuna, and striped mullet (USDOC, NMFS, 2006a).

Mississippi's total commercial landings in 2004 were 183.8 million pounds valued at nearly $44 million. Shrimp was the most important fishery landed, with 18.2 million pounds valued at $27 million. In addition, during 2004, the following three species each accounted for landings valued at over $500,000: Atlantic menhaden, blue crab, and Eastern oyster (USDOC, NMFS, 2006c).

Alabama's total commercial fishery landings for 2004 were 26.6 million pounds valued at $37 million. Shrimp was the most important fishery, with about 16.1 pounds landed valued at about $29.2 million. In addition, during 2004, the following species each accounted for landings valued at over $500,000: blue crab, Eastern oyster, and Spanish mackerel (USDOC, NMFS, 2006a).

Total commercial landings for the west coast of Florida in 2004 were 84.3 million pounds valued at $147.9 million. Shrimp was the most important fishery landed, with 18.2 million pounds valued at $ 34.7 million. In addition, during 2004, the following species each accounted for landings valued at over $4 million: stone crab, red grouper, gag, striped mullet, and Caribbean spiny lobster (USDOC, NMFS, 2006a).

Recent effects from the hurricanes of 2005 have had substantial impacts on the commercial fishing industry. It was initially believed that the hurricanes of 2005 would have devastating effects on the health and numbers of offshore fish stocks in the GOM. Preliminary results of surveys conducted by NOAA indicate that shrimp and bottom fish abundance was the same or slightly higher after the hurricanes than in the fall of 2004, with shrimp and other valuable species relatively abundant and widely distributed. The NOAA's annual survey of shrimp and bottomfish, which was completed in November 2005, also shows some species, such as the commercially valuable and overfished red snapper, had a higher population in 2005 than in 2004. The survey also found that the Atlantic croaker population doubled in 2005. Thus, it appears that shrimp and finfish resources of the northern Gulf fared much better during and after the hurricanes than did the fishing infrastructure that uses them (Hogarth, 2005).

The commercial fisheries landings of the Central Gulf Coast were drastically impacted by Hurricanes Katrina and Rita because of the severe impact on coastal port facilities and fishing vessels. There is no conclusive estimate of the number of fishing vessels sunk or driven ashore, but USCG initially estimates the number to be between 3,500 and 5,000. This estimate includes nearly 2,400 commercial vessels and 1,200 recreational boats (Hogarth, 2005). Comparing the same states (western Florida, Mississippi, Alabama, and Louisiana) and based on figures obtained for September 2005, there was a 97 percent reduction in shrimp landings and a 94 percent reduction in oyster landings, representing a combined loss of over $62 million for the month of September alone. Louisiana catches dropped off entirely for these species. Catches of a number of finfish species were essentially zero in September 2005, including menhaden, blue crab, spiny lobster, stone crab, yellowfin tuna, mullets, and freshwater crawfish. Reef fish catches declined by 44 percent regionwide. These reductions in commercial catches have persisted in most affected areas since September 2005 (December 15, 2005) (Hogarth, 2005).

As opposed to initial concerns about contamination of sediments and fish and shrimp tissue resulting from pollution caused by the hurricanes, NOAA studies found no evidence of hydrocarbons, persistent organic pollutants, or bacterial contamination (Hogarth, 2005; USDOC, NOAA, 2005a). The survey results are consistent with similar findings announced by the Food and Drug Administration (FDA), USEPA, and the States of Mississippi, Louisiana, and Alabama by January 2006, which concluded Gulf seafood was deemed safe for human consumption (USDOC, NOAA, 2006b).

Stock Status

The NMFS reports each year to the Congress and Fishery Management Councils on the status of all fish stocks in the Nation. Nationwide, 81 percent of the fish stocks and stock complexes with known status are not subject to overfishing, and 72 percent of the stocks and stock complexes with known status are not overfished. ("Overfished" is defined as a stock size that is below a prescribed biomass threshold. "Overfishing" is harvesting at a rate above a prescribed fishing mortality threshold.) The NMFS has increased the number of assessed stocks over the last several years, and this trend will continue. In 2004, NMFS completed 84 stock assessments, of which 10 were for stocks not previously assessed.

The number of commercial species designated to be overfished has been reduced from previous years. In 2004, only four major stock groups were overfished in the GOM: red snapper, vermilion snapper, red grouper, and greater amberjack. Twelve commercial species harvested from Federal GOM waters were considered to be at or near an overfished condition at the time of the previous Multisale EIS in 2002 (USDOI, MMS, 2002). Gag grouper and vermilion snapper were added to the 2001 NMFS report's list of stocks for which overfishing is occurring in the GOM (USDOC, NOAA, 2001a). Since that time, gag was removed from the list and greater amberjack was added. Six species—red snapper, vermilion snapper, greater amberjack, Nassau grouper, goliath grouper, and red drum—were listed in the report as overfished in the GOM. Red grouper and king mackerel were removed from the list of species reported as overfished since the previous EIS and greater amberjack was added. The status of another 29 GOM managed fishery species is described as "unknown."

Nearly all species substantially contributing to the GOM's commercial catches are estuarine dependent. The degradation of inshore water quality and loss of GOM wetlands as nursery areas are considered significant threats to commercial fishing (USEPA, 1992 and 1994). Natural catastrophes may change the physical characteristics of offshore, nearshore, and inshore ecosystems and destroy gear and shore facilities. This fact was more than evident with Hurricanes Katrina and Rita. Commercial fishery financial losses will continue for a significant period of time after these major events. Hurricane Andrew, in August 1992, also caused extensive damage to GOM commercial facilities.

Red and vermilion snapper resources in the GOM are believed to be severely overfished from both directed and bycatch fisheries. Red snapper is the most important species off the Central Gulf Coast in the reef fish complex managed under an FMP in terms of value and historical landings. Red snapper is the second and vermilion the third most important snapper species off the Florida west coast after yellowtail snapper. In recent years, fishers have reported seeing and catching many more and larger red snapper, and the species appears to be returning to the waters of the Eastern Gulf. However, the estimate of the resulting spawning potential ratio (SPR) has remained well below the overfishing limit (threshold) (SPR = spawning potential per recruit under a given fishing regime relative to the spawning potential per recruit with no fishing) (Schirripa, 1999). With several years of strong recruitment, one would expect the catches to improve. However, since newly recruited year-classes take some time to contribute significantly to the reproductive potential of the stock, it also takes time before these year-classes generate a corresponding increase in their spawning potential. This is particularly true when the spawning stock is composed of a large number of year-classes.

On October 30, 2003, NMFS determined that the GOM vermilion snapper fishery was overfished and undergoing overfishing. Amendments to the Reef Fish Fishery Management Plan for stock rebuilding were created for both red and vermilion snapper (Amendments 22 and 23, respectively) (GMFMC, 2004b and c). According to the MSFCMA, overfished stocks must be rebuilt to maximum sustainable yield (MSY) abundance levels in the shortest timeframe possible, taking into account the status and biology of the stock, the needs of fishing communities, international agreements, and ecological interactions.

Although stone crabs occur throughout the GOM, the majority of fishing occurs along the Gulf Coast of Florida. The majority of landings have been reported almost exclusively (98% by weight) in Florida Gulf Coast counties. The stone crab is a unique fishery because stone crabs are not killed, rather, the claws are removed and the crabs are returned alive to the water. Crabs that survive de-clawing can regenerate claws through molting, allowing new claws to be harvested. The biological linkage between the landings of claws and the underlying stock of crabs has not been fully assessed because of the lack of a statewide, fishery-independent sampling program. The major concern of the stone crab fishery is whether harvest has reached or exceeded maximum sustainable yield. Until recently, the fishery has been expanding in terms of increasing catch within traditional fishing areas, as well as previously unfished or underfished regions although landings leveled off during the 1990's. The GMFMC has considered limitations on the number of fishermen and traps in the stone crab fishery in the recent past, but no actions are pending.

Spiny lobster fishing is limited almost exclusively to the Eastern GOM. There are no certain measures of stock abundance. Landings were combined with lengths and sexes to estimate the number of lobsters landed by ages and season in a relatively recent stock assessment by Muller et al. (2000). It was determined that the lobster fishery continues to fluctuate without trend as it has done for the last 30 years.

Landings increased in the 2000 season after a decline in the 1998-1999 season. In 2004, landings remained substantial, with a total of over 4.5 million pounds valued at over $20.6 million.

The deep water of the proposed Lease Sale 224 area does not have any commercially valuable demersal or bottom-dwelling fish species. The only species groups of interest for the Sale 224 area are the pelagic highly migratory species groups that are not included in FMP through regional Fishery Management Councils but are addressed directly by NMFS through separate national-level management plans. These are the tunas, sharks, and swordfish in one FMP and the billfish in their own FMP.

In the mid-1980's, Atlantic swordfish were considered to be in or near a state of growth overfishing. In 1999, NMFS implemented a number of regulations that affected swordfish fishers, including: a prohibition on the use of driftnets in the swordfish fishery; regulations to aid in tracking swordfish trade, including dealer permitting and reporting for all swordfish importers, a documentation scheme that indicated the country of origin and flag of the vessel; and a prohibition on importing swordfish less than the minimum size. The same year, NMFS produced a new FMP that took the place of the previous FMP produced by the South Atlantic Fishery Management Council. In August 2005, a draft Consolidated Atlantic Highly Migratory Species Fishery Management Plan was published (USDOC, NMFS, 2005a). This new FMP includes several alternatives for pelagic longline closures in the GOM. Commercial landings of swordfish increased steadily in the 1990's and a total of 900,593 pounds were landed in 2004 (USDOC, NMFS, 2006a). At present, live bait use is prohibited in the GOM. Two longline closure areas are described below in GOM Area Closures.

The blue and white marlin species, which are classified as Atlantic stocks, are believed to be at or near the point of full exploitation. Both are considered to be overfished stocks where overfishing is a continued concern. The latest stock assessments for Atlantic blue marlin and Atlantic white marlin were conducted in 2000. The assessment for blue marlin was slightly more optimistic than the 1998 assessment; however, productivity is lower than previously estimated. Although blue marlin landings in 1999 were reduced by 29 percent from 1996 levels, these reductions are not sufficient to rebuild the stock. Recent assessments for white marlin are more pessimistic. Given that the stock is severely depressed, the Standing Committee for Research and Science (SCRS) concluded that the International Commission for the Conservation of Atlantic Tunas (ICCAT) should take steps to reduce the catch of white marlin as much as possible (USDOC, NMFS, 2006b).

The only tuna species landed in any significant volume in the GOM is the yellowfin tuna, with over 3.5 million pounds landed in 2004 (USDOC, NMFS, 2006a). The last full assessment was conducted for yellowfin tuna in 2003 applying various age structured and production models to the available catch data through 2001 (USDOC, NMFS, 2006b). For the Atlantic stock as a whole, total catches since 2001 have been declining; but, without a new assessment, it is not clear whether or not this reflects decreases in fishing effort and fishing mortality. In the GOM alone, landings have fluctuated with a recent high occurring in 2002 of over 4.2 million pounds, but the latest data for 2004 ranked third in the last four years and surpassed 2001 landings by 602,685 pounds. The SCRS recommended that there be no increase in the level of effective fishing effort exerted on Atlantic yellowfin tuna, over the level observed in 1992.

Stock assessments were conducted by NMFS for the large and small coastal shark complexes in 2002. The large coastal shark complex is considered to be an overfished stock with overfishing continuing to occur. The complex includes numerous species such as the silky, tiger, bull, spinner, lemon, nurse, and the several hammerhead species, but the status determination was based only on the sandbar and blacktip shark species. The blacktip shark resulted in the highest landings by weight and value for the GOM in 2004 with over 1 million pounds landed valued at $203,445 (USDOC, NMFS, 2006a); however, when considered individually, it is not considered overfished. The sandbar shark is the only other species with significant GOM landings in 2004 (772,800 pounds for the entire GOM). This species is not considered to be overfished and is in a rebuilding phase, but overfishing is still occurring (i.e., harvesting is at a higher rate than that which will meet the management goal).

Gulf of Mexico Area Closures

Grouper species can be overfished because they aggregate in great numbers year after year in the same locations during spawning; during that time the males are especially susceptible to being caught. The NMFS hopes to spare the spawning population by using closed seasons and Marine Protected Areas

(MPA's) as a management tool. Two MPA's have been designated in the west Florida shelf (**Figure 3-4**); the MPA's are now closed to all fishing except for pelagics. They are named the Madison and Swanson site (115 nmi^2), south of Panama City, Florida, and Steamboat Lumps (104 nmi^2), west of Tarpon Springs, Florida. The two grouper reserves went into effect on June 19, 2000. In addition, a sunset provision has been added after four years so that the effects of the closed areas can be evaluated. Both of the areas are along the 70- to 80-m (230- to 262-ft) depth contour. The Madison and Swanson site south of Panama City is a high-relief site. Steamboat Lumps, west of Tarpon Springs, is the lower portion of the original 423-nmi^2 closed-area proposal. It is a low-relief site that has been reported by fishermen to be a good area for gag spawning. Both of these sites are outside the area considered for leasing in this document, but they do remain in effect and have impacted the routing of pipelines in the past.

In 1999, numerous longline time and area closures in the GOM were proposed through the proposed Atlantic Highly Migratory Species Conservation Act. Only two longline closure areas resulted and on August 4, 2000, NMFS announced new regulations to reduce bycatch and bycatch mortality in the pelagic longline fishery. Two rectangular areas in the GOM (1 of which lies over a portion of the region known as DeSoto Canyon) were closed year-round to pelagic longline fishing beginning November 1, 2000. These closed areas cover 32,800 mi^2 (8,495,161 ha) (**Figure 3-5**). This region has been identified by NMFS as a swordfish nursery area where there has historically been a low ratio of swordfish kept to the number of undersized swordfish discarded, which over the period of 1993-1998 has averaged less than one swordfish kept to one swordfish discarded. The area closure is expected to produce approximately a 4 percent reduction in GOM and Atlantic undersized swordfish bycatch. The DeSoto Canyon area coordinates are as follows:

Upper Area

North boundary:	30° N. latitude
South boundary:	28° N. latitude
East boundary:	86° W. longitude
West boundary:	88° W. longitude

Lower Area

North boundary:	28° N. latitude
South boundary:	26° N. latitude
East boundary:	84° W. longitude
West boundary:	86° W. longitude.

3.3.2. Recreational Fishing

Marine recreational fishing in the Gulf Region from Louisiana to Florida is a major industry that is important to these States' cultures and economies. The primary source for marine recreational fisheries data in U.S. waters is the Marine Recreational Fisheries Statistics Survey (MRFSS) conducted by NOAA's Fisheries Service (USDOC, NMFS, 2005b). This survey combines random telephone interviews and onsite intercept surveys of anglers to estimate recreational catch and effort for inland, State, and Federal waters. In the GOM, surveys are conducted in western Florida, Alabama, Mississippi, and Louisiana. Additional information on recreational fishing is available in Hiett and Milon (2002).

Tables 3-7 through 3-9 show the MRFSS GOM data for 2005. Over 5.6 million people engaged in some form of recreational fishing in these states. Of the four states, western Florida had the highest number of anglers and fishing trips in 2005, followed (in descending order by number of trips) by Louisiana, Alabama, and Mississippi. Overall, the highest sales, income, and employment impacts were generated by angler expenditures in West Florida in 1999. The total economic impact of marine recreational fishing in West Florida totaled $2,723,707,000 including approximately 36,283 jobs. This impact was followed by Louisiana, Alabama, and Mississippi (in descending order). The total economic impact of recreational fishing in Louisiana was $737,962,000 and 9,487 jobs. Angler expenditures resulted in a $305,535,000 total economic impact and 4,484 jobs in Alabama. Recreational fishing had the smallest effect in Mississippi, with $163,032,000 of total economic impact and 1,941 jobs (Steinback et al., 2004). The most common mode of fishing in all Gulf States was private/rental boats, comprising over 50 percent of the trips in each State. This was followed closely by fishing from shore and distantly by fishing from charter vessels. The largest charter fleets closest to the proposed lease sale are located in Orange Beach, Destin, and Panama City. As noted in **Table 3-9**, only a small portion of the marine recreational fishing trips in the GOM extend into offshore water under Federal jurisdiction. Most marine anglers would not be expected to travel to the proposed Lease Sale 224 area since this location is at least 125 mi (200 km) offshore. In addition, most marine anglers are not equipped to fish in water depths of 800-3,200 m (2,625-10,500 ft), which is the water depth associated with the proposed action. Recreational fishing and diving are also popular near artificial reefs (e.g., platforms) that attract fish; however, there are no existing artificial structures in the proposed lease sale area.

In 2005, the percentage of effort expended in inland, State, and Federal waters varied by State. In Mississippi and Louisiana, approximately 90 percent of trips were made in inland waters as opposed to State and Federal ocean waters. In Florida and Alabama, the percentage of trips made in State ocean waters (38.9% and 44.7%, respectively) was much higher than the other two states. Although Hurricane Ivan heavily damaged charter boats, small boats, and fishing piers, much of this infrastructure has been rebuilt or is in the planning stages of new construction (Fullman, 2005). One direct result of Hurricane Ivan is that the Emerald Coast near Destin, Fort Walton Beach, and Okaloosa Island in Florida experienced an increase in recreational fishing due to the ocean carrying the fish closer to shore (Fullman, 2005). Recreational fishing also experienced an upsurge following Hurricane Ivan in the Pensacola Bay Area (Garrett, 2005).

Fishing in State and offshore waters often occurs around artificial structures. Off Alabama, Mississippi, and Louisiana, these structures include oil and gas platforms. An MMS study estimated that during 1999 there were 980,264 fishing trips taken within 300 ft (91 m) of an oil or gas structure or an artificial reef created from such structures (Hiett and Milon, 2002). This represented approximately 22 percent of the total (4.4 million) marine recreational fishing trips taken that year in the Gulf from Alabama through Texas. The study found that approximately $159.7 million in direct expenditures were associated with these visits.

The top species commonly caught by recreational fishers in the MRFSS Gulf Coast States are illustrated in **Table 3-7**. Herrings and spotted sea trout, both inland species, were the most common fish caught by marine anglers in the GOM during 2005. The estimated catch for herrings was over 24 million fish, while over 23 million spotted sea trout were caught. Other important inland species include saltwater catfishes, red drum, and pinfishes. In offshore oceanic waters of the GOM, the most important species in terms of pounds caught were mycteroperca grouper, red snapper, spotted sea trout, sheepshead, king mackerel, gray snapper, and red drum.

Hurricanes Ivan, Katrina, and Rita impacted recreational fishing from the Florida Panhandle to the Texas border, with additional impacts felt in southern Florida. Ivan heavily damaged charter boats, small boats, and fishing piers, much of this infrastructure has been rebuilt or is in the planning stages of new construction (Fullman, 2005). One direct result of Hurricane Ivan is that the Emerald Coast near Destin, Fort Walton Beach, and Okaloosa Island in Florida experienced an increase in recreational fishing due to the ocean carrying the fish closer to shore (Fullman, 2005). Recreational fishing also experienced an upsurge following Hurricane Ivan in the Pensacola Bay Area (Garrett, 2005). The hurricanes had a major impact on the supporting infrastructure that anglers are dependent upon to go fishing (e.g., bait shops, docks and marinas, lodging, fuel and ice facilities, etc.). In addition to damages to boats and facilities, revenue losses associated with lost markets of products or services are occurring. When considered on a regional basis, these lost market channels constitute a considerable reduction in the levels of economic activity, income generation, employment creation, and tax collections.

Most of the charter fishing industry in Louisiana was based in the eastern portion of the State and was hit hard by Hurricane Katrina, particularly the Venice area, which experienced a nearly complete loss of onshore marina facilities and harbored boats (Thomas, 2005). Most residents of fishing communities in lower St. Bernard and Plaquemines Parishes lost their homes; nearly all fishing camps in these regions were damaged and many were completely destroyed (Thomas and Caffey, 2005).

The estimated damages to the resident Mississippi recreational and charter boat fleet totaled to $159 million and $2.6 million, respectively (Mississippi State University Extension Service, 2006a). There were 37 marinas in the three coastal counties when Hurricane Katrina landed on the Mississippi Gulf

Coast, and all of them were impacted by the hurricane, with total damages reaching $41.38 million. All of the live bait dealers were also affected, with damages totaling $4.17 million (Mississippi State University Extension Service, 2006a). Employment levels have also been dramatically affected as follows: charter boat employment has shrunk to 15.2 percent of its pre-Katrina level; marina employment shrunk to 18.9 percent of its pre-Katrina level; and live bait employment dropped to 16.7 percent of its pre-Katrina level (Mississippi State University Extension Service, 2006b).

The NMFS is trying to assess the damages to marine-related infrastructure in the Gulf communities and is conducting a survey and analysis of the recreational fisheries impacts (USDOC, NMFS, 2005a). Mississippi State University is also conducting research on the impacts of Hurricane Katrina on coastal Mississippi marine resources (Mississippi State University, 2005). The MMS will continue to monitor data sources and will include updated data and information in future documents and analyses as they become available.

3.3.3. Recreational Resources

The northern GOM coastal zone is one of the major recreational regions of the U.S., particularly in connection with marine fishing and beach-related activities. The shorefronts along the Gulf Coasts of Florida, Alabama, Mississippi, Louisiana, and Texas offer a diversity of natural and developed landscapes and seascapes. The coastal beaches, barrier islands, estuarine bays and sounds, river deltas, and tidal marshes are extensively and intensively used for recreational activity by residents of the Gulf South and tourists from throughout the Nation, as well as from foreign countries. Publicly owned and administered areas (such as national seashores, parks, beaches, and wildlife lands), as well as specially designated preservation areas (such as historic and natural sites and landmarks, wilderness areas, wildlife sanctuaries, and scenic rivers), attract residents and visitors throughout the year. Commercial and private recreational facilities and establishments (such as resorts, marinas, amusement parks, and ornamental gardens) also serve as primary interest areas and support services for people who seek enjoyment from the recreational resources associated with the GOM.

Recreation and tourism are major sources of employment along the Gulf Coast. **Tables 3-10 and 3-11** present employment in tourism-related industries in 2004. To estimate travel/tourism related industries, a review of the 2004 county business patterns data was conducted (USDOC, Bureau of the Census, 2006). Employment data were derived from various travel-related industries including food and beverage stores, gas stations, general merchandise stores, passenger air transportation, transit and ground passenger transportation, scenic and sightseeing transportation, passenger car rental, travel arrangement and reservation services, arts/entertainment/recreation, and accommodation and food services.

The MMS defined 13 Economic Impacts Areas (EIA's) (**Table 3-12 and Figure 3-6**). The employment in these industries was calculated for the EIA's (**Table 3-11)**. The greatest concentration of tourism-related employment occurs in Texas and Florida, particularly in EIA's TX-3, FL-3 and FL-4. Within these impact areas, tourism-related employment is concentrated in the Houston-Galveston, Tampa-St. Petersburg, and Miami labor market areas (LMA's). The New Orleans LMA (LA-4) also has a relatively high amount of tourism-related employment.

The 1999-2000 National Survey on Recreation and the Environment (NSRE) is the first national survey to include a broad assessment of the Nation's participation in marine recreation (USDOC, NOAA, 2005b). Marine recreation is defined as coastal and ocean participation plus the Great Lakes participation in at least 1 of 19 activities/settings. Participation is defined as the number of people that performed the activity in each State and includes people that may live in any State. According to NSRE 2000, Florida was the number one destination for marine recreation. Over 22 million participated in some form of marine recreation in Florida. Texas ranked fifth, with slightly under 6.2 million participants. Participation was lower in Alabama, Louisiana, and Mississippi (2.5 million, 2.2 million, and 1.8 million, respectively) but still significant. The number one activity/setting for marine recreation was visiting beaches.

Beaches are a major recreational resource that attracts tourists and residents to the Gulf Coast for fishing, swimming, shelling, beachcombing, camping, picnicking, bird watching, and other activities. The scenic and aesthetic value of Gulf Coast beaches plays an important role in attracting visitors to the coastal zone. According to NSRE 2000 data on beach visitation by the state in which the beach is located, Florida ranks number one with 15.2 million participants. Florida has the Nation's second largest coast, approximately 8,400 mi (13,518 km) of tidally influenced shoreline. Two distinct waterfronts—the Atlantic Ocean and GOM—have approximately 825 mi (1,328 km) of sandy beach. The USEPA reports 408 beaches in 22 coastal counties along the Gulf (USEPA, 2004b). Tourism has been Florida's major source of income for many years. Although it initially attracted visitors from the Northeastern States during the winter months, it is now a year-round vacationland visited by tourists from every state, Latin America, and also from Canada and other foreign countries. Tourists visiting Florida's beaches in 2000 spent approximately $21.9 billion, resulting in an indirect economic effect of $19.7 billion and a total economic impact of $41.6 billion (Florida Sea Grant, 2005). More than one-third of Florida's out-of-state tourists visit the State's beaches during the 75 million trips they make to the State annually. Out-of-state beach tourists also paid approximately $600 million in State sales taxes and created more than 500,000 jobs. It is estimated that 77 percent of Florida's population lives in coastal areas and 79 percent of the State's payrolls are earned in Florida's coastal areas (FDEP, 2005). Although Florida's southeast beach region is visited by the largest number of tourists (approximately 25.3 million in 2003), the Southwest beach region had the second largest number of tourists with 14.2 million in 2003. The Northwest and Northeast beach regions were visited by approximately 11 million tourists (FDEP, 2005). The economic impact of these distinct beach regions is consistent with the numbers cited above. For example, the number of jobs created from beach tourism was 253,000 in the Southeast, 177,000 in the Southwest, 79,000 in the Northwest, and 27,000 in the Northeast. Similar patterns exist when comparing the four beach regions in their total contribution to the state's economy, the direct and indirect spending due to beach tourism, and the total spending by beach tourists. (FDEP, 2005). Although the Southeast beach region makes the largest contribution to Florida's economy in all of these measures, the other regions also make a substantial contribution. For example the percentage of tourists who visit Florida beaches is higher in some of the other regions: Northwest (85%), Southwest (83%), Northeast (63%), and Southeast (44%) (FDEP, 2005).

One tropical storm and four major hurricanes made landfall along Florida's coastline in 2004, impacting more than 695 mi (1,118 km (approximately 84%)) of Florida beaches through beach and dune erosion and debris. High winds caused the majority of structural damage. According to *Visit Florida*, the 2004 Hurricane season could have negative impacts on Florida tourism for years to come. *Visit Florida* also reports a potential loss of $2.7 billion in tourism and travel and $160 million in lost State tax revenues (FDEP, 2005). Although Florida's Panhandle, from Panama City west to Pensacola, experienced substantial damage from the 2004 hurricane season, much of the area had returned to normal by the summer of 2005 (Fullman, 2005; Uhlenbrock, 2006). The Gulf Islands National Seashore, which extends from Mississippi's Cat Island to the eastern end of Florida's Santa Rosa Island, sustained extensive damage from Hurricane Ivan in 2004 and from Hurricane Katrina in 2005 (Reed, 2006). Some areas of the park remain closed (USDOI, NPS, 2006).

According to the Alabama Department of Environmental Management (ADEM), the State has approximately 50 mi (80 km) of Gulf Beach (32 mi (51 km) in Baldwin County and 16 mi (26 km) on Dauphin Island) and an estimated 65-70 mi (105-113 km) of bay beaches, including Mobile Bay, Mississippi Sound, Perdido Bay, and Wolf Bay (ADEM, 2005). The USEPA reports a total of 95 coastal beaches in Alabama, 90 of which are in Baldwin County (USEPA, 2004b). In 2003, Baldwin County had a travel-related economic impact on Alabama totaling more than $1.8 billion (EDPA, 2005). According to NSRE 2000 data on beach visitation, over 1.2 million participants visited Alabama beaches. Gulf Shores and Orange Beach experienced heavy damage due to Hurricane Ivan in 2004. Most of the condominiums and hotels have recovered, although not all of the restaurants have returned. Gulf Shores is also a popular spring break destination for college students. Current hotel, condominium, and beach home reservations for the spring of 2007 are reported to be at pre-Ivan levels (Mitchell, 2007).

Including all bays, inlets, and promontories, Mississippi's GOM coastline has a total length of 359 mi (578 km). The coastline is extremely irregular. A series of low barrier islands lay offshore, of which the largest are Cat, Ship, Horn, and Petit Bois Islands. The USEPA reports 21 coastal beaches in the three Mississippi Gulf Coast counties: 3 in Hancock, 12 in Harrison, and 6 in Jackson (USEPA, 2004b). According to NSRE 2000 data on beach visitation, over 1.0 million participants visited Mississippi beaches.

Although there are a variety of beach activities along the Gulf Coast, the growth of casinos in Mississippi and southwest Louisiana has attracted many visitors since the 1990's. Before the 2005 hurricane season, Mississippi was the third largest casino market in the U.S., behind Las Vegas, Nevada, and Atlantic City, New Jersey. There were 28 casinos in Mississippi that generated nearly $2.7 billion in revenue. Approximately $331.7 million was generated in tax revenues. The taxes were allocated among housing, education, transportation, health care services, and youth counseling programs. Before Hurricane Katrina, it was estimated that Mississippi casinos admitted over 54.8 million people in 2003 (AGA, 2003). There were approximately 12 casinos in Mississippi's Gulf Coast area—1 in Bay St. Louis, 2 in Gulfport, and 9 in Biloxi. Gulf Coast casinos generated $1.15 billion in 2001 and employed nearly 17,000 people (Garrett, 2003). Biloxi casinos, in particular, accounted for $887 million (77%).

The gaming industry has substantially recovered since the 2005 hurricane season. For example, 10 casinos were open as of February 2007 in the Biloxi-Gulfport, Mississippi, metropolitan area. One new casino is under construction and is projected to open in July 2007. There are also at least four casinos that are currently being proposed (GulfCoastNews.com, 2007). A large amount of the casino rebuilding is a result of a legislative action in the fall of 2005, allowing shore-based rather than riverboat gambling. With no restrictions on size, damaged casinos along the Mississippi Gulf Coast are being rebuilt with even larger gaming facilities than existed before the hurricane. Hotel and restaurant construction and investment should demonstrate similar patterns to the current casino expansion in the area. This area is already showing some positive economic recovery signals (Scott, 2007). For example, the January 2007 Biloxi casino revenues were at 95 percent of the January 2005 level (City of Biloxi, 2007). As of December 2006, the Biloxi-Gulfport area is still 7,400 leisure and hospitality jobs (-26.0%) below the December 2004 level. There were approximately 15,000 hotel rooms in the area before Hurricane Katrina; however, there were only 4,049 open by the end of 2005. Currently, the number has reached 8,239 (largely due to more casinos opening) but this is still 55.4 percent of the pre-Katrina level (Scott, 2007). The casinos in the New Orleans metropolitan area are also experiencing a substantial increase in revenues despite the fact that one of the four casinos that were open before Hurricane Katrina remains closed and at least one of the casinos in the area is working with reduced staff. Much of the increase in revenues is due to the in-migration of construction workers involved in the rebuilding of the city and the hurricane damage experienced by the Mississippi gambling market (Scott 2007).

New Orleans' tourism industry was heavily impacted by Hurricane Katrina. The sector lost approximately 6,200 jobs (-40.8%) between August and October 2005. The lodging industry had recovered just over 50 percent of its pre-Katrina peak employment level by mid-year 2006. Since May 2006, there has not been much improvement in the industry (Scott, 2007). One of the ongoing problems facing the New Orleans tourism industry is the convention business. In 2004, New Orleans attracted 523,700 conventioneers. In 2005, approximately 372,000 conventioneers visited the city. In 2006, that number had dropped to only 197,000. The reduced level of convention business has directly affected the proposed $314 million phase-IV expansion of the Convention Center by putting the plans on hold. In addition, developers who were planning the construction of new hotels in the area have faced problems getting loans and higher construction costs after the hurricanes. Despite such problems, Harrah's Casino opened its 26-story, 450 room hotel in September of 2006. Pinnacle Entertainment, the owner of the Boomtown Casino in Harvey, LA, has announced plans to build a new 220-room, 4-star hotel. There are also at least three large hotels in downtown New Orleans and many smaller hotels in New Orleans East that have not reopened (Scott, 2007). Although there are some ongoing problems, 91% of major New Orleans area hotels are open (Greater New Orleans Community Data Center and The Brookings Institution Metropolitan Policy Program, 2007). In addition, Louis Armstrong International airport reached 65% of its pre-Katrina passenger (arrivals and departures) levels in January 2007 (Greater New Orleans Community Data Center and The Brookings Institution Metropolitan Policy Program, 2007).

The New Orleans restaurant sector has also faced many challenges since Hurricane Katrina. The restaurant industry plays a significant economic and cultural role in the community and serves as a major attraction for tourists. The industry lost approximately 28,300 jobs (-50.1%) immediately following the storm. Many restaurants flooded and the majority faced staffing problems because employees had few to no housing options. Restaurant owners also faced delays when the Louisiana Department of Health and Hospitals required that all eating establishments be re-inspected and re-certified before they could re-open. Furthermore, the number of customers was drastically reduced due to the lack of tourists and the much smaller local population. The restaurant industry experienced a steady recovery between September 2005 and May 2006 when it added 11,600 jobs. However, employment has stabilized in the second half of 2006 with little improvement. Employment continues to be 16,300 jobs below Pre-Katrina levels (Scott, 2007).

The Lake Charles, LA hotel market also experienced significant declines following Hurricane Rita losing 1,153 rooms (-24.6%). Despite this impact, the area recovered relatively quickly and is currently at 87.5 percent of its Pre-Rita room availability level. Although a few hotels have not reopened, there are plans for the construction of two new hotels and the expansion of one casino hotel. The recovery has leveled off since the beginning of 2006 and hotels continue to experience staffing shortages (Scott, 2007).

Louisiana has about 397 mi (639 km) of general coastline and 7,721 mi (12,425 km) of tidal shoreline, behind only Alaska and Florida in length of marine shore. Louisiana's coastline is primarily wetlands, and much of the State's 7,656 mi^2 (11,299,840 ac) of estuarine water is largely inaccessible to swimmers. The USEPA reports 16 coastal beaches in seven counties/parishes along the Gulf, half of which are in Cameron Parish (USEPA, 2004b). Louisiana beaches are primarily used by local and State residents, and use is highest during the spring and summer seasons (Louisiana Dept. of Health and Hospitals, Office of Public Health, 2005). The NSRE 2000 data on beach visitation estimates over 600,000 participants visited Louisiana beaches.

There is substantial recreational activity associated with the presence of oil and gas structures in the GOM from Alabama through Texas, and these activities have a considerable economic impact. A MMS study estimated that a total of 980,264 fishing trips were taken within 300 ft of an oil or gas structure or an artificial reef created from such structures during 1999 out of a total 4.48 million marine recreational fishing trips in the Gulf from Alabama through Texas (Hiett and Milon, 2002). In addition, the study found that there were 83,780 dive trips near oil and gas structures out of a total 89,464 dive trips. Overall, the study estimated a total of $172.9 million in trip-related costs for fishing and diving near oil and gas structures, with $13.2 million in trip expenditures for diving and $159.7 million associated with trip expenses for recreational fishing.

Table 3-13 presents data from the 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation for the five Gulf States (USDOI, FWS and USDOC, Bureau of the Census, 2001). In 2001, there were 2.5 million residents and nonresidents 16 years old and older who hunted in the Gulf States. These hunters spent approximately $3.4 billion, with $1.1 billion being spent on trip-related expenses such as food, lodging, and transportation and $2.3 billion being spent on equipment. State resident hunters numbered 2.1 million, accounting for 84 percent of the total, while 400,000 non-residents hunted in these States.

Nine million U.S. residents 16 years old or older fed, observed, or photographed wildlife in the Gulf States in 2001. These participants spent roughly $3.9 billion, with $1 billion being spent on trip-related expenses such as food, lodging, and transportation and $2.9 billion being spent on equipment. Approximately 66 percent of participants (5.9 million) enjoyed their activities close to home and are called "residential" participants. Those persons who enjoyed wildlife at least 1 mi (1.6 km) from home are referred to as "nonresidential" participants. Florida and Texas were the leading wildlife watching States, each accounting for 36 percent (3.2 million participants) of the total number of participants in the Gulf.

Some of the previous discussion describes the tourism and recreation baseline for the GOM prior to the impacts of Hurricanes Katrina and Rita. Both of these storms caused extensive adverse impact to tourism and recreation throughout the Gulf. These storms destroyed recreational beaches, public piers, hotels, casinos, marinas, recreational pleasure craft and charter boats, and numerous forms of other recreational infrastructure. Of the 13 casino-barge structures present along the Mississippi coast prior to Hurricane Katrina, most suffered severe external damage, seven broke completely free of their moorings, two partially broke free and damaged adjoining structures, one sank, and one was deposited inland by the storm surge (National Institute of Standards and Technology, 2006). The full extent of impacts to the tourism and recreation by the hurricanes has yet to be fully quantified, but it will likely take years for tourism and recreation to return to pre-hurricane levels. The MMS will update tourism and recreation data as they become available.

3.3.4. Archaeological Resources

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). The Archaeological Resources Regulation (30 CFR 250.194) provides specific authority to each MMS Regional Director to require archaeological resource surveys, analyses, and reports. Surveys are required prior to any exploration or development activities on leases within areas determined to have a high potential for archaeological resources (NTL 2005-G07 and NTL 2006-G07).

3.3.4.1. Historic

With the exception of the Ship Shoal Lighthouse structure, historic archaeological resources on the OCS consist of historic shipwrecks. An historic shipwreck is defined as a submerged or buried vessel, at least 50 years old, that has foundered, stranded, or wrecked and is presently lying on or embedded in the seafloor. This includes vessels that exist intact or as scattered components on or in the seafloor.

The MMS 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 1.5 km (1 mi) of shore and most of the remainder lie between 1.5 and 10 km (1 and 6 mi) of the coast (CEI, 1977). The 1989 study 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.

The 2003 study 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. Several of these pipeline hazard surveys succeeded in locating historic ships, ranging in age from an 18th-century armed sailing ship to a World War II German U-boat.

Historic shipwrecks have, to date, been discovered through oil industry sonar surveys in water depths up to 7,800 ft. In fact, in the last 5 years, over a dozen shipwrecks have been located in deep water and several 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 recommended including some deepwater areas, primarily on the approach to the Mississippi River, among those lease areas requiring archaeological investigation. With this in mind, MMS 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 MMS website under NTL 2005-G07 and NTL 2006-G07. Since implementation of these new lease blocks on July 1, 2005, at least 10 possible historic shipwrecks have been reported in this area.

Pearson et al. (2003) currently lists 550 wrecks in the EPA; however, this should not be considered an exhaustive list. Nearly 100 potentially important shipwrecks have been documented historically near the approaches to Mobile Bay (Mistovich and Knight, 1983; Marx, 1983; Irion, 1990). The precise locations of these vessels remain unknown. 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.

None of the historic shipwrecks identified in the MMS Shipwreck Database have been identified within the proposed Lease Sale 224 area. However, most of the wrecks in the database are known only through the historical record and, to date, have not been located on the ocean floor. Many of these reported shipwrecks may be considered historic and could be eligible for nomination to the National Register of Historic Places.

High concentrations of shipwrecks occur off Florida's west coast from Pensacola to the Apalachicola/Cape San Blas areas. In general, higher numbers of shipwrecks were reported throughout the EPA than were previously realized (Pearson et al., 2003). The major factors that would affect the integrity of wreck sites in the coastal areas are the broad, gently sloping shelf, the relatively low wave energy, and the carbonate sands on the seafloor. Ships that sank in this area are not considered to have a high potential for preservation because of the low sedimentation rates that occur here. Shipwrecks on the seabed would be exposed to decay and deterioration in the oxygenated bottom waters and to strong currents from the occasional tropical storm that traverses the area. Exceptions to low preservation potential would be in localized coastal areas where active sand deposition was occurring. Although little data currently exist to test this hypothesis, it is reasonable to expect that much of this area will be characterized by poor preservation of historic shipwrecks.

Submerged shipwrecks off the coast of Alabama are likely to be moderately well preserved. Wrecks occurring in or close to the mouth of Mobile Bay would have been quickly buried by transported sediment and therefore protected from the destructive effects of wood-eating shipworms (*Teredo navalis*) or storms (Anuskiewicz, 1989; page 90). 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. The cold water would also eliminate wood-eating shipworms.

There have been several recent deepwater shipwreck discoveries off the mouth of the Mississippi River. These wrecks were discovered by the oil and gas industry during required MMS remote-sensing surveys. The discoveries include two late 18th- to early 19th-century wooden sailing vessels, one lying in nearly 2,700 ft (822 m) of water and the other in 4,000 ft (1,219 m) of water. There are also several World War II casualties located in deep water off the mouth of the Mississippi River (e.g., *Alcoa Puritan, GulfPenn, Halo, Virginia, Robert E. Lee*, and the German submarine U-166). All of these wrecks have been investigated using a remotely-operated vehicle from a surface vessel and are in an excellent state of preservation.

Aside from acts of war, hurricanes 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 16 m (52 ft) of water and has been documented by MMS (Irion and Anuskiewicz, 1999) 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.

Recent hurricane activity in the GOM is certain to have impacted historic shipwrecks in shallow water. A good faith effort was made to identify any impacts to known historic shipwrecks; however, no such information was identified. Yet, 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. The MMS recently awarded a study to investigate the impacts that recent storm activity may have had on historic shipwrecks in the GOM. Fieldwork for this study will be carried out in 2007, with a final report of findings expected early in 2009.

3.3.4.2. Prehistoric

Available evidence suggests that sea level in the northern GOM was at least 90 m, and possibly as much as 130 m (427 ft), lower than present sea level during the period 20,000-17,000 years 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).

During periods that the continental shelf was exposed above sea level, the area was open to habitation by prehistoric peoples. The advent of early man into the GOM region is currently accepted to be around 12,000 years B.P. (Aten, 1983). The sea-level curve for the northern GOM proposed by Coastal Environments, Inc. (CEI) suggests that sea level at 12,000 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 B.P. Because of inherent uncertainties in both the depth of sea level and the entry date of prehistoric man into North America, MMS adopted the 60-m (197-ft) water depth as the seaward extent for archaeological site potential in GOMR.

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 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 MMS 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. Though 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.

In western Florida, evidence of Paleo-Indian occupation has been found near what would have been water sources in the karstic formations that extend the Floridian Aquifer (Anuskiewicz and Dunbar, 1993) under the GOM off the present-day Florida coast. Inundated prehistoric archaeological sites have been identified near sinkholes under Apalachee Bay (Anuskiewicz, 1988; page 181) and as far as 20 mi (32 km) offshore (Milanich, 1994; Anuskiewicz and Dunbar, 1993; Dunbar et al., 1989). These sites are associated with a Tertiary karst region that extends from Tampa Bay to Apalachee Bay along the Gulf Coast continental shelf.

Archaeological investigations in the Apalachee Bay region of Florida have produced numerous inundated prehistoric sites (Dunbar, et al., 1989; Faught 2004). The majority of the identified sites have been within State waters. However, human cultural debris (a possible secondary retouch flake) was discovered at Ray Hole Spring, a karst sinkhole, located in the Gainesville Lease Area, approximately 23 mi (37 km) south of Jefferson County, Florida, on the Federal OCS (Anuskiewicz and Dunbar, 1993).

Lease blocks with a high probability for prehistoric archaeological resources may only be found landward of a line that roughly follows the 60-m (197-ft) bathymetric contour. The MMS recognizes both the 12,000 B.P. date and 60-m (197-ft) water depth as the seaward extent for prehistoric archaeological potential on the OCS. Because of the water depths in the proposed Lease Sale 224 area (2,950-10,170 ft; 900-3,100 m), there is no potential for prehistoric archaeological resources in the area.

3.3.5. Human Resources and Land Use

3.3.5.1. Socioeconomic Analysis Area

3.3.5.1.1. Description of the Analysis Area

The MMS 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. The LMA's identified by this grouping are commuting zones, as identified by Tolbert and Sizer (1996). In their research, Tolbert and Sizer (1996) used journey-to-work data from the 1990 census to construct matrices of commuting flows from county to county. A statistical procedure known as hierarchical cluster analysis was employed to identify counties that were strongly linked by commuting flows. The researchers identified 741 of these commuting zones for the U.S. Twenty-three of these LMA areas span the Gulf Coast, from the southern tip of Texas to Miami and the Florida Keys, and comprise the 13 MMS-defined EIA's for the GOM. **Table 3-12** lists the counties and parishes that comprise the LMA's and EIA's. **Figure 3-6** illustrates the counties and parishes that comprise the EIA's.

The LMA's adjacent to the WPA are all within Texas and include Brownsville, Corpus Christi, Victoria, Brazoria, Houston-Galveston, and Beaumont-Port Arthur. The LMA's adjacent to the CPA include Lake Charles, Lafayette, Baton Rouge, Houma, and New Orleans, Louisiana; Biloxi-Gulfport, Mississippi; and Mobile, Alabama. The LMA's adjacent to the EPA are all within Florida and include Pensacola, Panama City, Tallahassee, Lake City, Gainesville, Ocala, Tampa-St. Petersburg, Sarasota, Ft. Myers, and Miami. 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.

3.3.5.1.2. Land Use

The primary region of geographic influence in terms of onshore activity of the proposed action is coastal Louisiana, with a lesser influence on coastal Texas, Mississippi, Alabama, and Florida. Few offshore oil and gas activities occur in the Florida area. 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, Louisiana, Mississippi, Alabama, and Florida 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.

Figures 3-7 through 3-9 illustrate the analysis area's key infrastructure. Major cities in the analysis area include Houston, Texas; Baton Rouge and New Orleans, Louisiana; and Mobile, Alabama. Other important cities in the analysis area include Corpus Christi, Galveston, Port Arthur, and Beaumont, Texas; Lake Charles and Lafayette, Louisiana; Pascagoula, Mississippi; and Mobile, Alabama. Several international and regional airports are located throughout the analysis area. One major interstate (I-10) traverses the area along the inner margin of the coastal zone, while six interstate highways access the area longitudinally. There are numerous highways into and across the analysis area. On November 28, 1995, Louisiana Highway 1 (LA Hwy 1) was designated as part of the National Highway System (NHS). The NHS Act designated 160,955 mi (259 031 km) of interstate, highways, and other roads that are critical for the economy, defense, and mobility of the Nation as the NHS. "These highways provide access to major ports, airports, rail stations, public transit facilities, and border crossings. They comprise only 4 percent of total highways in the country; however, they carry nearly 50 percent of total highway traffic including the majority of commercial and tourism traffic. They are estimated to service more than 90 percent of businesses and industries throughout the nation" (LA Hwy 1 Project Task Force, 1999). LA Hwy 1 was designated because of "its intermodal link to this Nation's energy supply" (LA Hwy 1 Project Task Force, 1999). The area's railroad configuration is similar to the highway system. An extensive maritime industry exists in the analysis area. **Chapter 3.3.5.8** describes OCS-related coastal infrastructure. A listing of major public, recreational, and conservation areas are presented in **Chapter 3.3.3**.

The Gulf coastal plain of Texas makes up most of eastern and southern Texas and constitutes more than one-third of the State. Near the coast this region is mostly flat and low-lying. It rises gradually to 300 m (1,000 ft) farther inland, where the land becomes more rolling. Belts of low hills cross the Gulf coastal plain in many areas. In the higher areas the stream valleys are deeper and sharper than those along the coast. Texas' coastline along the GOM is 367 mi (591 km). However, long narrow islands called barrier islands extend along the coast; if the shoreline of all the islands and bays is taken into account, the coastline is 3,359 mi (5,406 km) long. The region is made up of farmland (cotton, rice, and citrus fruit), forest, cattle ranches, major cities of commerce (e.g., Houston) and education, tourist locales (e.g., South Padre Island), Federal installations (e.g., Lyndon B. Johnson Space Center), and major ports. The oil and gas industry has also been part of the local economies since the early 1900's. Today, the majority of oil and gas corporations have headquarters in Houston, while numerous industries associated with oil and gas (petrochemicals and the manufacture of equipment) are located in the area. In addition to oil and gas, the area has aggressively pursued technology companies such as computers and aerospace. The military has had a significant presence in general, particularly in the Corpus Christi Bay area, and more recently in San Patricio County on the eastern shore of the bay.

The Louisiana coastal area includes broad expanses of coastal marshes and swamps interspersed with ridges of higher well-drained land along the courses of modern and extinct river systems. Most of the urban centers in coastal Louisiana are located along major navigable rivers and along the landward edge of the coastal zone (i.e., Lafayette and Lake Charles). Southwestern Louisiana is Acadian country. The area's natural features vary from marshland, waterways, and bayous in the coastal areas to flat agricultural lands in the northern part of the same parishes. While the area's traditionally strong ties to agriculture, fishing, and trapping are still evident, they are no longer the mainstay of the economy.

Southeastern Louisiana, from Jefferson Parish east to St. Tammany Parish and the State border with Mississippi, is a thriving metropolitan area with shipping, navigation, U.S. Navy facilities, and oil and chemical refineries, all vying with local residents for land. Historically, Terrebonne, Plaquemines, and Lafourche Parishes have been the primary staging and support area for offshore oil and gas exploration and development. The Port of Fourchon, at the mouth of Bayou Lafourche on the GOM, is a major onshore staging area for OCS oil and gas activities in the WPA and CPA, and is the headquarters of the Louisiana Offshore Oil Port (LOOP). **Chapter 3.3.5.2** discusses the Port Fourchon area in detail.

Coastal Mississippi is characterized by bays, deltas, marshland, and waterways. Two-thirds of this coast is devoted to State-chartered gambling barges and heavy tourism along the beachfront. The remaining third (Jackson County) is industrial—oil refining and shipbuilding. Upland portions of the three coastal counties—Hancock, Harrison, and Jackson—are timberlands. Jackson County has a strong industrial base and designated industrial parks. Pascagoula, in Jackson County, is home to Ingalls Shipyard and Chevron's Pascagoula Refinery. Bayou Casotte, also in Jackson County, currently has boat and helicopter facilities, and the onshore support base for drilling and production.

Southwestern Alabama's coastline is comprised of Mobile and Baldwin Counties, which oppose each other across Mobile Bay. Coastal resource-dependent industries in this area include navigation, tourism, marine recreation, commercial fishing, and most recently, offshore natural gas development and production. Large quantities of natural gas were discovered in Alabama's offshore waters in 1979. Baldwin County has a strong tourism economy and a large retiree population. The important commercial fishing industry in the area is located in southeastern Mobile County. The Port of Mobile, the largest seaport in Alabama, is also in Mobile County. The military has had a long presence in the area. The buildup and downsizing of military installations has handed the area some special challenges. There are several oil- and gas-related businesses, including Mobil's MaryAnn/823 plant, established in 1990, and Shell's Yellowhammer plant, founded in 1989; both of these plants process natural gas (Harris InfoSource, 1998).

The Florida Panhandle area has military, tourism, fishing, and ports as major components of the economy. The four main military installations are Pensacola Naval Air Station, Eglin Air Force Base (Fort Walton Beach), Tyndall Air Force Base, and the Coastal Systems Station (both in Panama City). These bases were largely untouched by the downsizing of the military in the 1990's and are expected to remain an important part of the Florida Panhandle economy for the foreseeable future. The development of the Florida Panhandle as a major tourist area began in the mid-1930's and grew rapidly after World War II, becoming what is now a key industry in the Florida Panhandle. "Sugar-white" beaches, fishing, other water-based activities, and natural habitats are key parts of the tourist attraction. In the Florida Panhandle, the commercial fishing industry employs around 700 people, who landed 8.9 million pounds of fish and 2.4 million pounds of shellfish. Two major, deepwater ports are the Port of Pensacola and the Port of Panama City. The Port of Panama City served as an onshore support base for exploratory drilling in the GOM in the early 1980's and in 1990 (Luke et al., 2002); however, conditions have changed since then (**Chapter 3.3.5.8.1**).

The U.S. Department of Agriculture's Economic Research Service (ERS) classifies counties into economic types that indicate primary land-use patterns (U.S. Dept. of Agriculture, ERS, 2004). Most notably, only 5 of the 132 counties in the analysis area are classified by ERS as farming dependent. Nine counties are defined as mining dependent, suggesting the importance of oil and gas development to these local economies. Manufacturing dependence is noted for another 27 of the counties. Local school districts and public facilities, such as hospitals and prisons, are often the largest employers in sparsely populated rural areas. Thus, it is not surprising that 16 rural counties and 14 metropolitan counties are classified as government employment centers. Another 21 of the counties have economies tied to service employment. The ERS also classifies counties in terms of their status as a retirement destination; 39 of the 132 counties are considered major retirement destinations and 7 of the rural counties are classified as recreation dependent. The varied land-use patterns are displayed in **Figure 3-10**.

3.3.5.2. How OCS Development Has Affected the Analysis Area

The following section presents a brief, general narrative of how OCS development has affected the analysis area over the last 25 years. This narrative is followed by a specific account of how OCS development has affected certain locales in the analysis area.

A recent study sponsored by MMS (Pulsipher, 2006) analyzes the socioeconomic impacts of the offshore oil and gas industry on Louisiana's coastal parishes. Specifically, growth in per capita personal income in 19 coastal parishes in Louisiana is compared with 45 noncoastal parishes over the 1969-2000 time period. The time period is divided into the 1969-1980 domestic "energy boom," the 1980-1985 "price erosion and collapse," the 1986-1990 "recovery," and the 1991-2000 "energy lull." Per capita personal income is divided into the components accounting for its rate of growth: improvements in industry mix, changes in relative wages, participation in the labor force, receipt of transfer payments, and property income for each of the four phases. The approach is a way to compare systematically the economic experience of the residents of coastal parishes with the experience of those further removed but still affected by the same changes in the regional and national economies. Comparisons using this same approach are also made of the five states bordering the GOM and of Louisiana's eight metropolitan areas to provide context.

The study found that offshore production mitigated or had an opposing (positive) effect compared with onshore production. It was a source of stability and growth for coastal communities. It gave them partial relief from the economic consequences of nose-diving onshore production during the collapse period. However, this result should not be confused with the cumulative effects of the offshore oil and gas industry. Looking at the experience of the coastal parishes of Louisiana and the five Gulf Coast States leads to a similar conclusion: although differential effects are evident during the collapse period, no lasting, cumulative effects from offshore oil and gas production—either positive or negative—are evident in the study results.

The fluctuations in the price of oil have affected the pace and timing of OCS development and corresponding OCS-related employment through the decades. The major changes were the downturn of the mid-1980's, stabilizing in the early 1990's, a downturn in the late 1990's, and stabilizing at a higher level in 2000 and the first few years following. In the 1990's advances in technology and the Deep Water Royalty Relief Act of 1995 generated resurgence in oil exploration and development. Further, shortage of skilled workers in the area resulted from industry restructuring management (Baxter, 1990), reluctance of workers who lost their jobs in the 1980's to return to them in the 1990's (Donato, 2004), and higher skill levels required by deepwater development. Technological innovations (such as the availability of 3D seismic data, slim-hole drilling, and hydraulic rigs) decreased the cost of exploration and thus stimulated the discovery and development of large or mega prospects that were previously considered uneconomic at low prices.

Needs specific to GOM deepwater projects have stressed support infrastructure, e.g., ports that can handle deeper draft service vessels and associated highways and water systems. Port Fourchon, Louisiana, has become one of these important focal points. Located at the mouth of Bayou Lafourche, it is one of the main service-supply bases for offshore oil and gas exploration and development in the GOM. Increased OCS activity is straining the local infrastructure, including LA Hwy 1, a substandard highway. It is the only land-based transportation route to the port. Since the 2005 hurricane season, the demand upon the Port has resulted in double-digit traffic increases on LA Hwy 1 (Falgout, 2006b). January and February 2006 traffic counts have averaged nearly 20 percent above those months for last year, further impacting an already stressed system (Falgout, 2006a). Also, LA Hwy 1 serves as a hurricane evacuation route for a local population of 35,000 residents and over 6,000 offshore workers, as well as an oil-spill response route for offshore spills (Paganie, 2006b). The Louisiana Department of Transportation and Development (DOTD) is constructing substantial improvements to LA Hwy 1 (Boulet, 2006a), and the LA 1 Coalition is advocating for more.

The MMS recognizes the importance of Port Fourchon and LA Hwy 1 to the Nation's energy infrastructure and the area's desire for impact assistance to ameliorate effects of the OCS Program. In addition, demand for port facilities has risen even more since Hurricanes Katrina and Rita as companies repair rigs, wells, and pipelines. The hurricanes damaged Port Fourchon only slightly, but they severely damaged ports in Venice and Cameron, which are still recovering. Lafourche Parish, where Port Fourchon is located, has one of the lowest unemployment rates in the Nation. The demand for OCS-related labor in the area has resulted in a temporary in-migration of labor, particularly in south Lafourche Parish. This net positive in-migration in some focal point locales has caused a scarcity of housing, a shortage of municipal personnel (i.e., policemen, firemen, engineers, etc.), stresses on the capabilities of available infrastructure, and an increase in the cost of living.

Distribution of Federal Offshore Revenues to States

Revenues from Federal onshore and offshore mineral leases are one of the largest sources of nontax income. The MMS 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. On December 20, 2006, President Bush signed into law the Gulf of Mexico Energy Security Act of 2006, which increased the distribution of offshore oil and gas revenues to the Gulf producing States (i.e., Texas, Louisiana, Mississippi, and Alabama).

Section 8(g)

Section 8(g) of the OCSLA Amendments of 1978 provided that the States were to receive a "fair and equitable" division of revenues generated from the leasing of lands within 3 mi (5 km) of the seaward boundary of a coastal State containing one or more oil and gas pools or fields underlying both the OCS and lands subject to the jurisdiction of the State. The States and the Federal Government, however, could not reach an agreement concerning the meaning of the term "fair and equitable." Revenues generated within the 3-mi 8(g) boundary were placed into an escrow fund beginning August 1979.

Congress resolved the dispute over the meaning of "fair and equitable" in the OCSLA Amendments of 1985 (P.L. 99-272). The law provides for the following distribution of Section 8(g) revenues to the States:

- disbursement of escrow funds during FY 1986-1987;
- a series of annual settlement payments disbursed to the States over a 15-year period from FY 1987 to FY 2001; and
- recurring annual disbursements of 27 percent of royalty, rent, and bonus revenues received within each affected State's 8(g) zone.

The table below shows the disbursement of Federal offshore 8(g) revenues by Gulf Coast State for FY 1986 through FY 2005.

Federal Offshore 8(g) Revenues by Gulf Coast State
($ millions)

State	FY 1986-2002	FY 2003	FY 2004	FY 2005
Alabama	$185.76	$13.20	$13.71	$14.62
Florida	$2.42	$0.00	$0.00	$0.00
Louisiana	$939.70	$29.56	$38.26	$30.90
Mississippi	$21.02	$0.43	$0.52	$1.02
Texas	$736.66	$14.93	$13.25	$10.42

Source: USDOI, MMS, 2006b.

Gulf of Mexico Energy Security Act of 2006

With the enactment of GOMESA, the Gulf producing States (i.e., Texas, Louisiana, Mississippi, and Alabama) will receive an increased share of the offshore oil and gas revenue. Beginning in FY 2007, and thereafter, Gulf producing States will receive 37.5 percent of revenue from new leases issued in the 181 Area and 181 South Area. Beginning in FY 2016, and thereafter, Gulf producing States will receive 37.5 percent from new leases in the existing areas available for leasing. The remaining 50 percent and 12.5 percent of the total revenues would be distributed to the U.S. Treasury and the LWCF, respectively.

According to a January 9, 2007, press release from Representative Bobby Jindal, it was estimated Louisiana would receive around "$200 million over the first 10 years, and anywhere from $650 million to $1 billion a year beginning in 2017" (U.S. House of Representatives, 2007).

The Land and Water Conservation Fund

The Land and Water Conservation Act of 1965 created the LWCF, which is administered by the National Park Service. It provides revenues for the Federal Government, State governments, and local governments to purchase parks and recreation areas and to plan, acquire, and develop land and water resources for recreational use, habitat protection, scenic beauty, and biological diversity. During the past decade, about 90 percent of the $900 million that the LWCF receives every year is from revenues generated from offshore oil and gas activities. In FY 2005, MMS disbursed $898,869,789 to the LWCF (USDOI, MMS, 2006b).

National Historic Preservation Fund

The National Historic Preservation Fund (NHPF) is administered by the National Park Service and is designed to expand and accelerate historic preservation plans and activities. The NHPF provides revenues for matching grants-in-aid to States and local governments, and funds the National Trust for Historic Preservation. Offshore mineral leasing receipts provide 100 percent of the $150 million transferred to the Fund annually. In FY 2005, MMS disbursed $150,000,000 to the NHPF (USDOI, MMS, 2006b).

Coastal Impact Assistance Program

The Energy Policy Act of 2005 (P.L. 109-58) was enacted on August 8, 2005. Section 384 of the Act establishes the Coastal Impact Assistance Program (CIAP). Under CIAP, MMS, as delegated by the Secretary of the Interior is authorized to distribute to eligible producing States and coastal political subdivisions $250 million for each of the fiscal years 2007 through 2010. In order to receive CIAP funds, States, in coordination with their coastal political subdivisions, are required to submit a coastal impact assistance plan (Plan) that MMS must approve prior to disbursing any funds; all funds shall be disbursed through a grant process. Pursuant to the Act, CIAP funds shall only be used for one or more of the uses defined in Chapter 1.

The Gulf of Mexico Region has received Louisiana's final CIAP Plan and Mississippi's draft CIAP Plan; both Plans remain under review. Once a final Plan has been approved by MMS, the State and its coastal political subdivisions are eligible to submit grant applications to MMS to fund projects in the Plan. Louisiana, which submitted a final Plan covering all four fiscal year allocations, has proposed 138 Tier 1 projects and 54 Tier 2 projects for a total of 192 projects. Proposed projects include marsh creation and restoration, coastal forest conservation, shoreline protection, and LA Hwy 1 improvements.

3.3.5.3. Current Oil and Gas Economic Baseline Data

Current oil and natural gas prices are above the economically viable threshold for drilling in the GOM. As of September 24, 2007, West Texas Intermediate was priced at $82.67/bbl and Henry Hub natural gas was priced at $5.964/MMBtu (million British thermal units) in the U.S. spot market (Oilnergy, 2007). The NYMEX contract for benchmark U.S. light, sweet crude was $57.55/bbl for April 2007 delivery and $59.96/bbl for May delivery. Futures tumbled upon concerns about the U.S. economy in general. A decline in the stock market was jittery upon the Mortgage Bankers Association report showing that home foreclosures surged to an all-time high in the last quarter of 2006, feeding concerns about weakening energy demand (Oil and Gas Journal Online, 2007).

Drilling rig use is employed by the industry as another barometer of economic activity. Marketed utilization rates (based on marketed supply) in the GOM hovered around 90 percent or higher for most of 2000 through May 2001, before beginning a downward spiral to a low of nearly 50 percent in November 2001. Over the last year rig utilization rates were back up to just under 90 percent and have remained stable, 86.3 percent in June 2005 and 88.5 percent in June 2006 (Rigzone, 2006). It should be noted that the effective utilization rate was essentially 100 percent, since the surplus rigs are not immediately ready and available for work. As utilization rates have escalated so too have average day rates. The average jack-up day rate in the GOM for April was $127,103 and for May was $132,900 (One Offshore, 2006a; 20:33). The average day rate trend for semisubmersibles in the GOM remains on an inclined path even though average day rates hit a peak of $376,990 in March before falling slightly to $343,827 for both

April and May (One Offshore, 2006a; 20:33). More upward pressure on GOM day rates seems likely, as a number of rigs will leave the area for long-term commitments in other markets.

As rig day rates hover at record highs, rig demand has been increasing worldwide. In 2005, 8 rigs were delivered; for 2006, 12 rigs were delivered (One Offshore, 2006b; 20:35). In the GOM, rig demand has been increasing at the same time that supply has been decreasing. Average May 2006 utilization was its highest level in years. Utilization rates were on the rise until August 2005, just prior to the devastating 2005 hurricane season that caused damage to several rigs and led part of the decrease in supply (One Offshore, 2006b; 20:35). The increasing number of rigs under construction and scheduled for delivery is insufficient to meet operators' growing demand for contract drilling services worldwide, so the tight U.S. Gulf rig supply situation will continue.

Heightened activity in the offshore rig market has also meant a boom for offshore service vessels (OSV). At the end of 2005, with the exception of a handful of vessels at shipyards, every active OSV in the GOM was working. Every vessel owner surveyed indicated that they could immediately put additional vessels to work if any were available (One Offshore, 2005a; 20:11). Day rates are reflecting the tight supply and heavy demand and some vessel owners feel that they can even name their price in certain situations. The April 2006 average day rates were as follows: anchor-handling tug/supply (AHTS) vessels range from $12,500 for under 6,000-horsepower (hp) vessels to $70,000 for over 6,000-hp vessels; supply boats range from $12,500 for boats up to 200 ft (61 m) and $19,000 for boats 200 ft (61 m) t and over; and crewboats range from $4,800 for boats under 125 ft (38 m) $7,667 for boats 125 ft (38 m) and over (Greenberg, 2006a). In comparison, the April 2005 average day rates were as follows: AHTS vessel ranges from $12,500 for under 6,000-hp vessels to $24,850 for over 6,000-hp vessels; supply boat ranges from $6,025 for boats up to 200 ft (61 m) and $11,515 for boats 200 ft (61 m) and over; and crewboats range from $2,625 for boats under 125 ft (38 m) to $4,825 for boats over 125 ft (38 m) and over (Greenberg, 2006a). As of June 2006, U.S. GOM OSV owners reported that 221 vessels (i.e., every available) were under contract. Operators are seeking long-term commitments, and 1- and 2-year firm deals are becoming more common (One Offshore, 2006c; 20:37).

Another indicator of the direction of the industry is the exploration and production (E&P) expenditures of the oil and gas companies. According to the *Original E&P Spending Survey* by equity research analysts at Lehman Brothers, U.S. exploration and production spending will increase to $57 billion in 2006 compared with estimated 2005 expenditures of $50 billion (One Offshore, 2005b; 20:9). This represents a 14.9-percent increase in spending on the part of the 247 companies participating in the survey. However, Lehman analysts note that costs are driving budgets and that much of this spending increase is being driven by higher costs. In a reversal of the trend in recent years, most majors are budgeting higher domestic spending in 2006. Lehman analysts believe that they have recently become more attracted to unconventional gas plays and that increased competition abroad from national oil companies and limited access to some areas of the world is pushing the majors back to the United States (One Offshore, 2005b; 20:9).

Lease sales are another indicator of the offshore oil and gas industry. Sales over the last several years have resulted in a relative increase in the number of blocks leased. In addition, recent lease sales show a continued strong interest in deep water and a renewed interest in shallow water. The most recent Central GOM sale held in March 2006 attracted 82 companies submitting 707 bids totaling close to $1 billion. The highest bid accepted was for almost $43 million. Although the three highest bids were all in deep water, the sale also indicated a continued interest in shallow-water areas as 47 percent of the blocks receiving bids were in less than 200 m (656 ft) of water (USDOI, MMS, 2006c).

Western Gulf Lease Sale 200, which was held in August 2006, garnered close to $341 million in high bids from 62 companies. The total of all 541 bids on 381 blocks was nearly $463 million, a 38 percent increase over last year's Western Gulf sale. Interest in deepwater oil and gas production continues to grow, with 67 percent of all blocks receiving bids in water depths greater than 400 m (1,312 ft). The increased number of blocks receiving bids in shallow water indicates ongoing industry interest in deep gas in shallow waters as well.

3.3.5.4. Demographics

Offshore waters of the WPA, CPA, and EPA lie adjacent to coastal Texas, Louisiana, Mississippi, Alabama, and Florida. In this description of the socioeconomic environment, sets of counties (and parishes in Louisiana) have been grouped on the basis of intercounty commuting patterns. The LMA's identified by this grouping are commuting zones, as identified by Tolbert and Sizer (1996). Tolbert and Sizer (1996) used journey-to-work data from the 1990 Census to construct matrices of commuting flows from county to county and employed a statistical procedure known as hierarchical cluster analysis to identify counties that were strongly linked by commuting flows. The researchers identified 741 of these commuting zones for the U.S. Twenty-three of these LMA areas span the Gulf Coast, from the southern tip of Texas to Miami and the Florida Keys, and comprise the 13 MMS-defined EIA's for the Gulf. **Table 3-12** lists the counties and parishes that comprise the LMA's and EIA's. **Figure 3-6** illustrates the counties and parishes that comprise the EIA's.

The LMA's adjacent to the WPA are all within Texas and include Brownsville, Corpus Christi, Victoria, Brazoria, Houston-Galveston, and Beaumont-Port Arthur. The LMA's adjacent to the CPA include Lake Charles, Lafayette, Baton Rouge, Houma, and New Orleans, Louisiana; Biloxi-Gulfport, Mississippi; and Mobile, Alabama. The LMA's adjacent to the EPA are all within Florida and include Pensacola, Panama City, Tallahassee, Lake City, Gainesville, Ocala, Tampa-St. Petersburg, Sarasota, Ft. Myers, and Miami. Use of the LMA geography brings together counties/parishes immediately adjacent to the GOM and also counties/parishes tied to coastal counties/parishes 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.

3.3.5.4.1. Population

Tables 3-14 through 3-26 provide an overview of the Gulf Coast population and employment in the GOM coastal region. The area's population increased by 19 percent between 1990 and 2000 and by 9 percent between 2000 and 2006. The region's current total population is 23.3 million. In the U.S., population age structures typically reflect the presence of the baby-boom generation. This scenario is manifested in the Gulf Coast region by the relative decline in lower age cohorts over time. More distinctive is the changing race and ethnic composition of the region, which has a long-standing tradition of cultural heterogeneity (Gramling, 1994). While the African-American population increased 23.6 percent between 1990 and 2000, the growth rate has declined to 8.2 percent between 2000 and 2006. The Hispanic population increased 53.8 percent between 1990 and 2000 and has continued to increase rapidly since 2000 (24.4%). This group is now the second largest race/ethnic group in the region, making up 25.8 percent of the Gulf Coast population. Although Asians and Pacific Islanders constitute a relatively small proportion of the Gulf Coast population, this group has experienced the highest growth rate between 1990 and 2000 (82.5%) and between 2000 and 2006 (28.2%). The white population has steadily declined and currently constitutes 53.6 percent of the region's population.

Based on employment, the largest industry sectors in the Gulf Coast region are services (35.6%) and retail trade (16.6%). The most notable changes in industry distribution have been the decreased share in manufacturing (declining from 9% in 1990 to 6% in 2006) and the increased share in services (29% in 1990 and 36% in 2006). These overall trends vary from one Gulf Coast State to another and from one LMA to another.

The 2004 hurricane season was the worst in Florida's history, with four hurricanes hitting the State, and causing at least 47 deaths (National Hurricane Center, 2007) and approximately $45 billion in damages (Blake, et al., 2006). Hurricane Ivan was the strongest and the only Category 5 hurricane of the 2004 Atlantic hurricane season. After peaking in strength, it moved north-northwest across the GOM and made landfall on September 16, 2004, as a strong Category 3 hurricane near Gulf Shores, Alabama. Despite the heavy damage that Hurricane Ivan caused, the impacts that the storm had on long-term population change were minimal compared with Hurricanes Katrina and Rita (Smith and McCarty, 2006). It is estimated that approximately 3 percent of Florida's residents had to move out of their homes because of damage following Hurricane Ivan (Smith and McCarty, 2006). Approximately 7.6 percent of Florida residents reported structural housing damage due to Hurricane Ivan (Smith and McCarty, 2006).

On August 29, 2005, Hurricane Katrina made landfall along the Gulf Coast near the Louisiana-Mississippi border. The storm caused catastrophic damage along the coasts of Louisiana, Mississippi, and Alabama, including a storm surge that breached the levee system protecting New Orleans and leading to widespread flooding of the city. Hurricane Katrina stands to be the costliest natural disaster in the history of the U.S.—estimates of economic losses run as high as $200 billion (Wolk, 2005)—and perhaps the greatest humanitarian crisis the Nation has experienced since the Great Depression—over 1,000 people were killed (CNN, 2005) and millions were affected (Ericson et al., 2005).

Less than 1 month later, on September 24, 2005, as the residents of the region still reeled from Hurricane Katrina, Hurricane Rita made landfall along the Gulf Coast near the Louisiana-Texas border. Though of a lesser magnitude than Katrina, Hurricane Rita nonetheless caused extensive damage throughout the region, particularly in the coastal parishes of southwestern Louisiana.

In response to the damage from the two disasters, the Federal Emergency Management Agency (FEMA) designated 433 counties and parishes spanning five states (i.e., Alabama, Florida, Louisiana, Mississippi, and Texas) as in need of Federal assistance (FEMA, 2005). FEMA designated a number of counties and parishes to receive public assistance to State and local governments and certain private nonprofit organizations, while a smaller number were designated to receive individual assistance for affected individuals and households for housing and assistance with other needs.

The Congressional Research Service (CRS) estimates that 700,000 or more people may have been directly impacted by Hurricane Katrina as a result of residing in areas that flooded or sustained significant structural damage. This estimate is based on a geographical analysis of FEMA flood and damage assessments and 2000 Census data. The analysis shows that the Louisiana parishes of Orleans and St. Bernard were especially hard hit by flooding, with an estimated 77 percent of Orleans' population affected and nearly all residents of St. Bernard affected. In Mississippi, 55 percent of Hancock County's population is estimated to have been affected by flooding and/or structural damage, and in the more populous Harrison County, about 19 percent of its population. In Louisiana, an estimated 645,000 people may have been displaced by the hurricane and 66,000 in Mississippi (based on 2000 Census data) (Gabe et al., 2005).

Hurricane Katrina had varying impacts on the population. The CRS estimates that, of the people most likely to have been displaced by the hurricane, about half lived in New Orleans. Because of the city's social and economic composition, the storm significantly impacted the poor and African-American population. The CRS estimates that one-fifth of those displaced by the storm were likely to have been poor, and 30 percent had incomes that were below 1.5 times the poverty line. African-Americans are estimated to have accounted for approximately 44 percent of storm victims. An estimated 88,000 elderly persons (aged 65 and older), many with strong community ties, may have been displaced, along with 183,000 children, many of whom were just starting the school year when the storm struck (Gabe et al., 2005). An estimated 4,500 American Indians living along the southeast Louisiana coast lost everything to Hurricane Katrina, according to State officials and tribal leaders. Officials estimate that 5,000-6,000 American Indians lost their homes or possessions because of Hurricane Rita. The Louisiana tribes most affected by the two hurricanes are the United Houma Nation, the Pointe-au-Chien Tribe, the Isle de Jean Charles Indian band of Biloxi-Chitimacha, the Grand Caillou-Dulac Band, and the Biloxi-Chitimacha Confederation of Muskogees (Democracy Now, 2005).

Between December 2005 and February 2006, estimates show that the city of New Orleans and the New Orleans metropolitan region experienced a measurable increase in its population. These include returnees as well as new migrants employed in the region (Katz et al., 2006). The City of New Orleans' population survey of residential structures estimates that there were approximately 181,400 residents living in the city in January 2006, far lower than its pre-Katrina population of 484,674 (Stone et al., 2006). The daytime population is significantly higher because of the influx of visitors and workers in the city. Although this population survey best reflects current conditions and provides reliable overnight and daytime population estimates, the methodology used is likely to underestimate the city's current population (Stone et al., 2006). The information from this survey is not intended to be an official census of the city.

In addition to the population statistics for the City of New Orleans, current data also show that the New Orleans metropolitan area population is currently 18 percent lower than before Hurricane Katrina made landfall. The pre-hurricane population estimate for the region was 1,292,774 and the current estimate is 1,065,000. Current population estimates show declines in Orleans Parish (46%), St. Bernard Parish (71%), and Plaquemines Parish (22%). However, Jefferson Parish (0.3%), St. Tammany Parish (8%), St. Charles Parish (10%), and St. John the Baptist Parish (7%) have all increased in population since the hurricane. Many businesses have also relocated from Orleans Parish to Jefferson and St. Tammany Parishes. All of these parishes have slowly increased in population since six months following Hurricane Katrina (Warner, 2006).

The first official U.S. Census Bureau estimate since Hurricane Katrina estimates the New Orleans population at 223,000 as of July 1, 2006. This represents a 54 percent decline since Hurricane Katrina. Jefferson Parish is estimated to be the state's most populous parish with 431,000 people (Scallan, 2007). However, this number is a 5 percent decline compared with the 2000 census. East Baton Rouge Parish is estimated to have 429,073 residents, which makes it the second largest parish in terms of population size. Ascension and Livingston Parishes, two suburbs of Baton Rouge, grew by 27 percent to 97,000 and by 25 percent to 114,000, respectively. These parishes were estimated to be the two fastest-growing parishes in the state. The St. Bernard Parish population was estimated at 15,514, a decrease of 77 percent since Hurricane Katrina (Scallan, 2007). Cameron Parish, which was heavily impacted by Hurricane Rita, lost 22 percent of its population and now has a population of 7,782 people. St. John the Baptist Parish showed a 13 percent increase to 48,537 from the 2000 Census. Although these statistics are the most recent official population estimates following the 2005 hurricane season, many parish government representatives do not believe that these estimates adequately reflect their communities' population size, particularly those in St. Tammany, St. Charles, St. Bernard, and Jefferson Parishes. Many of these parish leaders believe that the Census numbers underestimate the true population and growth rates in these communities (Scallan, 2007).

Tables 3-14 through 3-26 contain the analysis area's current baseline and projections for population, employment, business patterns, and income and wealth through 2030. These tables present projections by MMS-defined EIA. Projections through 2030 are based on the Woods & Poole's *Complete Economic and Demographic Data Source* (Woods & Poole Economics, Inc., 2006). These baseline projections assume the continuation of existing social, economic, and technological trends at the time of the forecast. Therefore, the projections include population and 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 projections include Woods & Poole's assumptions regarding Hurricane Katrina's impact on the Southeast. From 2005 to 2006, population, income, and employment were assumed to decline 86 percent in St. Bernard Parish, Louisiana; 66 percent in Orleans Parish, Louisiana; 51 percent in Plaquemines Parish, Louisiana; 16 percent in Hancock County, Mississippi; and 11 percent in Jefferson Parish, Louisiana. Some surrounding parishes and counties were similarly assumed to have population and employment gains because of Hurricane Katrina displacement. St. Tammany Parish, Louisiana, was assumed to gain 27 percent; St. John the Baptist Parish, Louisiana, 21 percent; St. James Parish, Louisiana, 14 percent; Ascension Parish, Louisiana, 10 percent; East Baton Rouge Parish, Louisiana, 10 percent; Stone County, Mississippi, 15 percent; St. Charles Parish, Louisiana, 18 percent; and Tangipahoa Parish, Louisiana, 18 percent from 2005 to 2006. Over the forecast period, Woods & Poole's 2006 forecast of Hurricane Katrina's impact assumes that all of the population, employment, and income gains and losses from Hurricane Katrina will mitigate and that New Orleans, Louisiana, will fully recover (Woods & Poole Economics, Inc., 2006).

Table 3-27 presents population projections for eight counties and parishes that were the most negatively affected by Hurricanes Katrina and Rita in terms of population and employment losses: St. Bernard, Orleans, Plaquemines, Jefferson, and Cameron Parishes, Louisiana; and Hancock, Jackson, and Harrison Counties, Mississippi. Many of these communities lost a substantial proportion of their population following the 2005 hurricane season. In general, the Mississippi Gulf Coast is expected to recover its population more quickly than the heavily impacted Louisiana parishes. For example, Jackson and Harrison Counties are projected to increase to their pre-hurricane level by 2009. Although the Louisiana parishes are projected to have a much slower population growth rate, all of the communities (except for Orleans Parish) are expected to completely recover by 2030. **Table 3-28** presents the baseline population projections for each EIA through 2048; these projections are used to analyze population impacts of the proposed action in **Chapter 4.3.14**.

3.3.5.4.2. Age

Tables 3-14 through 3-26 present population trends and projections for the Gulf Coast EIA from 1990 to 2030. The area is projected to increase in population throughout the period, with a considerable shift in age structure. Until 2015 (including the 2007-2012 period being considered in this analysis), when the baby boomers retire, the fastest growing age group will continue to be the 50- to 64-year olds. After 2015, the proportion in the 50-64 age group, as well as the younger age groups begin to decline.

Meanwhile, the age structure of the region will shift toward the more elderly. For example, the 65 and older age group increases from 13.3 percent of the total population in 2006 to over 19 percent in 2030.

Differences in age structure, as well as net migration, among the coastal EIA's could create variations in population growth. The highest rates of growth between 2006 and 2030 are expected adjacent to the WPA and the lowest adjacent to the CPA. The southern Florida and southeastern Texas areas are projected to have the highest growth rates, generally exceeding those expected for Louisiana, Mississippi, and Alabama. The lowest population growth rates are expected in the Louisiana EIA's. An exception is EIA LA-4, which is expected to have the highest population growth rate (55%) over this period due to the large population loss in the New Orleans metropolitan area following Hurricane Katrina. The EIA MS-1, which includes the Biloxi-Gulfport metropolitan area, is also expected to increase its population approximately 30 percent between 2006 and 2030. This high growth rate is also largely due to the substantial population loss that occurred after Hurricane Katrina (Woods & Poole Economics, Inc., 2006). (See **Chapter 3.3.5.4.1** for further discussion of the effect of Hurricanes Katrina and Rita on the elderly population.)

3.3.5.4.3. Race and Ethnic Composition

The racial and ethnic composition of the analysis area reflects both historical settlement patterns and current economic activities. For example, those counties in Texas where Hispanics are the dominant group—Cameron to Nueces (Brownsville to Corpus Christi)—were also first settled by people from Mexico. Their descendants remain, typically working in truck farming, tending cattle, or in low-wage industrial jobs. From Aransas to Harris County (Houston), the size of the African-American population increases, indicating more urban and diverse economic pursuits. In Jefferson County, Texas, adjacent to Louisiana, African-Americans outnumber Hispanics, reflecting the dominant minority status of African-Americans throughout the rest of the analysis area. Despite the larger number of white, non-Hispanic people in coastal Texas, Louisiana, Mississippi, and Alabama, together African-Americans and Hispanics outnumber whites, a trend which is national, not just regional, and which is increasing in intensity (Donator and Hakimzadeh 2006). (See **Chapter 3.3.5.4.1** for further discussion of the effect of Hurricanes Katrina and Rita on minority populations.) For example, it is estimated that approximately 45 percent of construction workers involved in the rebuilding effort and living in New Orleans, Louisiana, are Latino, of which 54 percent is undocumented (Fletcher et al., 2006). Compared with the U.S., there is a higher non-white racial composition to the Texas, Louisiana, Mississippi, and Alabama coastal areas with the exception of EIA TX-1. This EIA borders Mexico and has the highest concentration of Hispanic population. Southwestern Louisiana is Acadian country. Settlers included Houma Indians, French, Spanish, English, and African. The Florida EIA's racial composition predominantly mirrors that of the U.S., with the exception of EIA FL-2, which has a higher African-American population. (See **Chapter 3.3.5.9**, Environmental Justice, for further discussion of minority and low-income populations.)

3.3.5.5. Economic Factors

Tables 3-14 through 3-26 contain the analysis area's current baseline and projections for population, employment, business patterns, and income and wealth through 2030. These tables present projections by MMS-defined EIA. Projections through 2030 are based on the Woods & Poole's *Complete Economic and Demographic Data Source* (Woods & Poole Economics, Inc., 2006). 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 continuation of current patterns in OCS leasing activity as well as the continuation of trends in other industries important to the region. These projections include Woods & Poole's assumptions regarding Hurricanes Katrina and Rita's impact on the Southeast. From 2005 to 2006, population, income, and employment were assumed to decline 86 percent in St. Bernard Parish, Louisiana; 66 percent in Orleans Parish, Louisiana; 51 percent in Plaquemines Parish, Louisiana; 16 percent in Hancock County, Mississippi; and 11 percent in Jefferson Parish, Louisiana. Some surrounding parishes and counties were similarly assumed to have population and employment gains because of Katrina displacement. St. Tammany Parish, Louisiana, was assumed to gain 27 percent; St. John the Baptist Parish, Louisiana, 21 percent; Lamar County, Mississippi, 19 percent; St. Charles Parish, Louisiana, 18 percent; and Tangipahoa Parish, Louisiana, 18 percent from 2005 to 2006. Over the forecast period, Woods & Poole's initial forecast of Hurricane Katrina's impact assumes that all of the population, employment, and income gains and losses from Katrina will mitigate and that New Orleans will fully recover (Woods and Poole Economics, Inc., 2006).

While the OCS industry may not be the dominant industry in an individual EIA, it can be in a specific locale within an EIA, causing that focal point to experience impacts. For example, in Port Fourchon and Lockport, Louisiana, there has been an influx of workers from Mexico, India, and other parts of the U.S. because of the shortage of local workers in the local community. While these new residents are expected to only negligibly impact the EIA's demographics, they have presented the communities with added stress to infrastructure and government services. Many of these increased costs to local governments are hard to quantify. Some locally provided services are tied to the unique needs of the oil and gas offshore industry. For example, schools, city water, law enforcement, and roads have been particularly affected by the growth of offshore development (Keithly, 2001; Barrios, 2006; Boulet, 2006b).

3.3.5.5.1. Employment

Average annual employment growth projected from 2005 through 2030 range from a low of 1.22 percent for EIA LA-4 to a high of 2.50 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 1.57 percent per year, while the GOM economic impact analysis area is expected to grow at about 1.73 percent per year. As stated above, this represents growth in general employment for the EIA's. Continuation of existing trends at the time of the forecast (i.e., post-Katrina and Rita), both in OCS activity and other industries in the area, are included in the projections. (See **Chapter 3.3.5.5** for a more complete examination of employment and labor issues with respect to OCS-related infrastructure.)

The widespread destruction caused by Hurricanes Katrina and Rita will have both short- and long-term employment consequences. In October 2005, the Congressional Budget Office (CBO) estimated that between 280,000 and 400,000 people lost jobs directly because of Hurricane Katrina and an additional 12,600-80,000 lost jobs directly because of Hurricane Rita (CBO, 2005). However, the storms' initial adverse impacts will likely fade over time as many employees return to their former jobs or find new ones. Furthermore, the total employment impact in the region will include the positive employment impacts that accompany cleanup and rebuilding as well as the direct negative effects. Over the long term, the total employment in the GOM region may return to levels similar to what it would have been if the hurricanes had not occurred. However, the types of jobs may change and unemployment levels may persist in individual counties and parishes for a long time. The longer term hurricane employment impacts in the region are likely to be in Louisiana and Mississippi, particularly in the metropolitan statistical areas (MSA's) of New Orleans (LA-4) and Biloxi-Gulfport and Pascagoula (MS-1), largely because of the loss of available housing. According to the *Louisiana Economic Outlook: 2006-2007*, over 267,000 housing units were lost in the State, 75 percent of which were in the New Orleans area (Wall, 2006). An additional 61,000 units were rendered uninhabitable in Biloxi-Gulfport and 41,000 units in Pascagoula (Scott, 2006).

Table 3-27 presents employment projections for eight counties and parishes that were the most negatively affected by Hurricanes Katrina and Rita in terms of population and employment losses: St. Bernard, Orleans, Plaquemines, Jefferson, and Cameron Parishes, Louisiana; and Hancock, Jackson, and Harrison Counties, Mississippi (Woods & Poole Economics, Inc., 2006). Many of these communities lost a substantial proportion of their employment level following the 2005 hurricane season. In general, the Mississippi Gulf Coast is expected to recover its employment level more quickly than the heavily impacted Louisiana parishes. For example, Jackson and Harrison Counties in Mississippi are projected to recover to their pre-hurricane level by 2009, while St. Bernard and Orleans Parishes in Louisiana will only be at 28 percent and 42 percent of their 2005 pre-storm employment levels by 2009. Although the Louisiana parishes are projected to have a much slower employment growth rate, all of the parishes are expected to completely recover by 2030. **Table 3-29** presents the baseline employment projections for each EIA through 2046; these projections are used to analyze employment impacts of proposed action in **Chapter 4.3.14.3.** The MMS will continue to update baseline employment numbers in future documents as new information becomes available from Woods & Poole Economics, the U.S. Department of Labor's Bureau of Labor Statistics, individual State data, and published reports.

3.3.5.5.2. Income and Wealth

Median household income in the United States was $44,389 in the 2004. This value equaled the value for 2003 in real terms. Median incomes for Hispanic (who may be of any race) and Black (African-American) households was $34,241 and $30,134, respectively. The median household income for white non-Hispanics was $48,977, and Asian households had the highest level of median income ($57,518) (USDOC, Bureau of the Census, 2005a).

Income associated with the industrial sectors for the WPA EIA's and that of the CPA are similar. Because the service industry is a major employer in the analysis area, this industry contributes significantly (percentage-wise) to income. The manufacturing and construction industries also contribute greatly, in percentage terms, towards income earned for the EIA's.

The Woods and Poole 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 2005, all EIA's within the GOM analysis, with the exception of FL-4 (which had an index of 110.29), ranked below the U.S. in terms of wealth. The next two highest EIA's were TX-3 and LA-4, with indices of 83.76 and 81.73, respectively. The EIA FL-2 ranked the lowest of all EIA's in the region, with an index of 64.26. 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 MS-1 and AL-1, with 68.82 and 69.20, respectively.

Of the 132 counties that comprise the GOMR economic analysis area, only 12 ranked above the U.S. (6 in FL-4; 2 in TX-3; and 1 in FL-1, FL-3, LA-4, and TX-1). Collier County in FL-4 was the highest, with an index of 150.05. The lowest county is Starr County in TX-1 with an index of 36.49, followed by Hamilton County in FL-2 with 47.94 and Union County in FL-3 with 49.09. (See **Chapter 3.3.5.9** for further discussion of minority and low-income populations.)

3.3.5.5.3. Business Patterns by Industrial Sector

As shown in **Tables 3-14 through 3-26**, the industrial composition for the EIA's is similar. In 2005, the top three ranking sectors in terms of employment in all EIA's in the analysis area, except FL-4, were the services, retail trade, and State and local government sectors—with the service industry ranking number one in all EIA's and retail trade ranking second in all EIA's, except FL-2, where State and local government is second. In FL-4, the top three ranking sectors were services; retail trade; and finance, insurances and real estate, in that order, with State and local government a close fourth. In EIA's TX-1, LA-1, LA-3, and FL-2, construction ranks fourth; in EIA's AL-1, MS-1, and TX-2, manufacturing ranks fourth; in EIA's LA-4, TX-3, and FL-3, finance, insurance, and real estate ranks fourth; and in EIA LA-2, mining ranks fourth.

As part of its economic impact analysis in **Chapter 4**, MMS uses IMPLAN's input-output model. A set of multipliers is created for each EIA in the analysis area based on each EIA's unique industry make-up described above. 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 a lease sale.

The U.S. Department of Agriculture's Economic Research Service (ERS) classifies counties into economic types that indicate primary land-use patterns (U.S. Dept. of Agriculture, ERS, 2004). Most notably, only 5 of the 132 counties in the analysis area are classified by ERS as farming dependent. Nine counties are defined as mining dependent, suggesting the importance of oil and gas development to these local economies (3 in TX-1, 3 in LA-2, 2 in LA-3, and 1 in LA-4). Manufacturing dependence is noted for another 27 of the counties. Local school districts and public facilities, such as hospitals and prisons, are often the largest employers in sparsely populated rural areas. Thus, it is not surprising that 16 rural counties and 14 metropolitan counties are classified as government employment centers. Another 21 counties have economies tied to service employment. The ERS also classifies counties in terms of their status as a retirement destination; 39 of the 132 counties are considered major retirement destinations, and 7 of the rural counties are classified as recreation dependent. The varied land-use patterns are displayed in **Figure 3-10**.

3.3.5.6. Non-OCS-Related Marine Transport

An extensive maritime industry exists in the northern GOM. **Figure 3-11** shows the major ports and domestic waterways in the analysis area, while **Table 3-30** presents the 2004 channel depth, number of trips, and freight traffic of OCS-related waterways. Maritime traffic is either domestic or foreign. There is a substantial amount of domestic waterborne commerce in the analysis area through the Gulf Intracoastal Waterway (GIWW), which follows the coastline inshore and through bays and estuaries, and in some cases offshore. In addition to coastwise transport between GOM ports, foreign maritime traffic is extensive. Major trade shipping routes between Gulf ports and ports outside the northern GOM occur via the Bay of Campeche, the Yucatan Channel, and the Straits of Florida.

Port Fourchon is located near the mouth of Bayou Lafourche and serves as a major service base and support center for oil and gas operations in the Gulf of Mexico. Bayou Lafourche links a number of local communities to the GIWW, and thus serves purposes beyond just oil and gas. Commercial fishing is an important component of the local economy, and the Port Fourchon area has been an important unloading facility for shrimp and the commercial fishing fleet (USDOI, MMS, 2001b)

As stated in Chapter 4.1.3.1.3, Offshore Liquefied Natural Gas Projects, there are currently two LNG terminals operating in the GOM, one onshore and one offshore. There are an additional 15 onshore LNG terminals and 4 offshore LNG terminals proposed or approved (FERC, 2007a); however, many analysts predict only one-quarter of these terminals will be built (FERC, 2007b). Offshore LNG terminals are discussed in more detail in Chapter 4.1.3.1.3, Offshore Liquefied Natural Gas Projects.

For onshore LNG terminals it is expected that LNG carriers would use existing high-traffic waterways and should have similar impacts as other large vessels. The proposed Creole Trail LNG terminal along the Calcasieu River Channel in central Cameron Parish, Louisiana, would be one of the largest LNG terminals, with the capacity to receive up to 400 LNG carriers per year (Port of Lake Charles, 2007). Because of security and safety issues, waterways would be closed to other traffic when a LNG carrier moves to its onshore terminal.

According to applications submitted and NEPA documents prepared, it is projected that offshore LNG terminals would each be visited by 42-135 LNG carriers per year. Offshore LNG project applicants recommend LNG carrier vessel routes to and from the proposed terminals. These routes are not proposed as formal fairways but are general routes for the LNG carriers to "call" on the LNG receiving terminals. Recommended routes could appear on navigational charts as inbound and outbound arrows. However, no regulatory restrictions would be associated with these recommended routes. In addition to the LNG carriers, the offshore LNG terminals would be visited by one service vessel per week and three crewboat trips per week. The weekly service-vessel trips would not necessarily constitute new trips, as service vessels may stop at several offshore facilities during a single trip. Service vessels and crewboats would likely use waterways already heavily used by commercial and recreational vessels, and other offshore oil and gas industry vessels.

3.3.5.7. OCS-Related Offshore Infrastructure

3.3.5.7.1. Offshore Production Systems

Unless otherwise indicated, the following information is from the MMS study, *OCS-Related Infrastructure in the Gulf of Mexico Fact Book* (The Louis Berger Group, Inc., 2004) and *Deepwater Development: A Reference Document for the Deepwater Environmental Assessment Gulf of Mexico OCS (1998 through 2007)* (Regg et al., 2000).

Offshore production systems or platforms play a pivotal role in the development of offshore oil and gas resources. The purpose of a platform is to house production and drilling equipment and living quarters for personnel (for manned platforms). A platform can consist of an underwater part (jacket or tower), an above-water part (deck), living quarters, control building, and production modules. Several types of production systems are used for offshore oil and gas development in the GOM (**Figure 3-12**).

A tension-leg platform (TLP) consists of a floating structure or hull held in place by tensioned tendons connected to a foundation on the seafloor that is secured by piles driven into the seabed. The tensioned tendons provide a broad depth range of utilization and also limit the TLP's vertical motion and, to a degree, its horizontal motion. At present, TLP's can be used in water depths up to approximately 2,100 m (6,890 ft). The deepest TLP in the world was installed by ConocoPhillips at Magnolia in

December 2004 at 4,674 ft (1,224 m) of water (NaturalGas.org, 2006a; USDOI, MMS, 2006d and e; Oynes, 2006).

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. 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 of 3,000 m (9,842 ft) or deeper (Natural Gas.org, 2006a; USDOI, MMS, 2006d and e; Oynes, 2006).

Semisubmersible production structures (semisubmersibles) resemble their drilling rig counterparts and are the most common type of offshore drilling rig (NaturalGas.org, 2006a). Semisubmersibles are partially submerged with pontoons that provide buoyancy. The structures keep on station with conventional catenary or semi-taut line mooring systems connected to anchors in the seabed. Floating production systems are suited for deepwater production in depths up to 8,000 ft (2,438 m) (NaturalGas.org, 2006a; USDOI, MMS, 2006d and e).

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. Unlike wells from conventional fixed structures, subsea wells do not have surface facilities directly supporting them during their production phases. 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. Subsea systems are being installed at ever-increasing water depths. Subsea systems in the GOM are currently expected to be deployed in deep- and ultra-deepwater settings. Operators are contemplating subsea developments to depths of 3,000 m (9,842 ft) and greater.

One recent integrated subsea gas development involving multiple operators will use a semisubmersible topsides, 176 mi (281 km) of in-field flowlines, and produce 21 or more wells in 10 fields. This integrated surface "host" and subsea production system is in water approximately 2,438 m (8,000 ft) deep in Mississippi Canyon Block 920 and is called the Independence Hub. The Hub is likely to be a model for smaller discoveries that lie in deep- and ultra-deepwater settings because of the economic challenges of producing smaller discoveries from these depths. The Hub is now under construction and is projected to eventually produce 1 billion cubic feet (Bcf) of gas per day beginning in 2007 from fields in the eastern CPA that were not economic to produce individually (USDOI, MMS, 2005b).

Fabrication

Platforms are fabricated onshore and then towed to an offshore location for installation. Facilities where platforms are fabricated are called platform fabrication yards. Production operations at fabrication yards include the cutting and welding of steel components and the construction of living quarters and other structures, as well as the assembly of platform components. Fixed platform fabrication can be subdivided into two major tasks: jacket fabrication and deck fabrication.

The jacket is constructed by welding together steel plates and tubes to form a tower-like skeletal structure. Because the height of a jacket is several hundred feet, jackets are made lying horizontally on skid runners. Once the jacket is completed, it is pulled over, maintaining the same horizontal position, to a barge that transports it to an offshore location where the jacket is installed. Along with the jacket is the construction of smaller ancillary structures such as pile guides, boat landings, walkways, buoyancy tanks, handrails, etc. These structures are attached to the jacket while it is still in a horizontal position.

The deck is fabricated separately from the jacket. A typical deck is a flat platform supported by several vertical columns (deck legs). The deck provides the necessary surface to place production equipment, living quarters, and various storage facilities. Once the deck fabrication is completed, it is loaded onto a barge and transported to the site of the platform, where it is lifted by derrick barges and attached to the already installed jacket.

3.3.5.7.2. Offshore Transport

3.3.5.7.2.1. Pipelines

Pipelines are the primary method used to transport a variety of liquid and gaseous products between OCS production sites and onshore facilities around the GOM. These products include unprocessed (bulk) oil and gas; mixtures of gas and condensate; mixtures of gas and oil; processed condensate, oil, or gas; produced water; methanol; and a variety of chemicals used by the OCS industry offshore. As of June 2006, there were more than 37,000 km (22,991 mi) of active OCS pipelines. These pipelines are designated as either trunklines or gathering lines. Gathering lines are typically shorter segments of small-diameter pipelines that transport the well stream from one or more wells to a production facility or from a production facility to a central facility serving one or several leases, e.g., a trunkline or central storage or processing terminal. Trunklines are typically large-diameter pipelines that receive and mix similar production products and transport them from the production fields to shore. A trunkline may contain production from many discovery wells drilled on several hydrocarbon fields. The OCS-related pipelines nearshore and onshore may merge with pipelines carrying materials produced in State territories for transport to processing facilities or to connections with pipelines located further inland. Most of the active length of OCS pipelines transport either gas (59%) or oil (27%).

Over the last 10 years, the average annual installation rate for OCS pipelines was 1,600 km (994 mi) and more than 250 pipelines and pipeline segments. Pipelines in the CPA accounted for 83 percent of the length installed; pipelines in the WPA accounted for 17 percent. The installation rate for pipelines is expected to remain steady; this includes consideration of expansion and replacement of the existing and aging pipeline infrastructure in the GOM.

3.3.5.7.2.2. Service Vessels

Unless otherwise indicated, the following information is from *The Offshore Supply Boat Sector* (Barrett, 2005).

The GOM is a very developed market with ample infrastructure, so there tends to be more boat types than in other international locations. The main types of vessels used in the GOM offshore industry include AHTS's, OSV's, and crewboats. There is a large fleet of offshore tugs (AHTS vessels) whose sole job is to tow rigs from one location to another and to position the rig's anchors. This differs from many international locations, where boats that tow rigs usually serve other functions as well, such as carrying supplies. Offshore supply vessels deliver drilling supplies such as liquid mud, dry bulk cement, fuel, drinking water, drill pipe, casing, and a variety of other supplies to drilling rigs and platforms. The majority of OSV's in service are old, legacy boats built during the boom in the late 1970's/early 1980's. A typical boat from that era is about 180 ft (55 m) long and can carry about 1,200 bbl of liquid mud and about 1,000 tons (dead weight tons) of deck cargo. New generation OSV's are between 220 and 295 ft (67 and 90 m) long and can carry 3-10 times as much liquid mud and 2-4 times as much deck cargo. Typical OSV vessel specifications are shown in **Table 3-31**. Many, but not all, of the new generation OSV's are deepwater capable. Crewboats transport personnel to, from, and between offshore rigs and platforms. These boats are much smaller than the AHTS's or OSV's and can range in size from 75 to 190 ft. The smallest boats are typically used to transport crews between offshore installations and not to and from shore.

There are a variety of other types of vessels used by the oil and gas industry, including the following: utility/workboats that perform a lot of work in support of offshore construction projects; survey vessels that collect geophysical data; well stimulation vessels that perform fracturing and acidizing of producing wells; and multi-purpose supply vessels (MPSV) that can provide a combination of remote subsea intervention services, ROV operations, deepwater lifting and installation, delivery of supplies, fire fighting, and oil-spill recovery.

The GOM has long been one of the busiest supply-boat markets in the world, a direct result of the historical level of oil-field activity that has taken place in the region. The market is highly competitive, and it is estimated that there are over 150 different boat owners operating over 850 boats in the GOM. Tidewater is the dominant company (and the largest supply boat company in the world); however, it has an aging fleet that is losing more and more business to new, next generation vessels. Seacor (the second largest supply boat company in the world) is also a major player in the GOM. Both Seabulk and Trico

Marine also have a significant presence, but like Tidewater, have aging fleets. Edison Chouest Offshore, an early leader in introducing next generation, deepwater capable supply vessels, continues to focus on the Gulf market, as does Hornbeck Offshore, which has the youngest fleet of any significant player in the GOM.

Boat owners in the GOM typically use the spot market to win work rather than using long-term contracts, meaning that the job only lasts as long as the task at hand. Prior to the 2005 hurricane season, day rates had been quite volatile over the last few years and the weaker market had caused many boat owners to leave the market. Heightened activity in the offshore rig market following the 2005 hurricanes has also meant a boom for OSV's. At the end of 2005, with the exception of a handful of vessels at shipyards, every active OSV in the GOM was working. Every vessel owner surveyed indicated that they could immediately put additional vessels to work if any were available (Gulf of Mexico Newsletter, 2005a; 20:11). Day rates are reflecting the tight supply and heavy demand, and some vessel owners feel that they can even name their price in certain situations. In November 2006, OSV owners in the GOM are not working as many OSV's because many of the region's vessels are visiting yards and drydocks for regulatory and routine inspection. Though OSV activity is expected to decline in the winter due to weather and scheduling, the GOM fleet remained working, keeping utilization at essentially 100 percent (Gulf of Mexico Newsletter, (2006c; 21:7). The OSV day rates continue to fall. November's declines in OSV day rates are likely to be repeated as the construction season ends and operators push back some jackup drilling programs. The January 2007 average day rates were as follows: AHTS vessels for $75,000 for over 8,000-hp vessels; supply boats range from $10,490 for boats up to 200 ft (61 m) and $18,035 for boats 200 ft (61 m) and over; and crewboats range from $5,275 for boats under 125 ft (38 m) to $6,575 for boats 125 ft (38 m) and over (Greenberg, 2007). In comparison, the January 2006 average day rates were as follows: AHTS vessels for $60,000 for over 8,000-hp vessels; supply boat ranges from $11,800 for boats up to 200 ft (61 m) and $18,200 for boats 200 ft (61 m) and over; and crewboats range from $4,650 for boats under 125 ft (38 m) to $8,000 for boats over 125 ft (38 m) and over (Greenberg, 2007). As of June 2006, U.S. GOM OSV owners reported that 221 vessels (i.e., every available) were under contract. Operators are seeking long-term commitments, and 1- and 2-year firm deals are becoming more common (Gulf of Mexico Newsletter, 2006d; 20:37). As of January 2007, GOM OSV owners started reporting the lower day rates that they have been predicting. One owner commented, "It took us from July 2005 to September 2006 to get our rates as high as they made it to, and now we are turning around and coughing up 40 to 50 percent of all that in less than 30 days." In particular, platform supply vessels have experienced the majority of the decline (Gulf of Mexico Newsletter, 2007b; 21:15).

For the amount of damage Hurricane Katrina inflicted on the oil and gas industry, the offshore supply vessels operators came out relatively unscathed. Most workboat operators reported little or no damage to their fleets, and many were back at work assessing the damage offshore a few hours after the storm had passed. Many vessel operators had moved their fleets west toward Cameron, Louisiana, and as far as Galveston, Texas (Dupont et al., 2005). Tidewater Inc. reported no damage to its fleet, even though its main headquarters in New Orleans would be uninhabitable for several months. Hornbeck Offshore Services had moved its vessels west to Cameron, Louisiana, and survived the storm. Also, Edison Chouest Offshore's fleet was undamaged. All of L&M Botruc Rental's boats had been moved to Morgan City and some were already in Cameron. And, all went back to work shortly after the storm passed (Dupont et al., 2005).

Shortly after the hurricane, OSV operators were reporting increased demand from operators who were anxious to assess and repair any damage to platforms and rigs. Demand has also come from construction and diving companies that were mobilizing equipment and crews to conduct damage assessments on pipelines. Anchor-handling tugs have been in high demand to reel in floating drilling rigs (Dupont et al., 2005).

The hurricanes of 2005 put an additional premium on offshore supply boats. Tidewater Inc. (New Orleans, Louisiana) has 5 supply vessels and a fast-supply boat under construction; Rigdon (Houston, Texas) ordered 10 platform-supply vessels (PSV) being built at Bollinger Shipyards in Lockport, Louisiana; and Edison Chouest (Galliano, Louisiana) will expand its Gulf fleet with 3 AHTS vessels, 10 new PSV's, and 9 fast-supply vessels (Greenberg, 2006b). According to one construction survey, there were 36 supply boats on order in 2004 and 25 in 2005 (Hocke, 2006). As of June 2006, shipyards along the Gulf Coast are booked solid with at least 37 new offshore supply vessels being built. This, in addition to remaining hurricane-related repair projects, has kept the shipyards operating at full capacity (Greenberg and Krapf, 2006).

3.3.5.7.2.3. Helicopters

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. For small parts needed for an emergency repair or for a costly piece of equipment, it is more economical to get it to and from offshore fast rather than by supply boat. Normal offshore work schedules involve 2-week (or longer) periods with some crew changes on a weekly basis; therefore, helicopters will travel to some facilities at least once a week. According to the Helicopter Safety Advisory Conference (2006), from 1996 to 2003, helicopter operations (take offs and landings) in support of Gulfwide OCS operations have averaged, annually, 1.5 million operations, 3.1 million passengers, and 430,000 flight hours.

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 (304 m) over unpopulated areas and coastlines, and 2,000 ft (608 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 Marine Mammal Protection Act include provisions specifying helicopter pilots to maintain an altitude of 1,000 ft (304 m) within 100 yards (yd) (91 m) of marine mammals.

Many of the platforms offshore Texas, Louisiana, Mississippi, and Alabama serve as helicopter refueling stations. At present, aircraft fuel is barged to these offshore refueling stations. While there are offshore fueling sites, it saves the industry time and money not to stop. Transportation is one of the exploration and production industry’s top three costs. The newer helicopters operating in the GOM, though, have the range and capacity to fly without stopping to refuel, but they are more costly to operate.

Since the tasks the offshore helicopter industry provides are the same tasks supply vessels provide, they are competition for one another. While exploration and production companies like helicopters, the industry is outsourcing more and more operations to oil-field support companies, who are much more cost conscious and skeptical about the high cost of helicopters. Fast boats are beginning to erode the helicopter industry’s share of the offshore transportation business, particularly in shallow water. Another consideration for the helicopter industry is subsea systems. As discussed in **Chapter 3.3.5.7.1**, a subsea system consists of a single subsea well or several wells producing either to a nearby platform or to a distant production facility through pipeline and manifold systems. These systems decrease the number of platforms and personnel needed offshore, therefore reducing the amount of transportation needed.

3.3.5.7.3. Damage to Offshore Infrastructure from Recent Hurricanes

The following information is summarized from reports by MMS on the damage to the OCS-related platforms, rigs, and pipelines caused by Hurricanes Ivan, Katrina, and Rita (USDOI, MMS, 2005c-f and 2006f-j). **Chapter 4.1.3.3.4.2** discusses the cause and volume spills that resulted from recent hurricanes.

Hurricane Ivan (2004)

The MMS estimates that, of the approximately 4,000 structures in the GOM, 150 platforms and 10,000 mi (16,093 km) of pipeline were in the direct path of Hurricane Ivan. The range of damaged facilities included mobile drilling rigs, offshore platforms, producing wells, topside systems including wellheads and production and processing equipment, risers, and pipeline systems that transport oil and gas ashore from offshore facilities. Hurricane Ivan destroyed 7 structures (four 8-pile platforms, two caissons, and one 4-pile platform) and significantly damaged 24 others, primarily 8-pile platforms.

Hurricane Ivan's path brought it across the shelf and through the waters of the Mississippi River Delta, the area most susceptible to underwater mudslides in the Gulf. Thirteen pipelines were damaged because of mudslides, and four additional pipelines with a diameter wider than 10 in were damaged by other forces.

Almost 5 months after Hurricane Ivan, less than 10 percent of oil production and 5 percent of natural gas production remained shut-in. Approximately 98 percent of the major oil and gas platforms in the GOM are now producing. The final report of evacuation and production shut-in statistics, 5 months after Hurricane Ivan, stated evacuations were equivalent to 1.18 percent of 764 manned platforms. The shut-in oil production was equivalent to 7.42 percent of daily production of oil in the GOM, which is approximately 0.64 percent of oil production consumed in the U.S. each day. A few deepwater facilities accounted for 60 percent of the shut-in oil production. The shut-in gas production was equivalent to 1.19 percent of the daily production of gas in the GOM, which is approximately 0.24 percent of the gas production consumed in the U.S. each day. The cumulative shut-in oil production was equivalent to 7.246 percent of the yearly production of oil in the GOM, and the cumulative shut-in gas production is equivalent to 3.871 percent of the yearly production of gas in the GOM.

Hurricanes Katrina and Rita (2005)

Hurricanes Katrina and Rita were both geographically large storms that passed over much of the GOM's offshore oil and gas infrastructure. The MMS estimates that, of the approximately 4,000 structures in the GOM, 3,050 (76%) were in the direct path of either Hurricane Katrina or Hurricane Rita. The latest damage report released by MMS states 113 platforms were destroyed by Hurricanes Katrina and Rita.

The MMS estimates that 22,000 mi (35,405 km) of the 33,000 mi (53,108 km) of Gulf pipelines were in the direct path of either Hurricanes Katrina or Rita (2005). Because of the large amount of infrastructure in the path of hurricane-force winds and waves, the amount of damage was substantial. In comparison with Hurricane Ivan, Hurricanes Katrina and Rita accounted for considerably more damage because of the paths taken by these two devastating storms. Based on additional industry assessments, investigations, and reports, the number of pipelines reported damaged is 457. Of those, 101 were larger diameter pipelines (10 in or greater). As of May 1, 2006, 32 pipelines have returned to service.

As of May 1, 2006, four replacement platforms have been proposed by operators and approved by MMS. These replacement platforms will take the place of eight destroyed platforms with a pre-hurricane daily production of 16,700 bbl per day. While some damaged platforms are back online and some are still under repair, others have been damaged beyond repair. Recently, Chevron announced that it would sink its $250 million Typhoon oil platform that was damaged by Hurricane Rita. The Typhoon platform will be donated to a Federal program that uses decommissioned platforms and rigs to create new reefs on the seafloor (Bloomberg.com, 2006).

Over 90 percent of the manned platforms and over 85 percent of the working rigs were evacuated for the hurricanes. The latest report of evacuation and production shut-in statistics, 10 months after Hurricanes Katrina and Rita, stated evacuations were equivalent to 8.30 percent of manned platforms. This report also stated the shut-in oil production is equivalent to 11.998 percent of the daily oil production in the GOM, and shut-in gas production is equivalent to 9.357 percent of the daily gas production. The cumulative shut-in oil production was equivalent to 30.377 percent of the yearly production of oil in the GOM, and the cumulative shut-in gas production is equivalent to 22.017 percent of the yearly production of gas. As of October 1, 2006, additional production has come back online as evidence by the Mars platform, with current production figures of 124.5 million barrels of oil per day (MBOPD) and 133 million cubic feet per day (MMCfd).

Hurricane-Related Notices to Lessees and Operators

The effects of Hurricanes Ivan, Katrina, and Rita were detrimental to oil and gas operations on the OCS. These effects included structural damage to fixed production facilities, semisubmersibles, jack-ups, and pipelines. The MMS provides hurricane damage assessments, safety alerts, NTL's, and evacuation and production shut-in statistics at http://www.gomr.mms.gov/homepg/whatsnew/hurricane/index.html.

The MMS issued NTL 2005-G20, "Damage Caused by Hurricanes Katrina and Rita," to describe the inspections that needed to be conducted and the plans and reports that needed to be prepared because of the known and potential damage to OCS facilities caused by Hurricanes Katrina and Rita. This NTL superseded NTL 2005-G16 and became effective October 24, 2005. The MMS issued NTL 2005-G20 (Addendum No. 1), effective June 12, 2006, which supplements NTL 2005-G20 by extending the deadlines for conducting damage inspections, submitting inspection results, and completing any repairs. Also, the NTL specifies the contents of monthly inspection and status reports.

The 2004 and 2005 hurricanes did not cause any loss of life on the OCS because of industry's ability to secure wells and evacuate personnel successfully. Under 30 CFR 250.192, operators must submit statistics to MMS on the evacuation of personnel and curtailment of production because of hurricanes, tropical storms, or other natural disasters. Regulations require operators to

(a) submit the statistics by fax or email as soon as possible when evacuation occurs;

(b) submit statistics on a daily basis by 11:00 a.m., as conditions allow, during the period of shut-in and evacuation;

(c) inform MMS when production resumes; and

(d) submit statistics either by MMS district or the total figures for operations in the GOMR.

The MMS uses these data to work interactively with the USCG on rescues and oil spills, and to notify the news media and interested public entities that monitor shut-in production. Effective October 25, 2006, NTL 2006-G19, "Hurricane and Tropical Storm Evacuation and Production Curtailment Statistics," provides guidelines for submitting this information, and it also provides for statistics regarding the number of platforms and drilling rigs not evacuated.

During Hurricanes Ivan, Katrina, and Rita, 9 jack-up rigs and 19 moored rigs experienced a total failure of station-keeping ability. The MMS GOMR is concerned about the loss of these facilities and rigs as well as the potential for catastrophic damage to key infrastructure and the resultant pollution from future storms. In an effort to reduce these potential effects, MMS 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 MMS worked together to develop interim recommended practices for the use of jack-up and moored rigs during the 2006 hurricane season to potentially decrease the amount of failures during hurricanes. The MMS issued NTL 2007-G19, "Moored Drilling Rig Fitness Requirements for the 2007 Hurricane Season," and NTL 2007-G13, "Jack-up Drilling Rig Fitness Requirements for the 2007 Hurricane Season." These NTL's provide guidance on the information operators must submit with APD's to demonstrate the fitness of any jack-up or moored drilling rig used to conduct drilling, workover, or completion operations in the GOM OCS during the 2006 hurricane season. The MMS expects to update its hurricane-related NTL's with each new hurricane season.

Studies

Following Hurricanes Andrew, Lili, Ivan, Katrina, and Rita, MMS funded numerous studies to understand better the effects of these storms on the environment and on the Gulf's infrastructure. **Appendix B** provides a listing of the hurricane-related studies and their objectives. Examples of the study topics include the following: the damage to structures and pipelines; assess the actual wind, wave, and current forces that were present; determine the effectiveness of current design standards and pollution-prevention systems; and develop recommended changes to industry standards and MMS regulations, if needed. The majority of these studies on Hurricanes Andrew, Lili, and Ivan have been completed, but studies of Hurricanes Katrina and Rita are still in progress and will be made public upon their completion. Results from these studies will help MMS, and the industry that it regulates, to prepare better for these natural events.

3.3.5.8. OCS-Related Coastal Infrastructure

Unless otherwise indicated, the following information is from the MMS study, *Deepwater Program: OCS-Related Infrastructure in the Gulf of Mexico Fact Book* (Louis Berger Group, Inc., 2004).

The OCS development is supported by a large onshore infrastructure industry consisting of thousands of small and large contractors responsible for virtually every facet of the activity, including supply, maintenance, and crew bases. These contractors are hired by majors and independents alike to service production areas, provide material and manpower support, and to repair and maintain facilities along the coasts. The offshore support industry employs thousands of workers and is responsible for billions of dollars in economic activity in the analysis area. Virtually all of these support industries are found adjacent to ports.

For over a half century, the fabrication industry in the analysis area has been the cornerstone for the offshore oil and gas industry and a major contributor to the industry's labor demand. There are hundreds of onshore facilities in the analysis area that support the offshore industry. The fabrication corridor stretches approximately 1,000 mi (1,609 km) from the Texas/Mexico border to the Florida Panhandle. Other offshore support industries are responsible for such products and services as engine and turbine construction and repair, electric generators, chains, gears, tools, pumps, compressors, and a variety of other tools. Additionally, drilling muds, chemicals, and fluids are produced and transported from onshore support facilities. Many types of transportation vessels and helicopters are used to transport workers and materials to and from OCS platforms. As technology matures, additional support industries will evolve.

With the expanding interest in deepwater activities, many onshore facilities have migrated somewhat to areas that have capabilities of handling deepwater vessels, which require more draft. Since fewer ports have such access, dredging operations at existing facilities or contractor expansion to areas that can handle such vessels has occurred. This has also led to heated competition between port facilities. Many support industries have multiple locations among the key port facilities. For instance, Bollinger Shipyards has locations in Texas City, Texas, and Calcasieu, Morgan City, Lockport, Larose, Fourchon, Gretna, St. Rose, and Algiers, Louisiana (Bollinger, 2006).

Shipbuilding and repair facilities are located in key ports along the Gulf Coast. A typical shipbuilding facility consists of a variety of structures, including maintenance and repair facilities. These yards are typically found adjacent to a deep ship channel that allows them to serve deepwater vessels. Additionally, these facilities also serve other commercial and military needs in order to diversify and protect themselves against leaner oil industry times.

The marine construction industry is highly competitive. Competition is influenced by such factors as price, availability and capability of equipment and personnel, and reputation and experience of management. Conblocks for work in the GOM are typically awarded on a competitive bid basis 1-3 months before execution of the project. Customers usually request bids from companies they believe are technically qualified to perform the project. Although customers consider, among other things, the availability and technical capabilities of equipment and personnel, the condition of equipment, and the efficiency and safety record of the contractor, price is the primary factor in determining which qualified contractor is awarded the contract. Because of the lower degree of complexity and capital costs involved in shallow-water marine construction activities, there are a number of companies with one or more pipelay barges capable of installing pipelines in shallow water.

Companies that compete in the GOM pipelay market in water depths of 200 ft (61 m) or less are Horizon Offshore, Inc. (Horizon), Global Industries, Ltd. (Global), Cal Dive International, Inc. (Cal Dive), Chet Morrison Contractors, Inc. and a few smaller competitors. Horizon, Global, and Cal Dive also compete in water depths between 200 and 1,000 ft (61 and 304 m) (Horizon Offshore Inc., 2005). In the beginning of 2005, the number of pipelaying vessels in the GOM decreased, contributing to the remaining vessels' utilization. Global deployed vessels from its operations in the Gulf to perform work in international areas, and Torch Offshore, Inc. filed a voluntary petition for reorganization under Chapter 11 of the U.S. Bankruptcy Code in January 2005, temporarily removing its vessels and equipment from service.

As a result of these events, and coupled with the unprecedented hurricane and storm activity in the GOM during 2004 and 2005, vessel utilization during 2005 has significantly increased for companies like Horizon and CalDive. More recently, however, additional vessels have been mobilized in the Gulf. And, the demand for pipelay services is currently exceeding the availability of assets and equipment capable of satisfying such demand. It is anticipated that vessel utilization in the U.S. Gulf of Mexico will remain at high levels during 2006 and 2007.

Other support facilities are located near ports, including warehouses for chemicals, muds, tools, and other equipment. Crew quarters and bases are also near ports, but some helicopter facilities are located farther inland. Transportation to and from offshore rigs is a major expense for producers, and many transportation companies exist to provide this service. Often one or two supply vessels and at least one helicopter are used to support each platform.

Like onshore development, OCS exploration and production is driven by oil and gas prices. The 1986 collapse of oil prices forced many offshore companies to close their doors, while the remaining companies often consolidated and expanded operations to include commercial and military business. This was true throughout the entire supporting industry infrastructure.

During slow times, all areas feel the effects. Fewer rigs are built and maintained, fewer boats are needed, fewer chemicals are manufactured and purchased, and much less research and development (R&D) is conducted. Perhaps the most detrimental result of a downturn is the flight of many experienced personnel. This has led to severe problems for an industry closely tied to the price volatility of oil and natural gas. When experienced workers leave it is very difficult to entice them back to an industry that is so volatile.

One of the results of fewer R&D dollars is that producers, who are saddled with billion dollar projects, are forced to push much of the R&D expenditures for new technologies onto their suppliers. For example, it is common to see many suppliers shoulder the burden of seismic surveys today. Unfortunately, no single company can adequately fund and support such activities. It is important to realize that new technologies have led to the development of previously unrecognized, unreachable, or uneconomic reserves, which often lead to significant work for the onshore support industry.

Following the massive shift in the industry in the mid-1980's, subsequent price downturns have not been as decimating to the industry, though the 1998-1999 price drop did force companies to lay off employees and to close a few facilities. Drilling declined significantly but did not cause the massive contractor flight evidenced in the mid-1980's. During this downturn, activity shifted somewhat to platform removal, maintenance, renovations, and rig surveys. Some fabrication yards diversified in order to keep their doors open, often taking in non-oil-related work such as barge repair and even military work.

The move into deep water has increased activity and has led to a significant transformation for some contractors. Since ports with sufficient draft to accommodate deepwater-servicing equipment are limited, onshore effects appear to be concentrated in a few communities. This contrasts with earlier, nearer-shore developments that are supported by many ports and coastal communities.

The hurricanes of 2005 impacted every facet of the GOM oil and gas industry—from platform fabrication yards and service bases, to production platforms and drilling rigs, to processing facilities and deliveries to end-users, and everything in between. The impacts to the different sectors and facilities are detailed in the individual sections below. However, one of the most important findings of these sections is that, despite the amazing degree of destruction, these sectors, in large part, were able to recover relatively quickly and most are operating at or near pre-hurricane levels. Hurricane Ivan in 2004 also affected OCS-related coastal infrastructure, although the impact was much less severe in terms of the number of facilities affected and the overall damage.

3.3.5.8.1. Service Bases

Unless otherwise indicated, the following information is from the 2004 MMS study, *OCS-Related Infrastructure in the Gulf of Mexico Fact Book* (Louis Berger Group, Inc., 2004).

A service base is a community of businesses that load, store, and supply equipment, supplies, and personnel that are needed at offshore work sites. Although a service base may primarily serve the OCS planning area and EIA in which it is located, it may also provide significant services for the other OCS planning areas and EIA's.

The oil and gas industry has thrived in the GOM. With the industry has come a logistical support system that links all phases of the operation and extends beyond the local community. Land-based supply and fabrication centers provide the equipment, personnel, and supplies necessary for the industry to function through intermodal connections at the Gulf Coast ports. The necessary onshore support segment includes inland transportation to supply bases, equipment manufacturing, and fabrication. The offshore support involves both waterborne and airborne transportation modes.

States along the GOM provide substantial amounts of support to service the oil and gas industry that is so active on the OCS (**Figure 3-13**). Many ports offer a variety of services and support activities to assist the industry in its ventures. Personnel, supplies, and equipment must come from the land-based support industry. All of those services must pass through a port to reach the drilling site. **Table 3-32** shows the 50 service bases currently used for the OCS. These facilities were assessed from the MMS Platform Plans' primary service base designation. As can be seen from **Table 3-32**, 33 of the service bases (or 66%) are located adjacent to the CPA. Of these, 29 reside in Louisiana. In addition to servicing the offshore, several of the services bases are commercially oriented ports: Mobile, Alabama; Pascagoula, Mississippi; Lake Charles, Morgan City, and Port of Plaquemines/Venice, Louisiana; and Corpus Christi, Freeport, Galveston, and Port Arthur, Texas. The other service bases are a combination of local recreation and offshore service activity. Seven ports in Alabama, Mississippi, and Louisiana are expected potential service bases for activities resulting from proposed Lease Sale 224: Mobile and Theodore, Alabama; Pascagoula, Mississippi; and Grand Isle, Morgan City, Port Fourchon, and Venice, Louisiana. Four of the seven current service base ports, i.e., Mobile, Theodore, Morgan City, and Pascagoula, are commercially oriented. The other three ports are a combination of local recreation and offshore service activity. Two Florida ports—Panama City and Pensacola—could potentially act as service bases because of their location, but they are less likely candidates given that neither currently supports offshore activities. (Prior to 2002, Panama City served as a port supporting construction of an offshore pipeline from Mobile, Alabama, to Tampa, Florida, which is now completed.) The size of proposed Lease Sale 224 is likely too small to warrant signing long-term leases in new port areas when there are seven much better-situated staging areas already servicing the offshore industry (Dismukes, personal communication, 2007).

The extensive network of supply ports includes a wide variety of shoreside operations from intermodal transfer to manufacturing. Their distinguishing features show great variation in size, ownership, and functional characteristics. Basically, two types of ports provide this supply base. Private ports operate as dedicated terminals to support the operation of an individual company. They often integrate both fabrication and offshore transport into their activities. Public ports lease space to individual business ventures and derive benefit through leases, fees charged, and jobs created. These benefits spread throughout the entire area and are viewed as economic development impacts. Thus, the public ports play a dual role by functioning as offshore supply points and as industrial or economic development districts. An efficient network of ports lowers costs associated with oil and gas production and significantly boosts the well-being of citizens of the adjacent communities.

The significant prosperity that has followed the industry has resulted in issues and concerns that must be addressed at the local community level. For example, additional commercial traffic associated with offshore supplies has caused worsening of the conditions of LA Hwy 1, which is the only highway leading to Port Fourchon. 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. Local tax dollars cannot meet the many demands for improvements when they are needed in short timeframes. State and Federal matching funds are sought where possible, but the acquisition of those funds often has built-in delaying factors. Nevertheless, communities are attempting to meet the demands of the offshore industry. Thus, the oil and gas industry is determining the direction and scope of improvements being made at local levels. Communities, just like the ports, must be able to anticipate future demands for their services. In order to plan for this growth, communities need timely information about trends in the industry. The Energy Policy Act of 2005 created CIAP, which, among other things, can fund onshore infrastructure projects that mitigate the impacts of OCS activities. See **Chapter 2.1.2** for a discussion on mitigation measures.

Rapidly developing offshore technology has placed an additional burden on service-base ports. As OCS operations have progressively moved into deeper waters, larger vessels with deeper drafts have been phased into service, mainly for their greater range of travel, greater speed of travel, and larger carrying capacity. Services bases with the greatest appeal for deepwater activity have several common characteristics: a strong and reliable transportation system; adequate depth and width of navigation channels; adequate port facilities; existing petroleum industry support infrastructure; a location central to OCS deepwater activities; adequate worker population within commuting distance; and an insightful strong leadership. Typically, deeper draft service vessels require channels with depths of 6-8 m.

Edison Chouest, in 1996, built their C-Port facility in Fourchon, Louisiana, as a one-stop shopping service base for the offshore. The success of the C-Port as well as recent port expansions has caused Port Fourchon to emerge as the deepwater service-base port for the OCS. Shortly after C-Port opened in 1997 it was "busting at the seams" with activity and more space was needed. C-Port 2 was constructed in three phases, with the first to open in 1999 and the last completed in 2004 (DeLuca, 2005).

While some service bases only suffered minimal damage from Hurricanes Katrina and Rita, others did not fare so well. The Port of New Orleans and the Port of South Louisiana both were able to resume limited operations shortly after Hurricane Katrina. The Port of New Orleans suffered extensive damage, yet by the end of March 2006, approximately 70 percent of the Port of New Orleans was operational and 85 percent of workers had returned. Officials at the Port of South Louisiana assessed the damage at approximately $2 million (Louisiana Hurricane Resources, 2006). Port Fourchon suffered both wind and water damage during both hurricanes. It took on 2-8 ft (0.6-2.7 m) of water in both hurricanes and suffered $7 million in damage. However, within a week of the storm, the port was approaching 35-45 percent of pre-Katrina activity, and after a month it was at 90 percent (Russell, 2006).

Of the ports in Louisiana that service the offshore oil and gas industry, the Ports of Venice and Cameron were the hardest hit and took the longest to return to near normal operation levels. However, as of late August 2006, all of the U.S. Gulf Coast seaports impacted by Hurricanes Katrina and Rita have returned their operations to or near what they were before the storms hit (Dismukes, personal communication, 2006). Although operations at Venice are nearly back to normal, as of March 2007, the surrounding community still does not have adequate housing, grocery stores, or restaurants to support the 1,500-2,000 employees that work at the port. The surrounding community in Cameron is experiencing similar problems. Hence, most companies at the port are operating as if the port were an offshore facility, providing housing and three meals a day while employees work typical offshore schedules such as 7 days on/7 days off or 14 days on/7 days off to allow for long commutes. This is resulting in increased operating costs for the service companies. In addition, the companies located at Cameron are facing increased challenges (and operating costs) as a result of sedimentation of the Cameron Loop (or Monkey Island Loop) from Hurricane Rita. Originally dredged to 26 ft (8 m), some areas are now only 12-17 ft (4-5 m) deep, severely limiting the size of ships that can safely navigate those waters (Broussard, personal communication, 2006). As a result, some companies have relocated to areas outside the Cameron Loop, while some of the companies that stayed are using smaller boats that need to make more trips to provide the same level of service. Although the companies are able to absorb the increased operating costs (and pass some portion of them on to their customers) in the current economic environment of the industry, it remains to be seen how long they can continue to operate profitably under these conditions. As a result, the port would like to get the Cameron Loop dredged, at a minimum back to the original 26 ft (8 m) and ideally to a depth of 35 ft (11 m) to allow for deepwater access to service deepwater drilling and production.

As the industry continues to evolve so do the requirements of the onshore support network. With advancements in technology, the shoreside supply network continues to be challenged to meet the needs and requirements of the industry and will be challenged in the future. All supplies must be transported from land-based facilities to marine vessels or helicopters to reach offshore destinations. This uses both water and air transportation modes. The intermodal nature of the entire operation gives ports (that traditionally have water, rail, and highway access) a natural advantage as an ideal location for onshore activities and intermodal transfer points. Therefore, ports will continue to be a vital factor in the total process and must incorporate the needs of the offshore oil and gas industry into their planning and development efforts, particularly with regard to determining their future investment needs. In this manner, both technical and economic determinants influence the dynamics of port development.

The following are profiles of three ports that are significantly involved in offshore support and could service activity in the Lease Sale 224 area. These profiles are representative of OCS supply/crew bases. An effort has been made to describe their operational structure as well as to describe their facilities and equipment. However, to continue to offer a viable service and to stay current with technological trends and industry standards, ports must be able to incorporate offshore oil and gas trends into their planning for future infrastructure development, staffing needs, and other impacts associated with rapid industrial growth.

Morgan City, Louisiana

The Port of Morgan City is located within the community of Morgan City in St. Mary Parish, Louisiana. With immediate access to I-49, it is 1 hour away from New Orleans, Lafayette, and Baton

Rouge. Two thousand linear feet of rail spur and 1,500 linear feet of sidings connect the port warehouses with Burlington Northern mainline. Daily rail service is provided by Burlington Northern. The port was created in 1952. Since 1957, it has been active in both domestic and international trade. It is governed by a nine-member Board of Commissioners, who are appointed by the Governor and serve for a 9-year term. Morgan City is the only medium draft harbor between New Orleans and Houston on the Gulf. Its 400-ft (122-m) wide channel is maintained by the U.S. Army Corps of Engineers to a constant depth of 20 ft (6 m) (EconSouth, 2004). Its docking and cargo handling facilities serve a wide variety of medium draft vessels.

Centrally located along the Gulf Coast, the port is only 18 mi (29 km) from the open waters of the GOM at the intersection of the Gulf Intracoastal Waterway (GIWW) and the Atchafalaya River. It is on the east bank of the Atchafalaya River in a natural wide and deep harbor known as Berwick Bay. The Atchafalaya River, the GIWW, and Bayous Boeuf, Black, and Chene are the connections to traffic throughout the continental U.S. and abroad. The Atchafalaya River flows southward a distance of 135 mi (217 km) and empties into the Atchafalaya Bay. Traffic between points in the southwest U.S. and the Upper Mississippi River Valley saves approximately 342 mi (550 km) per round trip by using the Atchafalaya River rather than the alternate link of the GIWW via the Harvey Locks at New Orleans.

The port is suitable to handle container, general, and bulk cargo. There are over 200 private dock facilities located in the Morgan City vicinity, most of which are oil and gas related. The port's facilities include heavy-lift, barge-mounted cranes with capacities to 5,000 tons, track cranes to 300 tons, and mobile cranes to 150 tons (Port of Morgan City, 2006a). Its facilities include an 800-ft (244-m) dock, a 20,000 ft^2 (1,858 m^2) warehouse with rail access, a large marshalling yard, a 50-ton capacity mobile track crane, and a 40-ton, top-lift container stacker (Port of Morgan City, 2006b).

Port Fourchon, Louisiana

Port Fourchon, Louisiana, is located at the mouth of Bayou Lafourche where it empties into the GOM. It is approximately 60 mi (97 km) south of New Orleans. Its easy accessibility from any area in the GOM has made it one of the most active oil and gas ports on the coast. Port Fourchon's location at the end of LA Hwy 1 is in the center of one of the richest and most rapidly developing industrial areas of the Gulf region. While the growth of other ports has slowed, Port Fourchon has been expanding to meet the changing needs of the offshore oil-field industry. Port Fourchon has been designated as one of Louisiana's Enterprise Zones and therefore offers many tax advantages. Its close proximity to the GOM, along with its planned development and multidimensional services, makes Port Fourchon one of the most significant oil and gas ports on the Gulf Coast.

The development and supervision of Port Fourchon is under the authority of the Board of Commissioners of the Greater Lafourche Port Commission (GLPC) with headquarters in Galliano, Louisiana. The Commission is composed of nine members who are elected to serve 6-year terms. Established in 1960, the GLPC Board is the only elected port authority in Louisiana and its members must be at least 21 years of age and residents of the 10th Ward of Lafourche Parish, Louisiana. The Commission regulates commerce and vessel traffic within the Port Fourchon area, owns land and lease facilities, establishes 24-hr law enforcement through its Harbor Police Division, maintains paved roads, and provides facilities for governmental coordination such as the U.S. Customs Service and U.S. Coast Guard. Over its 50-year history, the GLPC has cultivated opportunities for businesses and steady economic growth for Port Fourchon and the surrounding area.

Port Fourchon is a multiuse port primarily servicing the needs of oil and gas development. Major tenants of the port include companies that provide logistics support, drilling fluids, food services, rig repair and construction, and helicopter transportation. Over 95 percent of tonnage handled at the port is oil and gas related. The port also serves as the land base for the Louisiana Offshore Oil Port (LOOP). Other uses include commercial fishing, recreation, and shipping (Greater Lafourche Port Commission, 2006a).

Port Fourchon has become the primary service base for OCS deepwater drilling. The port currently serves over 75 percent of the GOM's deepwater oil production (Greater Lafourche Port Commission, 2006b). Its location gives it an unparalleled advantage in that it is farther south than any other base in Louisiana. And, with a channel depth of 23 ft (7 m) and width of 300 ft (91 m), the port atblocks a substantial amount of drilling rig repair and refurbishing business. Today the port covers an area of nearly 1,300 ac (526 ha) (Paganie, 2006a). To respond to the increased developments in deepwater drilling, the port has been expanding. Construction began in 2001 on Phase 1 of the Northern Expansion area. Phase 1 is a 700-ac (283 ha) site with 21,000 linear feet of water frontage, 700-ft (213-m) wide slips, and a major rig repair facility. Further expansion plans are for Fourchon Island. Plans include dredging a 50-ft (15 m) channel to extend 6.5 mi (10.5 km) into open waters to further accommodate rig repair and refurbishment. The port has grown at a phenomenal rate because of the growth in the oil and gas industry and its development in the deepwater areas of the GOM (Paganie, 2006a; Greater Lafourche Port Commission, 2006c). Specifically, the port has grown from 2 to 160 companies in the past two decades. Most of that growth has occurred since 1995 when the Port was less than one-third of its current size (Louisiana Sea Grant, 2006b).

The port is connected to the GIWW via Bayou Lafourche, the Houma Navigation Canal, and the Barataria Waterway. The port also houses a large number of docks with crane service, loading/unloading equipment, warehouses, refrigerated warehouse, and numerous storage yards. Improved and unimproved property is available.

While location on the GOM is an advantage to Port Fourchon, the flood-prone, 2-lane LA Hwy 1 is a major impediment for the port. However, the Louisiana DOTD is preparing design and rights-of-way acquisition plans for the construction of a 17-mi (27.3-km) elevated 4-lane highway from Golden Meadow to Port Fourchon. The new highway is expected to open in January 2008 (Paganie, 2006a).

Port Fourchon serves a significant portion of the GOM offshore oil and gas industry. And, after the hurricane damages to the ports of Cameron and Venice, this share increased dramatically. “Rather than highlighting the port's vulnerabilities, Hurricane Katrina elevated Port Fourchon's importance. The port took a relatively small blow from both Hurricanes Katrina and Rita. But the two storms severely hit Louisiana energy ports in Venice and Cameron, forcing service companies there to relocate to Port Fourchon” (Russell, 2006). Although other ports are open and accessible, such as Morgan City, Galveston, or New Orleans, Port Fourchon provides the only port in Louisiana with direct access to the GOM. **Chapter 3.3.5.2** also discusses the port and its conditions, including hurricane impacts.

Port of Mobile, Alabama

With its deepwater seaport facilities at the Port of Mobile, the Alabama State Docks is conveniently located on the Central GOM. It is closer to open water than any other major port on the Gulf. Although, there has been commerce in and out of the Port of Mobile since the early part of the 17th century, it was not until 1826 that the U.S. Congress authorized money for the development of a navigable channel in Mobile Bay. The current navigation channel, maintained by the U.S. Army Corps of Engineers, provides a navigational depth of 45 ft from the GOM to the mouth of the Mobile River. Four trunkline railroads (Burlington Northern/Santa Fe, CSX, Illinois Central, and Norfolk Southern) serve the port, which is situated at the intersection of two major interstate highways. The State offers 1,500 mi (24,151 km) of navigable inland barge routes and is served by the Tennessee-Tombigbee Waterway, which connects 16,000 mi (25,750 km) of interstate barge lanes with the Port of Mobile.

For the first 200 years of its existence, the Port of Mobile did not have a central organization to guide the development and operation of the port. In 1922 the State Docks Commission was established with the power to build, operate, and maintain wharves, piers, docks, quays, grain elevators, cotton compresses, warehouses, and other water and rail terminals, structures, and facilities. Since that time, the Alabama State Docks have been a part of Alabama State government and functions as an independent department with a board of directors. Today, the Department operates as a self-supporting enterprise agency of the Executive branch of State government.

In 2004, the economic impact to the State of Alabama was over $3 billion statewide. Tax payments of $467 million were made from activities in the international trade sector. And most importantly, the Alabama State Docks supports the jobs of more than 118,000 Alabamians (Alabama State Port Authority, 2006a).

The port offers 27 general cargo berths where ships can load to a draft of 40 ft (12 m). Berth 2 at the southern end of the main complex has a newly paved 16-ac (6.5-ha) container yard. Located in the Theodore industrial complex on Mobile Bay at the entrance of Theodore Ship Channel is the Mobile Middle Bay Port, comprised of 13 new buildings and 200 ac (81 ha) of prime waterfront property. The property has a two-sided, 600-ft (183-m) pier and offers more than 240,000 ft^2 (2.2 ha) of covered space on a 40-ft (12-m) channel depth. And, on the turning basin of Theodore Ship Channel, a new Marine Liquid Bulk Terminal was dedicated in May 2000. It has a 1,100-ft (335-m) pier that can accommodate ships up to 850 ft (259 m) in length with 125-ft (38-m) beam and a 400-ft (122-m) or two 300-ft (91.4-m) barges. The terminal is capable of allowing four vessels to dock at one time because of its pier jetty design. A major safety feature is a laser approach monitoring system, allowing pilots to better monitor speed and angle for a safer vessel docking (Alabama State Port Authority, 2006b).

3.3.5.8.2. Navigation Channels

Unless otherwise indicated, the following information is from the 2004 MMS study, *OCS-Related Infrastructure in the Guld of Mexico Fact Book* (Louis Berger Group, Inc., 2004). **Table 3-30** identifies the waterways and their maintained depth, while **Figure 3-11** shows their locations throughout the analysis area. In addition to OCS activities, navigation waterways also attract recreational and commercial developments along their banks. These developments are generally dependent upon the water resources or transportation that those waterways make accessible.

3.3.5.8.3. Helicopter Hubs

Helicopter hubs or "heliports" are facilities where helicopters can land, load and offload passengers and supplies, refuel, and be serviced. These hubs are used primarily as flight support bases to service the offshore oil and gas industry. Most of the OCS-related helicopter trips originate at helicopter hubs in coastal Texas and Louisiana. There are approximately 247 heliports within the Gulf region that support OCS activities; 122 are located in Texas, 81 in Louisiana, 34 in Florida, 6 in Mississippi, and 4 in Alabama (Louis Berger Group, Inc., 2004). Based on proximity to service bases and simple straight-line, shortest distance to the proposed Sale 224 area, MMS anticipates industry would use helicopter hubs in southeastern Louisiana, Mississippi and Alabama. Three helicopter companies dominate the GOM offshore helicopter industry: Bristow Group (formerly Offshore Logistics), Era Aviation (Era), and PHI (formerly Petroleum Helicopters, Inc) (U.S. Securities and Exchange Commission, 2005a). These top three providers account for nearly 80 percent of the aircraft available in the Gulf (U.S. Securities and Exchange Commission, 2005b).

Offshore helicopter business volume is linked to drilling activity, which is, in turn, tied to the price of oil. When there is more cash flowing in the oil and gas industry, there is more drilling and therefore more helicopter trips (Craig, personal communication, 2001). As discussed in **Chapter 3.3.5.2**, because of the low price of oil (as low as $10/bbl) during 1998-1999, the offshore oil and gas industry experienced a slowdown that resulted in a slowdown for the helicopter industry. During this time the oil and gas industry merged, consolidated, and formed alliances. And, instead of running their own fleets, many oil and gas companies contract helicopter support companies to service their offshore rigs. Therefore, during this downturn in the late 1990's helicopter services to the offshore oil and gas industry also declined. In the early 1990's, 75-80 percent of PHI's operating revenues were generated by oil and gas transportation services in the GOM (U.S. Securities and Exchange Commission, 1994). This number has declined to just 62 percent in 2004 and 60 percent in 2005 (U.S. Securities and Exchange Commission, 2005c). To balance revenues, many helicopter transportation service companies have diversified over the years. For instance, PHI also provides air medical transportation services for hospital and emergency service agencies. The share of PHI's operating revenues from these services has increased from 17 percent in 2003 to 31 percent in 2005 (U.S. Securities and Exchange Commission, 2005c).

Each of these offshore helicopter support companies depend on a small number of customers for a significant portion of their revenues. Often, contracts are entered with customers for terms of at least 1 year, and often, additions to the fleet will be covered or allocated to a specific company contract. The PHI's largest customer provides the company with 14 percent of its operating revenues (U.S. Securities and Exchange Commission, 2005c). Era Aviation's (now a division of Seacor) 10 largest customers account for 45 percent of its operating revenues (U.S. Securities and Exchange Commission, 2005c). And, 48 percent of Bristow's operating revenue comes from its top 10 customers (U.S. Securities and Exchange Commission, 2005d). The loss of any one customer could materially affect any company's operations.

The outlook for the helicopter transportation industry is favorable as prices for oil and gas climb and production in the GOM is expected to increase. The offshore helicopter business has been improving.

PHI's operating revenues for 2005 were $39.5 million higher than 2004, an increase of 22 percent (U.S. Securities and Exchange Commission, 2005c). This increase is attributed to an increase in flight hours in the GOM and an increase in contracted aircraft. Deepwater drilling, which is farther offshore, is also a growth area for helicopters. In 2000, about 35 percent of PHI's business is in support of deepwater oil and gas activities. This number is expected to increase (Persinos, 2000).

To meet the demands of deepwater (travel further and faster, carry more personnel, all-weather capabilities, and the need for lower operating costs), the offshore helicopter industry is purchasing new helicopters. For example, Bristow recently acquired 15 new medium-sized helicopters from Sikorsky Aircraft Corporation. Of these 15, 6 were delivered in FY 2004, 4 in FY 2005, 2 in the first half of FY 2006 and 1 is expected in 2007. In addition, the contract with Sikorsky was amended to acquire 32 additional medium-sized helicopters between 2007 and 2013 (U.S. Securities and Exchange Commission, 2005b). The PHI also has deliveries scheduled for FY 2006 and FY 2007 for 3 additional transport category aircraft and 24 additional medium and light aircraft for service in the GOM (U.S. Securities and Exchange Commission, 2005c). The helicopters operating in the GOM have travel ranges up to 450 nmi, can attain speeds over 200 mph, carry up to 20 passengers, and may cost $10 million or more.

While some heliports located farther inland have closed or consolidated, some heliports are expanding or opening due to more of the industry's work being farther offshore. Air Logistics (now Bristow Group) opened a 90-ac (36.4-ha) facility in Galliano, Louisiana, in 2004. The site features more than 33,000 ft^2 (0.3 ha) of ramp area with 28 helipads to provide improved access to operations in the GOM (Kammerzell, 2004). And, in 2001, Era Aviation expanded it base in Venice, Louisiana, to take advantage of deepwater market opportunities (Sullivan, 2004; Kelly, 2000).

All three GOM dominant offshore helicopter companies saw an increase in operations and revenues in the months after Hurricanes Katrina and Rita. Bristow Group stated that current activity levels in the GOM are at or near all-time highs (U.S. Securities and Exchange Commission, 2006).

3.3.5.8.4. Construction Facilities

Unless otherwise indicated, the following information is from the 2004 MMS study, *OCS-Related Infrastructure in the Gulf of Mexico Fact Book* (Louis Berger Group, Inc., 2004).

Platform Fabrication Yards

Platforms are fabricated onshore then towed to an offshore location for installation. Facilities where platforms are fabricated are called platform-fabrication yards. Production operations at fabrication yards include cutting and welding of steel components, construction of living quarters and other structures, as well as assembling platform components. There are 43 platform fabrication yards located in the analysis area. **Table 3-33** shows the distribution of platform fabrication yards by State. Most of the yards are located in Louisiana (31). Major fabrication yards in the analysis area include Atlantic Marine, Friede Goldman, Gulf Island Fabricators, J. Ray McDermott, and Unifab International. In early 2000, platform fabrication yards were facing a difficult market with low volumes and low margins. Competition from companies within the GOM as well as overseas was causing every project to be bid very aggressively (Hull, 2002). However, as activity in the GOM has been increasing and the number of projects slated for deep water increases, platform fabrication yards are feeling the impact (*Natural Gas Week*, 2005). One company increased its number of workforce by 250 employees after landing a contract to build two platforms. Even before the hurricanes of 2005, fabrication yards were already busier than the previous year (*Natural Gas Week*, 2005).

The location of platform fabrication yards is tied to the availability of a navigable channel sufficiently large to allow for towing of bulky and long structures such as offshore drilling and production platforms. Thus, platform fabrication yards are located either directly on the coast of the GOM or inland, along large navigable channels, such as the Intracoastal Waterway. Average bulkhead depth for water access for fabrication yards in the Gulf is 15-20 ft (4.6-6.1 m) (*Offshore*, 2000). Most fabrication yards in the analysis area are located along the Intracoastal Waterway and within easy access to the GOM. At least 12 of these plants have deep channel access to their facilities, which allows them to easily handle deeper draft vessels required in deepwater.

For the most part, each yard has a specialty, whether it is the fabrication of separator or heater/treater skids, the construction of living quarters, the provision for hookup services, or the fabrication of jackets, decks, and topside modules. Few facilities have complete capabilities for all facets of offshore projects. Despite the longer-term outlook most producers take toward offshore exploration and production, activity is still closely tied to the price of oil and gas. As prices drop, supporting industries such as fabrication become less busy, often resulting in layoffs that tend to drive experienced workers to other industries.

Because of the size of the fabricated product and the need to store a large quantity of materials such as metal pipes and beams, fabrication yards typically occupy large areas, ranging from just a few acres to several hundred acres. Typical fabrication yard equipment includes lifts and cranes, various types of welding equipment, rolling mills, and sandblasting machinery. Besides large open spaces required for jacket assembly, fabrication yards also have covered warehouses and shops. Because the construction of platforms is not likely to be standardized, an assembly-line approach is unlikely and most fabrication yards work on projects one at a time. Once a platform is completed, it is towed to its offshore location; work then begins on a new platform. The number of employees varies between fabrication yards, from less than a hundred to several thousands, and because of the project-oriented type of work, temporary workers account for a significant portion of the workforce.

As mentioned, platform fabrication is not a mass production industry; every platform is custom built to meet the requirements of a specific project. This feature has given rise to a great degree of specialization in platform fabrication. No two fabrication yards are identical; most yards specialize in the fabrication of a particular type of platform or platform component. Examples of specialization include the construction of living quarters, provision of hook-up services, and fabrication of jackets and decks. According to a published survey of fabrication yards in the GOM, 23 yards fabricate jackets, 15 fabricate decks, 29 fabricate modules, 22 fabricate living quarters, and 20 fabricate control buildings (*Offshore*, 2000). Despite the specialization of these yards, most facilities do include

- steel stockyards and cutting shops that supply and shape steel;
- assembly shops that put together a variety of components such as deck sections, modules, and tanks;
- paint and sandblasting shops;
- dry docks that work on small vessels;
- piers that work on transportation equipment and the platform components that are mobile and can be transported onto barges; and
- pipe and welding shops.

Despite the large number of platform fabrication facilities in the analysis area, only a few facilities can handle large-scale fabrication. Nine yards have single-piece fabrication capacity over 100,000 tons and 12 have capacity to fabricate structures for water depths over 1,000 ft (304 m). Only a few yards fabricate structures other than fixed platforms: one fabricates compliant towers (J. Ray McDermott, Inc. in Amelia, Louisiana) and two fabricate tension-leg platforms (Gulf Island Fabrication Inc. in Houma, Louisiana, and Friede Goldman Offshore in Pascagoula, Mississippi) (*Offshore*, 2000). Another important characteristic of the industry is the high degree of interdependency and cooperation among the fabrication yards; offshore platforms, particularly the ones destined for deep water, are such complex engineering projects, most facilities do not have the technical capabilities to complete the entire project "in-house."

Over the history of its existence, the platform fabrication industry has been closely tied to the fortunes of the oil and gas industry. Drilling and production activities are sensitive to the changing prices for oil and gas. This sensitivity, in turn, is translated into cycles for the fabrication industry, where a period of no work follows a period of more fabrication orders than a yard can complete. In order to shield themselves from the volatility inherent in the oil and gas industry, platform fabrication yards in the analysis area have started to implement various diversification strategies. These diversification strategies, coupled with the new challenges brought about by deepwater oil and gas exploration and development, are significantly changing the industry.

In order to use the existing equipment and to retain their highly-skilled workforce during periods of low or no fabrication orders, many fabrication yards are expanding their operations into areas such as maintenance and renovations of drilling rigs, fabrication of barges and other marine vessels, dry-docking, and surveying of equipment. Another avenue of diversification is pursuit of international platform fabrication. For example, McDermott does fabrication for offshore waters in the Far East and Middle East. Fabrication yards in the analysis area have the advantages of vast experience in fabrication work and good climatic conditions that allow for year-round operations. Fabrication companies have also developed new offshore management software and company specific systems for managing and monitoring offshore sites onshore. New and improved platforms or platform upgrades and revamps complement many of these systems and software.

The platform fabrication industry has experienced a lack of skilled workers at the beginning of an upswing in the business cycle; during the downswing the skilled labor migrates to other jobs. Having learned from past mistakes, some fabrication companies have organized technical training programs in the local communities. A locally trained workforce provides a readily available pool of skilled labor for the fabrication yards. Other companies have found a solution to the workforce problem through the acquisition of several individual fabrication yards located within the commuting area. This allows companies to dispatch their personnel to several yards to accommodate the existing need at any given time.

The back-to-back hurricanes, Katrina and Rita, significantly increased the workload for platform fabricators as many struggled to get back on their feet and repair damage to their own facilities (Petroleum Intelligence Weekly, 2005). While some suffered minimal damage, others were shut down for weeks. Not only were platform fabricators' facilities flooded or damaged, but so were their employees' homes. The labor market for fabrication yards has historically been tight, and the hurricanes increased the shortage of both skilled and unskilled laborers. One fabrication company noted that FEMA has allowed contractors to pay significantly higher wages than normal for the area, only making the labor situation worse (Gulf Island Fabrication Inc., 2005). In addition, the hurricanes increased the levels of silt in navigational channels, causing water depths to delay operations (Guillet, 2006).

While many facilities experienced a variety of damages during the 2005 hurricane season, this damage appears to be short-run in nature, lasting only several weeks and at best through the end of 2005. There are no current reports of any facilities being permanently damaged or taken out of service for any extended period of time. Current industry reports indicate that all platform fabrication facilities are operational. Further, no trade associations have reported any permanent outages, damages, or ongoing negative implications created by the hurricanes of 2005.

Because the hurricanes caused significant damage to existing fields and platforms, the focus for fabricators and their customers is getting production back online. New construction activities may be delayed until repairs to existing structures are completed. However, with high oil and gas prices leading to increased exploratory drilling, especially in deep water, and new LNG projects beginning to materialize, platform fabricators are expected to remain busy for the remainder of 2007 (Gulf Island Fabrication Inc., 2005).

Labor issues have been an issue for the industry for several years, particularly in skilled trades like welding. However, at the current time, there are no reports or indications from the trade press, industry, or trade associations that any worsening of these labor issues as a result of the 2005 tropical activity will be permanent or even long term.

Generally, most industry forecasts are positive for all service, support, and equipment manufacturing in the industry. Demand for services and equipment from this sector, including general maintenance and platforms, ships, and other offshore support structures and vessels is strong. Tight markets have allowed this sector of the industry to significantly increase charges to energy companies developing, and reworking, facilities in the GOM.

Pipecoating Plants and Yards

Pipecoating plants generally do not manufacture or supply pipe. They receive the manufactured pipe by rail or water at either their plant or pipe yard depending on their inventory capabilities. At the plant, pipe surfaces are coated with metallic, inorganic, and/or organic materials to protect from corrosion and abrasion. This process also adds weight to counteract buoyancy. Sometimes the inside of the pipe is also coated for corrosion control. Two to four sections of pipe are then welded at the plant into 40-ft (12-m) segments. The coated pipe is stored (stacked) at the pipe yard until it is needed offshore. It is then placed on barges or lay vessels where the pipeline contractor welds the 40-ft (12 m) sections together and cleans and coats the newly welded joints. Finally, the pipe is laid.

There are 19 pipecoating plants in the analysis area (**Table 3-33**). Twelve of the 19 plants are located in EIA's TX-2 and LA-2. There are two pipecoating plants in the Mississippi-Alabama area, two in the Florida Panhandle area, and one near Tampa, Florida. To meet deepwater demand, pipecoating companies have been expanding capacity or building new plants. Major pipecoating companies in the analysis area are Bay, Bredaro Price, and Womble.

The pipecoating industry is labor intensive. The coatings are mostly applied by hand. The companies try to maintain a core base of laborers, then either scale up or down with temporary labor according to workload. Because of the cyclical nature of the business, maintaining labor is a problem for the industry. In addition, pipecoating companies compete with other infrastructure industries for welders. In order to reduce this problem, several companies have started welding training programs. Some pipecoating plants are affiliated with a mill. These are American mills that manufacture high-grade pipe with light walls that can be used in shallow water. Foreign mills, mostly in Europe and Japan, manufacture heavy-walled pipe needed for deepwater pressure. U.S. Steel in Youngstown, Ohio, currently has the capability to manufacture the thick pipe necessary for deep water, but it lacks the processing needed to heat-treat the pipe. Pipecoating customers are both exploration and production operators (direct) and pipelaying contractors (subcontracting). A new trend in the industry is single-source contracts where the pipe manufacturing, coating, welding, and laying are all under one contract. This results in a more efficient, less costly operation. At present, only foreign companies have this capability.

The Bayou Companies' facility at the Port of Iberia was submerged in 5 ft of water during Hurricane Rita. The coating plant was out of service for 2 weeks as a result of the storm but has returned to normal operations (Landry, 2006; Dismukes, 2006, personal communication). The storm, plus customer demand, has led to the decision to build a new facility at the Bayou Companies' site. The new plant will be 11 ft above sea level (Landry, 2006). According to Merritt Chastain at the National Association of Pipecoating Applicators, the Bayou Companies in Louisiana is really the only pipecoating applicator on the Gulf Coast that was impacted by either storm.

Shipyards

The 1980's were dismal times for the shipbuilding industry. This was brought about by a combination of factors that included lack of a comprehensive and enforced U.S. maritime policy, failure to continue funding subsidies established by the Merchant Marine Act of 1936, and the collapse of the U.S. offshore oil industry, which not only hurt the shipbuilding industry but all support industries such as small shipyards and repair yards. Approximately 120,000 jobs for shipyard workers and shipyard suppliers were lost. Realizing the need to be able to compete in the international shipbuilding market, the Federal Government implemented a number of programs to strengthen the industry. The National Shipbuilding and Shipyard Conversion Act of 1993 established a program to support the industrial base for national security objectives. And, the National Defense Authorization Act of 1994 expanded the existing Title XI Federal Ship Financing Program. The goal was to reestablish the American shipbuilding industry as an internationally competitive industry (Industry Pro, 2006).

At present, there are about 89 shipyards in the U.S. with the capability of repairing oceangoing ships greater than 400 ft (122 m) in length. Only nine are capable of building large oceangoing vessels, while the rest deal mainly in repairs. Of these 89 yards, 34 are located on the Gulf Coast (USDOT, 2003). In addition to the major shipyards, there are about 2,600 other companies that build or repair other craft such as tugboats, supply boats, ferries, fishing vessels, barges, and pleasure boats. Within the analysis area, there are 94 shipyards (**Table 3-33**). Major shipyards in the analysis area include Bender Shipbuilding and Repair Company (Mobile, Alabama); Northrop Grumman Ship Systems (Avondale, Louisiana; Pascagoula, Mississippi); Signal International (Pascagoula, Louisiana; Port Arthur and Orange, Texas); VT-Halter (Pascagoula and Moss Point, Mississippi); and Bollinger (New Orleans, Sulphur, and Lockport, Louisiana; Texas City, Texas) (USDOT, 2003).

The American Shipbuilding Association is the professional organization for those in the industry who are capable of constructing mega vessels that are in excess of 400 ft (122 m) in length and weigh in excess of 20,000 dead weight tonnage (DWT) (American Shipbuilding Association, 2006). For this reason, their membership consists of only six companies. Of those six, two have a presence in the GOM

(American Shipbuilding Association, 2006). Both Avondale Shipyard of New Orleans, Louisiana, and Ingalls Shipyard of Pascagoula, Mississippi, have enormous capabilities and expertise in the design, construction, and repair of vessels.

The existence of enormous commercial needs has led to the development of a very large number of boat and barge builders. These companies have directed their efforts toward the requirements of specific industries such as the offshore oil and gas industry, which is undergoing a recovery from the marked decline of the 1980's. The vessels they produce are not as large as those being built by Avondale and Ingalls. However, as the oil and gas industry has evolved and becomes more sophisticated, particularly with deepwater drilling, so too has the capability of this segment of the boat-building industry. The need for supply and other types of industry support vessels has increased. With changing technology has come the need for more sophisticated and higher capacity vessels. Many of these companies are now producing ships in the 300-ft (92 m) range. Five of the six most active shipyards are still in the commercial business and all are actively pursuing further supply-vessel opportunities.

During FY 2003, the U.S. ship construction and ship repair industry invested more than $345 million in the upgrade and expansion of facilities. Much of this investment was to improve efficiency and competitiveness in the commercial shipbuilding arena. Improvements were made to update and convert shipyard facilities to be more commercially viable. Examples of recent capital investments are new pipe and fabrication shops, drydock extensions, automated steel process buildings, and expanded design programs. Many of these improvements have been necessary because of the increased use of U.S. shipyards, particularly those along the Gulf Coast, resulting from the resurgence of the offshore oil and gas industry (USDOT, 2003).

The 2005 hurricanes put an additional premium on offshore supply boats. At present, the offshore drilling industry is extremely strong, and rig supply is extremely tight as is the supply of offshore service vessels. Strong demand in the GOM and the need to replace old equipment has led several operators to announce significant vessel construction programs (Greenberg, 2006b).

The hurricanes of 2005 put an additional premium on offshore supply boats. Five of the six most active shipyards are still in the commercial business and all are actively pursuing further supply-vessel opportunities. For example, Tidewater Inc., (New Orleans, Louisiana) has 5 supply vessels and a fast-supply boat under construction; Rigdon (Houston, Texas) ordered 10 PSV's being built at Bollinger Shipyards in Lockport, Louisiana; and Edison Chouest (Galliano, Louisiana) will expand its Gulf fleet with 3 AHTS vessels, 10 new PSV's and 9 fast-supply vessels (Greenberg, 2006b). According to one construction survey, there were 36 supply boats on order in 2004 and 25 in 2005 (Hocke, 2006). As of June 2006, shipyards along the Gulf Coast are booked solid with at least 37 new offshore supply vessels being built. This, in addition to remaining hurricane-related repair projects, has kept the shipyards operating at full capacity (Greenberg and Krapf, 2006). In fact, it is becoming difficult to find slots for new construction, and some boat operators have been forced to look outside the GOM for shipyard capacity (Greenberg, 2006b). The damaged rigs and platforms in the Gulf as a result of the hurricanes of 2005 created a great need for shipbuilding services. However, a number of shipyards were severely damaged. While some yards, such as Austal USA in Mobile, Alabama, and Conrad Industries in Morgan City, Louisiana, sustained only minor damage, other yards such as Northrop Grumman in Pascagoula, Mississippi, and New Orleans; Bollinger Shipyards in Lockport, Louisiana, reported significant damage (Marine Log, November 2005). VT Halter Marine suffered water and wind damage at all three of its Mississippi locations (Dupont et al., 2005). The physical damages to the facilities have been repaired and they are at or near normal conditions (Dismukes, 2006, personal communication).

However, severe labor shortages caused even more problems than the physical damage for some GOM area shipyards. A large number of the shipyards' skilled labor force was displaced by Hurricane Katrina. Even two months after the storm, a number of companies remained shuttered solely because their employees did not have housing (Carr, 2005). In late 2005, Northrop was still hiring at all of its facilities along the Gulf Coast. The Company did not expect 1,500-2,000 of its employees to return at all (*Inside the Navy*, 2005). In November, Bollinger Shipyards actually had to back out of a $700 million contract and pass on another $150 million contract because high wages and scarce employees threatened the company's ability to make a profit (White, 2006). The labor shortage also forced the Navy to make an adjustment to its contract with Northrop Grumman and defer an order for an amphibious assault ship scheduled to be built at Northrop's Avondale yard from FY 2007 to FY 2008 (White, 2006). Labor constraints in shipyards continue to be an issue; however, it is expected that skilled workers will return along with new workers lured by the strong market outlook (Rach, 2006).

3.3.5.8.5. Processing Facilities

Unless otherwise indicated, the following information is from the 2004 MMS study, *OCS-Related Infrastructure in the Gulf of Mexico Fact Book* (Louis Berger Group, Inc., 2004).

Refineries

Petroleum is a mixture of hydrocarbons formed beneath the earth's surface. Found in both gaseous and liquid form, the exact composition of these hydrocarbons varies according to locality. Crude oil is a mixture of hydrocarbon compounds and relatively small quantities of other materials such as oxygen, nitrogen, sulfur, salt, and water. Crude oil varies in color and composition from a pale yellow, low-viscosity liquid to a heavy black tar consistency. Because it is of little use in its raw state, further processing of crude oil is necessary to unlock the full potential of this resource.

A refinery is an organized arrangement of manufacturing units designed to produce physical and chemical changes to turn crude oil into petroleum products. Refineries vary in size, sophistication, and cost depending on their location, the types of crude they refine, and the products they manufacture. Because crude oil is not homogeneous (varying in color, viscosity, sulfur content, and mineral content), oil produced from different fields or geographic areas have different quality characteristics that give rise to different economic values. In the refinery, most of the nonhydrocarbon substances are removed from crude oil, and the oil is broken down into its various components and blended into useful products.

One-third of operable U.S. petroleum refineries are located in the Gulf States of Alabama, Louisiana, Mississippi, and Texas. Most of the region's refineries are located in Texas and Louisiana (**Table 3-33**). Texas has 25 operating refineries, with a combined crude oil capacity of 4.6 million barrels (MMbbl)/day, while Louisiana has 17 operating refineries with 2.8 MMbbl/day of capacity, representing 27.2 and 16.3 percent, respectively, of total operating U.S. refining capacity (USDOE, EIA, 2005a).

In the early 1980's, the Crude Oil Entitlements Program ended and crude oil prices were no longer controlled. This caused the number of petroleum refineries to drop sharply, leading to 13 years of decline in U.S. refining capacity. Between 1981 and 1989, the reduction in the number of refineries from 324 to 204 represented a loss of 3 MMbbl/day in operable capacity. Another 41 refineries (mainly small) shut down between 1990 and 1997. Since the 1980's, the refining industry's focus has turned from increasing crude oil distillation capacity to investment in downstream charge capacity, thereby increasing overall refinery complexity. This transition began several years before the passage of the Clean Air Act Amendments in 1990 as a result of increase demand for lighter, cleaner products that have to be produced from increasingly heavier and more-sour crude oils.

The 1990's were characterized by low product margins and low profitability. Stiff environmental mandates, stemming from 1990 amendments to the Clean Air Act, increased capital costs on the industry at a time of relatively flat product demand. By implementing massive capital spending programs, refiners met and surpassed plant emission goals while retooling to produce a new generation of cleaner burning fuels. Low profitability was also partially because of the narrowing spread between petroleum product prices and raw material input costs. Additionally, persistently low profits prompted domestic refiners and marketers to make concerted efforts to realize greater value from their fixed assets and to reduce their operating costs. Refining operations were consolidated, the capacity of existing facilities was expanded, and several refineries were closed.

Most refineries are part of major, vertically integrated oil companies that are engaged in both upstream and downstream aspects of the petroleum industry. These companies dominate the refining industry. A wave of mergers in the 1990's and recent years has further consolidated the downstream petroleum industry. The top 10 U.S. refiners in 1993 accounted for almost 56 percent of the market (Public Citizen, 2004). Today, the top 10 U.S. refiners, most all of them major, integrated oil companies, account for 75 percent of the total domestic refinery operating capacity (USDOE, Office of Electricity Delivery and Energy Reliability, 2005b; USDOE, EIA, 2005b).

Thirty-three of the Gulf Coast's 40 operating refineries were impacted by the hurricanes and 9 sustained damage (6 of Louisiana's 17, 2 of Texas' 17, and 1 of Mississippi's 4). These damaged facilities resulted in a total loss of capacity of 2.3 MMbbl/day, which represented 31 percent of GOM refining capacity and 13 percent of U.S. operating capacity (USDOE, EIA, 2005a; USDOE, Office of Electricity Delivery and Energy Reliability, 2005a-d). In addition, facilities that did not sustain direct damage were impacted by supply interruptions. All refineries impacted by the 2005 hurricanes are back up and running at capacity levels that existed before the storms.

Petrochemical Plants

The chemical industry converts raw materials such as oil, natural gas, air, water, metals, and minerals into more than 70,000 different products. The non-fuel components derived from crude oil and natural gas are known as petrochemicals. Petroleum is composed mostly of hydrogen and carbon compounds (called hydrocarbons). It also contains nitrogen and sulfur, and all four of these components are valuable in the manufacture of chemicals.

The industrial organic chemical sector includes thousands of chemicals and hundreds of processes. In general, a set of building blocks (feedstocks) is combined in a series of reaction steps to produce both intermediate and end products. The processes of importance in petrochemical manufacturing are distillation, solvent extraction, crystallization, absorption, adsorption, cracking, reforming, alkylation, isomerization, and polymerization.

The boundaries of the petrochemical industry are rather unclear. On the upstream end, they blend into the petroleum refining sector, which furnishes a major share of petrochemical feedstocks; downstream it is often impossible to draw a clear line between petrochemical manufacturing and other organic chemistry-based industries such as plastics, synthetic fibers, agricultural chemicals, paints and resins, and pharmaceuticals. Operating in this field are petroleum companies who have broadened their interests into chemicals, chemical companies who buy raw petroleum materials, and joint ventures between chemical and petroleum companies.

Texas, Louisiana, New York, California, and Pennsylvania are the top U.S. chemical producers in terms of value of shipments (USDOC, Bureau of the Census, 2006). However, most of the basic chemical production is concentrated in the analysis area, where petroleum and natural gas feedstocks are available from refineries. Over 90 percent of primary petrochemical capacity (as measured by ethylene production) is located in Texas and Louisiana (Federal Reserve Bank of Dallas, 2005). At present, there are 55 petrochemical establishments in the U.S., 29 of which are in Texas and Louisiana (USDOC, Bureau of the Census, 2006). The distribution of these plants by state is shown in **Table 3-33**.

Chemical manufacturing facility sites are typically chosen for their access to raw materials and to transportation routes. And, because the chemical industry is its own best customer, facilities tend to cluster near such end-users. A small number of very large facilities account for the majority of the industry's value of shipments. The top 5 percent of plants (there are 644 plants with more than 250 employees) manufacture over 50 percent of the total value of shipments (USDOC, Bureau of the Census, 2005b).

Laid out like industrial parks, most petrochemical complexes include plants that manufacture any combination of primary, intermediate, and end-use products. Changes in market conditions and technologies are reflected over time in the changing product slates of petrochemical complexes. In general, petrochemical plants are designed to attain the cheapest manufacturing costs and thus are highly synergistic. Product slates and system designs are carefully coordinated to optimize the use of chemical by-products and to use heat and power efficiently.

The transformation of raw materials into chemical products requires chemical, physical, and biological separation and synthesis processes. These processes use large amounts of energy for heating, cooling, or electrical power. The industry is the single largest consumer of natural gas (over 10% of the domestic total) and uses virtually all the liquefied petroleum gas (LPG) consumed in U.S. manufacturing. Other energy sources include by-products produced onsite, hot water, and purchased steam. Physical and biological separation plays a critical role in processing and accounts for 40-70 percent of both capital and operating costs (USDOE, EIA, 2006b). The most widely used separation process is distillation, which accounts for as much as 40 percent of the industry's energy use. Chemical synthesis is the backbone of the industry; process heat is integral and supports nearly all chemical operations (USDOE, EIA, 2006b). As a result of Hurricane Katrina, many chemical firms suffered severe flooding and power outages, including Dow in St. Charles and Plaquemines, Louisiana, and DuPont at its titanium dioxide plant in DeLisle, Mississippi (Reisch and Tullo, 2005). Hurricane Rita forced shutdowns of ethylene plants throughout Texas and Louisiana coastal areas. Six ethylene plants in Beaumont and Port Arthur, Texas, and two plants in Lake Charles, Louisiana, were without power for at least 1-2 weeks in September-October 2005 (Lippe, 2005). For facilities that were not damaged or that sustained minimal damage, the strain on the oil and gas supply kept a number of chemical plants on partial or complete shutdown (FERC, 2005). The *Oil and Gas Journal* reported in July that any remaining hurricane-related repairs were completed in the first quarter of 2006 and currently there are no reports of any remaining damages or shutdowns (Lippe, 2006).

Gas Processing Plants

After raw OCS gas is brought to the earth's surface and transported onshore, it is processed at a gas processing plant to remove impurities such as water, carbon dioxide, sulfur, and inert gases, and it is transformed into a sellable, useful energy source. It is then moved into a pipeline system for transportation to an area where it is sold. Because natural gas reserves are not evenly spaced across the continent, an efficient, reliable gas transportation system is essential. At present, there are 249 gas processing plants in the Gulf States, representing 58 percent of U.S. gas processing capacity (USDOE, EIA, 2006c). The distribution of these plants by state is shown in **Table 3-33**. Major operators include BP, Exxon, Dynergy, Duke Energy, and El Paso.

Natural gas is found below the earth's surface in three principal forms: associated gas, nonassociated gas, and gas condensate. Associated gas is found in crude oil reservoirs, either dissolved in the crude oil, or combined with crude oil deposits. This gas is produced from oil wells along with the crude and is separated from the oil at the head of the well. Nonassociated gas is found in reservoirs separate from crude oil; its production is not a result of the production of crude oil. It is commonly called "gas-well gas" or "dry gas." In 2004 about 75 percent of U.S. wellhead natural gas production was nonassociated gas (USDOE, EIA, 2006c). Gas condensate is a hydrocarbon that is neither true gas nor true liquid. It is not a gas because of its high density, and it is not a liquid because no surface boundary exists between gas and liquid. Gas condensate reservoirs are usually deeper and have higher pressures, which pose special problems in the production, processing, and recycling of the gas for maintenance of reservoir pressure.

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 (the lightest hydrocarbon component) and ethane. In general, there are four types of natural gas: wet, dry, sweet, and sour. Wet gas contains some of the heavier hydrocarbon molecules and water vapor. When the gas reaches the earth's surface, a certain amount of liquid is formed. A wet gas may contain five or more gallons of recoverable hydrocarbons per thousand cubic feet; the water has no value. If the gas does not contain enough of the heavier hydrocarbon molecules to form a liquid at the surface, it is a dry gas. Sweet gas has very low concentrations of sulfur compounds, while sour gas contains excessive amounts of sulfur and an offensive odor. Sour gas can be harmful to breathe or even fatal.

Centrally located to serve different fields, natural-gas processing plants have two main purposes: (1) remove essentially all impurities from the gas and (2) separate the gas into its useful components for eventual distribution to consumers. The modern gas-processing industry uses a variety of sophisticated processes to treat natural gas and extract natural-gas liquids from the gas stream. The two most important extraction processes are the absorption and cryogenic expander process. Together, these processes account for an estimated 90 percent of total natural-gas liquids production (NaturalGas.Org, 2006b).

More than half of the current natural gas processing plant capacity in the U.S. is located convenient to Federal offshore, Texas and Louisiana. Four of the largest capacity natural gas processing/treatment plants are found in Louisiana while the greatest number of individual natural gas plants is located in Texas. Louisiana continues to lead the U.S. states in processing capacity, followed closely by Texas. Between them, the two states hold more than 53 percent of the Nation's natural gas processing capacity (USDOE, EIA, 2006c).

Over the past 10 years, the number of gas processing plants in the U.S. has decreased from 727 in 1995 to 530 in 2004. However, average daily processing capacity has increased by 49 percent. In Texas, the number of plants and overall processing capacity has decreased, but the average capacity per plant has increased from 66 MMcfd to 95 MMcfd as newer plants were added and old, less efficient plants were idled. In Alabama, Mississippi and the eastern portion of South Louisiana, new larger plants and plant expansions built to serve new offshore production increased the average plant capacity significantly (USDOE, EIA, 2006c).

Although Texas and Louisiana still account for the larger portion of U.S. natural gas plant processing capability, other States have moved up in the rankings somewhat during the past 10 years as new trends in natural gas production and processing have come into play. Most of these plants are located in five other states: Oklahoma, Wyoming, Colorado, New Mexico, and California. These states account for 37 percent of the natural gas processing facilities and 28 percent of capacity (USDOE, EIA, 2006c).

The hurricanes of 2005 initially shut down 13.5 billion cubic feet per day (Bcfd) of the Gulf Coast's capacity for gas processing (11.7 Bcfd of Louisiana's capacity, 1.8 Bcfd of Alabama and Mississippi's capacity). This represents 66.5 percent of the Gulf States' processing capacity (Lippe, 2005). Gas processing station outages in the aftermath of Hurricane Katrina proved to be a significant constraint to offshore production restoration activities since facilities that were ready to come online could not send production to shore for processing because of the outages. These facilities would have to wait weeks in order for facilities to start limited restoration and to by-pass the constrained facilities and reroute production to other onshore areas.

With the exception of one facility (BP's Grand Chenier) that has been permanently shut down as a result of the 2005 hurricanes, all of the affected gas processing plants along the Gulf Coast have been restored to active status. Most facilities operating along the GOM were at a 50 percent or less utilization factor prior to the storms so not all of the damaged capacity has been restored; however, there is spare capacity to service the processing markets (USDOE, Office of Electricity Delivery and Energy Reliability, 2005f; Dismukes, 2006).

3.3.5.8.6. Disposal and Storage Facilities for Offshore Operations

Unless otherwise indicated, the following information is from the 2004 MMS study, *OCS-Related Infrastructure in the Gulf of Mexico Fact Book* (Louis Berger Group, Inc., 2004).

The infrastructure network needed to manage the spectrum of waste generated by OCS exploration and production activities and returned to land for management can be divided into three categories:

(1) transfer facilities at ports, where the waste is transferred from supply boats to another transportation mode, either barge or truck, toward a final point of disposition;

(2) special-purpose, oil-field waste management facilities, which are dedicated to handling particular types of oil-field waste; and

(3) generic waste management facilities, which receive waste from a broad spectrum of American industry, of which waste generated in the oil field is only a small part.

The first two categories lend themselves to a capacity analysis while the third does not. **Table 3-33** shows the waste disposal facilities in the analysis area by state.

The capacity of a waste facility has two dimensions. The first is the throughput capacity over a given period of time. In the short term, a waste facility can face limits to the volume of waste it accepts either from permit conditions or from physical limitations to the site, such as unloading bays, traffic conditions, or equipment capacity. Life-of-site capacity is also a limiting factor for disposal facilities. Limitations of storage space or, in the case of an injection well, service life of the well make it necessary to consider what must happen after existing facilities have exhausted their capacity.

A number of different types of waste are generated as a result of offshore exploration and production activity. The different physical and chemical characters of these wastes make certain management methods preferable over others. The types of waste include the following:

- solids, such as drill cuttings, pipe scale, produced sand, and other solid sediments encountered during drilling, completion, and production phases;

- aqueous fluids having relatively little solids content, such as produced waters, waters separated from a drilling mud system, clear brine completion fluids, acids used in stimulation activities, and wash waters from drilling and production operations

(Although most of these are potentially dischargeable under the NPDES general permit, the possibility always exists that some amount of material will become contaminated beyond the limits of treatment capabilities and will require disposal in a land-based facility. A minute percentage of the total volume consists of chemicals (such as zinc bromide), which do not meet discharge criteria.);

- drilling muds (oil-based, synthetic, or water-based);
- naturally occurring radioactive materials (NORM), such as tank bottoms, pipe scale, and other sediments that contain naturally high levels of radioactive materials (NORM occurs in sludge and also as scale on used steel vessels and piping when equipment has been exposed to other NORM materials after very long periods of use.);
- industrial hazardous wastes, such as solvents and certain compounds, with chemical characteristics that render them hazardous under Subtitle C of the RCRA and thus not subject to the exemption applicable to wastes generated in the drilling, production, and exploration phases of oil and gas activities;
- nonhazardous industrial oily waste streams generated by machinery operations and maintenance, such as used compressor oils, diesel fuel, and lubricating oils, as well as pipeline testing and pigging fluids (Wastes from marine transportation as well as pipeline construction and operations are always classified as industrial wastes, while some operators and State regulators may choose to handle or classify waste from drilling and production machinery this way. Used oil generated by exploration and production operations may legally be mixed with produced oil, but refineries discourage the practice. These streams often become commingled with wash water. They may be handled in drums or in bulk as part of a larger waste stream.); and
- municipal solid waste generated by the industry's personnel on offshore rigs, platforms, tankers, and workboats.

Federal regulations govern what may be discharged in GOM waters and set different standards in different parts of the Gulf Coast. **Table 3-34** summarizes current Federal rules. Wastes that cannot be discharged or injected offshore must be brought to shore. Transportation, packaging, and unloading of the waste at ports are governed by USDOT regulations while the USCG regulates vessel fitness. Once on the dock, transportation and packaging is subject to an overlay of USDOT and State laws. State regulations governing reporting and manifesting requirements may vary somewhat, but Federal law has, for the most part, preempted the field of transportation waste regulation. Dockside facilities that serve as transfer points from water to land modes of transportation are regulated by both USCG and State regulations covering the management of oil-field wastes.

Once at a waste management facility, regulations regarding storage, processing, and disposal vary depending on the type of waste. Most would fall under the oil and gas waste exemption of RCRA Subtitle C and would be subject only to State regulations regarding the disposal of oil-field wastes. A minute volume of the waste would be subject to Federal regulation as hazardous waste under RCRA Subtitle C. State laws governing hazardous wastes are allowed to be more restrictive than Federal law, but no material differences exist between State and Federal law in Texas, Louisiana, Mississippi, or Alabama. For the most part, the wastes generated by oil-field activities, called nonhazardous oil-field waste (NOW) are exempt from hazardous waste regulation by Federal law because they are produced from the exploration, development, or production of hydrocarbons and thus fall under what is generally referred to as the oil and gas waste exemption found in 40 CFR 261.

Waste fluids and solids containing NORM are subject to State regulations that require special handling and disposal techniques. There are currently no Federal regulations governing NORM. The special handling and disposal requirements for NORM generally result in the segregation of these materials from NOW and in substantially higher disposal costs when managed by commercial disposal firms.

The Railroad Commission (RRC) of Texas has jurisdiction over the handling and disposal of NORM wastes in the state they are produced during the exploration and production of oil and gas. All other disposal of NORM wastes is regulated by the Texas Commission on Environmental Quality (TCEQ, 2006). The RRC regulates the disposal of oil and gas NORM under Title 16, Part 1, Chapter 4, Subchapter F, or the Texas Administrative Code. The disposal methods prohibited by Subchapter F include the discharge of oil and gas NORM waste other than produced water, the spreading of oil and gas NORM waste on public or private roads, and any other method that is not specifically provided for by Subchapter F (Railroad Commission of Texas, 2006).

The disposal options for NORM-contaminated solids differ from the options for NORM-contaminated equipment. The NORM-contaminated solids, such as pipe scale, may be disposed of on the site where they were generated by burial or placement in a well that is being plugged and abandoned. Contaminated soil may be spread onto the land under certain conditions. Subchapter F also authorizes disposal of oil and gas NORM waste at a licensed facility and injection of NORM treated by a licensee provided the operator complies with specific requirements contained in the rule. The NORM-contaminated equipment that is waste, i.e., equipment that is no longer wanted, may be recycled as scrap metal or disposed of. Subchapter F does not allow the burial of NORM-contaminated equipment. Buried flowlines that contain NORM, however, may remain buried contingent on the lease agreement. The NORM-contaminated tubulars and other equipment may also be placed in a plugged and abandoned well. Equipment must be removed from a lease when the last well on the lease is plugged. All tanks, vessels, related piping, and flowlines be emptied, and requires all tanks, vessels, and related piping to be removed in 120 days (Railroad Commision of Texas, 2006).

The State of Louisiana was the first state to develop a NORM regulatory program in 1989. This program was further enhanced by amendments in 1992 and 1995. The Louisiana Department of Environmental Quality has a comprehensive, oil-field NORM regulatory program that addresses identification, use, possession, transport, storage, transfer, decontamination, and disposal of NORM. Primary NORM regulations are in Louisiana Administrative Code 33:XV, Chapter 14: "Regulation and Licensing of NORM." Louisiana generally considers oil and natural gas well and production facilities, pipeyards, scrap yards, wood pulp processors, gas gathering stations, and rare earth chloride processing facilities to have the potential for NORM accumulation. Initial surveys are required on all potentially contaminated sites. Follow-up confirmatory surveys need to be performed whenever activities at the site could result in a possible change in regulatory status of the site.

The USEPA has established a hierarchy of waste management methods that it deems preferentially protective of the environment. For those technologies applicable to oil and gas production waste, the following general waste management techniques are described in order of USEPA's preference:

- *Recycle/Reuse*—When usable components such as oil or drilling mud can be recovered from a waste, these components are not discarded and do not burden the environment with impacts from either manufacturing or disposal.
- *Treatment/Detoxification*—When a waste cannot be recycled or reused, it can sometimes be treated to remove or detoxify a particular constituent prior to disposal. Neutralization of pH or the removal of sulfides is examples of technologies that are used with oil and gas wastes.
- *Thermal Treatment/Incineration*—Wastes with organic content can be burned, resulting in a relatively small amount of residual ash that is incorporated into a product or sent to disposal. This technology results in air emissions, but the residuals are generally free of organic constituents.
- *Subsurface Land Disposal*—This technology places waste below usable drinking water resources and is viewed as superior to landfilling because of the low potential for waste migration. Injection wells and salt cavern disposal are examples of this type of technology.
- *Surface Land Disposal/Treatment*—This type of technology involves the placement of wastes into a landfill or onto a land farm. Although well-designed and constructed landfills minimize the potential for waste migration, generators remain concerned

about migration of contaminants into water resources and avoid it whenever practical. The USEPA classifies surface land disposal as the least desirable disposal method.

Several waste management methods are used to handle the spectrum of wastes generated by OCS activity, and most types of wastes lend themselves to more than one method of management. Each option has a different set of environmental impacts, regulatory constraints, costs, and capacity limitations.

The U.S. oil and gas production includes an average of 10 bbl of water for each barrel of oil produced. Produced water comprises 98 percent of all waste generated by petroleum exploration and production activities (USDOE, OFE, NETL, 2005). Underground injection is the most common disposal method of produced water; over 90 percent of onshore produced water is disposed of through injection wells (USEPA, 2000).

Nonhazardous Oil-field Waste Sites

One of the largest companies operating waste facilities on the Gulf Coast is Newpark Resources, Inc., which operates seven receiving and transfer facilities along the coast from Venice, Louisiana, to Corpus Christi, Texas. Waste products are collected at the transfer facilities from offshore, land, and inland waters exploration and production markets. Newpark also owns a fleet of 49 double-skinned barges certified by the USCG to transport E&P waste to support these facilities. Waste received at the transfer facilities is moved by barge through the Gulf Intracoastal Waterway to a processing and transfer facility at Port Arthur, Texas, and if not recycled, it is trucked to injection disposal facilities at Fannett, Texas. Including its 400-ac (161.9-ha) site at Fannett, the company holds an inventory of approximately 1,250 ac (506 ha) of injection disposal property in Texas and Louisiana (Newpark, 2006a).

Newpark has been handling an increased amount of Gulf Coast waste. The number of barrels processed from the Gulf Coast has increased from 5.8 MMbbl in 2002 to 6.9 MMbbl in 2005 and a projected 7.2 MMbbl in 2006. However, Newpark's market share has been decreasing (from 66% in 2002 to 55% in 2006) (Newpark, 2006b).

One commercial salt cavern, operated by Trinity Field Services, opened near Hamshire, Texas, on the Trinity River. Four other commercial salt domes are operational in northeastern and western Texas. One commercial salt dome, Lotus, L.L.C. in Andrews County near the New Mexico border, accepts NORM, some of which comes from offshore operations. Because of their distance from the Gulf Coast, no others receive any OCS waste. With the addition of Trinity Field Services bringing 6.2 MMbbl of available space to the market, enough to take 8-10 years' worth of OCS liquids and sludges at current rates, the OCS has its first salt dome disposal operation in a competitive location (Louis Berger Group Inc., 2004).

Landfills

Workers on a rig or production platform generate the same types of waste as any other consumer in industrial society, and are therefore responsible for their fair share of municipal solid waste (MSW). A large volume of industry-specific trash also makes its way to a landfill (Louis Berger Group, Inc., 2004).

A modern landfill is an engineered facility with protective liners and caps to isolate the waste from the larger environment. The MSW is placed in an excavated cell, usually lined with high-density polyethylene to prevent leakage into the groundwater. A landfill must apply cover material of earth or some kind of nonputrescible material to the working face of the MSW daily. Drilling muds and wastewater streams that have been solidified may often serve as daily cover. Use of this type of material often improves a site's soil balance, meaning the volume of soil required over the life of the landfill for its construction and operation will be less than if these materials were not available and other soils had to be hauled in at a cost. Up to a point, the materials consume no airspace since they are merely displacing soils that would be used for cover in any event. For this reason, landfills will often accept these materials at a reduced price, or even at no charge. In addition to everyday municipal solid waste, certain approved landfills will take decommissioned oil and gas processing equipment and piping (Louis Berger Group, Inc., 2004).

Since 1947, when offshore production first began in the Gulf, the industry has removed more than 2,200 structures from Federal waters. The number and type of structures removed varies considerably from year to year but during the last decade about 125 structures per year were removed (Kaiser, 2005).

Some obsolete platforms are donated to artificial reef programs. But, for those that are not, a typical decommissioning involves the oil and gas processing equipment and piping being taken ashore for refurbishment and reuse, selling as scrap, or disposal in an approved landfill. Although companies typically recycle piling and conductors, there are few opportunities for reusing topsides equipment because of age, corrosion, and changes in technical standards (Kaiser, 2005).

The destruction of Hurricane Katrina created an incredible amount of debris. As of February 2006, the Louisiana Dept. of Environmental Quality gave the following estimates for waste management: 16-17 million cubic yards of debris hauled away; 29,025 drums of hazard waste; 27,067 propane tanks; 1,782,424 small containers of hazardous waste; 221,456 refrigerators and 29,123 freezers; 27,920 air conditioners; 111,418 washer/dryers; 53,566 stoves; 34,567 water heaters; and 32,719 dishwashers (Holden et al., 2006). Some of the platforms destroyed by Hurricanes Katrina and Rita (**Chapter 3.3.5.7.3**) will be sunk to create artificial reefs, and some of the materials will be recycled; however, a large part of these destroyed platforms and rigs will wind up in Gulf Coast landfills.

3.3.5.9. Environmental Justice

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 with low incomes. Those environmental effects encompass human health, social, and economic consequences. The Federal agency in charge of the proposed action must provide opportunities for community input during the NEPA process. (See **Chapter 5** for a discussion of scoping, and community consultation and coordination.)

Environmental justice concerns may be related to nearshore and onshore activities that result from a proposed action. These concerns are addressed in two categories—those related to routine operations and those related to nonroutine events (accidents). Concerns related to routine operations center on increases in onshore activity (such as employment, migration, commuter traffic, and truck traffic) and on additions to or expansions of the infrastructure supporting this activity (such as fabrication yards, supply ports, and onshore disposal sites for offshore waste). Concerns related to nonroutine events focus on oil spills.

The OCS Program in the GOM is large and has been ongoing for more than 50 years. During this period, substantial leasing has occurred off Texas, Louisiana, Mississippi, and Alabama. An extensive support infrastructure system exists consisting of platform fabrication yards, shipyards, repair and maintenance yards, onshore service bases, heliports, marinas for crewboats and supply boats, pipeline coating companies, waste management facilities, gas processing plants, petrochemical plants, 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. Support system infrastructure is described in **Chapter 3.3.5.8**. The potential impacts to and from infrastructure is an ongoing concern for Gulf Coast States and communities. The MMS is currently conducting several studies to obtain and refine pertinent information.

Conducting environmental justice assessments in the GOM has been problematic for the following reasons. First, the U.S. GOM is a geopolitical area containing a large number of potentially affected minority and low-income populations. Second, the nature of the OCS leasing program makes it hard to predict where the onshore effects of offshore lease sales will occur. Third, each industry sector is associated with particular impacts that are often cumulative based on the mix of activities occurring in each geographic location. A recent MMS study describes the major categories of existing OCS-related infrastructure: platform fabrication yards, port facilities, shipyards and shipbuilding yards, support and transport facilities, waste management facilities, pipelines, pipecoating yards, natural gas processing facilities, natural gas storage facilities, refineries, and petrochemical facilities (Louis Berger Group, Inc., 2004). **Figures 3-7 through 3-9** illustrate the distribution of the facilities identified throughout the Gulf Coast.

There are 81 counties or parishes that contain facilities, with 5 being the median number of facilities across these counties or parishes. The 39 counties or parishes that contain more than 5 facilities are defined as having a concentrated level of infrastructure. These are further divided into three levels of concentration: low (6-15 facilities); medium (16-49 facilities); and high (50 or more facilities). As shown in **Table 3-35**, all but one of the counties considered to have a high concentration of infrastructure are located in Louisiana (5 parishes) or Texas (4 counties). Most of the counties or parishes considered to have low and medium concentration are also located in these two states.

Environmental justice maps (**Figures 3-14 through 3-19**) display the location of oil-related infrastructure and the distribution of low-income and minority residents across GOM counties and parishes. These maps illustrate possible disproportionate effects on low-income or minority groups in the region. Ten counties (or parishes in Louisiana) are considered to have a high concentration of oil-related infrastructure (**Table 3-35**). Of these 10 counties, 5 have higher minority percentages than their respective State average. These counties and parishes include Mobile, Alabama; St. Mary, Louisiana; Galveston, Harris, and Jefferson, Texas. Only 2 of the 10 high infrastructure concentration counties and parishes also have higher poverty rates than their respective State poverty rate. Both St. Mary Parish in Louisiana and Jefferson County in Texas have higher poverty rates than the mean poverty rates in their states.

Fifteen counties and parishes are considered to have a medium concentration of oil-related infrastructure (**Table 3-35**). Five of these parishes or counties have a higher poverty rate than the mean rate in their State. These include Iberia, Orleans, and Vermilion Parishes in Louisiana and Nueces and San Patricio Counties in Texas. Eight of the 15 medium concentration counties also have higher minority populations than their State averages. These counties and parishes include Hillsborough, Florida; East Baton Rouge, Iberia, Orleans, and St. James, Louisiana; and Calhoun, Nueces and San Patricio, Texas. Because of the concentration of OCS-related facilities and high poverty and/or minority rates, these communities are critical when determining potential effects of industry activities on low-income or minority populations.

The MMS has recently investigated an area of potential environmental justice concern in Lafourche Parish, Louisiana (Hemmerling and Colten, 2003). Five different classes of relevant OCS activities exist in the region, including transportation corridors, oil and natural gas pipelines, petroleum bulk storage facilities, shipyards, and a natural gas processing plant. The majority of OCS-related infrastructure is located in south Lafourche Parish where the Houma Indian population is clustered. According to Hemmerling and Colten, south Lafourche Parish still provides valuable habitat land for traditional subsistence activities such as hunting, fishing, and trapping practiced by the Houma and other groups in the area (Hemmerling and Colten, 2003). Minority populations in this area could sustain disproportionate effects should an accident occur.

A similar MMS study entitled *Environmental Justice: A Comparative Perspective in Louisiana* (Hemmerling and Colten, in preparation) has been conducted in Jefferson and St. Bernard Parishes. As with the Lafourche Parish study, it is using geographical information system (GIS)-based techniques to identify and assess impacts from different sectors of the oil extraction and processing industry.

Potentially vulnerable minority populations also reside along the Gulf Coast. **Figures 3-14 through 3-16** indicate the substantial proportions of African-American and Hispanic persons along the coast. The Hispanic population tends to be concentrated in Texas and south Florida. The African-American population makes up a significant proportion of the population along the Central Gulf Coast. Another minority group of concern is Native Americans. Using 1999 estimates from the Bureau of the Census, it is possible to identify counties and parishes with significant populations of Native Americans. While most of the percentages are quite small—three-quarters are 0.5 percent or less—there are a handful of counties or parishes with more than a 2-percent Native American population. The Mowa Choctaw tribe of Washington County, Alabama, constitutes 5 percent of the county's population. The United Houma Nation represents 4 percent of the population of Terrebonne Parish, Louisiana, and just over 2 percent of Lafourche Parish, Louisiana. The Alabama-Coushatta tribe is 2 percent of the population of Polk County, Texas. Increased oil and gas activities in these areas could affect these Native American populations. Lafourche Parish, Louisiana, especially, is already serving as one of the few deepwater servicing facilities on the Gulf Coast.

The Poarch Creek Indians is the only federally recognized Indian tribe in the State of Alabama, operating as a sovereign nation with it own system of government and bylaws. Unlike many eastern Indian tribes, the Poarch Creeks were not removed from their tribal lands and have lived together for almost 200 years near Poarch, Alabama. The reservation is located in rural Escambia County, and 57 mi

(92 km) east of Mobile. The tribe was affected by Hurricane Ivan by loss of electricity (Poarch Band of Creek Indians, 2005).

On August 29, 2005, Hurricane Katrina made landfall on the Gulf Coast between New Orleans, Louisiana, to the west, and Mobile, Alabama, to the east. Hurricane Katrina had differential impacts on the Gulf Coast population. Approximately one-half of the displaced population lived in New Orleans, Louisiana, where the storm heavily impacted the poor and African0Americans (Gabe et al., 2005). In addition, the three states where communities were damaged or flooded rank among the poorest in the country. For example, according to the 2000 U.S. Census, Mississippi ranked second only to the District of Columbia in its poverty rate. Louisiana ranked third and Alabama ranked sixth in the country. Approximately one-fifth (21%) of the population most directly affected by the storm was poor. This poverty rate is significantly higher than the national poverty rate of 12.4 percent reported in the 2000 Census. Furthermore, it is estimated that over 30 percent of the most impacted population had incomes below one-and-one-half times the poverty line and over 40 percent had incomes below twice the official poverty line (Gabe et al., 2005).

Hurricane Katrina also disproportionately affected African-Americans living in New Orleans, Louisiana. An estimated 310,000 (44% of total storm victims) African-Americans were directly impacted by the hurricane, primarily as a result of flooding in Orleans Parish, Louisiana. In Orleans Parish, approximately 272,000 (73% of the affected population) blacks were displaced. It is estimated that 101,000 non-black residents in Orleans Parish were displaced to flooding or damage. Although 63 percent of the non-black population in Orleans Parish was also displaced from their homes, the percentage is lower than that experienced by blacks. Among blacks in Orleans Parish, Louisiana, over one-third (89,000 or 34% of displaced blacks) were estimated to have been poor in the 2000 Census. Approximately 14.6 percent (14,000) of the non-black (predominately white) displaced residents were poor (Gabe et al., 2005). (Also see **Chapter 3.3.5.4.1** for further discussion of the effect of Hurricanes Katrina and Rita on minority populations.)

Hurricane Katrina lifted and dislodged a partially filled 250,000-bbl aboveground storage tank at the Murphy Oil Refinery, which is a part of the Meraux oil facility located in Meraux, St. Bernard Parish, Louisiana. During the time of impact, the tank contained 85,000 bbl of mixed crude oil, and approximately 25,110 bbl (1.05 million gallons) were released. The released oil affected approximately 1,800 homes in an adjacent residential neighborhood in an area of approximately 1 mi^2 (640 ac). The primary contaminants detected in soil sediments were PAH's, diesel and oil range organic chemicals, and arsenic. The USEPA is monitoring Murphy Oil's sampling and cleanup at residential properties, parks, roads, sidewalks, and other public spaces that were contaminated by the spill. The USEPA is also identifying and characterizing the full extent of contamination in the area by providing written and photographic documentation of response activities and monitoring removal activities (USEPA, 2006b). Communities such as St. Bernard Parish, Louisiana, are potentially vulnerable to such accidents because of their close proximity to OCS-related infrastructure.

CHAPTER 4

ENVIRONMENTAL AND SOCIOECONOMIC CONSEQUENCES

4. ENVIRONMENTAL AND SOCIOECONOMIC CONSEQUENCES

4.1. IMPACT-PRODUCING FACTORS AND SCENARIO—ROUTINE OPERATIONS

4.1.1. Offshore Impact-Producing Factors and Scenario

This section describes the offshore infrastructure and activities (impact-producing factors (IPF's)) associated with the proposed action (i.e., proposed lease sale) that could potentially affect the biological, physical, and socioeconomic resources of the GOM. Offshore is defined here as the OCS portion of the GOM that begins 10 mi (16 km) offshore Florida; and 3 nmi offshore Louisiana, Mississippi, and Alabama (**Figure 1-1**). Coastal infrastructure and activities associated with the proposed action are described in **Chapter 4.1.2**, Coastal Impact-Producing Factors and Scenario.

Offshore activities are described in the context of a scenario for the proposed action. The MMS's GOM OCS Region developed these scenarios to provide a framework for detailed analyses of potential impacts of the proposed lease sale. The scenario is a hypothetical framework of assumptions based on estimated amounts, timing, and general locations of OCS exploration, development, and production activities and facilities, both offshore and onshore. The proposed action is represented by a set of ranges for resource estimates, projected exploration and development activities, and impact-producing factors. The proposed sale is expected to be within the scenario ranges. The scenario does not predict future oil and gas activities with absolute certainty, even though it was formulated using historical information and current trends in the oil and gas industry. Indeed, the scenario is only approximate since future factors such as the contemporary economic marketplace, the availability of support facilities, and pipeline capacities are all unknowns. Notwithstanding these unpredictable factors, the scenario used in this SEIS represents the best assumptions and estimates of a set of future conditions that are considered reasonably foreseeable and suitable for presale impact analyses. The development scenario does not represent an MMS 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.

The MMS assumes fields discovered as a result of the 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, and abandonment for leases in the GOM. For modeling purposes, a 40-year analysis period, as used in the proposed *Outer Continental Shelf Oil and Gas Leasing Program: 2007-2012* (5-Year Program) is used. Activity projections become increasingly uncertain as the length of time for projections are made increases and the number of influencing factors increases. The projections used to develop the proposed action scenario are based on resource estimates as summarized in the *Assessment of Undiscovered Technically Recoverable Oil and Gas Resources of the Nation's Outer Continental Shelf 2006* (USDOI, MMS, 2006f), current industry information, and historical trends.

The analysis of potential environmental and socioeconomic impacts presented in past EIS's and EA's were based on these exploration and development activity scenarios that, in most cases, were overestimated. If the level of activity was overestimated, the environmental and socioeconomic impacts of a lease sale may have been overstated. Based on a recent analysis prepared by MMS, slightly over half of the time the actual activity fell below the lowest level of forecasted activity (USDOI, MMS, 2007f). When within the forecasted range, the majority of time the actual activity was at or near the low end of the forecasted range. In addition, a single lease sale accounts for only a small percentage of the total OCS activities.

The examination of previously forecasted activity did not include the proposed lease sales addressed in the 2007-2012 Multisale EIS. In late 2002, MMS contracted Innovation & Information Consultants, Inc. (IIC, Inc.) to develop a model that would estimate oil and gas exploration and discovery, development, and production in the GOM. The Exploration, Development, and Production (EDP) model was delivered to MMS in 2004 and was used to develop the proposed action scenario presented in this EIS. As stated in the model's documentation, the EDP model "incorporates actual historical data, and allows easy comparison between the actual historical data and the future model years." As the model was developed, modifications were made to "ensure that the model accurately portrayed historical precedent" (Ashton et al., 2004a-c).

The EDP model relies on more factors than previous modeling methods (Upton and Ashton, 2005). Constraints include leasing policy, rig availability, and resource assessment. Inputs include prices, costs, field characteristics, reserve growth, and policy variables. The production function is based on historical production data by field size and location. Another improvement over previously used modeling methods is that the EDP model defines undiscovered resources by field instead of a Gulfwide undiscovered resource volume.

The statistics used for these historic trends exhibit a lag time of about 2 years; therefore, the models using the trends also reflect 2-year-old statistics. In addition, the overall trends average out the "boom and bust" nature of GOM OCS operations. The models cannot fully adjust for short-term changes in the rates of activities and these forecasts only provide estimates at the annual level. The level of aggregation used to generate the historical input parameters for modeling purposes does indeed remove the daily, monthly, and seasonal activity and production variations that result from product price fluctuations, weather conditions, rig availability, infrastructure maintenance and probably a host of other factors. Since the downturn in activity and production levels that occurs for any reason, including hurricanes, is recorded in the historical annual input parameters, the modeling effort does indirectly account for activity and production disruptions that may result from future hurricane activity in the GOM.

The presentation of a "high case" and a "low case" scenario demonstrates the range of possibilities that could occur during any year of the forecast period and that this range of possibilities includes the range of activity levels that could occur during a "boom" year or "bust" year. What MMS does not forecast is the year or years that such a "boom" or "bust" will occur. Since boom and bust cycles of the oil industry are largely price driven and forecasting short-term price fluctuations is quite difficult and unreliable, MMS does not attempt to forecast which years, during the next 40 years, that a "boom" or "bust" will occur. Rather, MMS addresses the possibility that a "boom" or "bust" will occur by offering a range of possibilities with our "high case" and "low case" scenarios. The MMS believes that the models, with continuing adjustments and refinements, adequately project GOM OCS activities in the long term for the EIS analyses.

The proposed action scenario is largely 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;
- oil and gas technologies, and the economic considerations and environmental constraints of these technologies; and
- short-term price fluctuations that are not part of this scenario.

The proposed action is EPA Lease Sale 224. For comparative purposes, the proposed EPA lease sale would represent less than 1 percent of the OCS Program in the WPA and CPA based on barrels of oil equivalent (BOE) resource estimates. Specific projections for activities associated with the proposed action are discussed in the following scenario sections. The potential impacts of the activities associated with the proposed action are considered in the environmental analysis sections (**Chapter 4.3**).

In April 2007, MMS published 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; Volumes I and II* (USDOI, MMS, 2007a). That EIS analyzed lease sales in the CPA, which abuts the proposed project area analyzed in this SEIS. As in this document, a set of ranges for resource estimates, projected exploration and development activities, and IPF's were developed for a "typical" CPA lease sale. The estimated amount of resources projected to be developed as a result of any one of the CPA lease sales was 0.776-1.292 BBO and 3.236-5.229 Tcf of gas. As a result of any one of the CPA lease sales, it was projected that 65-96 exploration and delineation wells and 330-468 development wells would be drilled, 28-39 production structures would be installed, and 130-1,700 km (81-1,056 mi)of new pipeline would be installed, resulting in 0-1 new pipeline landfalls. By comparison, the EPA proposed lease sale projects 0.10-0.14 BBO and 0.16-

0.34 Tcf of gas, 5-15 exploration and delineation wells, 15-20 development wells drilled with one production structure installed, no new pipeline landfalls, and 190-440 km (118-273 mi) of new pipeline installed.

4.1.1.1. Resource Estimates and Timetables

4.1.1.1.1. Proposed Action

The proposed action scenario is used to assess the potential impacts of the proposed lease sale. The resource estimates for the 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 area; and (2) estimates of the portion or percentage of these resources assumed to be leased, discovered, developed, and produced as a result of the 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. Due to the inherent uncertainties associated with an assessment of undiscovered resources, probabilistic 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 the MMS brochure entitled, *Assessment of Undiscovered Technically Recoverable Oil and Gas Resources of the Nation's Outer Continental Shelf 2006* (USDOI, MMS, 2006f). The estimates of the portion of the resources assumed to be leased, discovered, developed, and produced as a result of the proposed action are based upon logical sequences of events that incorporate past experience, current conditions, and foreseeable development strategies. Historical databases and information derived from oil and gas exploration and development activities in analogue areas are available to MMS and were used for this analysis. The undiscovered, unleased, conventionally recoverable resource estimates for the proposed action are expressed as ranges, from low to high. These estimates describe the range of oil and gas production volumes that MMS anticipates will result from proposed Lease Sale 224.

Table 4-1 presents the projected oil and gas production for the Lease Sale 224 proposed action. **Table 4-2** provides a summary of the major scenario elements of the proposed action and some of the related IPF's.

The estimated amounts of resources projected to be leased, discovered, developed, and produced as a result of the proposed EPA lease sale are 0.1-0.14 BBO and 0.16-0.34 Tcf of gas.

The numbers of exploration and delineation wells, production platforms, and development wells projected to develop and produce the estimated resources for the proposed action are given in **Table 4-2. Table 4-2** also includes estimates of the major IPF's related to the projected levels of exploration, development, and production activity.

For purposes of analysis, the life of the leases resulting from the proposed action is assumed to not exceed 40 years. Exploratory drilling activity takes place over an 8- to 10-year period, beginning as early as 1 year after the lease sale, and development activity takes place over a 20- to 30-year period. Production of oil and gas begins as early as the third year after the lease sale and continues through the 40^{th} year. Final abandonment and removal activities are completed no later than in the 40^{th} year.

4.1.1.2. Exploration and Delineation

4.1.1.2.1. Seismic Surveying Operations

Geophysical seismic surveys are performed to obtain information on surface and near-surface geology and on subsurface geologic formations. The MMS completed a PEA on G&G activities on the GOM OCS (USDOI, MMS, 2004). The PEA includes a detailed description of seismic surveying technologies and operations. The G&G PEA is incorporated here by reference and summarized below. High-resolution surveys done in support of lease operations are authorized under the terms and conditions of the lease agreement, and are referred to as postlease surveys. Prelease surveys take into account similar seismic work performed off-lease and collectively authorized under MMS's G&G permitting process.

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. Deep-penetration, CDP seismic surveys obtain data about geologic formations >10,000 m (32,800 ft) below the seafloor. High-energy, marine seismic surveys include both 2D and 3D surveys. Data from 2D/3D surveys are used to map structural features of stratigraphically important horizons in order to identify potential hydrocarbon traps. They can also be used to identify and map habitats for chemosynthetic communities.

Prior to 1989, explosives (dynamite) were used in certain limited areas to generate seismic pulses needed for the surveys. However, the damaging environmental impacts associated with explosives' acoustical energy (high velocity and high peak pressure) led the seismic industry to replace the explosives with seismic airguns. Considered nonexplosive, the piston-type airguns use compressed air to create impulses with superior acoustic signals without generating the environmental impacts of explosives. Due to the decreased impacts, ease of deployment, and reduced regulatory timeframes that come with using airguns, it is assumed that no explosives would be used in future seismic surveys.

Typical seismic surveying operations tow an array of airguns and a streamer (signal receiver cable) behind the vessel 5-10 m (16-33 ft) below the sea surface. The airgun array produces a burst of underwater sound by releasing compressed air into the water column, which creates an acoustical energy pulse. Depending on survey type and depth to the target formations, the release of compressed air every couple of seconds creates a regular series of strong acoustic impulses separated by silent periods lasting 7-16 seconds. Airgun arrays are designed to focus the sound energy downward. Acoustic (sound) signals are reflected off the subsurface sedimentary layers and recorded near the water surface by hydrophones spaced within streamer cables. These streamer cables are often 3 mi (5 km) or greater in length. Vessel speed is typically 4.5-6 kn (about 4-8 mph) with gear deployed.

The 3D seismic surveying enables a more accurate assessment of potential hydrocarbon reservoirs to optimally locate exploration or development wells and minimize the number of wells required to develop a field. State-of-the-art computers have the power to manipulate and process large tracks of 3D seismic data. The 3D surveys carried out by seismic vendors can consist of several hundred OCS blocks. Multiple-source and multiple-streamer technologies are used for 3D seismic surveys. A typical 3D survey might employ a dual array of 18 guns per array. Each array might emit a 3,000-in^3 burst of compressed air at 2,000 pounds per square inch (psi), generating approximately 4,500 kilojoule (kJ) of acoustic energy for each burst. At 10 m (33 ft) from the source, the pressure experienced is approximately ambient pressure plus 1 atmosphere (atm). The streamer array might consist of 6-8 parallel cables, each 6,000-8,000 m (19,685-26,247 ft) long, spaced 75 m (246 ft) apart. A series of 3D surveys collected over time, commonly referred to as a 4D or time-lapse survey, is used for reservoir management (to monitor how a reservoir is draining to optimize the amount of hydrocarbon that is produced).

Multicomponent data, sometimes referred to as 4C data, is a product of an emerging technology that incorporates recording the traditional seismic compressional (P) waves with a full complement of other wave types, but predominantly shear (S) waves. The 4C technology provides a second independent image of a geologic section as well as improves the lithology picture in structurally complex areas. It can also aid in reservoir fluid prediction. The 4C data may be 2D or 3D in nature and procedurally involves draped or towed ocean-bottom receiver cable(s) for acquisition. The 4C data can be used as a defining prelease tool or a postlease aid for reservoir prediction.

Postlease seismic surveying may include high-resolution, 2D, 3D, or 4D surveying. In addition, multicomponent data (2D-4C and 3D-4C data) may be collected to improve lithology and reservoir prediction. High-resolution surveying is done on a site-specific or lease-specific basis or along the proposed pipeline route. These surveys are 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 hard-bottom areas, topographic features, potential chemosynthetic community habitat, or historical archaeological resources. New technology has allowed for 3D acquisition and for deeper focusing of high-resolution data. It is assumed at least one postlease, high-resolution seismic survey would be conducted for each lease.

Deeper penetration seismic surveying (2D, 3D, or 4D) may also be done postlease for more accurate identification of potential reservoirs, increasing success rates for exploratory drilling and aiding in the identification of additional reservoirs in "known" fields. The 3D technology can be used in developed areas to identify bypassed hydrocarbon-bearing zones in currently producing formations and new productive horizons near or below currently producing formations. It can also be used in developed areas for reservoir monitoring and field management. The 4D seismic surveying is used for reservoir monitoring and management, as well as in identifying bypassed "pay zones." Through time-lapsed surveys, the movement of oil, gas, and water in reservoirs can be observed over time. Postlease, deep seismic surveys may occur periodically throughout the productive life of a lease.

Under the Marine Mammal Protection Act, MMS is seeking regulations governing the possible harassment and nonserious injury of several species of marine mammals in the GOM as a result of seismic surveys. As part of that request, MMS prepared projections of seismic surveys for a 5-year period (2004-2009). Projected operations were divided into three categories: deep seismic, high-resolution seismic, and vertical seismic profiling (VSP). Deep seismic operations would be conducted prelease, and high-resolution seismic and VSP operations would be conducted postlease. The MMS projected annually 95-130 VSP operations, 12,500-16,500 mi (20,115-26,554 km) surveyed by high-resolution seismic, and 1,500-3,000 blocks surveyed by deep seismic. These projections did not include activities associated with the proposed Lease Sale 224 area.

4.1.1.2.2. Exploration and Delineation Plans and 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 to a prospective geologic structure to determine if a resource exists. If a resource is discovered in quantities appearing to be economic, one or more followup delineation wells help define the amount of resource or the extent of the reservoir.

In the GOM, exploration and delineation wells are typically drilled with MODU's; for example, jack-up rigs, semisubmersible rigs, or drillships. 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 table below indicates the depth ranges for exploration rigs used in this analysis for GOM MODU's.

MODU or Drilling Rig Type	Water-Depth Range
Semisubmersible	100-3,000 m
Drillship	≥600 m

The scenarios for the proposed action assume 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 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. This scenario assumes that the average exploration or delineation well depth will be approximately 3,674 m (12,055 ft) below mudline.

Some delineation wells may be drilled using a sidetrack technique. In sidetracking a well, a portion of the existing wellbore is plugged back to a specific depth, directional drilling equipment is installed, and a new wellbore is drilled to a different geologic location. The lessee may use this technology to better understand their prospect and to plan future wells. Use of this technology may also reduce the time and exploration expenditures needed to help evaluate the prospective horizons on a new prospect.

The cost of an ultra-deepwater well (>6,000 ft or 1,829 m water depth) can be $30-$50 million or more, without certainty that objectives can be reached. Some recent ultra-deepwater exploration wells in the GOM have been reported to have cost upwards of $100 million.

The MMS requires that operators conduct their offshore operations in a safe manner. Subpart D of the MMS's operating regulations (30 CFR 250) provides guidance to operators on drilling activities. For example, operators are required by 30 CFR 250.400 to take necessary precautions to keep their wells under control at all times using the best available and safest drilling technology (NTL 99-G01; "Deepwater Emergency Well Control Operations"). Deepwater areas pose some unique concerns regarding well-control activities. In 1998, the International Association of Drilling Contractors (IADC) published deepwater well-control guidelines (IADC, 1998) to assist operators in this requirement. These guidelines address well planning, well-control procedures, equipment, emergency response, and specialized training for drilling personnel.

As drilling activities occur in progressively deeper waters, operators may consider using MODU's that have onboard hydrocarbon storage capabilities. This option may be exercised if a well requires extended flow testing, 1-2 weeks or longer, in order to fully evaluate potential producible zones and to justify the higher costs of deepwater development activities. The liquid hydrocarbons resulting from an extended well test could be stored onboard a rig and later transported to shore for processing. Operators may also consider barge shuttling hydrocarbons from test well(s) to shore. There are some dangers inherit with barging operations if adverse weather conditions develop during testing. If operators do not choose to store produced liquid hydrocarbons during the well testing, they must request and receive approval from MMS to burn test hydrocarbons. The MMS will only grant permission to flare or vent associated natural gas during well cleanup and for well-testing procedures for a limited period of time.

Exploration Plans

The regulation at 30 CFR 250 Subpart B specifies the requirements for the EP's that operators must submit to MMS for approval prior to deploying an exploration program. An EP must be submitted to MMS for review and approval 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, and other relevant information; it also includes the 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 further explained in NTL's 2006-G14 and 2007-G11. The NTL 2006-G14 provides guidance on information requirements and establishes the contents for OCS plans required by 30 CFR 250 Subpart B. This NTL, along with NTL 2007-G11, supersedes NTL 2006-G15. In the revised final Subpart B regulations, the contents of an EP are given. The NTL 2007-G11 provides guidance for submitting OCS plans to the MMS GOMR.

The requirements for archaeological and shallow hazards surveys and their reports are specified in their own NTL's—2005-G07 ("Archaeological Resource Surveys and Reports") and 98-20 ("Shallow Hazards Requirements").

Drilling Rig Availability

Competition for and availability of deepwater drilling rigs in the GOM may limit the availability of MODU's suitable for deepwater and ultra-deepwater prospects. Drilling activities may also be constrained by the availability of rig crews, shore-base facilities, risers, and other equipment. A search on the Rigzone website (Rigzone, 2006) showed that operators in the GOM currently had commitments for the following rig classes: 118 jack-ups, 35 semisubmersibles, and 6 drillships. Operators had a rig utilization rate of about 85 percent, which means that at any time approximately 85 percent of these rigs are actively drilling. The Rigzone website indicates the total worldwide deployment capability for these MODU classes as 315 jack-ups, 140 semisubmersibles, and 33 drillships.

It is estimated that 5-15 exploration and delineation wells will be drilled as a result of the proposed action (**Table 4-2**). All of the wells will fall within the deepwater or ultra-deepwater range.

4.1.1.3. Development and Production

4.1.1.3.1. Development and Production Drilling

Delineation and production wells are sometimes collectively termed development wells. A development well is designed to extract resource from a known hydrocarbon reservoir. After a discovery the operator must decide whether or not to complete the well without delay, to delay completion with the rig on station so that additional tests may be conducted, or to temporarily abandon the well site and move the rig off station to a new location and drill another well. Sometimes an operator will decide to drill a series of development wells, move off location, and then return with a rig to complete all the wells at one time. If an exploration well is clearly a dry hole, the operator permanently abandons the well without delay.

When the decision is made to complete the well, a new stage of activity begins. Completing a well involves preparing the well for production. The MMS estimates that 87 percent of development wells would become producing wells. The typical process includes setting and cementing the production casing, installing some downhole production equipment, perforating the casing and surrounding cement, treating the formation, setting a gravel pack (if needed), and installing production tubing. One form of formation treatment is known as "fracing." Fracing involves pressurizing the well to force chemicals or mechanical agents into the formation. Mechanical agents, such as sand or small microspheres (tiny glass beads), can be used to prop open the created fractures that act as conduits to deliver hydrocarbons to the wellbore. Well treatment chemicals are commonly used to improve well productivity. For example, acidizing a reservoir to dissolve cementing agents and improve fluid flow is the most common well treatment in the GOM. After a production test determines the desired production rate to avoid damaging the reservoir, the well is ready to go online and produce.

Development wells in the proposed sale area may be drilled from movable structures, such as fixed bottom-supported structures, floating vertically-moored structures, and drillships (dynamically positioned drilling vessels). The spectrum of these production systems are shown in **Figure 3-12**.

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 the number of anticipated tie backs from other fields can also influence an operator's 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 increasingly in deep water, subsea. Advances in the composition of drilling fluids and drilling technology are likely to provide operators with the means to reduce rig costs in the deepwater regions of the Gulf of Mexico.

Until recently, there had been a gradual increase of drilling depth (as measured in true vertical depth (TVD)). Beginning in 1996, the maximum drilling depth increased rapidly, reaching depths below 9,144 m (30,000 ft) in 2002. The Transocean *Discoverer Spirit* (Green Canyon Block 512) drilled the deepest well in the GOM to date, reaching a TVD of 10,411 m (34,157 ft) in December 2005. The recent dramatic increase in TVD may be attributed to several factors, including enhanced rig capabilities, deeper exploration targets, royalty relief for shallow water, deep gas prospects, and the general trend toward greater water depths.

The MMS has described and characterized production structures in its deepwater reference document (Regg et al., 2000). These descriptions are summarized in **Chapter 3.3.5.7.1** and were used in preparing the scenario for this SEIS. In the proposed sale area, the scenarios assume that a spar or similar platform would be utilized. It is assumed that all would be manned and that a helipad will be located on the structure.

Industry Challenges and Emerging Technologies

In recent years, operators have pushed into deeper water in parallel with increasingly deeper wells (in TVD). Deeper wells have pushed current drilling procedures and materials into a new frontier. These deeper wells have encountered high-pressure, high-temperature (HPHT) conditions. Drilling in HPHT environments is the greatest technological and regulatory challenge to the oil and gas industry today. The basic building blocks of structural integrity are being challenged. Metals that have been in use for many years now face unique environmental conditions. The MMS is working with industry to evaluate the risks and set limits to avoid these potential hazards. The American Petroleum Institute has formed a team to develop a Recommended Practice (RP) on HPHT wells. The RP is designed to be an "umbrella type" document that would guide the formulation of several other documents that address HPHT equipment.

The MMS has the responsibility to approve only those technologies proven to provide maximum protection to the environment. To assure that oil and gas exploration, development, and production activities on the OCS are conducted in a safe and pollution-free manner, the OCSLA, as amended, requires that all OCS technologies and operations use the best available and safest technology (BAST) whenever practical (**Chapter 1.5**). The BAST measures are required to protect safety, health, and the environment, if it is economically feasible and the benefits outweigh the costs (30 CFR 250.107(c) and (d)). Conformance to the standards, codes, and practices referenced in 30 CFR 250 is considered the application of BAST.

The MMS is also sponsoring research and participating in internal and industry-related conferences to stay at the forefront of new technology and is actively involved in developing policies that will best promote human safety and environmental integrity. As deepwater wells are drilled to greater and greater depths, they begin to encounter the same HPHT conditions that shallow-water wells see at greater drilling depths. The HPHT compounds the technological challenges faced in deepwater exploration and especially in deepwater completion and production. Consequently, there is tremendous potential for growth and development in the HPHT area.

The pipeline from a subsea completion to its host structure is commonly referred to as the tieback. The tieback length varies considerably with each development. Most subsea wells are located within 10 mi (16 km) of their host platform. The Mensa field remains the current world record holder for a subsea tieback length of 62 mi (100 km) from its host. The second longest subsea tieback in the world (55 mi or 88 km) is Canyon Express, linking Aconcagua, Camden Hills, and King's Peak projects to their host platform. The number of long tiebacks is likely to increase as the industry moves into deepening water depths with limited infrastructure to support the new development. The real key to making these extended tiebacks work lies in flow assurance. Industry has used pipe-in-pipe flowlines to insulate the production from the cold water and seabed. Cold temperatures can foster hydrate formation in the pipelines, particularly if flow within the pipeline is diminished. Likewise, colder temperature can cause other problems, e.g., paraffinic deposition within the line. Chemicals may be added to the flow stream to enhance flow assurance. Industry is also examining sources of heat to maintain flow within the pipelines. Long tiebacks require long control umbilicals. The umbilicals control the wells and also provide conduits between the host and the subsea well for chemical treatments. For example, hydrate, corrosion, scale, and paraffin inhibitors may be transported to the well for injection via the well's umbilical. These inhibitors are used to maintain flow assurance and to increase the longevity of the pipelines.

The longer subsea tiebacks being used to develop marginal deepwater fields pose another challenge for industry, namely in the design and installation of pipelines rated for the HPHT well's shut-in tubing pressure (SITP) of 15,000 psi and/or 350 ^{o}F (177 ^{o}C). Rather than relying on the physical strength of steel to withstand the SITP, a high-integrity pressure protection system (HIPPS) (**Chapter 4.1.1.8**) provides alternate overpressure protection for a pipeline or flowline. The HIPPS employs valves, logic controllers, and pressure transmitters to shut down the system before a pipeline is overpressured and/or ruptured.

Production hubs, e.g., Independence Hub, may find an increasing role in development in the GOM. Multiple fields using subsea technology may be connected to a centrally located production hub to facilitate the project's development. Fields that are considered marginal to produce may be developed through the economy of scale offered by this type of host.

New operational techniques such as managed pressure drilling (MPD) will facilitate exploration and development activities by allowing lessees to drill wells not previously considered possible. The MPD is a drilling methodology that has returns to the surface using an equivalent mud weight, which is basically a combination of static mud weight, equivalent circulating densities, and surface back pressure maintained at or above open-hole pore pressure.

New types of material for risers are likely to be submitted to MMS for review and approval. Composite materials may be substituted in part or in whole for conventional steel risers. As operations move into deepening water depths, the weight of risers will also increase using conventional technology. Composite material may be used to lessen this weight-bearing requirement while maintaining the same level of safety afforded by the conventional steel risers. Riser configurations may also change. Equipment, including buoyant cells, may be affixed to lessen loads on rigs and production facilities.

Subsea processing is expected to enhance production from subsea wells. The overall process considers various types of liquid/gas separation, produced-water disposal, and subsea booster pumps. This technology will enable operators to produce lower pressure wells in greater water depths with increased distance to the "host" facility by reducing the volume of fluids and increasing the pressure in the flowline. Subsea processing is also expected to increase the recoverable reserves from the reservoirs, especially in ultra-deepwater.

Rig stationkeeping and survivability issues came to the forefront during the 2005 hurricane season. The MMS has addressed these concerns in two NTL's (NTL's 2007-G13 and 2007-G19). These NTL's highly recommend that lessees and operators follow the recommendations of API RP 95J (for jack-up rigs) and API RP 95F (for floating rigs). Rig owners are currently improving their mooring systems to minimize movement off station.

Ocean currents may disrupt offshore operations and reduce the working life of certain equipment. In an effort to understand currents in the GOM and to provide information for forecasting, hindcasting, and fatigue damage, MMS created a program to monitor currents from all deepwater rigs and floating platforms. The MMS issued NTL 2005-G05, "Deepwater Ocean Current Monitoring on Floating Facilities," which requires operators to submit data in a standardized format to a publicly accessible website. This information is displayed real-time and can be downloaded for the forecasting of currents and for historic reference. Operators are encouraged to use the information from nearby facilities, as well as their own, for daily operations and for determining damage caused by severe currents. In addition, site-specific data must be used in the design of new floating production facilities and drilling rigs, and their ancillary equipment, such as steel catenary risers and mooring systems.

Expandable tubulars may play an increasing part in future wells in the GOM. This technology allows tubulars (e.g., casing) to be installed in a well and then expanded to a larger internal diameter by forcing a specially designed tool down the tubular. The larger diameter tubular will allow installation of larger downhole equipment that may ultimately enhance production.

Synthetic-based drilling fluids (SBF) have also had a significant effect on exploration and development operations. The SBF are synthetic; therefore, they are neither oil-based nor water soluble. The SBF are a recently developed and USEPA-permitted drilling fluid. The SBF do not contain toxic PAH and are recycled, thus reducing discharges, and are more protective of the environment than earlier fluids. A Department of Energy publication (USDOE, OFE, 1999) cites results from a GOM operator study that concluded that SBF significantly outperformed water-based fluids (WBF). Of eight wells drilled under comparable conditions to the same depth, the study found that the three wells drilled using SBF were completed in an average of 53 days at a cost of approximately $5.5 million. In comparison, the five wells drilled using WBF were completed in an average of 195 days at a cost of approximately $12.4 million. The environmental benefits from the use of SBF include reduced air emissions because of shorter drilling times and less waste because SBF are reconditioned and recycled.

New types of drilling fluid are expected to be developed to handle the harsh conditions encountered in HPHT wells. Some drilling fluid companies are in the process of examining alternative formulas for their products. Issues of concern will be the compatibility of the drilling fluid and the residual left on the cuttings when discharged into the environment. Prior to their use, these fluids will have to be approved by USEPA if any discharge will occur.

Deepwater Operations Plans

Deepwater Operations Plans (DWOP's) are required of all deepwater development projects in water depths ≥1,000 ft (305 m) and for all projects proposing subsea production technology. The DWOP is designed to address industry and MMS 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 MMS. The DWOP provides MMS with information specific to deepwater/subsea equipment issues to demonstrate that a deepwater project is being developed in an acceptable manner. The MMS will review deepwater development activities from a total system perspective, emphasizing the operational safety, environmental protection, and conservation of natural resources. The DWOP was established through the NTL process, which provides for a more timely and flexible approach to keep pace with the expanding deepwater operations and subsea technology. On August 30, 2005, the DWOP requirements were incorporated into MMS's operating regulations via revisions to 30 CFR 250 Subpart B.

A conceptual DWOP is required initially and is usually followed by a Development and Production Plan (DPP).

Development and Production Plan

The chief planning document that lays out an operator's specific intentions for development is the DPP. Requirements for lessees and operators submitting a DPP are addressed in 30 CFR 250, Subpart B.

4.1.1.3.2. Infrastructure Emplacement/Structure Installation and Commissioning Activities

Bottom-founded or floating structures may be placed over development wells to facilitate production from a prospect. These structures provide the means to access and control the wells. They serve as a staging area to process and treat produced hydrocarbons from the wells, initiate export of the produced hydrocarbons, conduct additional drilling or reservoir stimulation, conduct workover activities, and carry out eventual abandonment procedures. There is a range of offshore infrastructure installed for hydrocarbon production. Among these are pipelines, fixed and floating platforms, caissons, well protectors, casing, wellheads, and conductors.

Subsea wells may also be completed to produce hydrocarbons from on the shelf and in the deepwater portions of the GOM. The subsea completions require a host structure to control their flow and to process their well stream. Control of the subsea well is accomplished via an umbilical from the host.

Pipelines are the primary means of transporting produced hydrocarbons from offshore oil and gas fields to distribution centers or onshore processing points. Pipelines range from small-diameter (generally 4-12 in) gathering lines, sometimes called flowlines, that link individual wells and production facilities to large-diameter (as large as 36 in) lines, sometimes called trunklines, for transport to shore. There are currently over 34,600 mi (54,718 km) of active pipelines on the GOM OCS. Pipelines are installed by lay barges that are either anchored or dynamically-positioned while the pipeline is laid. Pipeline sections may be welded together on a conventional lay barge as it moves forward on its route or they may be welded together at a fabrication site onshore and wound onto a large-diameter spool or reel. Once the reel barge is on location, the pipeline is straightened and lowered to the seafloor on its intended route. Both types of lay barge use a stinger to support the pipeline as it enters the water. The stinger helps to prevent undesirable bending or kinking of the pipeline as it is installed.

To keep floating structures on station, a mooring system must be designed and installed. Lines to anchors or piling arrays attach the floating components of the structure. With a TLP, tendons stem from a base plate on the sea bottom to the floating portion of the structure. Commissioning activities involve the emplacement, connecting, and testing of the structure's modular components that are assembled on site.

It is estimated that a single production structure will be installed as a result of the proposed action. Due to the water depth within the proposed lease sale area (800-3,200 m (2,625-10,500 ft)), bottom-founded structures are not projected. It is anticipated that a spar or similar technology will be used to recover and produce oil and natural gas in the sale area.

Bottom Area Disturbance

Structures emplaced on the OCS to facilitate oil and gas exploration and production include MODU's (semisubmersibles and drillships), pipelines, and fixed surface, floating, and subsea production systems described above. The emplacement or removal of these structures disturbs small areas of the sea bottom beneath or adjacent to the structure. If mooring lines of steel, chain, or synthetic polymer are anchored to the sea bottom, areas around the structure can also be directly affected by their emplacement. This disturbance includes physical compaction or crushing beneath the structure or mooring lines and the resuspension and settlement of sediment caused by the activities of emplacement. Movement of floating types of facilities will also cause the movement of the mooring lines in its array. Small areas of the sea bottom will be affected by this kind of movement. Impacts from bottom disturbance are of concern near sensitive areas such as chemosynthetic communities, high-density biological communities in water depths ≥400 m (1,312 ft), and archaeological sites.

Semisubmersibles can be operated in a wide range of water depths and disturb about 2-3 ha (5-7 ac), depending on their mooring configurations. In water depths >600 m (1,968 ft), dynamically-positioned (DP) drillships could be used; these drillships disturb only a very small area where the bottom template and wellbore are located, approximately 0.25 ha (0.62 ac). Since the advent of synthetic mooring lines, some drillships may be moored to the bottom. Drillships would affect an area of the bottom similar to that of the semisubmersibles, depending on their mooring array at their water depth.

At water depths exceeding 400 m (1,312 ft), compliant towers, TLP's, spars, and floating production systems (FPS's) would be used (**Figure 3-12**). A compliant tower would disturb the same bottom area—about 2 ha (4.9 ac)—as a conventional, fixed platform. A TLP consists of a floating structure held in place by tensioned tendons connected to the seafloor by pile-driven anchors. The bottom area disturbed by a TLP is dependent on the mooring line configuration and would be about 0.5 ha (1.2 ac) per anchor. A spar platform consists of a large-diameter cylinder supporting a conventional deck, three types of risers (production, drilling, and export), and a hull that is moored by a catenary system of 6-20 lines anchored to the seafloor. A spar would disturb about 1 ha (2.5 ac) of bottom area per mooring line, because mooring lines tend to be anchored farther away from the surface structure, which tends to cause more contact and scraping of the sea bottom near the anchor. Where applicable, a taut leg mooring system may be employed. This type of system exerts more tension on the mooring lines and results in fewer impacts to the seafloor.

Subsea production systems located on the ocean floor are connected to surface topsides by a variety of components. These bottom-founded components are an integrated system of flowlines, manifolds, flowline termination sleds, umbilicals, umbilical sleds, blowout preventers, well trees, and production risers that disturb approximately 1 ha (2.5 ac) of sea bottom per well produced.

Due to the depth of the water, burial of the pipelines would not be required, minimizing the impact to the seafloor.

Sediment Displacement

Displaced sediments are those that have been physically moved "in bulk." Displaced sediments will cover or bury an area of the seafloor, while resuspended sediments will cause an increase in turbidity of the adjacent water column. Resuspended sediments eventually settle, covering the surrounding seafloor. Resuspended sediments may include entrained heavy metals or hydrocarbons.

The chief means for sediment displacement is the overboard discharge of drill cuttings carried to the surface and by drilling mud. Cuttings that outfall from surface platforms settle to the sea bottom as a mound or plume if influenced by the prevailing currents. Mooring lines in contact with the sea bottom can scrape sediment into heaps and mounds as the surface facility moves in response to currents.

Trenching for pipeline burial will not be required in water depths >200 ft (61 m), and it is not projected that any pipelines from the proposed lease area would be trenched.

4.1.1.3.3. Infrastructure Presence

4.1.1.3.3.1. Anchoring

Most exploration drilling, platform, and pipeline emplacement operations in shallow waters of the OCS require anchors to hold the rig, topside structures, or support vessels in place. These anchors disturb the seafloor and sediments of the area. Due to water depth, it is projected that dynamically-positioned drillships would be used. These 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, especially 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 will use anchors placed away from their location of work when installing and removing structures.

4.1.1.3.3.2. Space-Use Conflicts

During OCS operations, the areas occupied by seismic vessels, structures, anchor cables, and safety zones are unavailable to commercial fishermen. However, commercial fishing in the area of the proposed sale is minimal.

Longline fishing is performed in water depths >100 m (328 ft) and usually beyond 300 m (984 ft). All surface longlining is prohibited in the northern DeSoto Canyon area (designated as a swordfish nursery area by the National Oceanic and Atmospheric Administration, NMFS. Longline fishing will also probably be effectively precluded from blocks for miles around the closure area because of the great length of typical longline sets and time required for their retrieval. The closure does not extend into the area of the proposed lease sale.

In water depths >450 m (1,476 ft), production platforms will be compliant towers or floating structures (such as TLP's and spars); this is beyond the range of typical commercial bottom trawling. Even though production structures in deeper water are larger and individually will take up more space, there will be fewer of them compared with the great numbers of bottom-founded platforms in shallower water depths. Production structures in all water depths have a life expectancy of 20-30 years. The MMS data indicate that the total area lost to commercial fishing due to the presence of production platforms has historically been and will continue to be less than 1 percent of the total area available. A maximum of 6 ha (15 ac) will be lost to commercial fishing as a result of the proposed action in the EPA.

4.1.1.3.3.3. Bottom Debris

Bottom debris 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 illegally tossed overboard from fixed or floating facilities. The maximum quantity of bottom debris per operation is estimated to be several tons. The MMS requires site clearance over the assumed areal extent over which debris will fall. **Chapter 4.1.1.11** describes the requirements and guidelines for removing bottom debris and gear after structure decommissioning and removal operations. There are also requirements for verification that operational debris has been removed from the areas around the platform removal site (e.g., by trawling the area to verify that the site has, in fact, been cleared of debris).

The Fishermen's Contingency Fund (FCF) was established to provide recourse for recovery of commercial fishing equipment losses due to entanglement on OCS oil and gas structures and debris. Direct payments for claims in FY 2003 totaled $107,989 and total payments for FY 2004 were $187,429 (USDOC, NMFS, Office of Management and Budget, 2006).

Most of the debris loss during the lifespan of this operation will be removed from the seafloor during the structure decommissioning, site clearance, and verification process.

4.1.1.3.4. Workovers and Abandonments

Completed and producing wells may require periodic reentry that is designed to maintain or restore a desired 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 strata) or to permanently abandon a part or all of a well. Examples of workover operations are acidizing the perforated interval in the casing, plugging back, squeezing cement, milling out cement, jetting the well in with coiled tubing and nitrogen, and setting positive plugs to isolate hydrocarbon zones. 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 7 days. Current oil-field practices include preemptive procedures or treatments that reduce the number of workovers required for each well. On the basis of historical data, MMS 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. An operator may temporarily abandon a well to (1) allow detailed analyses or additional delineation wells while deciding if a discovery is economically viable, (2) save the wellbore for a future sidetrack to a new geologic bottom-hole location, or (3) wait on design or construction of special production equipment or facilities. The operator must meet specific requirements to temporarily abandon a well (30 CFR 250.703). Permanent abandonment operations are undertaken when a wellbore is of no further use to the operator (i.e., the well is a dry hole or the well's producible hydrocarbon resources have been depleted). During permanent abandonment operations, equipment is removed from the well, and specific intervals in the well that contain hydrocarbons are plugged with cement. A cement surface plug is also required for the abandoned wells. This serves as the final isolation component between the wellbore and the environment.

Table 4-2 shows there are 91-126 workovers projected as a result of the proposed action. The projected number of workovers is a function of producing wells, including one permanent abandonment operation per well.

4.1.1.4. Operational Waste Discharged Offshore

The primary operational waste discharges generated during offshore oil and gas exploration and development are drilling fluids, drill cuttings, deck drainage, sanitary wastes, and domestic wastes. During production activities, additional waste streams include produced water, produced sand, and well treatment, workover, and completion (TWC) fluids. Minor additional discharges occur from numerous sources; these discharges may include desalination unit discharges, blowout preventer fluids, boiler blowdown discharges, excess cement slurry, several fluids used in subsea production, and uncontaminated freshwater and saltwater.

The USEPA, through general permits issued by the USEPA Region that has jurisdictional oversight, regulates all waste streams generated from offshore oil and gas activities. The USEPA published the effluent guidelines for the offshore oil and gas extraction point-source category in 1993 (58 FR 12454). Synthetic-based fluids (SBF) were first used in the GOM in 1992 and effluent guidelines limitations for SBF were published January 22, 2001, and incorporated in the NPDES permits of both USEPA GOM regions. The USEPA Region 4 has jurisdiction over the eastern portion of the GOM OCS including all of the EPA and a portion of the CPA off the coasts of Alabama and Mississippi (**Figure 4–1**). The USEPA Region 6 has jurisdiction over the rest of the CPA. In January 2006, MMS adopted new administrative boundaries that have resulted in the extension of the MMS CPA eastward. The USEPA has not changed its boundaries. The USEPA Region 6 administers the NPDES general permit for activities in Federal waters off the coast of Mississippi and westward.

Each USEPA Region has promulgated general permits for discharges that incorporate the 1993 effluent guidelines and 2000 effluent guidelines for SBF-wetted cuttings as a minimum. The current Region 4 general permit (GMG460000) was issued on December 9, 2004, became effective January 1, 2005, and expires on December 31, 2009 (USEPA, 2004d). It was preceded by the permit (GMG280000) issued October 16, 1998, modified March 14, 2001, and expired on October 31, 2003.

4.1.1.4.1. Drilling Muds and Cuttings

The largest quantity of discharge generated by drilling operations is drilling fluids (also known as drilling muds) and cuttings. Drilling fluids are used in rotary drilling to remove cuttings from beneath the bit, to control well pressure, to cool and lubricate the drill string and its bit, and to seal the well. Drill cuttings are the fragments of rock generated during drilling and carried to the surface with the drilling fluid. Drilling discharges of muds and cuttings are regulated by USEPA through an NPDES permit.

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 or mineral, diesel oil, or synthetic oil in nonaqueous-based fluids. Additional chemicals are added to improve the performance of the drilling fluid (Boehm et al., 2001).

Water-based drilling fluids (WBF) have been used for decades in drilling on the OCS. The WBF may have mineral oil added for lubricity. The discharge of WBF and cuttings associated with WBF is allowed almost everywhere on the OCS under the general NPDES permits issued by USEPA Regions 4 and 6, as long as the discharge meets guidelines. Individual permits may also be obtained.

Discharge of WBF results in increased turbidity in the water column, alteration of sediment characteristics because of coarse material in cuttings, and trace metals. Occasionally, formation oil may be discharged with the cuttings, adding hydrocarbons to the discharge. In shallow environments, WBF are rapidly dispersed in the water column immediately after discharge and rapidly descend to the seafloor (Neff, 1987). In deep waters, fluids dispersed near the water surface would disperse over a wider area than fluids dispersed in shallow waters.

The early nonaqueous drilling fluids, termed oil-based drilling fluids (OBF), were occasionally used for directional drilling and in drill-bore sections where additional lubricity was needed. Crude, diesel, and mineral oil were used. Diesel OBF contains light aromatics such as benzene, toluene, and xylene, and mineral oil was advantageous over diesel because it was less toxic. Hydrocarbon concentration and impacts to benthic community diversity and abundance have been observed within 200 m (656 ft) of the drill site with diminishing impacts measured to a distance of 2,000 m (6,562 ft) (Neff, 1987). All OBF and associated cuttings must be transported to shore for recycling or disposal unless reinjected. All OBF are likely to be replaced by SBF in deepwater drilling because of the many advantageous features of SBF (Neff et al., 2000).

The SBF are manufactured hydrocarbons. Since the SBF are not petroleum based, they do not contain the aromatic hydrocarbons and polycyclic aromatic hydrocarbons (PAH) that contributed to OBF toxicity and persistence on the seafloor (OGP, 2003). The SBF mud system also contains additives such as emulsifiers, clays, wetting agents, thinners, and barite. Since 1992, SBF have been increasingly used, especially in deep water, because they perform better than WBF and OBF. The SBF reduce drilling times and costs incurred from expensive drilling rigs. By 1999, about 75 percent of all wells drilled in waters deeper than 305 m (1,000 ft) were drilled with SBF in the GOM (CSA, 2004). Although there are many types of SBF, internal olefins and linear alpha olefins are most commonly used in the GOM.

A literature review (Neff et al., 2000) discusses the current knowledge about the fate and effects of SBF and SBF wetted cuttings discharges on the seabed. Like OBF, SBF are hydrophobic, do not disperse in the water column and therefore are not expected to adversely affect water quality if permit requirements are followed. The SBF-wetted cuttings settle close to the discharge point and affect the local sediments. Cuttings piles with a maximum depth of 8-10 in (20-25 cm) were noted in a seabed study of shelf and slope locations where cuttings drilled with SBF were discharged. The primary effects are smothering of the benthic community, alteration of sediment grain size, and addition of organic matter, which can result in localized anoxia during the time it takes the SBF to degrade (Melton et al., 2004). Different formulations of SBF use base fluids that degrade at different rates, thus affecting the duration of the impact. Esters and olefins are the most rapidly biodegraded SBF.

Bioaccumulation tests indicate that SBF and their degradation products should not bioaccumulate (Neff et al., 2000). In a study to measure degradation rates of SBF on the seafloor and to characterize the microbial populations, the sulfate-reducing bacterial counts increased in sediments incubated with SBF under deep-sea conditions (Roberts and Nguyen, 2006). Biodegradation proceeded after a lag period of up to 28 weeks, influenced by both the SBF type and prior exposure of the sediments to SBF. Sulfate depletion in the test sediments because of microbial activity coincided with SBF degradation. Incubation at atmospheric pressure or high pressure did not affect the rate of biodegradation. In the joint industry study required as part of the USEPA Region 6 NPDES permit, sediment recovery was noted during the 1-year interval between the first and second sample collection as indicated by a decrease in SBF concentrations. Deposited cuttings and measurable sediment effects indicative of organic enrichment were concentrated within 250 m (820 ft) distance in both shelf and slope sites (CSA, 2004). The SBF concentrations in sediments at drill locations contained average internal olefin SBF concentrations of 500-13,000 ppm on the shelf and concentrations of 2,000-11,750 ppm on the slope, 1-4 years after discharge.

The discharge of the base SBF drilling fluid is prohibited. The SBF and the cuttings must meet environmental requirements. Both USEPA Regions permit the discharge of cuttings wetted with SBF as long as the retained SBF amount is below a prescribed percent meets biodegradation and toxicity requirements, and is not contaminated with the formation oil or PAHs.

Typically, the upper portion of the well is drilled with WBF to a depth in the range of 800-2,000 m (2,625-6,562 ft) and, following “switchover,” the remainder is drilled with SBF. The upper sections would be drilled with a large diameter bit; progressively smaller drill bits are used with increasing depth. Therefore, the volume of cuttings per interval (length of wellbore) in the upper section of the well would be greater than the volume generated in the deeper sections.

Barite, barium sulfate, is used as a weighting agent and is a major component of all drilling fluid types. The amount of barite discharged from 81 wells during 1998-2002 was estimated because the quantity of barite used has declined with advances in SBM technology and drilling. The quantity of barite discharged for a shallow well (3,962 m or 13,000 ft) to a deep well (6,400 m or 21,000 ft) is 110 tons barite per well and 586 tons barite per well, respectively (Candler and Primeaux, 2003).

A comparative study of surface and subsurface sediment samples from six offshore drill locations showed higher levels of total mercury found in the sediments closest to the drilling sites as compared with the sites greater than 3 km (1.9 mi) distant. The higher total mercury concentrations corresponded to the higher barium concentrations also present. The higher total mercury levels in nearfield sediments did not translate to higher methylmercury concentration in those sediments, with a few exceptions (Trefrey et al., 2002). Sediment redox conditions and organic content influence methylmercury formation.

Atmospheric mercury deposition is believed to be the main source of anthropogenic mercury inputs into the marine environment. However, mercury in fish tissue is a concern, and mercury in barite has been suggested as a secondary source in the GOM. Mercury and other trace metals are naturally occurring impurities in barite. Since 1993, USEPA has required the concentrations of mercury and cadmium to be ≤1 ppm and 3 ppm, respectively, in the stock barite used to make up drilling muds. Through mercury and cadmium regulation, USEPA can also control levels of other trace metals in barite. This reduces the addition of mercury to values similar to the concentration of mercury found in marine sediments throughout the GOM (Avanti Corporation, 1993a and b; USEPA, 1993). Concentrations of total mercury in uncontaminated estuarine and marine sediments generally are 0.2 μg/g dry weight or lower. Surface sediments collected 20-2,000 m (66-6,562 ft) away from four oil production platforms in the northwestern GOM contained 0.044-0.12 μg/g total mercury. These amounts are essentially background concentrations for mercury in surficial sediments on the GOM OCS (Neff, 2002).

Barite is nearly insoluble in seawater, thus trapping mercury and other trace metals in the barite grains. Therefore, unless the mercuric sulfide in the barite can be microbially methylated, this source of mercury is relatively unavailable for uptake into the marine food web. The solubility of barite and the rate at which it dissolves (and thereby releases associated metals such as mercury), the amount of metals released from the barite, and the rate of dissolution of barite and release of metals after burial under simulated seafloor conditions was studied (Crecelius et al., in preparation). The research used three grades of barite: one commercially available barite ore used in drilling fluids, which meets USEPA acceptance criteria for trace metal content, and two grades of barite to represent those used in the GOM prior to the 1993 USEPA regulation enacted to reduce the concentrations of Hg and Cd in drilling fluid. The solubility of the associated mercury in seawater at two pH concentrations tended to increase with time for at least several months but remained well below the USEPA water quality criterion. The studies conducted at varying pH levels to mimic digestive tract conditions showed that very little (<0.1%) of the Hg in barite became biologically available.

In a survey conducted by NMFS, seven species of reef fish were obtained at locations with extensive oil drilling, and thus barite, and were compared with reef fish obtained at locations with no drilling. No differences in mercury levels between the two groups were noted (Lowery and Garrett, 2005).

4.1.1.4.2. Produced Waters

Produced water is brought up from the hydrocarbon-bearing strata along with produced oil and gas. This waste stream can include formation water, injection water, well treatment, completion, and workover compounds added downhole and compounds used during the oil/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.

In addition to the added chemical products, produced water contains chemicals that have dissolved into the water from the geological formation where the water was stored. The amount of dissolved solids can be more concentrated than is found in seawater. Produced water contains inorganic and organic chemicals and radionuclides (226Ra and 228Ra). The composition of the discharge can vary greatly in the amounts of organic and inorganic compounds.

Both USEPA general permits allow the discharge of produced water on the OCS provided it meets discharge criteria. The produced water is treated to separate free oil from the water. Since the oil/water separation process does not completely separate all of the oil, some hydrocarbons remain with the produced water and often the water is treated to prevent the formation of sheen. Produced water may be discharged if the oil and grease concentration does not exceed 42 mg/L daily maximum or 29 mg/L monthly average. The discharge must also be tested for toxicity. Both USEPA permits require no discharge within 1,000 m (3,281 ft) of an area of biological concern. Region 4 also requires no discharge within 1,000 m (3,281 ft) of any federally—designated, dredged material ocean disposal site. Region 4 permits the discharge of a smaller range of produced water volumes than Region 6.

The Region 6 NPDES permit required the Produced Water Hypoxia Study, in which produced water was collected from 50 platforms that discharge into the hypoxic zone and was analyzed for oxygen-demanding characteristics (Veil et al., 2005). Samples from platforms that produced mostly gas had higher average BOD and TOC concentrations but smaller volumes than platforms that produced mostly oil. About 508,000 bbl/day of produced water was generated in the hypoxic zone in 2003. The estimated BOD loading is 104,000 lb/day. The study determined that the produced-water nutrient contribution was a minute fraction of the nutrient concentrations introduced by the Mississippi and Atchafalaya Rivers (Veil et al., 2005).

Estimates of the volume of produced water generated per well vary because the percent water is related to well age and hydrocarbon type. Usually, produced-water volumes are small during the initial production phase and increase as the formation approaches hydrocarbon depletion. Produced-water volumes range from 2 to 150,000 bbl/day (USEPA, 1993). In some cases, a centralized platform is used to process water from several surrounding platforms. Some of the produced water may be reinjected into the well. Reinjection occurs when the produced water does not meet discharge criteria or when the water is used as part of operations.

The MMS maintains records of the volume of water produced from each block on the OCS and its disposition—injected on lease, injected off lease, transferred off lease, or discharged overboard. At present, the quantity discharged overboard is about 93-99 percent of the total volume of produced water extracted. The amount discharged overboard for the years 1996-2005 is summarized by water depth in **Table 4-3** and the amount extracted is shown in **Figure 4-2**. The largest amount of produced water generated in this 10-year period was in 2001 on the shelf, and the volume for all water depths in 2001 was 686 MMbbl. In subsequent years, the amount of produced water generated on the shelf decreased to around 580 MMbbl. For the water depths 0-400 m (0-1,312 ft), the volume of produced water decreased by an average of 34 percent in 2004 and 2005, reflecting the damaging effects of the hurricanes. The majority of blocks where water is produced are on the continental shelf off the coast of Louisiana. Very little water is produced off the coast of Texas because these are primarily gas fields.

Deepwater (>400 m (1,312 ft) water depth) production is fairly recent and very little water is produced at this time. In 2003, 30 MMbbl of produced water was generated in deep and ultra-deepwater. Produced-water generation and discharge in the 400- to >2,400-m (1,312- to >7,874-ft) water depth increased by about 50 percent from 2003 to 2005, but the volume is approximately 5 percent of the volume generated in shallower waters. The low temperature and high pressure conditions found in deep water can result in flow problems such as hydrate formation in the lines. Additional quantities of chemicals are used to assure production, and even with recovery systems, some of these chemicals will be present in produced water (Regg et al., 2000). For deepwater operations, new technologies are being developed but the technologies that may discharge or reinject produced water at the seafloor or at "minimal surface structures" before the production stream is transported by pipeline to the host production facility are still years away (USDOI, MMS, 2006g).

4.1.1.4.3. Well Treatment, Workover, and Completion Fluids

Wells are drilled using a base fluid and a combination of other chemicals to aid in the drilling process. Fluids (drilling muds) present in the borehole can damage the geologic formation in the producing zone. Completion fluids are used to displace the drilling fluid and protect formation permeability. "Clear" fluids consist of brines made from seawater mixed with calcium chloride, calcium bromide, and/or zinc bromide. These salts can be adjusted to increase or decrease the density of the brine to hold back-pressure on the formation. Additives, such as defoamers and corrosion inhibitors, are used to reduce problems associated with the completion fluids. Recovered completion fluids can be recycled for reuse.

Workover fluids are used to maintain or improve existing well conditions and production rates on wells that have been in production. Seven workovers are projected per producing well over their lifetime. Workover operations include casing and subsurface equipment repairs, re-perforation, acidizing, and fracturing stimulation. During some of the workover operations, the producing formation may be exposed, in which case fluids like the aforementioned completion fluids are used. In other cases, such as acidizing and fracturing (also considered stimulation or well treatment), hydrochloric (HCl) and other acids are used. Both procedures are used to increase the permeability of the formation. The acids dissolve limestone, sandstone, and other deposits. Because of the corrosive nature of acids, particularly when hot, corrosion inhibitors are added. Since the fluids are altered with use, they are not recovered and recycled; however, these products may be mixed with the produced water.

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. A wide variety of chemicals are used including corrosion and scale inhibitors, bactericides, paraffin solvents, demulsifiers, foamers, defoamers, and water treatment chemicals (Boehm et al., 2001). Some of the production chemicals mix with the production stream and are transported to shore with the product. Other chemicals mix with the produced water. Most produced water cannot be discharged without some chemical treatment. Even water that is reinjected downhole must be cleaned to protect equipment. The types and volumes of chemicals that are used changes during the life of the well. In the early stages, defoamers are used. In the later stages, when more water than oil is produced, demulsifiers and water-treatment chemicals are used more extensively.

Both USEPA Regions 4 and 6 allow the discharge of well-treatment, completion, and workover fluids that meet the specified guidelines. Additives containing priority pollutants must be monitored. Some well treatment, workover, and completion chemicals are discharged with the drilling muds and cuttings or with the produced-water streams. Both must meet the general toxicity guidelines in the NPDES general permit. Discharge and monitoring records must be kept.

4.1.1.4.4. Production Solids and Equipment

As defined by USEPA in the discharge guidelines (58 FR 12454), produced sands are slurried particles, which surface from hydraulic fracturing, and the accumulated formation sands and other particles including scale, which is generated during production. This waste stream also includes sludges generated in the produced-water treatment system, such as tank bottoms from oil/water separators and solids removed in filtration. The guidelines do not permit the discharge of produced sand, which must be transported to shore and disposed of as nonhazardous oil-field waste according to State regulations. Estimates of total produced sand expected from a platform are from 0 to 35 bbl/day according to USEPA (1993).

A variety of solid wastes are generated including construction/demolition debris, garbage, and industrial solid waste. No equipment or solid waste may be disposed of in marine waters.

4.1.1.4.5. Deck Drainage

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. The USEPA general guidelines for deck drainage require that no free oil be discharged, as determined by visual sheen.

The quantities of deck drainage vary greatly depending on the size and location of the facility. An analysis of 950 GOM platforms during 1982-1983 determined that deck drainage averaged 50 bbl/day/platform (USEPA, 1993). The deck drainage is collected, the oil is separated, and the water is discharged to the sea. Impacts from the discharge of deck drainage are assumed to be negligible for the proposed action.

4.1.1.4.6. Treated Domestic and Sanitary Wastes

Domestic wastes originate from sinks, showers, laundries, and galleys. Sanitary wastes originate from toilets. For domestic waste, no solids or foam may be discharged. In addition, the discharge of all food waste within 12 nmi from nearest land is prohibited. In sanitary waste, floating solids are prohibited. Facilities with 10 or more people must meet the requirement of total residual chlorine greater than 1 mg/L and maintained as close to this concentration as possible. There is an exception in both general permits for the use of marine sanitation devices.

In general, a typical manned platform will discharge 35 gallons per person per day of treated sanitary wastes and 50-100 gallons per person per day of domestic wastes (USEPA, 1993). It is assumed that these discharges are rapidly diluted and dispersed; therefore, no analysis of the impacts will be performed for the proposed action.

4.1.1.4.7. Minor Discharges

Minor discharges include all other discharges not already discussed that may result during oil and gas operations. Minor or miscellaneous wastes include desalination unit discharge, blowout preventer fluid, boiler blowdown, excess cement slurry, uncontaminated freshwater and saltwater, and miscellaneous discharges at the seafloor, such as subsea wellhead preservation and production control fluid, umbilical steel tube storage fluid, leak tracer fluid, and riser tensioner fluids. In all cases, no free oil shall be discharged with the waste. Unmanned facilities may discharge uncontaminated water through an automatic purge system without monitoring for free oil. The discharge of freshwater or seawater that has been treated with chemicals is permitted providing that the prescribed discharge criteria are met. No projections of volumes or contaminant levels of minor discharges are made for the proposed action because the impacts are considered negligible.

4.1.1.4.8. Vessel Operational Wastes

The USCG defines an offshore service vessel (OSV) as a vessel propelled by machinery other than steam that is of more than 15 gross tons and less than 500 gross tons and that regularly carries goods, supplies, individuals in addition to the crew, or equipment in support of exploration, exploitation, or production of offshore mineral or energy resources (46 CFR 90.10-40). Operational waste generated from supply vessels that support oil and gas operations include bilge and ballast waters, trash and debris, and sanitary and domestic wastes.

Bilge water is water that collects in the lower part of a ship. The bilge water is often contaminated by oil that leaks from the machinery within the vessel. The discharge of any oil or oily mixtures is prohibited under 33 CFR 151.10; however, discharges may occur in waters >12 nmi if the oil concentration is <100 ppm. Discharges may occur within 12 nmi if the concentration is <15 ppm.

Ballast water is used to maintain stability of the vessel and may be pumped from coastal or marine waters. Generally, the ballast water is pumped into and out of separate compartments and is not usually contaminated with oil; however, the same discharge criteria apply as for bilge water (33 CFR 151.10).

The discharge of trash and debris is prohibited (33 CFR 151.51-77) unless it is passed through a comminutor and can pass through a 25-mm mesh screen. All other trash and debris must be returned to shore for proper disposal with municipal and solid waste.

All vessels with toilet facilities must have a marine sanitation device (MSD) that complies with 40 CFR 140 and 33 CFR 149. Vessels complying with 33 CFR 159 are not subject to State and local MSD requirements. However, a State may prohibit the discharge of all sewage within any or all of its waters. Domestic waste consists of all types of wastes generated in the living spaces on board a ship including gray water that is generated from dishwasher, shower, laundry, bath and washbasin drains. Gray water from vessels is not regulated in the GOM. Gray water should not be processed through the MSD, which is specifically designed to handle sewage.

4.1.1.4.9. Assumptions about Future Impacts from OCS Wastes

- The use of SBF will increase, replacing the use of OBF in most situations.
- New types of muds may be developed to address conditions in HPHT wells.
- The discharge of cuttings wetted with SBF (i.e., cuttings with drilling fluid adhered to the surface of the rock fragments) to the seafloor will reduce the volume of cuttings transported to shore for disposal.
- New technologies in deep water may result in discharges at the seafloor, reducing the potential for water column impacts but increasing impacts at the seafloor.
- The movement into deep water will result in fewer total platforms but greater volumes of discharges at each platform. Volumes of discharges may change in response to new deepwater technologies.

4.1.1.5. Trash and Debris

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). Some personal items, such as hardhats and personal flotation devices, are accidentally lost overboard from time to time. Generally, galley, operational, and household 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, and therefore, generate more solid trash than production operations.

The MMS regulations, USEPA's NPDES general permit, and USCG regulations implementing MARPOL 73/78 Annex V prohibit the disposal of any trash and debris into the marine environment. Victual matter or organic food debris may be ground up into small pieces and disposed of overboard from structures located more than 20 km (12 mi) from shore.

Over the last several years, companies have employed trash and debris reduction and improved handling practices to reduce the amount of offshore trash that could potentially be lost into the marine environment. Improved trash management practices, such as substituting paper and ceramic cups and dishes for those made of styrofoam, recycling offshore trash, and transporting and storing supplies and materials in bulk containers when feasible, are commonplace and have resulted in a marked decline in accidental loss of trash and debris.

4.1.1.6. Air Emissions

The OCS activities that use any equipment that burns/vents a fuel, that transports and/or transfers hydrocarbons, or that results in accidental releases of petroleum hydrocarbons or chemicals, causes emissions of air pollutants. Some of these pollutants are precursors to ozone, which is formed by complex photochemical reactions in the atmosphere.

The criteria pollutants considered here are nitrogen oxides (NO_x), carbon monoxide (CO), sulphur oxides (SO_x), volatile organic chemicals (VOC), and particulate matter 2.5-10 microns in size (PM_{10}) and less than 2.5 microns in size ($PM_{2.5}$). Criteria pollutant emissions from OCS platforms and nonplatform operations are shown in **Table 4-4**. These emissions are taken from the 2000 MMS emissions inventory of offshore OCS activities (Wilson et al., 2004).

Flaring is the venting and/or burning or releasing 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 MMS operating regulations provide for some limited volume, short duration flaring, or venting of some natural gas volumes upon approval by MMS. These operations may occur for short periods (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. Emissions from flaring/venting are included in the emissions tables and in the modeling analysis.

4.1.1.7. Noise

Noise associated with OCS oil and gas development results from seismic surveys, the operation of fixed structures such as offshore platforms and drilling rigs, and helicopter and service-vessel traffic. Noise generated from these activities can be transmitted through both air and water, and may be extended or transient. Offshore drilling and production involves various activities that produce a composite underwater noise field. The intensity level and frequency of the noise emissions are highly variable, both between and among the various industry sources. Noise from proposed OCS activities may affect resources near the activities. Whether a sound is or is not detected by marine organisms would depend both on the acoustic properties of the source (spectral characteristics, intensity, and transmission patterns) and sensitivity of the hearing system in the marine organism. Extreme levels of noise can cause physical damage or death to an exposed animal; intense levels can damage hearing; and loud or novel sounds may induce disruptive behavior or other responses of lesser importance.

When the MMPA was enacted in 1972, the concept that underwater sounds of human origin could adversely affect marine mammals was not considered or recognized (MMC, 2002). Concern on the effects of underwater noise on marine mammals and the increasing levels of manmade noise introduced into the world's oceans has since become a major environmental issue (Jasny, 1999). It is generally recognized that commercial shipping is a dominant component of the ambient, low-frequency background noise in modern world oceans (Gordon and Moscrop, 1996) and that OCS-related, service-vessel traffic would contribute to this. For the GOM, that contribution to existing shipping noise is likely insignificant (USDOI, MMS, 2004). Another sound source more specific to OCS operations originates from seismic operations. Airguns produce an intense but highly localized sound energy and represent a noise source of possible concern. The MMS has completed a PEA on G&G permit activities in the GOM (USDOI, MMS, 2004). The PEA includes a detailed description of the seismic surveying technologies, energy output, and operations; these descriptions are incorporated here by reference.

Marine seismic surveys direct a low-frequency energy wave (generated by an airgun array) into the ocean floor and record the reflected energy waves' strength and return arrival time. The pattern of reflected waves, recorded by a series of hydrophones embedded in cables towed by the seismic vessel (streamers) or ocean bottom cables (OBC) placed on the ocean floor, can be used to "map" subsurface layers and features. Seismic surveys can be used to check for foundation stability, detect groundwater, locate mineral deposits (coal), and search for oil and gas. Most commercial seismic surveying is carried out for the energy sector (Gulland and Walker, 1998). Two general types of seismic surveys are conducted in the GOM relative to oil and gas operations. High-resolution site surveys collect data up to 1 km (0.6 mi) deep through bottom sediments and are used for initial site evaluation for potential structures as well as for exploration. This involves a small vessel and usually a single airgun source and is also usually restricted to small areas, most often a single lease site. Deep seismic surveys involve a larger "standard" survey vessel and an airgun array. Deep seismic surveys may be either 2D or 3D and are discussed below.

Seismic exploration and development surveys are often conducted over large survey areas (multiple leases and blocks) and obtain information on geological formations to several thousands meters below the ocean floor. For 2D surveys, a single streamer (hydrophones) is towed behind the survey vessel, together with a single source (airguns) (Gulland and Walker, 1998). Seismic vessels generally operate at low hull speeds (<10 kn or 11 mph) and follow a systematic pattern during a survey, typically a simple grid pattern for 2D work with lines no closer than half a kilometer.

In simplistic terms, 3D surveys collect a very large number of 2D slices, perhaps with line separations of only 25-30 m (82-98 ft). A 3D survey may take months to complete and involves a precise definition of the survey area and transects, usually a series of passes to cover a given survey area (Caldwell, 2001). In 1984, industry operated the first twin streamers. By 1990, industry achieved a single vessel towing two airgun sources and six streamers. Industry continues to increase the capability of a single vessel, now using eight streamer/dual source configurations and multi-vessel operations (Gulland and Walker, 1998). For exploration surveys, 3D methods represent a substantial improvement in resolution and useful information relative to 2D methods. Many areas in the GOM previously surveyed using 2D have been or will be surveyed using 3D. It can be assumed that, for new deepwater areas, 3D surveys would be the preferred method for seismic exploration until and if better technology evolves.

A typical 3D airgun array would involve 15-30 individual guns. The firing times of the guns are staggered by milliseconds (tuned) in an effort to make the farfield noise pulse as coherent as possible. In short, the intent of a tuned airgun array is to have it emit a very symmetric packet of energy in a very short amount of time, and with a frequency content that penetrates well into the earth at a particular location (Caldwell, 2001). The noise generated by airguns is intermittent, with pulses generally less than 1 second in duration for relatively short survey periods of several days to weeks for 2D work and site surveys (Gales, 1982) and weeks to months for 3D surveys (Gulland and Walker, 1998). Airgun arrays produce noise pulses with very high peak levels. The pulses are a fraction of a second and repeat every 5-15 seconds. In other words, while airgun arrays are by far the strongest sources of underwater noise associated with offshore oil and gas activities, because of the short duration of the pulses, the total energy is limited (Gordon and Moscroup, 1996). At distances of about 500 m (1,640 ft) and more (farfield), the array of individual guns would effectively appear to be a single point source (Caldwell, 2001). In the past, sound-energy levels were expected to be less than 200 dB re^{-1}µPa-m (standard unit for source levels of underwater sound: 200 decibels, reference pressure 1 micropascal, reference range 1 meter) at distances beyond 90 m from the source (Gales, 1982). Gulland and Walker (1998) state a typical source would output approximately 220 dB re^{-1}μPa-m, although the peak-to-peak source level directly below a seismic array can be as high as 262 dB re^{-1}μPa-m (Davis et al., 1998b). Recent work by Tolstoy et al. (2004) in the Gulf of Mexico suggests that for deep water (~3,200 m or 10,500 ft) the 180-dB radii would occur at less than 1 km (0.6 mi) from the source, while in shallow waters (~30 m (98 ft)), the 180-dB radii would be considerably larger (e.g., ~3.5 km (2.2 mi)). The 180 dB re^{-1}μPa-m level is an estimate of the threshold of sound energy that may cause hearing damage in cetaceans (U.S. Dept. of the Navy, 2001). Until further studies are completed, NMFS continues to use this estimated threshold. It is unclear which measurements of a seismic pulse provide the most helpful indications of its potential impact on marine mammals (Gordon et al., 1998). Gordon et al. speculate that peak broadband pressure and pulse time and duration would be most relevant at short ranges (hearing damage range) while sound intensity in 1/3 octave bands is a more useful measurement at distance (behavioral effects).

Information on drilling noise in the GOM is unavailable to date. From studies mostly in Alaskan waters, drilling operations often produce noise that includes strong tonal components at low frequencies, including infrasonic frequencies in at least some cases. Drillships are apparently noisier than semisubmersibles (Richardson et al., 1995). Sound and vibration paths to the water are through either the air or the risers, in contrast to the direct paths through the hull of a drillship.

Machinery noise generated during the operation of offshore structures can be continuous or transient, and variable in intensity. Underwater noise from fixed structures ranges from about 20 to 40 dB above background levels within a frequency spectrum of 30-300 Hz at a distance of 30 m (98 ft) from the source (Gales, 1982). These levels vary with type of platform and water depth. Underwater noise from platforms standing on metal legs would be expected to be relatively weak because of the small surface area in contact with the water and the placement of machinery on decks well above the water.

Aircraft and vessel support may further ensonify broad areas. Noise generated from helicopter and service-vessel traffic is transient in nature and extremely variable in intensity. Helicopter sounds contain dominant tones (resulting from rotors) generally below 500 Hz (Richardson et al., 1995). Helicopters often radiate more sound forward than backward; thus, underwater noise is generally brief in duration, compared with the duration of audibility in the air. In addition to the altitude of the helicopter, water depth and bottom conditions strongly influence propagation and levels of underwater noise from passing aircraft. Lateral propagation of sound is greater in shallow than in deep water. Helicopters, while flying offshore, generally maintain altitudes above 700 ft during transit to and from the working area and an altitude of about 500 ft while between platforms.

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, laden or not, 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. For a given vessel, relative noise also tends to increase with increased speed. Commercial vessel noise is a dominant component of manmade ambient noise in the ocean (Jasny, 1999). Given the amount of vessel traffic from all sources in the GOM, CSA concludes that the contribution of noise from offshore service vessels is a minor component of the total ambient noise level (USDOI, MMS, 2004). In the immediate vicinity of a service vessel, noise could disturb marine mammals; however, this effect would be limited in area and duration.

4.1.1.8. Offshore Transport

4.1.1.8.1. Pipelines

Pipelines are the primary method used to transport a variety of liquid and gaseous products between OCS production sites and onshore facilities around the GOM. Over the last 10 years, the average annual installation rate for OCS pipelines was 1,600 km (994 mi) and more than 250 pipelines and pipeline segments. Pipelines in the CPA accounted for 83 percent of the length installed; pipelines in the WPA accounted for 17 percent. The installation rate for pipelines is expected to remain steady; this includes consideration of the expansion and replacement of the existing and aging pipeline infrastructure in the GOM.

The MMS projected the number of Federal OCS landfalls that may result from proposed lease sales in order to analyze the potential impacts to wetlands and other coastal habitats. In the Multisale EIS and other previous EIS's and EA's, MMS 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, MMS projected up to one pipeline landfall per lease sale; however, recent MMS analysis showed that even one landfall as a result of an individual lease sale may be unlikely (USDOI, MMS, 2007g). It is expected that pipelines from the single projected offshore production facility will connect to the existing pipeline infrastructure, which will result in zero new pipeline landfalls. It is not projected that any pipelines will be installed in water depths <200 ft (61 m). The typical operational life of a pipeline has been estimated to be 20-40 years, but with current corrosion management that lifetime has been significantly increased. One technique for extending the operational life of a gas pipeline is to periodically treat the inside of the pipe with a corrosion inhibiting substance (CIS). The treatment may be applied as either an aerosol that is pumped in with the production stream or as a liquid "slug" that is pushed through the pipe with a series of mechanized plungers, referred to as "pigs."

Newer installation methods have allowed the pipeline infrastructure to extend to deeper water. At present, the deepest pipeline in the Gulf is in 2,700 m (8,858 ft) water depth. More than 454 pipelines reach water depths of 400 m (1,312 ft) or more, and 331 of those reach water depths of 800 m (2,625 ft) or more.

The following information is from MMS's *Deepwater Gulf of Mexico 2006: America's Expanding Frontier* (USDOI, MMS, 2006d). Pipeline installation activities in deepwater areas can be difficult both in terms of route selection and construction. Depending on the location, the sea-bottom surface can be extremely irregular and present engineering challenges (e.g., high hydrostatic pressure, cold temperatures, and darkness, as well as varying subsurface and bottom current velocities and directions). Rugged seafloor may cause terrain-induced pressures within the pipe that can be operationally problematic, as the oil must be pumped up and down steep slopes. An uneven seafloor could result in unacceptably long lengths of unsupported pipeline, referred to as "spanning," which in turn could lead to pipe failure from bending stress early in the life of the line. It is important to identify areas where significant lengths of pipeline may go unsupported. Accurate, high-resolution, geophysical surveying becomes increasingly important in areas with irregular seafloor. Recent advances in surveying techniques have significantly improved the capabilities for accurately defining seafloor conditions, providing the resolution needed to determine areas where pipeline spans may occur. After analyzing survey data, the operator chooses a route that minimizes pipeline length and avoids areas of seafloor geologic structures and obstructions that might cause excessive pipe spanning, unstable seafloor, and potential benthic communities.

The greater pressures and colder temperatures in deep water present difficulties with respect to maintaining the flow of crude oil and gas through pipelines. Under these conditions, the physical and chemical characteristics of the produced hydrocarbons can lead to the accumulation of gas hydrate, paraffin, and other substances within the pipeline. These accumulations can restrict and eventually block flow if not successfully prevented and/or abated. There are physical and chemical techniques that can be applied to manage these potential accumulations. The leading strategy to mitigate these deleterious effects is to minimize heat loss from the system by using insulation. Other measures include forcing plunger-like "pigging" devices through the pipeline to scrape the pipe walls clean, and the continuous injection of flow-assurance chemicals (e.g., methanol or ethylene glycol) into the pipeline system to minimize the formation of flow-inhibiting substances. However, the great water depths of the OCS and the extreme distance to shoreside facilities make these flow-assurance measures difficult to implement and can significantly increase the cost to produce and transport the product. Companies are continuously looking for and developing new technologies such as electrically and water-heated pipelines and burial of pipelines in deepwater for insulation purposes.

Long-distance transport of multiphase well-stream fluids can be achieved with an effectively insulated pipeline. There are several methods to achieve pipeline insulation: pipe-in-pipe systems, which included electrically and water-heated pipelines; pipe with insulating wrap material; and as previously mentioned, buried pipelines where the soils act as an insulator. The design of all of these systems seeks a balance between the high cost of the insulation, the intended operability of the system, and the acceptable risk level. Such systems minimize the costs, revenue loss, and risks from the following:

- hydrate formation during steady state or transient flowing conditions;
- paraffin accumulation on the inner pipe wall that can result in pipeline plugging or flow rate reductions;
- adverse fluid viscosity effects at low temperatures that lead to reduced hydraulic performance or to difficulties restarting a cooled system after a short shut-in; and
- additional surface processing facilities required to heat produced fluids to aid in the separation processes.

Formation of gas hydrates in deepwater operations is a well-recognized and potentially hazardous operational problem in water depths >1,000 ft (300 m). Seabed conditions of high pressure and low temperature become conducive to gas hydrate formation in deepwater. Gas hydrates are ice-like crystalline solids formed by low-molecular-weight hydrocarbon gas molecules (mostly methane) combining with produced water. The formation of gas hydrates is potentially hazardous because hydrates can restrict or even completely block fluid flow in a pipeline, resulting in a possible overpressure condition. The interaction between the water and gas is physical in nature and is not a chemical bond. Gas hydrates are formed and remain stable over a limited range of temperatures and pressures.

Hydrate prevention is normally accomplished through the use of methanol, ethylene glycol, or triethylene glycol as inhibitors, and the use of insulated pipelines and risers. Chemical injection is sometimes provided both at the wellhead and at a location within the well just above the subsurface safety valve. Wells that have the potential for hydrate formation can be treated with either continuous chemical injection or intermittent or "batch" injection. In many cases, batch treatment is sufficient to maintain well flow. In such cases, it is necessary only to inject the inhibitor at well start-up, and the well will continue flowing without the need for further treatment. In the event that a hydrate plug should form in a well that is not being injected with a chemical, the remediation process would be to depressurize the pipelines and inject the chemical. Hydrate formation within a gas sales line can be eliminated by dehydrating the gas with a glycol dehydrating system prior to input of gas into the sales line. In the future, molecular sieve and membrane processes may also be options for dehydrating gas. Monitoring of the dewpoint downstream of the dehydration tower should take place on a continuous basis. In the event that the dehydration equipment is bypassed because it may be temporarily out of service, a chemical could be injected to help prevent the formation of hydrates if the gas purchaser agrees to this arrangement beforehand.

Hydrocarbon flows that contain paraffin or asphaltenes may occlude pipelines as these substances, which have relatively low melting points, form deposits on the interior walls of the pipe. To help ensure product flow under these conditions, an analysis should be made to determine the cloud point and hydrate formation point during normal production temperatures and pressures. To minimize the formation of paraffin or hydrate depositions, wells can be equipped with a chemical injection system. If, despite treatment within the well, it still becomes necessary to inhibit the formation of paraffin in a pipeline, this can be accomplished through the injection of a solvent such as diesel fuel into the pipeline.

Pigging is a term used to describe a mechanical method of displacing a liquid in a pipeline or to clean accumulated paraffin from the interior of the pipeline by using a mechanized plunger or "pig." Paraffin is a waxy substance associated with some types of liquid hydrocarbon production. The physical properties of paraffin are dependent on the composition of the associated crude oil and of temperature and pressure. At atmospheric pressure, paraffin is typically a semisolid at temperatures above about 100 ^{o}F (38 ^{o}C) and will solidify at about 50 ^{o}F (10 ^{o}C). Paraffin deposits will form inside pipelines that transport liquid hydrocarbons and, if some remedial action such as pigging is not taken, the deposited paraffin will eventually completely block all fluid flow through the line. The pigging method involves moving a pipeline pig through the pipeline to be cleaned. Pipeline pigs are available in various shapes and are made of various materials, depending on the pigging task to be accomplished. A pipeline pig can be a disc or a spherical or cylindrical device made of a pliable material such as neoprene rubber and having an outside diameter nearly equal to the inside diameter of the pipeline to be cleaned. The movement of the pig through the pipeline is accomplished by applying pressure from gas or a liquid such as oil or water to the back or upstream end of the pig. The pig fits inside the pipe closely enough to form a seal against the applied pressure. The applied pressure then causes the pig to move forward through the pipe. As the pig travels through the pipe, it scrapes the inside of the pipe and sweeps any accumulated contaminants or liquids ahead of it. In deepwater operations, pigging will be used to remove any paraffin deposition in the pipelines as a normal part of production operations. Routine pigging will be required of oil sale lines at frequencies determined by production rates and operating temperatures. The frequency of pigging could range from several times a week to monthly or longer, depending on the nature of the produced fluid. In cases where paraffin accumulation cannot be mitigated, extreme measures can be taken in some cases such as coil tubing entry into a pipeline to allow washing (dissolving) of paraffin plugs. If that fails, then it could result in having to replace a pipeline.

Pipeline Applications

Review of pipeline applications includes the evaluation of protective safety devices such as pressure sensors and automatic valves, and the physical arrangement of those devices proposed to be installed by the applicant. The purpose of the safety devices is to protect the pipeline from possible overpressure conditions and for detecting and initiating a response to abnormally low-pressure conditions. Once a pipeline is installed, operators conduct monthly overflights to inspect pipeline routes for leakage. **Chapter 1.5**, Postlease Activities (Pollution Prevention), discusses this topic in depth.

Applications for pipeline decommissioning must also be submitted for MMS review and approval. Decommissioning applications are evaluated to ensure they will render the pipeline inert, 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.

High-Integrity Pressure Protection System (HIPPS)

The following information is from MMS's *Deepwater Gulf of Mexico 2006: America's Expanding Frontier* (USDOI, MMS, 2006d).

The longer subsea tiebacks being used to develop marginal deepwater fields pose another challenge for industry, namely in the design and installation of pipelines rated for the HPHT well's SITP of 15,000 psi and/or 350 ^{o}F (177 ^{o}C). Rather than relying on the physical strength of steel to withstand the SITP, a HIPPS provides alternate overpressure protection for a pipeline or flowline. The HIPPS employs valves, logic controllers, and pressure transmitters to shut down the system before a pipeline is overpressured and/or ruptured.

The MMS has been working with API and DeepStar to formulate the regulatory framework for the installation of an HIPPS in the GOM. DeepStar is a joint industry technology development project representing large and mid-size operators to help address common deepwater business challenges. DeepStar is expected to finish its HIPPS study in 2006, and API will address HIPPS in its Recommended Practice API RP 17 O in late 2006 or early 2007. However, it is anticipated that the GOM Region will receive applications for the use of an HIPPS in 2006. Once design specifications for each section of the HIPPS system are finalized, MMS will hold operators to the design codes.

There are 190-440 km (118-273 mi) of new pipelines projected as a result of the proposed action (**Table 4-2**). 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 structure and which existing or proposed pipelines would be utilized. Many factors would affect the actual transport system, including company affiliations, amount of production, product type, and system capacity.

In the last few lease sale EIS's, MMS assumed the majority of new pipelines would connect to the existing pipeline network in State and Federal waters, and very few would result in new pipeline landfalls. When developing the scenario for this EIS, MMS reexamined this assumption and found it is still supported by MMS data. During the 10-year period (1996-2005) analyzed, there were about 2,300 OCS-pipelines installed. Of those, only 11 (0.5%) resulted in new pipeline landfalls. The rest (95.5%) connected to the existing pipeline network in either State or Federal waters. To project the number of new pipeline landfalls, MMS examined the historical relationship between new pipeline landfalls to a variety of factors including platforms installed, oil and gas production, and total number of new pipelines. Therefore, it is expected that pipelines constructed as a result of the proposed action would connect to existing or proposed pipelines in and near the proposed lease sale area, resulting in no new pipeline landfalls.

4.1.1.8.2. Service Vessels

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 MMS 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 an a development well. 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 service base.

Service-vessel trips projected for the proposed action are 15,000-20,000 trips. This equates to an average annual rate of 375-500 trips. **Table 3-30** shows over 1 million trips occurred on OCS-related waterways in 2004. The number of service-vessel trips projected annually for the proposed action would represent less than 0.05 percent of the total annual traffic on these OCS-related waterways.

4.1.1.8.3. Helicopters

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. An operation is considered a take off and landing.

Deepwater operations require helicopters that travel farther and faster, carry more personnel, are all-weather capable, and have lower operating costs. There are several issues of concern for the helicopter industry's future. Since the tasks the offshore helicopter industry provides are the same tasks supply vessels provide, they are competition for one another. Fast boats are beginning to erode the helicopter industry's share of the offshore transportation business, particularly in shallow water. The exploration and production industry is outsourcing more and more operations to oil-field support companies who are much more cost conscious and skeptical about the high cost of helicopters. Another consideration for the helicopter industry is new technology such as subsea systems. These systems decrease the number of platforms and personnel needed offshore, therefore reducing the amount of transportation needed.

To meet the demands of deepwater activities, the offshore helicopter industry is purchasing new helicopters that travel farther and faster, carry more personnel, are all-weather capable, and have lower operating cost. The number of helicopters operating in the GOM is expected to decrease in the future, and helicopters that do operate are expected to be larger and faster.

According to the Helicopter Safety Advisory Conference (2006), from 1996 to 2003, helicopter operations (take offs and landings) in support of Gulfwide OCS operations have averaged, annually, 1.5 million operations, 3.1 million passengers, and 430,000 flight hours.

Helicopter operations projected for the lifetime of the proposed action are 3,000-5,000 operations (**Table 4-2**). This equates to an average annual rate of 75-125 operations.

4.1.1.8.4. Alternative Transportation Methods of Natural Gas

Trends in energy supply and demand are affected by a large number of factors that are difficult to predict, such as energy prices, U.S. economic growth, advances in technologies, changes in weather patterns, and future public policy decisions. According to FERC, natural gas accounts for almost one-fourth of all energy consumed in the U.S. The U.S. Energy Information Administration (EIA) forecasts natural gas demand to grow to almost 40 percent by 2025 (FERC, 2004). As the country's gas consumption is expected to increase significantly over the next 20 years, industry is looking at alternative methods of transporting OCS gas in the GOM.

These alternative methods involve transporting natural gas as liquefied natural gas (LNG) or compressed natural gas (CNG) in specially designed vessels. The focus has been on deep water where it is costly and technically challenging to install pipelines to transport associated gas. The LNG and CNG options may make it economically viable to produce marginal gas fields. The CNG option may also be an economical way of transporting "stranded" associated gas instead of the gas being flared or re-injected. Although both technologies could bring gas to shore, most discussions suggest the use of offshore terminals and the existing nearshore pipeline infrastructure. The offloading gas terminals would require USCG-designated safety zones with "no surface occupancy" restrictions for oil and gas exploration, development, and production operations.

At present, LNG is being imported into five existing U.S. terminals, and more terminals are proposed. The four existing onshore facilities are located in Everett, Massachusetts; Cove Point, Maryland; Elba Island, Georgia; and Lake Charles, Louisiana. The fifth operational terminal is the Gulf Gateway Energy Bridge, located in the offshore GOM in West Cameron Block 603. It is the first new U.S. LNG terminal to be constructed in more than 20 years, and it received its first cargo in March 2005 (USDOE, EIA, 2005c).

The CNG, like LNG, is odorless, colorless, and tasteless and consists mostly of methane. The CNG process uses less energy than the LNG process because liquefaction and regasification are not required as it is with LNG. The CNG does not have the cryogenic issues associated with LNG projects. However, CNG is stored at a much higher pressure than LNG. The CNG technology provides an effective way for shorter-distance transport of the gas. The CNG technology is easy to deploy with less requirements for facilities and infrastructure. Additionally, CNG may be refueled from low-pressure or high-pressure systems. The difference lies in the cost of the station versus the refueling time.

4.1.1.9. Hydrogen Sulfide and Sulfurous Petroleum

Sulfur may be present in oil as elemental sulfur, within H_2S gas, or within organic molecules, all three of which vary in concentration independently. Although sulfur-rich petroleum is often called "sour" regardless of the type of sulfur present, the term "sour" should properly be applied to petroleum containing appreciable amounts of H_2S, and "sulfurous" should be applied to other sulfur-rich petroleum types. Using this terminology, the following matrix of concerns is recognized:

Potentially Affected Endpoint	Sour Natural Gas	Sour Oil	Sulfurous Oil
Engineering	Equipment and pipeline corrosion	Equipment and pipeline corrosion	N/A
On-Platform Industrial Hygiene	Irritation, injury, and lethality from leaks	Irritation, injury, and lethality from outgassing from spilled oil	Irritation, injury, and lethality from exposure to sulfur oxides produced by flaring
Off-Platform General Human Health and Safety	Irritation, injury, and lethality from leaks	Irritation, injury, and lethality from outgassing from spilled oil	Irritation, injury, and lethality from exposure to sulfur oxides produced by flaring
Marine and Coastal Species and Habitats	Irritation, injury, and lethality from leaks	Synergistic amplification of oil-spill impacts from outgassing	No effects other than impacts hydrocarbon contact and acid rain

Sour Oil, Sour Gas, and Sulfurous Oil in the Gulf of Mexico

Occurrence

Sour oil and gas occur sporadically throughout the GOM OCS, primarily off the Louisiana, Mississippi, and Alabama coasts. Occurrences of H_2S offshore Texas are in Miocene rocks and occur principally within a geographically narrow band. The occurrences of H_2S offshore Louisiana are mostly associated with salt and gypsum deposits. Examination of industry exploration and production data show H_2S concentrations vary from fractional ppm, in either oil or gas, to 650,000 ppm in the gas phase of a single oil well. The next highest concentrations of H_2S have been in the range of 20,000-55,000 ppm in some natural gas wells offshore Mississippi/Alabama. There is some evidence that petroleum from deepwater areas may be sulfurous, but there is no evidence that it is sour. Deep gas reservoirs on the GOM continental shelf are likely to have high corrosive content, including H_2S.

Treatment (Sweetening)

Removal of H_2S from sour petroleum may proceed in one of two ways. The product can either be "sweetened" (removal of H_2S from the hydrocarbons) offshore or it can be transported onshore to a processing facility equipped to handle H_2S hydrocarbons, where the product is sweetened. Gas streams with H_2S or SO_2 are frequently treated offshore by amine units to reduce the corrosive properties of the product. A by-product of this process is a concentrated acid gas stream, which is frequently treated as a waste and flared if SO_2 emissions are not of concern. In cases where SO_2 emissions must be minimized, other options for handling acid gas must be sought. Sulfur recovery units to further process the H_2S to elemental sulfur or reduced sulfur compounds is a common method of treating acid gas streams. Re-injection of acid gas is an option that has also been considered. The feasibility of re-injecting acid gas in the offshore environment has not been demonstrated. In addition, MMS conservation requirements may not allow re-injection of this gas. Another option would be to send the untreated gas to shore for treatment; this requires the use of "sour gas" pipelines built to handle the highly corrosive materials.

Requirements for Safety Planning and Engineering Standards

The MMS reviews all proposed actions in the GOM OCS for the possible presence of H_2S. Activities found to be associated with a presence of H_2S are subjected to further review and requirements. Federal regulations at 30 CFR 250 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 delimits procedures to ensure the safety of the workers on the production facility. In addition, all operators are required to adhere to the National Association of Corrosion Engineers' (NACE) *Standard Material Requirement MR.01-75-96 for Sulfide Stress Cracking Resistant Metallic Materials for Oilfield Equipment* (NACE, 1990). These engineering standards serve to enhance the integrity of the infrastructure used to produce the sour oil and gas, and further serve to ensure safe operations. An NTL (98-16) titled "Hydrogen Sulfide (H_2S) Requirements" was issued on August 10, 1998, to provide clarification, guidance, and information on the revised requirements. The NTL provides guidance on sensor location, sensor calibration, respirator breathing time, measures for protection against sulfur dioxide, requirements for classifying an area for the presence of H_2S, requirements for flaring and venting of gas containing H_2S, and other issues pertaining to H_2S-related operations.

Environmental Fate of H_2S

Atmospheric Release

Normally, dispersion mechanisms in the surface mixed layer of the atmosphere (wind, etc.) cause natural gas leaks and associated H_2S to disperse away from release sites. The MMS reviews of proposed sour gas operations are based on the conservative assumptions of horizontal, noncombusted releases to achieve environmentally conservative results, although vertical release or combustion of the gas plume (greatly reducing potential exposure) would be possible. Both simple Gaussian estimation techniques (conforming to air quality rules) and more rigorous analytical modeling are used in the MMS review of activities associated with a presence of H_2S. For a very large facility (throughput on the order of 100 MMcfd of produced natural gas) with high concentration levels (on the order of 20,000 ppm) and using very calm winds (speed of <1 m/sec), H_2S levels reduce to 20 ppm at several kilometers from the source; H_2S levels are reduced to 500 ppm at 1 km (0.6 mi). Most "sour gas" facilities have H_2S concentrations below 500 ppm, which reduces to 20 ppm within the dimensions of a typical platform (or considerably less).

Aquatic Release

Hydrogen sulfide is soluble in water with 4,000 ppm dissolving in water at 20 °C (68 °F) and one atmosphere pressure. This implies that a small sour gas leak would result in almost complete dissolution of the contained H_2S into the water column. Larger leaks would result in proportionally less dissolution, depending on turbulence, depth of release, and temperature; and H_2S could be released into the atmosphere if the surrounding waters reach saturation or the gas plume reaches the surface before complete dissolution. Because the oxidation of H_2S in the water column takes place slowly (on the order of hours), the chemical oxygen demand of H_2S is spread out over a long time interval (related to the ambient current speed) and should not create appreciable zones of hypoxia; except, in the case of a very large, long-lived submarine release.

H_2S Toxicology

Humans

The Occupational Safety and Health Administration's permissible exposure limit for H_2S is 20 ppm. A permissible exposure limit is an allowable exposure level in workplace air averaged over an 8-hour period. The American Conference of Governmental Hygienists recommends a time weighted average concentration of 10 ppm. The time-weighted average is a concentration for a normal 8-hour workday to which nearly all workers may be repeatedly exposed, day after day, without adverse affect. This is 10 times lower than the "immediately dangerous to life and health" level of 100 ppm set by the National Institute for Occupational Safety and Health. Despite a normal human ability to smell H_2S at levels below 1 ppm, H_2S is considered to be an insidious poison because the sense of smell rapidly fatigues, failing to detect H_2S after continued exposure. Although there are many different systems of classifying exposure levels and their associated health risks, MMS has synthesized these into a single, simple set of concentration levels to be used in identifying and assessing exposure risks:

Atmospheric Exposure Levels (volume fractions)	Characteristic Human Health Impact	Protective Measures Taken by MMS at this Level
20 ppm	Irritation within minutes	Operator required to develop and file "H_2S Contingency Plan"
100 ppm	Injury within minutes	
500 ppm	Death within minutes	Operator required to model atmospheric dispersion of total, horizontal, noncombusted rupture

Fish

Toxicity data presented below has been centered around the effects on predominantly freshwater organisms. Toxicity effects offshore and in the coastal waters may differ significantly.

Fish will strongly avoid any water column that is contaminated with H_2S, provided an escape route is available. In terms of acute toxicity testing, fish can survive at levels reaching 0.4 ppm (Van Horn, 1958; Theede et al., 1969). Walleye eggs (*Stizostedion vitreum*) did not hatch at levels from 0.02 to 0.1 ppm (USEPA, 1986). The hatchability of northern pike (*Esox lucius*) was substantially reduced at 25 ppb with complete mortality at 45 ppb. Northern pike fry had 96-hour LC_{50} values that varied from 17 to 32 ppb at O_2 levels of 6 ppm. Sensitive eggs and fry of northern pike exhibited no observable effects at 14 and 4 ppb, respectively (Adelman and Smith, 1970; USEPA, 1986). In a series of tests on the eggs, fry, and juveniles of walleyes, white suckers (*Catostomus commersoni*), and fathead minnows (*Pimephales promelas*), with various levels of H_2S from 2.9 to 12 ppb, eggs were the least sensitive while juveniles were the most sensitive. In 96-hour bioassays, fathead minnows and goldfish (*Carassius auratus)* varied greatly in tolerance to H_2S with changes in temperature (Smith et al., 1976; USEPA, 1986). Pacific salmon (*Oncorhynchus sp.*) experienced 100 percent mortality within 72 hours at 1 ppm.

On the basis of chronic toxicity testing, juveniles and adults of bluegill (*Lepomis macrochirus*) exposed to 2 ppb survived and grew normally. Egg deposition in bluegills was reduced after 46 days of exposure to 1.4 ppb (Smith et al., 1976; USEPA, 1986). White sucker eggs were hatched at 15 ppb, but juveniles showed growth reductions at 1 ppb. Safe levels for fathead minnows were between 2 and 3 ppb. For *Gammarus pseudolimnaeus* and *Hexagenia limbata*, 2 and 15 ppb, respectively, were considered safe levels (USEPA, 1986).

4.1.1.10. New and Unusual Technologies

Technologies continue to evolve to meet the technical, environmental, and economic challenges of deepwater development. The MMS prepared a PEA to evaluate potential effects of deepwater technologies and operations (USDOI, MMS, 2000). As a supplement to the PEA, MMS prepared a series of technical papers that provides a profile of the different types of development and production structures that may be employed in the GOM deepwater (Regg et al., 2000). The PEA and technical papers were used in the preparation of this SEIS.

The operator must identify new or unusual technology (NUT) in exploration and development plans. 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 MMS 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 Gulfwide OCS Program are synthetic mooring lines, subsurface safety devices, and multiplex subsea controls.

Some new technologies differ in how they function or interface with the environment. These include equipment or procedures that have not been installed or used in GOM OCS waters. Having no operational history, they have not been assessed by MMS through technical and environmental reviews. New technologies may be outside the framework established by MMS regulations and, thus, their performance (safety, environmental protection, efficiency, etc.) has not been studied by MMS. 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 if an operator wishes to deploy it.

The MMS 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 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 for which MMS does not have sufficient information to determine its potential impacts to the environment. In this later case, MMS 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 MMS'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 MMS 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 MMS regulation must be fully described and justified before it would be approved for use. For MMS 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 MMS uses to assess the adequacy of protection provided by alternative technology or operations. Actual operational experience is necessary with alternative compliance measures before MMS would consider them as proven technology.

4.1.1.11. Decommissioning and Removal Operations

During exploration, development, and production operations, the seafloor around activity sites within the proposed lease sale area becomes the repository of temporary and permanent equipment and structures. In compliance with Section 22 of MMS'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), lessees are required 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. The structures are generally grouped into two main categories depending upon their relationship to the platform/facilities (piles, jackets, caissons, templates, mooring devises, etc.) or the well (i.e., wellheads, casings, casing stubs, etc.).

There are possible exemptions to the 1-year deadline, including the exemptions stated in Section 388 of the Energy Policy Act. Section 388 clarifies the Secretary's authority to allow an offshore oil and gas structure, previously permitted under the OCSLA, to remain in place after oil and gas activities have ceased in order to allow the use of the structure for other energy and marine-related activities. This authority provides opportunities to extend the life of facilities for non-oil and gas purposes, such as research, renewable energy production, aquaculture, etc., before being removed.

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, and they can be deployed and operated by divers, ROV's, or from the surface. 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.

Nonexplosive severing tools are used on the OCS for a wide array of structure and well decommissioning targets in all water depths. Based on 10 years of historical data (1994-2003), nonexplosive severing is employed exclusively on about 58 (~37%) removals per year (USDOI, MMS, 2005a). Since many decommissionings use both explosive and nonexplosive technologies (prearranged or as a backup method), the number of instances may be much greater. Over the next 5 years, MMS estimates that 55-94 structure removals could employ nonexplosive severance annually. Common nonexplosive severing tools consist of abrasive cutters (e.g., sand cutters and abrasive water jets), mechanical (carbide) cutters, diver cutting (e.g., underwater arc cutters and the oxyacetylene/oxy-hydrogen torches), and diamond wire cutters.

With the exception of minor air and water quality concerns (i.e., exhaust from support equipment and toxicity of abrasive materials), nonexplosive severing tools generally cause little to no environmental impacts; therefore, there are very few regulations regarding their use. However, the use of nonexplosive cutters leads to greater human health and safety concerns, primarily because (1) divers are often required in the methodology (e.g., torch/underwater arc cutting and external tool installation and monitoring), (2) more personnel are required to operate them (increasing their risks of injury in the offshore environment), (3) lower success rates require that additional cutting attempts be made, and (4) the cutters can only sever one target at a time, taking on average 30 minutes to several hours for a complete cut (USDOI, MMS, 2005a). The last two items are often hard to quantify and assign risks to the cutters, but the main principle is that there is a linear relationship between the length of time any offshore operation is staged and on-site (exposure time) and the potential for an accident to occur (TSB and CES, LSU, 2004). Therefore, even if there are no direct injuries or incidents involving a diver or severing technicians, the increased "exposure time" needed to successfully sever all necessary targets could result in unrelated accidents involving other barge/vessel personnel.

Explosive severance tools can be deployed on almost all structural and well targets in all water depths. Historically, explosive charges are used in about 98 (~63%) decommissioning operations annually (USDOI, MMS, 2005a), often as a back-up cutter when other methodologies prove unsuccessful. Explosives work to sever their targets by using (1) mechanical distortion (ripping), (2) high-velocity jet cutting, and (3) fracturing or "spalling."

Mechanical distortion is best exhibited with the use of explosives such as standard and configured bulk charges. If the situation calls for minimal distortion and an extremely clean severing, most contractors rely upon the jet-cutting capabilities of shaped charges. In order to "cut" with these explosives, the specialized charges are designed to use the high-velocity forces released at detonation to transform a metal liner (often copper) into a thin jet that slices through its target. The least used method of severing currently in use on the GOM OCS is fracturing, which uses a specialized charge to focus pressure waves into the target wall and use refraction forces to spall or fracture the steel on the opposing side (NRC, 1996).

The MMS first addressed removal operations and the potential impacts of severing methodologies (nonexplosive/explosive tools) in a PEA prepared in 1987 (USDOI, MMS, 1987). The scope of the decommissioning activities analyzed in the document was limited to traditional, bottom-founded structures (i.e., well protectors, caissons, and jacketed platforms) and did not address well abandonment operations; activities similar in nature, but monitored and reported according to a separate section of the OCSLA regulations. In addition, since the majority of removal operations took place in water depths less than 200 m (656 ft), only the shelf areas of the GOM were addressed by the proposed action.

The MMS recently prepared a new PEA, *Structure-Removal Operations on the GOM Outer Continental Shelf* (USDOI, MMS, 2005a), to evaluate the full range of potential environmental impacts of structure-removal activities in all water depths in the CPA and WPA and the Sale 181/189 area in the EPA of the GOM. The activities analyzed in the PEA 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 PEA include seafloor disturbances, air emissions and 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, and archaeological resources; or other OCS pipeline, navigation, and military uses. On the basis of this PEA, MMS determined that an EIS was not required and prepared a Finding of No Significant Impact (FONSI).

On February 28, 2005, MMS submitted the new structure-removal PEA and a petition for new Incidental-Take Regulations under the MMPA to NMFS. After review of the petition and PEA, NMFS published a Notice of Receipt of MMS'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 Rule for the Incidental Take of marine mammals under the MMPA in the *Federal Register*. The subsequent public comment period ended May 22, 2006, and MMS expects the Final Rule to be published in the *Federal Register* in the spring of 2007. In addition, NMFS recently concluded an ESA Section 7 Consultation on their MMPA rulemaking efforts. The agency issued a new BiO and ITS in August 2006, which superseded the previous BiO's related to decommissioning operations.

In water depths greater than 800 m (2,625 ft), OCS regulations would offer the lessees the option to avoid the jetting 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 MMS—data necessary for subsequent reporting to the U.S. Navy. In some cases, industry has indicated that it could 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.

After bottom-founded objects are severed and the structures are removed, operators are required to verify that the site is clear of any obstructions that may conflict with other uses of the OCS. The MMS NTL 98-26, "Minimum Interim Requirements for Site Clearance (and Verification) of Abandoned Oil and Gas Structures in the GOM," provides the requirements for site clearance. The lessee must develop, and submit to the MMS for approval, a procedural plan for the site clearance verification procedures. For platform and caisson locations in water depths of less than 91 m (300 ft), the sites must be trawled over 100 percent of the designated area in two directions (i.e., N-S and E-W). Individual well-site clearances may use high-frequency (500 kilohertz (kHz)) sonar searches for verification. Site-clearance verification must take place within 60 days after structure removal operations have been conducted.

There is only one platform predicted as a result of the proposed action. The platform may be severed from its moorings, using explosives, upon termination of use. It is anticipated that multiple appurtenances will not be removed from the seafloor if placed in waters exceeding 800 m (2625 ft). An estimate of the well stubs and other various subsea structures that may be removed using explosives is not possible at this time.

4.1.2. Coastal Impact-Producing Factors and Scenario

4.1.2.1. Coastal Infrastructure

The following sections discuss OCS-related coastal infrastructure: service bases, helicopter hubs, construction facilities, processing facilities, terminals, disposal and storage facilities for offshore operations, and navigation channels. No new facilities are projected as a result of the proposed action; however, the proposed action may contribute to the use of existing facilities.

4.1.2.1.1. 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. Although a service base may primarily serve the OCS planning area and EIA's in which it is located, it may also provide significant services for the other OCS planning areas and EIA's. **Table 3-32** shows the 50 services bases currently used by operators to service the GOM OCS. These facilities were identified as the primary service base by platform plans received by MMS. Those most likely to service the Lease Sale 224 area include: Fourchon, Venice, and Morgan City, Louisiana; Pascagoula, Mississippi; and Theodore, Alabama (Dismukes, 2007). However, given Port Fourchon's dominance in servicing deepwater activities (**Chapter 3.3.5.8.1**), it will most likely be the primary service base for activities that take place as a result of the proposed action.

As the industry continues to evolve, so do the requirements of the onshore support network. With advancements in technology, the shore-side supply network will continue to be challenged to meet the needs and requirements of the industry. All supplies must be transported from land-based facilities to marine vessels or helicopters to reach offshore destinations. This utilizes both water and air transportation modes. The intermodal nature of the entire operation gives ports (which traditionally have water, rail, and highway access) a natural advantage as an ideal location for onshore activities and intermodal transfer points. Therefore, ports will continue to be a vital factor in the total process and must incorporate the needs of the offshore oil and gas industry into their planning and development efforts particularly with regard to determining their future investment needs. In this manner both technical and economic determinants must influence the dynamics of port development.

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

It is assumed the primary service base would be Port Fourchon, Louisiana. The proposed action will not require any additional service bases to be constructed or significantly change any of the existing identified service bases.

4.1.2.1.2. Helicopter Hubs

Helicopter hubs or "heliports" are facilities where helicopters can land, load, and offload passengers and supplies, refuel, and be serviced. These hubs are used primarily as flight support bases to service the offshore oil and gas industry. There are approximately 247 heliports within the Gulf region that support OCS activities; 122 are located in Texas, 81 in Louisiana, 34 in Florida, 6 in Mississippi, and 4 in Alabama (The Louis Berger Group, Inc., 2004). Most helicopter trips transport both personnel and equipment and supplies. Thus, heliports in Florida are not likely to service the Lease Sale 224 area because corresponding support activities do not exist. Based on proximity to service bases and simple straight-line, shortest distance to the proposed Lease Sale 224 area, MMS anticipates industry would use helicopter hubs in southeastern Louisiana, Mississippi, and Alabama. Three helicopter companies dominate the GOM offshore helicopter industry: Bristow Group (formerly Offshore Logistics), Era Aviation (Era), and PHI (formerly Petroleum Helicopters, Inc). A few major oil companies operate and maintain their own fleets, although this is a decreasing trend. Instead of running their own fleets, oil and gas companies are increasingly subcontracting the whole operation on a turnkey basis to independent contractors. More and more operations are outsourcing to oil-field support companies, such as Baker Hughes, who are much more cost conscious and skeptical about the high cost of helicopters.

To meet the demands of deep water (travel farther and faster, carry more personnel, be all-weather capable, and have lower operating cost), the offshore helicopter industry is purchasing new helicopters. While some heliports located farther inland have closed or consolidated, some heliports are expanding or opening due to more of the industry's work being farther offshore. Another consideration for the helicopter industry is new technology such as subsea systems. These systems decrease the number of platforms and personnel needed offshore, therefore reducing the amount of transportation needed.

Helicopter operations projected for the proposed action are 3,000-5,000 operations (**Table 4-2**). This equates to an average annual rate of 75-125 operations.

4.1.2.1.3. Construction Facilities

4.1.2.1.3.1. Platform Fabrication Yards

Given the platform fabrication industry characteristics and trends therein, it is not likely that new yards will emerge. The existing fabrication yards do not operate as "stand alone" businesses, rather they rely heavily on a dense network of suppliers of products and services. Also, since such a network has been historically evolving in Louisiana and Texas for over 50 years, the existing fabrication yards possess a compelling force of economic concentration to prevent the emergence of new fabrication yards. There are 43 platform fabrication yards in the analysis area.

With respect to the deepwater development, the challenges for the fabrication industry stem from the greater technical sophistication and the increased project complexity of the deepwater structures, such as compliant towers and floating structures. The needs of the deepwater projects are likely to result in two important trends for the fabrication industry. The first is the increasing concentration in the industry, at least with respect to the deepwater projects. As technical and organizational challenges continue to mount up, it is expected that not every fabrication yard will find adequate resources to keep pace with the demands of the oil and gas industry. The second trend is the closer integration—through alliances, amalgamations, or mergers—among the fabrication yards and engineering firms.

No new facilities are expected to be constructed as a result of the proposed action.

4.1.2.1.3.2. Shipyards

The 1980's were dismal for the shipbuilding industry. Several mergers, acquisitions, and closings occurred during the downturn. Of those that have remained, 94 are located within the analysis area (**Table 3-33**). Several large companies dominate the oil and gas shipbuilding industry. Most yards in the analysis area are small. To a great extent, growth will be based on a successful resolution of several pertinent issues that have affected and will continue to affect shipbuilding in the U.S. and particularly in the analysis area: maritime policy, declining military budget, foreign subsidies, USCG regulations, OPA 90, financing, and an aging fleet.

No new facilities are expected to be constructed as a result of the proposed action.

4.1.2.1.3.3. Pipecoating Facilities and Yards

There are currently 19 pipecoating plants in the analysis area (**Table 3-33**). Pipe-coating facilities receive manufactured pipe, which they then coat the surfaces of with metallic, inorganic, and organic materials to protect from corrosion and abrasion and to add weight to counteract the water's buoyancy. Two to four sections of pipe are then welded at the plant into 40-ft (12-m) segments. The coated pipe is stored (stacked) at the pipeyard until it is needed offshore.

To meet deepwater demand, pipecoating companies have been expanding capacity or building new plants. A new trend in the industry is single-source contracts where the pipe manufacturing, coating, welding and laying are all under one contract. This results in a more efficient, less costly operation. At present, though, only foreign companies have this capability.

No new facilities are expected to be constructed as a result of the proposed action.

4.1.2.1.4. Processing Facilities

4.1.2.1.4.1. Refineries

A refinery is an organized arrangement of manufacturing units designed to produce physical and chemical changes to turn crude oil into petroleum products. In the refinery, most of the nonhydrocarbon substances are removed from crude oil and it is broken down into its various components, and blended into useful products.

In the early 1980's, the Crude Oil Entitlements Program ended and crude oil prices were no longer controlled. This caused the number of petroleum refineries to drop sharply leading to 13 years of decline in U.S. refining capacity. The decade of the 1990's was characterized by low product margins and low profitability. Refining operations were consolidated, the capacity of existing facilities was expanded, and several refineries were closed. Most refineries are part of major, vertically integrated oil companies that are engaged in both upstream and downstream aspects of the petroleum industry. These companies dominate the refining industry, although most majors are spinning off their refinery facilities to independents or entering joint ventures to decrease the risk associated with low refining returns. One-third of operable U.S. petroleum refineries are located in the Gulf States of Alabama, Louisiana, Mississippi, and Texas. Most of the region's refineries are located in Texas and Louisiana (**Table 3-33**). Texas has 25 operating refineries, with a combined crude oil capacity of 4.6 MMbbl/day, while Louisiana has 17 operating refineries with 2.8 MMbbl/day of capacity, representing 27.2 and 16.3 percent, respectively, of total operating U.S. refining capacity. Crude from Lease Sale 224 area would most likely be sent to refineries in Louisiana and Mississippi because of existing infrastructure in place and available capacities after announced expansions (Dismukes, 2007).

Two significant environmental considerations facing U.S. refiners are Phase 2 Clean Air Act Amendments (CAAA) of 1990; reformulated motor gasoline (RFG) requirements and the growing public opposition to the use of methyl tertiary butyl ether (MTBE). In order to meet Phase 2 RFG requirements, U.S. refiners will incur numerous expenses and make substantial investments. The MTBE is an additive that increases the oxygen content of motor gasoline causing more complete combustion of the fuel and less pollution. It was a relative inexpensive way for refiners to meet Phase 1 CAAA RFG requirements. Since March 1999, 19 states have adopted partial or complete bans on the use of MTBE because of concerns about groundwater contamination (USEPA, 2004c). This will cause additional outlays of money and some restructuring of current facilities in order to move to ethanol.

Distillation capacity is projected to grow from the 2004 year-end level of 16.9-18.5 MMbbl/day in 2025 and 19.3 MMbbl/day in 2030 (USDOE, EIA, 2006d). Almost all capacity additions are expected to occur on the Gulf Coast. Financial, environmental, and legal considerations make it unlikely that new refineries will be built in the United States; therefore, expansion at existing refineries likely will increase total U.S. refining capacity in the long run. Refineries will be continued to be utilized intensely, from 93 percent in 2004 to 95 percent in 2030 (USDOE, EIA, 2006d).

No new facilities are expected to be constructed as a result of the proposed action.

4.1.2.1.4.2. Gas Processing Plants

After raw gas is brought to the earth's surface, it is processed at a gas processing plant to remove impurities such as water, carbon dioxide, sulfur, and inert gases and transformed into a saleable, useable energy source. The total number of natural gas processing plants operating throughout the U.S. has been declining over the past several years as companies have merged, exchanged assets, and closed older, less efficient plants. However, this trend was reversed in 1999. Louisiana, Mississippi, and Alabama's capacity is undergoing significant increases as a wave of new plants and expansions try to anticipate the increased new gas coming ashore from developments in the GOM. At present, there are 249 gas processing plants in the Gulf States, representing 58 percent of U.S. gas processing capacity. The distribution of these plants by state is shown in **Table 3-38**. There is plently of excess capacity available to process the gas that is forecast to be produced as a result of the proposed action.

No new gas processing facilities are expected to be constructed as a result of the proposed action.

4.1.2.1.5. Disposal and Storage Facilities for Offshore Operational Wastes

Both the GOM offshore oil and gas industry and the oil and gas waste management industry are undergoing significant changes. New drilling technologies and policy decisions as well as higher energy prices should increase the level of OCS activity and, with it, the volumes of waste generated. The oil-field waste industry, having been mired in somewhat stagnant conditions for almost two decades, has developed new increments of capacity, and some new entrants into the market have added to industry capacity and the diversity of technologies available for the industry to use.

Facilities that accept OCS-generated waste such as municipal waste landfills and hazardous waste treatment, storage and disposal facilities, are diverse and manage waste for the broad base of U.S. industry. The OCS activity does not generate a large part of the waste stream into these facilities and is not expected to be material to the overall capacity of the industry. Capacity of industrial waste management facilities is for the most part abundant, as U.S. industries have learned to minimize wastes they ship to offsite facilities for management. As part of an ongoing study, The Center for Energy Studies at LSU conducted an extensive review of the current utilization and capacities of landfills and oil and gas production waste sites and concluded that there are no commonly accepted or recognized problems in terms of limited capacity, high capacity utilizations, or significant constraints in storing waste from oil and gas facilities, now or in the forseeable future (Dismukes et al., 2007).

No new disposal and storage facilities will be built as a result of the proposed action.

4.1.2.1.5.1. Nonhazardous Oil-field Waste Sites

Long-term capacity to install subsurface injection facilities onshore is itself not scarce and oil-field waste injection well permits do not generally attract much public opposition. With the volume of produced water frequently exceeding the volume of oil a well produces by tenfold or more, the main limitation to widespread use of land-based subsurface injection facilities is the space at docks and the traffic in and out of ports.

With the addition of Trinity Field Services to the market, the OCS market has its first salt dome disposal operation in a competitive location, with 6.2 MMbbl of space available initially. This is enough capacity to take 8-10 year's worth of OCS liquids and sludges at current generation rates and a potential of several times that amount with additional solution mining. Salt domes are well-known and well-documented geological structures, and others could be placed into service as demand dictates. Salt caverns are a finite resource, but nevertheless have the potential to take decades' worth of OCS offsite NOW generation.

No new NOW waste sites will be built as a result of the proposed action. Capacity to manage waste generated by the proposed action's drilling and production activities is adequate for the present.

4.1.2.1.5.2. Landfills

The use of landfarming of OCS waste is likely to decline further, particularly with greater availability of injection methods for wastes containing solids. Future regulatory efforts are likely to discourage the practice by adding requirements that damage the economics, if not by an outright ban on future permits.

In addition to drilling and production wastes, trash and debris from the offshore oil industry are shipped onshore for disposal. These wastes include mud bags, drums, crates, and a variety of domestic wastes. The OCS-generated trash and debris are not allowed to be disposed of at the commercial oil-field waste disposal sites. Instead, the trash and debris are disposed of at either municipal or industrial landfills, depending on the method or company that is hired to haul the trash from the service base or directly from the offshore facility. However, the volume of these wastes expected to be generated by activities associated with the proposed action will not represent a large part of the waste stream into these facilities and is not expected to be material to their overall capacity.

No new landfills will be built as a result of the proposed action.

4.1.2.1.6. Navigation Channels

The current system of navigation channels around the northern Gulf is believed to be generally adequate to accommodate traffic generated by the proposed action. Gulf-to-port channels and the Gulf Intracoastal Waterway that support the prospective ports are sufficiently deep and wide enough to handle the additional traffic. As exploration and development activities increase on deepwater leases in the GOM, vessels with generally deeper drafts and longer ranges will be used as needed to support deepwater activities. Therefore, several OCS-related port channels may be deepened or widened during the life of the proposed action to accommodate deeper draft vessels. Typically, no channel deeper than 8 m (26 ft) will be needed to accommodate these deeper draft vessels. No navigation channels in the EPA are known to presently support OCS activities.

No new navigation channels will be required by the proposed action. In addition, current navigation channels will not significantly change as a result of the proposed action.

4.1.2.2. Discharges and Wastes

4.1.2.2.1. Onshore Facility Discharges

The primary onshore facilities that support offshore oil and gas activities include service bases, helicopter hubs at local ports/service bases, construction facilities (platform fabrication yards, pipeyards, shipyards), processing facilities (refineries, gas processing plants, petrochemical plants), and terminals (pipeline shore facilities, barge terminals, tanker port areas). A detailed description of these facilities is given in **Chapter 3.3.5.8**, OCS-Related Coastal Infrastructure. Water discharges from these facilities are from either point sources, such as a pipe outfall, or nonpoint sources, such as rainfall run-off from paved surfaces. The USEPA or the USEPA-authorized State program regulates point-source discharges as part of NPDES. Facilities are issued general or individual permits that limit discharges specific to the facility type and the waterbody receiving the discharge. Other wastes generated at these facilities are handled by local municipal and solid waste facilities, which are also regulated by USEPA or an USEPA-authorized State program.

Since no new coastal infrastructure is anticipated to result from the proposed action, wastewater and generated wastes will be treated and disposed from existing facilities following established procedures.

4.1.2.2.2. Coastal Service-Vessel Discharges

Operational discharges from vessels include sanitary and domestic waters, bilge waters, and ballast waters. Support-vessel operators servicing the OCS offshore oil and gas industry may still legally discharge oily bilge waters in coastal waters, but they must treat the bilge water to limit its oil content to 15 ppm prior to discharge. Ballast water may be subject to the USCG Ballast Water Management Program to prevent the spread of aquatic nuisance species (*Federal Register*, 2004). Sanitary wastes are treated on-board ships prior to discharge. State and local governments regulate domestic or gray water discharges.

4.1.2.2.3. Offshore Wastes Disposed Onshore

All wastes that are not permitted to be discharged offshore by USEPA must be transported to shore or reinjected downhole. Additionally, wastes may be disposed of onshore because they do not meet permit requirements or onshore disposal is economically advantageous. Most OBF muds are recycled, and OBF cuttings are disposed of onshore. Both USEPA Regions 4 and 6 permit the discharge of SBF wetted cuttings, provided the cuttings meet the criteria with regard to percent SBF retained, PAH content, biodegradability, and sediment toxicity. The SBF fluid is either recycled or transferred to shore for regeneration and reuse or disposal. Drill cuttings contaminated with hydrocarbons from the reservoir fluid must be disposed of onshore or reinjected.

The USEPA allows TWC fluids to be commingled with the produced-water stream if the combined produced-water/TWC discharges pass the toxicity test requirements of the NPDES permit. Facilities with less than 10 producing wells may not have enough produced water to be able to effectively commingle the TWC fluids with the produced-water stream to meet NPDES requirements (USEPA, 1993). Spent TWC fluid is stored in tanks on tending workboats or is stored on platforms and later transported to shore on supply boats or workboats. Once onshore, the TWC wastes are transferred to commercial waste-treatment facilities and disposed in commercial disposal wells. Offshore wells are projected to generate an average volume of 200 bbl from either a well treatment or workover job every 4 years. Each new well completion would generate about 150 bbl of completion fluid.

Current USEPA NPDES general permits prohibit operators in the GOM from discharging any produced sands offshore. Cutting boxes (15- to 25-bbl capacities), 55-gallon steel drums, and cone-bottom portable tanks are used to transport the solids to shore via offshore service vessels. Total produced sand from a typical platform is estimated to be 0-35 bbl/day (USEPA, 1993). Both Texas and Louisiana have State oversight of E&P waste management facilities (Veil, 1999). Texas and Louisiana accept the majority of RCRA E&P waste; Mississippi and Alabama each have several sites that inject produced water, and treat or landfill solid wastes. They are primarily operated to serve a single operator (Puder, 2006).

4.1.2.2.4. Beach Trash and Debris

According to USEPA, there are two different sources from which debris pollutes our oceans: land-based and ocean-based. The first source, land-based, causes 80 percent of the marine debris found on our beaches and waters. Additionally, sources of land-based marine debris includes beachgoers, storm-water runoff, landfills, solid waste, rivers, floating structures, ill-maintained garbage bins, and litterbugs. The Ocean Conservancy (formerly the Center for Marine Conservation) reports that beachgoers are a prime source of beach pollution, leaving over 75 tons of trash per week. Marine debris also comes from combined sewer overflows and typically includes medical waste, street litter, and sewage. The second source of marine debris is from ocean sources, and this type of debris includes galley waste and other trash from ships, recreational boaters, fishermen, and offshore oil and gas exploration and production facilities. Commercial and recreational fishers produce trash and debris by discarding plastics (e.g., ropes, buoys, fishing line and nets, strapping bands, and sheeting), wood, and metal traps. Some trash items, such as glass, pieces of steel, and drums with chemical or chemical residues, can be a health threat to local water supplies, to beachfront residents, and to users of recreational beaches. To compound this problem, there is population influx along the coastal shorelines. These factors, combined with the growing demand for manufactured and packaged goods, have led to an increase in nonbiodegradable solid wastes in our waterways (USEPA, 2006c).

The Ocean Conservancy sponsors both the International Beach Cleanup (ICC) as well as the National Marine Debris Monitoring Program (MDP). The ICC is supported by USEPA, and the first cleanup was in 1986 in Texas. The campaign currently involves all of the states and territories of the U.S. and more than 100 countries around the world. The ICC is the largest volunteer environmental data-gathering effort and associated cleanup of coastal and underwater areas in the world. It takes place every year on the third Saturday in September. The September 18, 2004, cleanup brought out over 300,000 citizens of 88 countries to help clean over 11,000 mi (17,703 km) of shoreline. Volunteers removed nearly 8 million pounds of trash, litter, and debris worldwide. In the U.S., 158,000 volunteers from 49 states and territories cleaned over 8,000 mi (12,875 km) of beaches, streams and riverbanks. To address the marine debris problem, USEPA teamed up with the Ocean Conservancy to create the MDP, which began establishing marine debris monitoring sites along the GOM. The program began in 1996 with the establishment of 40 monitoring sites from the Texas/Mexico border to Port Everglades, Florida, and included Puerto Rico and the U.S. Virgin Islands. To date, the MDP has nearly 700 volunteers in 19 coastal states and 2 U.S. territories monitoring marine debris at over 130 marine debris-monitoring sites. Additionally, 163 study sites have been designated and 128 sites are collecting data (The Ocean Conservancy, 2005; USEPA, 2006c).

The Louisiana event is coordinated by the Louisiana Department of Environmental Quality (LADEQ), Litter Reduction and Public Action Program. During the 2004 Louisiana Beach Sweep and Inland Waterway Cleanup, 2,045 volunteers came to clean up shorelines and waterways. Volunteers covered 72 mi (116 km) and picked up 56,619 pounds of debris. The 2005 Louisiana Beach Sweep and Inland Waterway Cleanup were canceled because of Hurricanes Katrina and Rita (LADEQ, 2006).

The Mississippi Marine Debris Task Force sponsors the annual Mississippi Coastal Cleanup. In 2003, approximately 4,513 volunteers picked up trash along 233 mi (359 km) of coastal waterways and the barrier islands during the Mississippi Coastal Cleanup. Volunteers collected 72,988 pounds of trash. The 2004 and 2005 cleanups were canceled because of Hurricane Ivan in 2004 and Hurricanes Katrina and Rita in 2005 (Mississippi Alabama Sea Grant Consortium, 2006).

The Alabama Coastal Cleanup is coordinated through the Alabama Department of Conservation and Natural Resources, State Lands Division, Coastal Section and the Alabama People Against a Littered State. Alabama joined this effort in 1987. Since then, 41,946 participants in Alabama have removed a total of 746,850 pounds of debris and cleaned 2,182 mi (3,511 km) of coast. Because of Hurricane Katrina, some cleanup zones for the September 17, 2005, event were canceled (Alabama Coastal Cleanup, 2006).

The 2005 hurricane season also disrupted Florida's cleanup efforts. However, in 2004, 15,121 Florida residents participated in the International Coastal Cleanup. The volunteers covered 871 mi (1,401 km) of shoreline and picked up 284,436 pounds of trash. The Florida Coastal Cleanup started in Florida in 1988 and went international in 1989. It has grown to 52 main cleanup zones in Florida (International Coastal Cleanup, 2005).

4.1.2.3. Noise

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. The intensity and frequency of the noise emissions are highly variable, both between and among these sources. The level of underwater sound detected depends on receiver depth and aspect, and the strength/frequencies of the noise source. The duration that a passing airborne or surface sound source can be received underwater may be increased in shallow water by multiple reflections (echoes).

Service vessels and helicopters (discussed also in **Chapters 4.1.1.8.2 and 4.1.1.8.3**) may add noise to broad areas. Sound generated from helicopter and service-vessel traffic is transient in nature and extremely variable in intensity.

Helicopter sounds contain dominant tones (resulting from rotors) generally below 500 Hz (Richardson et al., 1995). 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. Lateral propagation of sound is greater in shallow than in deep water. Helicopters, while flying offshore, generally maintain altitudes above 700 ft during transit to and from the working area. A range of 75-125 helicopter operations (take off and landing) is projected to occur annually as a result of the proposed action in the EPA.

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. Broadband source levels for most small ships (e.g., support and supply ships) are ~170-180 dB re 1 μPa (Richardson et al., 1995). 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. A range of 375-500 service-vessel round trips is projected to occur annually as a result of the proposed action in the EPA.

4.1.3. Other Cumulative Activities Scenario

4.1.3.1. Other Major Offshore Activities

4.1.3.1.1. Marine Transportation

An extensive maritime industry exists in the northern Gulf of Mexico. **Figure 3-11** showed the major ports and domestic waterways in the analysis area, while **Table 3-30** presents the 2004 channel depth, number of trips, and freight traffic of OCS-related waterways. Marine transportation within the analysis area should grow linearly based on historical freight traffic statistics given current conditions. Should any infrastructure changes occur, then the marine transportation would reflect these changes. For example, if a port in the analysis area (or outside the analysis area) deepened its channel or constructed new railroads or highways into the port area, then the number of trips and the volume of commodities into and out of the port would change accordingly. Or if a refinery near one of the ports were to close, then tanker traffic to that port may decrease.

Tanker imports and exports of crude and petroleum products into the GOM are projected to increase (USDOE, EIA, 2001). In 2000, approximately 2.08 BBO of crude oil (38% of U.S. total) and 1.09 BBO of petroleum products (13% of U.S. total) moved through analysis area ports. By 2020, these volumes are projected to grow to 2.79 BBO of crude oil and 1.77 BBO of petroleum products. Crude oil will continue to be tankered into the GOM for refining from Alaska, California, and the Atlantic.

Marine transportation is not expected to change as a result of the proposed action.

4.1.3.1.2. Military Activities

The air space and waterways of the Eastern Gulf of Mexico are used extensively by the Department of Defense (DOD) for conducting various air-to-air, air-to-surface, surface to surface, and fleet training mission operations. TheDOD has essentially designated the entire EPA into operating areas of various types. Within the proposed EGOM Sale 224 area, there are 4 Eglin Water Test Areas (i.e., EWTA-1, EWTA-2A, EWTA-2C, and EWTA-3).

Typically, military activity areas include airspace designated by the Air Force in which military aircraft conduct various weapons test and training missions. During periods of such missions, the Federal Aviation Administration (FAA), the controlling agency, will route civilian aircraft so as to avoid the military operations. From time-to-time, these operations include activities that result in debris that may burn up in the atmosphere or fall to the Gulf surface. When such is the case, the area will be cleared of all shipping prior to the operations.

The Navy uses the Gulf waters for shakedown cruises for newly-built ships, for ships completing overhaul or extensive repair work in Gulf shipyards such as Pascagoula, Mississippi, and for various types of training operations. While no aircraft carriers are currently home-ported in the Gulf, carriers may from time-to-time conduct flight operations in the Gulf. No areas in the Gulf have been designated as Naval operating areas requiring restrictions on the navigation of other vessels.

Future uses of the Eastern Gulf by the military are expected to increase. The new F-22 fighter aircraft is based at Tyndall Air Force Base and the new F-35 Joint Strike Fighter is programmed to be based at Eglin Air Force Base in 2009. Both bases are located in northwest Florida. In addition, a new generation of theater missile defense weapons systems may require the large air and water spaces of the Eastern Gulf for development and testing. The Eastern Gulf is the largest area of the continental U.S. in which long-range systems can be tested. Using areas outside the U.S., such as Pacific Ocean ranges, would increase costs and decrease flexibility tremendously.

In order to accommodate oil and gas exploration activities on the currently active leases in the Eastern Gulf, an agreement between MMS and the Air Force provides for five groups of leases to open for exploration activities for three months on a rotating basis. Military operations will avoid the open window, allowing exploration activities to be conducted. If more than three months is needed for the exploration activities, the Air Force and MMS can usually work out an agreement that extends the open window, allowing the activities to be completed. To date, this agreement has worked to the satisfaction of all the parties.

With regards to future potential leases from proposed Lease Sale 224, the Department of Defense has previously determined that the sale will not interfere with current and future military uses given continued use of the following stipulations and provided the area available for leasing remains west of the identified critical Military Mission Line, which is 86˚41' W. longitude.

The standard “Military Areas” stipulation, which is routinely applied to all GOM leases, is planned for all leases from proposed Lease Sale 224. That stipulation includes the following general provisions:

- *Hold and Save Harmless*: Lessee assumes all risks of damage or injury to persons or property in connection with activity performed by the lessee.
- *Electromagnetic Emissions*: Lessee agrees to control its own electromagnetic emissions and must coordinate with appropriate military installation command headquarters.
- *Operational*: Lessee must enter into an agreement with the appropriate military command headquarters prior to commencing any activities in designated warning and water test areas).

For many years, the MMS GOMR has reminded lessees and designated operators of their obligation to enter into this agreement and provided the address and telephone number of the appropriate military command headquarters each time an EP, DPP, or lease-term pipeline application was approved for activities on OCS leases that contained the stipulation. Effective January 27, 2004, the MMS GOMR no longer provided these lease stipulation reminders in each individual EP, DPP, or lease-term pipeline approval letter. Instead, NTL 2004-G02, "Military Warning and Water Test Areas," was issued to serve that purpose.

In addition to the above-noted standard "Military Areas" stipulation, proposed Lease Sale 224 would also receive two other military stipulations which have been routinely applied to Eastern GOM sale leases in recent years. Those are generally described as follows:

- *Evacuation:* Lessee recognizes and agrees that oil and gas resource exploration, exploitation, development, production, abandonment, and site cleanup operations on the leased area of submerged lands may occasionally interfere with tactical military operations, and in such cases, the United States reserves and has the right to temporarily suspend operations and/or require evacuation on the lease in the interest of national security.
- *Coordination:* The placement, location, and planned periods of operation of surface structures on this lease during the exploration stage are subject to approval by the MMS Regional Director after the review of an operator's EP regarding its compatibility with planned military activities. Prior to approval of the EP, the lessee shall consult with the appropriate military command headquarters regarding the location, density, and the planned periods of operation of such structures, and to maximize exploration while minimizing conflicts with Department of Defense activities. When determined necessary by the appropriate military command headquarters, the lessee will enter a formal Operating Agreement with such military command headquarters that delineates the specific requirements and operating parameters for the lessee's final activities.

The detailed texts of all the military stipulations that would apply to leases from proposed EGOM Sale 224 are shown in **Chapter 2.2.1.3.2** of this SEIS.

4.1.3.1.3. Offshore Liquefied Natural Gas Projects

In late 2002, the Deepwater Ports Act of 1974 (DWPA) was amended to include the establishment of natural gas ports on the OCS (the Maritime Transportation Security Act of 2002, Public Law 107-295, November 2002). The Act's amended provisions transferred the regulatory oversight of offshore natural gas terminals from FERC to the Department of Transportation (DOT). The USCG, which moved from DOT to the Department of Homeland Security in 2003, retained its operational responsibilities for deepwater ports.

In June 2003, the Secretary of Transportation delegated the authority to license deepwater ports to the MARAD Administrator. The license application process is administered jointly between MARAD and USCG, with MARAD primarily responsible for administrative matters and project financial reviews and USCG primarily responsible for project engineering, operations, safety, and environmental reviews, which include compliance with NEPA. The license review process, including a decision on the license application, must be completed within 356 days of the filing of an application.

At present in the GOM, the only existing onshore LNG terminal is located in Lake Charles, Louisiana, and the only existing offshore LNG terminal is Gulf Gateway located approximately 116 mi (187 km) offshore Louisiana. There are an additional 15 proposed or approved onshore LNG terminals and 4 proposed or approved offshore LNG terminals (FERC, 2007a). The following section discusses offshore LNG terminals projected, approved, and existing in the GOM.

Of the approximately 40 LNG terminals that are proposed or being discussed by the LNG industry for North America, many industry analysts predict that only 12 of the 40 will ever be built. Any LNG terminal project that is approved must also obtain a Coastal Use Permit in accordance with the Coastal Zone Management Act, Section 401 (CWA) water quality certificate, and Section 404/10 Department of the Army permit. The market ultimately determines whether an approved LNG terminal is ever built. Even if an LNG terminal project receives all of the Federal and State approvals, it still must meet complicated global issues surrounding financing, gas supply, and market conditions (FERC, 2007b). The following offshore projects are either proposed or licensed in the GOM (**Table 4-5**).

Gulf Gateway is located approximately 116 mi (187 km) offshore Louisiana and consists of a submerged turret loading system. On March 20, 2005, Gulf Gateway successfully commenced operations. The initial cargo delivery was made to the port by the world's first LNG regasification vessel, the *EBRV Excelsior*.

Gulf Landing, as of March 29, 2007, has been halted. Originally projected to be located about 38 mi (61 km) offshore Louisiana, Shell announced the project proposed for the Gulf of Mexico had been pulled off the drawing board by for various reasons.

The Main Pass Energy Hub facility is located approximately 16 mi (26 km) offshore Louisiana. Alabama, Louisiana, and Mississippi have been designated as adjacent coastal states for this application process. The facility will be a mix of new and existing structures. The proposal also includes the development of salt caverns for the storage of regasified natural gas. The Governor of Louisiana sent a letter to MARAD objecting to the project, citing concerns about fisheries impacts from the open rack vaporizer (ORV) system and the need for revenue sharing from activities at the port. The applicant altered its application by proposing to use a closed-loop system instead of the preferred open-loop ORV system to regasify the LNG. This change will minimize potential impacts to the GOM fisheries. However, a portion of the regasified natural gas will be consumed to provide the heat for the vaporization process (direct burning of about 1-1.5%). A favorable Record of Decision was issued by MARAD in January 2007 for the project with the closed loop system. To date, the required state and federal permits have not been issued.

The Bienville Offshore Energy Terminal will be located approximately 63 mi (101 km) offshore Alabama. The proposed facility will utilize HiLoad technology and a SALM for offloading, and will use ORV technology on the HiLoads for regasifying the LNG offshore. The NEPA clock was stopped on February 28, 2007, to obtain data needed to resolve agency comments on the DEIS. Upon resolution of these comments, DEIS preparation it is expected to continue.

An application has been received by USCG for the Port Pelican LNG Hub west of Tampa Bay, Florida. Additional information is not available at this time.

More detailed information about each project can be obtained from the MARAD Internet website (http://www.marad.dot.gov/dwp/deepwater_ports/index.aspwww.dms.dot.gov) or from the USDOT Internet website (http://www.dot.gov). Use the USDOT Docket Number provided in **Table 4-5** to go directly to the docket or you may use the project name in a "simple search" to locate information on a specific port.

Most of the new U.S. LNG capacity is projected for the GOM area because of the locale's many operational advantages. There is spare capacity in the existing pipeline infrastructure to move the regasified natural gas to market, and deepwater ports can serve onshore facilities including intrastate as well as interstate pipelines. The "new" Gulf Coast terminals are projected to account for more than 70 percent of the imports into the U.S. in 2025 (USDOE, EIA, 2005c).

According to the Maritime Transportation Act of 2002 (MTSA), all LNG tankers entering U.S. waters must have certified security plans. These plans must be updated at least every 5 years and be re-approved whenever a change is made to a tanker that could affect the vessels security. Additionally, the MTSA specifies that all U.S. port facilities deemed at risk for a "transportation security incident" must prepare and implement security plans for deterring such incidents to the "maximum extent practicable. New marine anti-terrorist regulations became effective on July 1, 2004. The International Ship and Port Facility Security Code (ISPS Code) is a comprehensive set of measures to enhance the security of ships and port facilities developed in response to the perceived threats to ships and port facilities in the wake of the September 11th attacks in the U.S. (USDOE, EIA, 2004b).

For security and safety reasons, there are zones proposed around LNG terminals. The first is a 500-m (1,640-ft) safety zone, established and enforced by the USCG, that excludes all unauthorized vessels from entering the designated area at any time. The second zone ranges from 2 km (1.2 mi) to 3.2 km (2 mi) or larger and advises mariners that a LNG carrier and/or support vessels may be operating in the area. The purpose of this zone is to minimize the potential for collisions or other impacts with LNG carriers and support vessels by other marine traffic in the vicinity of the terminal.

4.1.3.2. Other Major Influencing Factors on Coastal Environments

4.1.3.2.1. Submergence of Wetlands

Other major factors contributing to submergence of wetlands along the Gulf Coast are eustatic sea-level rise and land subsidence. Eustatic sea-level rise is caused by the reduction of the volume of water stored in the polar ice caps and expansion of ocean waters because of global warming. Land subsidence is caused by a variety of localized natural and manmade events such as down-warping or horizontal movement of the earth's crust; weighted surface compression; oxidation, consolidation, settling, and dewatering of surface sediments; and depressurization of subsurface reservoirs during oil and gas production (Swanson and Thurlow, 1973; Morton, 2003; Morton et al., 2002). In localized areas, subsidence and sea-level rise can be offset by sedimentation, placement of dredged material, and peat formation.

During the past century, the rate of eustatic sea-level rise along the Louisiana coast was relatively constant at 2.3 mm/yr (0.09 in/yr), although the rate has varied from a sea-level decrease of 3 mm/yr (0.12 in/yr) to a maximum increase of 10 mm/yr (0.39 in/yr) over decade-long periods (Turner and Cahoon, 1988; Williams and Burkett, 2002). Submergence in the Gulf 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). One of the major factors causing greater submergence rates in Louisiana is reduced sedimentation, resulting from deltaic abandonment, flood control, and channelization of the Mississippi River. There is scientific consensus that sea-level rise will continue and is likely to increase into the next century. Based on the 2001 Intergovernmental Panel on Climate Change report, the best mid-range estimate is for a sea-level rise of approximately 50 cm (20 in) over the next century.

Subsidence or sinking of the land surface in southern Louisiana and the entire south-central U.S. is mainly attributed to the weight of Mississippi River mud that makes up the geography of the region, drainage and oxidation of organic soils, natural compaction and dewatering of surficial sediments, and tectonic activity (geosynclinal downwarping and movement along growth faults). The problem is aggravated in Louisiana by flood protection measures and disruption of natural drainage ways that reduce sediment deposition to the Deltaic region. Fluid withdrawal, including groundwater withdrawals and oil and gas production, can cause localized subsidence in the aquifer system and above the producing reservoirs. In coastal Louisiana, about 400 km^2 (98,842 ac) of wetlands have a subsidence potential greater than 10 cm (4 in) because of fluid withdrawal (Turner and Cahoon, 1988). Morton et al. (2002) used geodetic releveling surveys to identify historical subsidence rates of 9.4 mm/yr and averaging 6.4 mm/yr along Bayou Petit Caillou in Terrebonne Parish, Louisiana. The average subsidence rate for Terrebonne Parish over the last 5,000 years is calculated at <3 mm/year (0.12 in/yr) (Roberts et al., 1994). Thus, hydrocarbon production can induce local subsidence rates sufficient to result in significant landloss in coastal areas.

4.1.3.2.2. River Development and Flood Control Projects

In recent decades, alterations in the upstream hydrology of the rivers draining into the northern GOM have resulted in a variety of coastal impacts. Dams and reservoirs on upstream tributaries trap much of the sediment load in the rivers. The suspended sediment load of the Mississippi River has decreased nearly 60 percent since the 1950's, largely as a result of dam and reservoir construction upstream (Tuttle and Combe, 1981; Turner and Cahoon, 1988).

In a natural system, over-bank flooding introduces sediments into adjoining wetlands. Flood control on the Mississippi and other rivers has largely eliminated flood-borne sedimentation in the Gulf coastal wetlands, contributing to their deterioration.

Channelization of the Mississippi and other rivers in conjunction with flood control levees has also contributed to wetland loss and has interrupted wetland creation around the Gulf by preventing distribution of alluvial sediments across deltas and flood plains. Prior to channelization, the flow of rivers was distributed among several distributary channels that delivered sediment over a broad area during high river stages. Today, sediment from the Mississippi River is primarily discharged through the main channel directly to the deep waters of the continental slope. The only significant exception to this scenario is the diversion of approximately 30 percent of the Mississippi River flow to the Atchafalaya

River; this diversion does not capture 30 percent of the sediment flow, however, since most of the sediment is restricted to the deeper river channel.

4.1.3.2.3. Dredging

Dredging operations include sediment and gravel harvesting; pipeline installation; canal installation, maintenance, and modifications; harbor installation and maintenance; and stream channelization.

Numerous channels are maintained throughout the onshore cumulative activity area by Federal, State, county, commercial, and private interests. Proposals for new and maintenance dredging projects are reviewed by Federal, State, and county agencies as well as by private and commercial interests to identify and mitigate adverse impacts upon social, economic, and environmental resources.

Typically, COE schedules surveys every 2 years on each navigation channel under its responsibility to determine the need for maintenance dredging. Maintenance dredging is then performed on an as needed basis. Dredging cycles vary broadly from channel to channel and from channel segment to channel segment. A cycle may be 1-6 years. The COE is charged with maintaining all larger navigation channels in the cumulative activity area. The COE dredges millions of m^3 of dredged material per year in the cumulative activity area. Some shallower port-access channels may be deepened over the next 10 years to accommodate deeper draft vessels. These vessels, which support deepwater OCS activities, may include those with drafts to about 7 m (23 ft).

Materials from maintenance dredging are primarily disposed of on existing dredged-material disposal banks and in dredged-material disposal areas. Additional dredged-material disposal areas for maintenance or new-project dredging are developed as needed and must be evaluated and permitted by the COE and relevant State agencies prior to construction. Some dredged sediments are dispersed into offshore waters at established offshore disposal sites. Materials may also be used in a beneficial manner to restore and create habitat, beach nourishment projects, and industrial and commercial development.

When placing the material on a typical dredged material disposal site, the usual fluid nature of the mud and subsequent erosion causes widening of the site, which may bury adjacent wetlands, submerged vegetation, or nonvegetated water bottoms. Consequently, adjacent soil surfaces may be elevated, converting wetlands to uplands, fringes of shallow waterbodies to wetlands, and some nonvegetated water bottoms to shallower water bottoms or emergent areas that may become vegetated due to increased light at the new soil surface.

Dredged materials from channels are often contaminated with toxic heavy metals, organic chemicals, pesticides, oil and grease, and other pollutants originating from municipal, industrial, and vessel discharges and nonpoint sources, and thus can result in contamination of areas formerly isolated from major anthropogenic sources (USEPA, 1979). The vicinities around harbors and industrial sites are most noted for this problem. Hence, sediment discharges from dredging operations can be major point sources of pollution in coastal waters in and around the Gulf. In addition, inland and shallow offshore disposal can change the navigability and natural flow or circulation of waterbodies.

In 1989, USEPA estimated that more than 90 percent of the volume of material dumped in the oceans around the U.S. consisted of sediments dredged from U.S. harbors and channels (USEPA, 1989). As of February 1997, in response to the Marine Protection, Research, and Sanctuaries Act of 1972, USEPA had finalized the designation of eight dredged-material disposal sites in the cumulative activity area. Another four sites in the Gulf are considered interim sites for dredged-material disposal. These sites primarily facilitate the COE's bar-channel dredging program. Generally, each bar channel of navigation channels connecting the Gulf and inland regions has 1-3 disposal sites used for disposal of maintenance dredged material. These are usually located in State waters. Some designated sites have never been used.

Installation and maintenance of any navigation channel and many pipeline canals connecting two or more waterbodies changes the hydrodynamics in their vicinity. These changes are typically associated with saltwater intrusion, reduced freshwater retention, changed circulation patterns, changed flow velocities, and erosion. When these channels are permitted for construction through sensitive wetland habitats or when sites are permitted for dredged-material disposal, measures are required to mitigate unavoidable adverse environmental impacts. Structures constructed to mitigate adverse hydrodynamic impacts and accelerated erosion includes dams, weirs, bulkheads, rip-rap, shell/gravel mats, and gobi mats.

Typically, little or no maintenance is performed on mitigation structures. Without maintenance, many mitigation facilities, particularly in regions where the soil is poorly consolidated and has a high organic content, are known to become ineffective within a few years of construction. The number of mitigation structures associated with navigation and pipeline channels is unknown.

4.1.3.2.4. Coastal Restoration

The coastal infrastructure that supports State and OCS oil and gas activities would benefit from coastal restoration. Coastal erosion could have a significant negative impact on this coastal infrastructure, including pipelines, navigation channels, and supply bases (U.S. Dept. of the Army, COE, 2004c). The extensive pipelines traversing coastal Louisiana are affected by coastal erosion as barrier islands and coastal wetlands erode and as open water scours away land-protecting pipelines. Exposed pipelines, that were once buried, are at increased risk from failure or damage because of lack of structural stability, anchor dragging, and boat collisions. Navigation infrastructure is also already being impacted by coastal erosion as shown in three areas of the GIWW. In those areas there is increased shoaling, causing traffic moving on the waterway to slow down, increasing the time and cost of moving commodities. Annual dredging maintenance cost has increased to keep the channel at authorized depths. Supply bases servicing offshore OCS oil and gas activities are also impacted by coastal erosion. These bases provide necessary supplies and maintenance services to the offshore platforms and serve as "jumping-off" points for employees that work on offshore platforms. If one of the important supply bases, such as Port Fourchon, was severely impacted by coastal degradation, the operational cost of offshore production could go up significantly.

State

Louisiana

The Louisiana DNR's Office of Coastal Restoration and Management is responsible for the maintenance and protection of the State's coastal wetlands, and the Coastal Restoration and Engineering Divisions are responsible for the construction of projects aimed at creating, protecting, and restoring the State's wetlands.

In Louisiana, from 1986 to 2005, 558 coastal restoration projects have been constructed from 1986 to 2005 (LADNR, 2006). Of those, 41 were State-funded projects, 74 were Coastal Wetlands Planning Protection and Restoration Act projects, 37 were part of the Parish Coastal Wetlands Restoration Program (Christmas Tree Program), 35 were other federally-assisted projects, and 371 were part of the Vegetation Planting Program. An additional 59 Breaux Act projects have been approved and are in the design phase.

In December 2005, the Louisiana State legislature established the Coastal Protection and Restoration Authority (CPRA) and charged it with coordinating the efforts of local, State, and Federal agencies to achieve long-term and comprehensive coastal protection and restoration that integrates flood control and wetland restoration. In February 2007, CPRA published the Draft *Integrated Ecosystem Restoration and Hurricane Protection—Louisiana's Comprehensive Master Plan for a Sustainable Coast*. The following four objectives were defined for the plan:

- reduce risk to economic assets;
- restore sustainability to the coastal ecosystem;
- maintain a diverse array of habitats for fish and wildlife; and
- sustain Louisiana's unique heritage and culture.

The plan made the following four assumptions:

- a healthy landscape is essential to achieving both a sustainable ecosystem and reliable flood protection;
- a "multiple lines of defense" strategy should guide flood protection decisions;

- change is inevitable whether or not we take action. Therefore, we must embrace actions that allow us to meet our objectives; and
- everyone will be affected, so everyone has a stake in working toward a balanced outcome.

Coastal restoration measures were identified based on the premise that restoring sustainability to the coastal landscape is a priority, and hurricane protection measures work in concert with a healthy landscape to provide reliable flood protection to south Louisiana communities. Also included is a procedure for implementing an adapative management strategy. The plan described the following projects, which the State envisions must be undertaken to protect and restore Louisiana's coast.

- restoring sustainability to the Mississippi River Delta by land-building diversions, land-sustaining diversions, use of navigation channels as "new" distributaries, marsh creation, barrier shoreline restoration, and shoreline stabilization;
- closure of the Mississippi River Gulf Outlet (MRGO) to deep-draft navigation;
- restoring sustainability to the Atchafalaya Delta and Chenier Plain by managing river and freshwater supplies to allow better maintenance of water sources throughout the year to reduce the impacts of periodic saltwater intrusion, marsh creation, and lake shoreline stabilization; and
- hurricane protection must balance the need for storm protection while not stopping the natural flow of water, leading to further landloss; and CPRA's ongoing analyses will define the standard of protection that is achievable for all of Louisiana's coastal communities.

Federal

In FY 2001, CIAP was authorized by Congress to assist States in mitigating the impacts associated with OCS oil and gas production. Congress appropriated approximately $150 million to NOAA to be allocated to seven coastal states—Alabama, Alaska, California, Florida, Louisiana, Mississippi, and Texas. Under CIAP, NOAA administered more than 150 separate grants to States and localities. The CIAP funded more than 600 projects including habitat protection and restoration, land acquisition, and water quality improvement projects. Under the Energy Policy Act of 2005, Congress reauthorized CIAP, which is now administered by MMS (**Chapter 1.3**). Under Section 384 of the Energy Policy Act, MMS shall disburse $250 million for each FY 2007 through 2010 to eligible producing States (i.e., Alaska, California, Louisiana, Mississippi, Alabama, and Texas) and coastal political subdivisions.

MMS Study

The MMS was a sponsor and participant in "The Economic and Market Impacts of Coastal Restoration: America's Wetland Economic Forum II" held in late September 2006. Part of this effort, lead by the LSU Center for Energy Studies, examined the local, regional, and national infrastructure at risk in the Gulf region, with a particular focus on energy infrastructure. The project examined the potential positive impacts that coastal restoration would play in protecting and maintaining energy infrastructure. The study used GIS tools to simulate coastal erosion and flooding scenarios to identify potential "at risk" energy infrastructure assets along the Gulf Coast, including Louisiana. The recent flooding experiences from Hurricanes Katrina and Rita were used in case studies to examine recent infrastructure exposure to flooding. Scenarios on coastal erosion and storm surge relationships were considered. Traditional economic analysis using valuation techniques will be considered, as well as other methods like economic impact approaches. The first phase of this project will be to recommend methods for estimating overall economic impacts of coastal restoration. A case study examining potential infrastructure at risk along coastal Louisiana (as opposed to the entire Gulf Coast) was provided. The first phase of the project was completed and presented at the Economic Forum II in late September 2006.

The second phase involved presenting additional findings at the 3rd National Conference on Coastal and Estuarine Habitat Restoration held in December 2006 in New Orleans, Louisiana. A copy of the research and findings can be found at the LSU Center for Energy Studies website (http://www.engr.lsu.edu/publications). The research showed that the energy industry has a considerable range of assets along the coast (in the order of billions, if not hundreds of billions, of dollars of investment) that is potentially exposed to erosion-related problems. Coastal restoration would appear to have significant collateral benefits in supporting these assets, in addition to the more widely discussed public benefits, although the research did not attempt to quantify them. The author notes that individual firms are not likely to consider the broader public benefits in choosing the least cost option to protect their assets (i.e., choosing between "hardening" their existing infrastructure versus investing in coastal restoration) since some portion of the additional public benefits associated with coastal restoration cannot be captured by these firms making the investment in restoration.

4.1.3.2.5. Alternative Energy

On August 8, 2005, President George W. Bush signed into law the Energy Policy Act of 2005 (the Act). Section 388 (a) of the Energy Policy Act of 2005 amended Section 8 of the OCSLA (43 U.S.C. 1337) to authorize DOI to grant leases, easements, or right-of-ways 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 the OCS lands. The Act clarifies the Secretary's authority to allow the existing oil and gas structures on the OCS lands to remain in place after oil and gas activities have ceased and to extend the life of these facilities for non-oil and gas activities such as research, renewable energy production, aquaculture, etc., before being removed. The MMS is authorized to develop a comprehensive program and regulations to implement the new authority. As a part of this process, MMS has published an Advance Notice of Proposed Rulemaking (ANPR) in the *Federal Register* on December 30, 2005, and seeks comments on alternate energy-related uses on the OCS. The MMS published a NOI to prepare a programmatic EIS on May 6, 2006.

Wind energy is one of the most popular sources of clean and renewable energy that has been in use for centuries and is the only alternate use of the OCS Federal lands to be discussed in this section. Wind farms are composed of tens of individual wind turbines in an area that produces electricity for commercial consumption. Today, wind energy is the fastest-growing renewable energy resource in the world. Worldwide total installed wind power capacity now stands at 59,322 megawatts (MW) and U.S. installed wind power capacity is 9,149 MW (Global Wind Energy Council, 2006). Offshore wind has emerged as a promising renewable energy resource for a number of reasons: (1) strong and consistent winds are in proximity to major load centers in the energy-constrained northeastern U.S.; (2) 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 (3) as a fuel, wind is both cost-free and emission free (MTC et al., 2005).

At present, 10 offshore wind farms are in operation; all are located off the coast of Europe in waters generally shallower than 25 m (82 ft). Many other countries, including the U.S., are also expressing serious interest in developing this offshore resource (British Wind Energy Association, 2005). Two wind farm projects are currently going through the permitting process in the U.S. The Cape Wind project is located on Horseshoe Shoal in Nantucket Sound, Massachusetts, and consists of 130 turbines designed to generate up to 468 MW. The Long Island Power Authority project is located off the south shore of Long Island, New York. This project would consist of 40 turbines designed to generate 130 MW of energy for the Long Island, New York, region. Initial applications for these projects were submitted before the passage of the Energy Policy Act of 2005.

The wind resource potential of the GOM is not very well documented. Archer and Jacobson (2003) conducted a study of U.S. winds and wind power at 80 m (256 ft) height. Their study concluded that the GOM has a higher potential of wind resources than previously thought. These unexpected levels of wind velocity have led to interest in wind energy generation in the GOM. On October 24, 2005, the Texas General Land Office (GLO) announced that the State of Texas has signed an agreement with Galveston-Offshore Wind, LLC, to allow the first offshore wind energy project on the GOM. Under the terms of this agreement, the company will lease an 11,355-ac (4.6 ha) tract located about 7 mi (11 km) off the coast of Galveston Island in Texas State waters. The company will also build and operate two 80-m (256-

ft) meteorological towers to collect wind data in the GOM. Data gathered from these towers will help to evaluate the site's potential and to determine exact location of the wind farm. The company plans to build 50 turbines expected to produce 150 MW of electricity, enough to power about 40,000 homes (Texas General Land Office, 2005). In May 2006, the GLO announced the State's second—and the Nation's largest—offshore wind farm, which will be built off the coast of Padre Island National Seashore. Houston-based Superior Renewable Energy will build and operate the wind farm, which will generate 500 MW of electricity—enough to power 125,000 homes. The project is expected to be running in 5 years.

Until MMS promulgates the regulations under which these offshore projects will operate, MMS will accept no proposals for alternate energy development or for alternate uses of the existing oil and gas facilities located on the Federal OCS. Once MMS finalizes appropriate regulations, the demands for projects of this type are expected to grow on the OCS. Evaluation of meteorological data collected in Texas State waters would also tell us in the near future about the possibility of siting wind farms on the Gulf's OCS for generating electricity.

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

Petroleum hydrocarbons can enter the GOM from a wide variety of sources. These sources include both natural geochemical processes and the onshore and offshore activities of man. Natural seeps are the predominant petroleum hydrocarbon source to offshore waters. The discharge of petroleum hydrocarbons in produced water is the largest oil input to the OCS that is the result of human activities. Land-based sources are the greatest source of hydrocarbons to coastal waters. Spills of hydrocarbons may occur in both offshore and coastal waters when crude oil is extracted as well as during transportation and consumption of petroleum products. Numerical estimates of the contribution of these sources to the GOM coastal and offshore waters are presented in **Tables 4-6 and 4-7**, respectively. In these tables, the GOM is divided into Western and Eastern so that the contribution from regional industrial activities or urban areas can be observed. These estimates include information presented in *Oil in the Sea III: Inputs, Fates, and Effects* (NRC, 2003), and incorporate new research and databases that have become available since the previous version of *Oil in the Sea* was published in 1985.

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

Tables 4-6 and 4-7 and the following paragraphs provide a description of these estimated oil input sources.

4.1.3.3.1. Natural Seepage

Natural seeps provide the largest petroleum input to the offshore GOM, about 95 percent of the total. Estimates have ranged from 28,000 bbl per year (4,000 tonnes) to 204,000 bbl (29,150 tonnes) of oil per year (McDonald, 1998a; Wilson et al., 1973). Using commercial remote-sensing data, Mitchell et al. (1999) estimated a range of 280,000 bbl to 700,000 bbl per year (40,000 to 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 about 980,000 bbl (140,000 tonnes) per year. As seepage is a natural occurrence, the rate is expected to remain the same throughout the 40-year analysis period **(Table 4-7**).

4.1.3.3.2. Produced Water

Small amounts of oil are routinely discharged in produced water during OCS operations. Produced water is treated and discharged overboard. The oil and grease content is limited by USEPA effluent limitation guidelines to a monthly average of 29 mg/L oil content (USEPA, 1993). The NRC (2003) estimates the discharge of 4,130 bbl (590 tonnes) per year of petroleum hydrocarbons to the coastal western GOM and 11,900 bbl (1,700 tonnes) to the offshore western GOM through produced-water discharges.

A typical annual amount of OCS-produced water to be discharged in the future was estimated based on annual historical quantities reported to MMS for the last 10 years (**Chapter 4.1.1.4.2**). The average annual volume of 596 MMbbl per year of OCS-produced water would contribute 19,250 bbl (2,750 tonnes) of petroleum hydrocarbons to the GOM waters (**Tables 4-6 and 4-7**).

4.1.3.3.3. Land-based Discharges

Land-based sources provide the largest petroleum input to the coastal waters of both the western and eastern GOM. For coastal waters, 77,000 bbl (11,000 tonnes) of petroleum hydrocarbons enter the western GOM and 11,200 bbl (1,600 tonnes) enter the eastern GOM from land-based discharges. Land-based sources include residual petroleum hydrocarbons in municipal and industrial wastewater treatment facility discharges as well as urban run-off. 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.

The previous edition of *Oil in the Sea* (NRC, 1985) determined petroleum in urban runoff based on the human population. *Oil in the Sea* (NRC, 2003) utilized USEPA's water quality data repository (STORET) when available, which measures ambient oil and grease in major rivers, and U.S. Bureau of Census data to generate a unit load of petroleum hydrocarbon per square mile of urban area (NRC, 1995). Oil and grease measurements include compounds that are not of petroleum origin so a conversion factor obtained from existing research was used to convert oil and grease measurements to petroleum hydrocarbons.

4.1.3.3.4. Spills

Oil spills occur during the production, transportation, and consumption of oil. This wide variety of sources includes spills from production wells and platforms during extraction; spills during transportation by tanker, barge, and other vessels; spills from pipelines in both Federal and State waters; shore-based storage tanks and coastal facilities; mystery sources; and spills during refining and consumption. The composition of spilled hydrocarbons includes crude oil, refined fuels such as diesel during transport and storage and spills during consumption. The NRC (2003) estimates that 630 bbl (90 tonnes) of petroleum hydrocarbons are spilled from coastal western GOM and 350 bbl (50 tonnes) are spilled from offshore western GOM. Spills from pipelines in the coastal area of the western GOM contribute 6,230 bbl (890 tonnes) and are the largest amount of oil by source to that region. Spillage from tankers in the coastal area of the eastern GOM contribute 980 bbl (140 tonnes), the largest amount of oil by source to that region, but the data do not differentiate between foreign, State, or OCS oil. Spills of refined products from coastal pipelines and marine terminals are the main contributors to the coastal facility inputs to coastal waters. In offshore waters, spills from commercial vessels >100 gross tons (GT) contribute 490 bbl (70 tonnes) per year to the eastern OCS and are the largest amount of oil by source to that region. Tank vessel spills input 10,500 bbl (1,500 tonnes) per year to the western OCS. At the national level, tankers and tank barges were responsible for 82 percent of the total spillage. The type of oil spilled nationally was as follows: 36 percent crude oil; 36 percent heavy distillate (No. 6 fuel oil, bunker C); 25 percent light distillate (diesel, kerosene); and 3 percent gasoline (NRC 2003).

4.1.3.3.4.1. Trends in Reported Spill Volumes and Numbers

Databases on spills that have occurred in the GOM are not comprehensive. As almost 38 percent of all U.S. spills have occurred within the waters of the GOM and Gulf Coast States, the trends for all U.S. spills is assumed to be representative of trends in spills that have occurred in the northern GOM. The following is a summary of what is known about trends in U.S. spill risk and is derived from USCG data through 2004, which does not take into account 2005 spills, comprehensive data on which is not yet available (USDOT, Coast Guard, 2007):

Volumes

- The volume of reported spill incidents in U.S. waters has been on a steady downward trend since 1973. There has been a general downward trend in the number of spills over 24 bbl (1,000 gallons).
- There have been no oil spills reported over 23,810 bbl (1 million gallons) since 1991. The total volume spilled in 2003 is at the lowest amount in over 25 years.
- The majority of reported spills since 1973 involved discharges between 0.024 and 2.4 bbl (1 and 100 gallons).
- The decline in oil-spill volume, particularly in the face of growing domestic demand for imported oil, represents the combined effects of an increasingly effective campaign of positive prevention and preparedness initiatives to protect U.S. coastal waters from oil pollution.

Number

- Prior to 2002, the total number of reported spill incidents remained relatively constant from year to year.
- The total number of reported spill incidents dropped dramatically in 2002 and remained relatively constant from 2002 to 2004.

Location

- Most (74.6%) of all reported spills from 1973 to 2004 occurred within 3 nmi of shore.
- Most (83.6%) of the volume of all reported spills occurred in waters within 3 nmi of shore.

Sources

- Spills from tank vessels (ships/barges) account for the majority of volume spilled: 46.7 percent of the volume of oil spilled from 1973 to 2004 came from tank vessels; 22 percent from facilities and other non-vessels; 17.3 percent from pipelines; 7.7 percent from mystery spills; and 6.3 percent from non-tank vessels.
- 33.1 percent of the number of all spills from 1973 to 2004 occurred from non-tank vessels; 25.1 percent were "mystery" spills; 28.8 percent were from facilities and other non-vessels; 9.8 percent were from tank vessels (ships and barges carrying oil); and 3.2 percent were from pipelines.
- The rates for oil spills ≥1,000 bbl from OCS platforms, tankers, and barges continues to decline.

Types of Oil

- A combination of crude oil and heavy oil is the type of oil with the greatest volumes spilled (61.7%).
- Crude oil and heavy oil were the most frequent types of oil spilled (34.7% of the number of spills from 1973 to 2004 were the discharge of crude oil or heavy oil).

4.1.3.3.4.2. Spills as the Result of Hurricanes

This section discusses the causes and volumes of spills that resulted from Hurricanes Lili, Ivan, Katrina, and Rita. **Chapter 3.3.5.7.3** gives a summary of damage to the OCS-related platforms, rigs, and pipelines caused by Hurricanes Ivan, Katrina, and Rita.

As discussed in **Chapter 1.5**, MMS's regulations that govern oil and gas production safety systems require that 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. Part of those safety systems are subsurface safety valves (SSSV's), which shut off well flow in the production tubing (100 ft (30 m)) or more below the seafloor), in the event of emergencies, such as fire or production tubing separation. All wells on the OCS must be equipped with SSSV's. Should a platform be damaged, these valves "shut-in" production flow to prevent pollution events until the production can be safely reestablished. During Hurricanes Ivan, Katrina and Rita, these valves performed 100 percent successfully (Watson, 2005; USDOI, MMS, 2005g).

Hurricane Lili (October 2002) damaged the wellhead of a well that had been shut-in awaiting MMS approval for plugging and abandonment operations. A mixture of oil, gas, and water was discharged over several days. Of the approximately 350 bbl of oil spilled, 205 bbl were not recovered (USDOI, MMS, 2003).

Hurricane Ivan (September 2004) caused mudslides in the vicinity of the mouth of the Mississippi River. Although platforms were shut-in as part of the hurricane evacuation procedures, pipelines that were severed by the mudslides released product present in the lines. Some pipelines were dragged 200-300 ft (61-91 m) from their original position and others were buried in 20-30 ft (6-9 m) of mud. On the OCS about 5,000 bbl of oil were spilled, and in State waters about 11,000 bbl was spilled. Tropical Storm Matthew (October 2004) further dispersed the unrecovered oil.

Hurricane Katrina (August 2005) resulted in considerable catastrophic onshore damage to storage tanks and pipelines along the Mississippi River onshore, including storage tanks that emptied into a residential area in Chalmette, Louisiana. Ten spills resulted in the release of 191,000 bbl onshore (Louisiana Sea Grant, 2005). On the OCS, Hurricane Katrina caused 71 spills of ≥1 bbl. None of these OCS spills reached the coastline. Of the 71 spills totaling 4,530 bbl that occurred from damage to pipelines and offshore facilities during and after Hurricane Katrina, 23 (33%) were of amounts ≥50 bbl. These 23 spills account for 4,007 bbl of petroleum products, 88 percent of the total spillage because of Hurricane Katrina. The spill at Mississippi Canyon Block 109 has been estimated down to a range of 600-960 bbl from an original reported estimate of 2,000 bbl, which was found to be inaccurate after further investigation. For OCS waters, Hurricane Katrina spill data was reviewed and compiled and is available on the MMS website at http://www.mms.gov/incidents/SigPoll2005.htm. This data is not final but was updated in January 2007 and will change as more information about lost material is collected.

The storm surge from Hurricane Rita (September 2005) damaged booms and re-oriented oil spilled during Hurricane Katrina, but it did not result in additional large spills onshore (Louisiana Sea Grant, 2005). On the OCS, 54 pollution incidents that involved spills of ≥1 bbl, none of which reached the shoreline, were recorded. The 54 spills of ≥1 bbl totaled 11,772 bbl of petroleum. Sixteen of these spills, at ≥50 bbl each, accounted for 97 percent of the total spillage volume, or 11,427 bbl. Hurricane Rita resulted in five spills of ≥1000 bbl, which account for 8,429 bbl, or 72 percent, of the total spill volume because of this storm. The locations and spill estimates, respectively, for each of these five largest spills are as follows: Eugene Island Block 51, Eugene Island Block 95, Eugene Island Block 314, South Marsh Island Block 146, and Ship Shoal Block 250, reporting spills of 100-1,812 bbl; 100-1,551 bbl; 2,000 bbl; 1,494 bbl; and 1,572 bbl.

Spill amounts for Eugene Island Blocks 51 and 95 have been estimated to range from a value of at least 100 bbl, considered likely, to a high value of 50 percent of a worst-case scenario spill for these locations. This worst-case scenario of 100 percent loss at 100 percent capacity is considered unlikely because the pipeline cracks were small, the pipelines were found to have retained sizeable volumes of condensate subsequent to the hurricane, and there were no sheen sightings reported despite overflight activity in and around the areas in question. These factors do not support the occurrence of a spill of large magnitude. For OCS waters, Hurricane Rita spill data is currently available on the MMS website at http://www.mms.gov/incidents/SigPoll2005.htm.

The USCG uses a spill classification system to categorize spill sizes. Under this system, a large spill is ≥2,381 bbl (100,000 gallons), a medium spill is between 238 and <2,381 bbl (10,000 and 100,000 gallons), and a minor spill is <238 bbl (10,000 gallons). Hurricanes Katrina and Rita, despite the amount of destruction they caused to offshore structures, caused no large oil spills within the OCS. A total of 125 spills (of ≥1 bbl), totaling 16,302 bbl, were caused by these two hurricanes. No comprehensive surveys have been conducted to determine the extent of negative impacts, though none have been reported, to birds or mammals as a result of these materials spilled from Federal OCS facilities.

Hurricane Katrina caused 57 percent of the total number of spills but accounted for 28 percent of the total volume of spilled petroleum. Hurricane Rita, responsible for 43 percent of the total number of spills, caused a larger spill volume, accounting for 72 percent of the total number of barrels spilled. Of the 124 total spills, 39 were ≥50 bbl, and these account for 95 percent of the total number of barrels spilled. The five largest spills, estimated at ≥1,000 bbl, that occurred as a result of these two storms and were previously mentioned individually, represent only 4 percent of the total number of spills but represent 52 percent of the total volume of spilled petroleum. The estimated spill amounts for Hurricanes Katrina and Rita and their combined totals are presented in the tables below.

Spill Estimates for Hurricanes Katrina and Rita (in bbl) for Spills ≥1 bbl

Hurricane	Crude and Condensate	Diesel and Refined Petroleum	Total Spillage	Number of Spills
Katrina	3,940	590	4,530	71
Rita	8,176	3,596	11,772	54
Total	12,116	4,186	16,302	125

Spill Estimates for Hurricanes Katrina and Rita (in bbl) for Spills ≥50 bbl

Hurricane	Crude and Condensate	Diesel and Refined Petroleum	Total Spillage	Number of Spills
Katrina	3,428	579	4,007	23
Rita	8,038	3,389	11,427	16
Total	11,446	3,968	15,434	39

The impacts of hurricanes on water quality include sediment resuspension and re-release of any contaminants present, increased mixing within the water column, oil and chemical spills, and the introduction of nutrients and chemical and biological contaminants transported via onshore flooding. Studies of the impacts to coastal waters by USEPA and NOAA have shown that degradation is temporary, and recovery will occur within weeks for pathogenic contaminants to months for oil spills that require cleanup. Pollutant levels were below USEPA National Ambient Water Quality Criteria and NOAA effects levels for sediments. In some cases, such as destroyed platforms or pipelines, the oil remains sequestered until the time when the structure is decommissioned, at which time the oil can be recovered.

4.1.3.3.4.3. Projections of Future Spill Events

Table 4-8 provides the estimated number of all spill events that MMS 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 4-8** includes spills due to both OCS and non-OCS activities, in two size categories (≥1,000 bbl and <1,000 bbl), and in coastal or offshore waters. The number of offshore OCS spills ≥1,000 bbl was determined using 40-year program resource projections and spill rates, while the number of offshore non-OCS spills and coastal OCS and non-OCS spills <1,000 bbl was determined from historical counts. No annual average for all spills is appropriate because the timeframes and peak years vary for the different types of activities that could spill oil. More detailed coverage of projected OCS oil-spill probability of occurrence and transport is presented in **Chapter 4.3.**

The projections of future spill occurrences shown in **Table 4-8** were formulated using the following sources: an MMS analysis of the USCG database on spill incidents in all navigable waters (USDOT, Coast Guard, 2006); USCG data provided to MMS on all GOM oil spills from 1985 to 2001; and an analysis of crude oil and petroleum product spills ≥1,000 bbl from OCS operations and from tanker and barge operations. Spill rates for OCS Program and non-OCS Program activities are shown in **Table 4-9** (Anderson and LaBelle, 2000).

4.1.3.3.4.4. OCS-Related Offshore Oil Spills

Spills could happen because of an accident associated with production and development activities. Spills estimated to occur as a result of the proposed action (**Chapter 4.2.1**) are a subset of all potential OCS spills; therefore, the discussion and information found in **Chapter 4.2.1.5** on MMS estimates of future spill sizes, characteristics, and fate is incorporated here by reference.

Probability of OCS Offshore Spills ≥ 1,000 bbl Occurring: The probabilities of one or more offshore spills ≥1,000 bbl occurring from future OCS operations in the CPA and WPA are provided in Table 4-15 of the Final Multisale EIS (USDOI, MMS, 2007a). For the Gulfwide OCS Program, there is a greater than 99 percent chance that there will be an offshore spill ≥1,000 bbl occurring in the next 40 years.

Probability of OCS Offshore Spills ≥ 10,000 bbl Occurring: The probabilities of one or more offshore spills ≥10,000 bbl occurring from future OCS operations in the CPA and WPA are provided in Table 4-15 of the Final Multisale EIS (USDOI, MMS, 2007b). For the Gulfwide OCS Program, there is greater than a 99 percent chance that one or more spills ≥10,000 bbl will occur in the next 40 years.

Mean Number of OCS Offshore Spills (OCS Program): Based on an analysis of spill rates and projected sources, and using the low and high resource estimates, MMS projected the mean number of offshore oil-spill events estimated to occur and the likelihood that these events will occur from OCS Program activities. Table 4-15 of the Final Multisale EIS (USDOI, MMS, 2007a) provides the mean number of offshore spills ≥1,000 bbl and ≥10,000 bbl estimated by source and for the CPA and WPA, as well as the Gulfwide OCS Program.

In the estimate of the number of spills by size category shown below, if the low resource estimate is realized, about 43 possible spills ≥1,000 bbl that could occur. For the high resource estimate, about 49 possible spills ≥1,000 bbl could occur. The following table provides MMS's estimate of the mean number of spills to occur in each size grouping.

Estimated Number of Offshore Spill Events (mean)
by Size Category for Different OCS Oil Development Scenarios

Size Category	OCS Program—Gulfwide
≤1 bbl	95,900-109,350
>1 and <10 bbl	2,150-2,450
≥10 and <50 bbl	450-500
≥50 bbl and <500 bbl	180-205
>500 and <1,000 bbl	15-17
≥1,000 bbl	43-49

Sources of OCS Offshore Spills: Spill occurrence risk may vary by operation or source. Besides spills occurring from facilities and during pipeline transport, as was the only case for the proposed action, offshore spills could occur due to OCS future operations from an FPSO or from shuttle tankers transporting OCS crude oil into ports. For the CPA OCS Program, here 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 analysis period (USDOI, MMS, 2007a; Table 4-15).

Estimated Spill Size: **Table 4-8** shows the estimated spill sizes for OCS spills. Offshore spill sizes were estimated based on historical records for a representative future year (Anderson and LaBelle, 2000).

Annual Numbers: **Table 4-8** shows the estimated number of OCS spills yearly rather than for the 40-year program. One offshore OCS-related spill of ≥1,000 bbl due to a pipeline release is anticipated. 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.

4.1.3.3.4.5. Non-OCS-Related Offshore Spills

Most offshore non-OCS spills occur from vessel and barge operations. Transit spills occur from navigation-related accidents such as collisions and groundings. Intrinsic spills are those occurring from accidents associated with the vessel itself, such as leaks from hull cracks, broken seals, and bilge upsets. Transfer spills occur during cargo transfer from accidents such as hose ruptures, overflows, and equipment failures.

Collisions and groundings have occurred very infrequently, less than one per 1,000 trips (USDOT, Coast Guard, 1993) and do not usually result in an oil spill. However, these accidents have resulted in the largest spills. The frequency of vessel collisions, and thus associated spills, increases as the proximity to shore increases because of the often-congested waterways in the Gulf region.

Most small non-OCS offshore spills occur during the cargo transfer of fuel and crude oil. Lightering of oil (the transfer of crude oil from supertankers to smaller shuttle tankers) is a common occurrence in the GOM. There have been about 3-4 spills per 1,000 lightering transfers, with an average spill size of 3 bbl (USDOT, Coast Guard, 1993).

Table 4-8 provides MMS's projections of spills that could occur offshore from non-OCS sources for a typical future year. It is assumed that all offshore spills ≥1,000 not related to OCS operations 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 the USCG and analyzed by MMS. 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. Spill sizes for the spills projected ≥1,000 bbl are derived from median spill sizes for the particular sources found in Anderson and LaBelle (2000).

The data for spills <1,000 bbl that occur annually offshore and are not related to OCS operations was obtained from Dickey (2006) and analyzed by MMS. The estimated number was 1,000-1,300 spills <1,000 bbl occurring offshore annually from all non-OCS sources. The sources of these spills include spills from fishing boats, unclassified vessels, recreational vessels, and unknown sources. The assumed spill size of 5 bbl was derived by an analysis of all USCG data for spills in the size ranges of 1 to <1,000 bbl.

4.1.3.3.4.6. OCS-Related Coastal Spills

The MMS does not regulate the operations that could spill oil in the coastal zone and does not maintain a database on these spills. The MMS relies on spill data obtained from the *Pollution Incidents In and Around U.S. Waters A Spill/Release Compendium: 1969-2004* (USDOT, Coast Guard, 2006), and by request from USCG. However, these databases do not differentiate between spills associated with OCS and non-OCS activities. The MMS used several methods to describe coastal spills. The MMS uses the total annual spill occurrence record for the Gulf area to estimate the number of coastal oil spills attributable to the OCS Program. The volume percentage related to OCS operations of the total volume of crude oil produced or transported in the Gulf area was used to approximate the percentage of spills likely to have occurred as a result of OCS oil-handling operations. Based on these percentages, future spill risk is projected. .

Table 4-8 provides MMS's projections of the number of spills that will 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. Less than one spill per year of ≥1,000 bbl related to the proposed activity on the OCS is estimated to occur in coastal waters. Such a spill would only occur about once every 6 years. A spill ≥1,000 bbl would likely be from a pipeline accident. 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 primarily within the Houston/Galveston area of Texas and the deltaic area of Louisiana. Based on an MMS analysis of the USCG data on all U.S. coastal spills by volume, 41 percent of OCS coastal spills will occur in State offshore waters, 2 percent will occur in Federal offshore waters, and 57 percent will occur in inland waters. It is assumed all offshore coastal spills will contact land and proximate resources.

For OCS coastal spills <1,000 bbl, a spill size of 5 bbl is assumed; for OCS coastal spills ≥1,000 bbl, a spill size of 4,200 bbl is assumed. These assumed sizes are based on analysis of the USCG spill database for the spill size ranges of 1 to <1,000 bbl and on composites of the median size of a pipeline spill and a barge spill (Anderson and LaBelle, 2000), which are the two most likely sources of OCS-related spills that would occur in coastal waters and be ≥1,000 bbl.

4.1.3.3.4.7. Non-OCS-Related Coastal Spills

Using the same analysis described above, MMS also estimated the number of spills that are likely to occur in the coastal zone from non-OCS sources (**Table 4-8**).

Non-OCS-related coastal spills primarily occur from vessel accidents. Vessel accidents can spill oil from the tanks of import/export tankers while at ports or in bays and harbors; from the cargo tanks of barges and tank vessels that transport crude oil and petroleum products along channels, bayous, rivers, and especially while traversing the GIWW; and from fuel tanks of all other types of vessels, such as recreational boats or grain tankers. Other sources include spills during pipeline transport of petroleum products; crude oil; State oil and gas facilities; petrochemical refinery accidents; and from storage tanks at terminals.

A coastal non-OCS Program spill ≥1,000 bbl occurred roughly once every 2 years in the 1985-2001 USCG records. This is a very rough estimate due to the infrequent occurrence of a spill of this size in coastal waters. Coastal non-OCS Program 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 an MMS analysis of U.S. spill data maintained by USCG (USDOT, Coast Guard, 2007), 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.

4.1.3.3.4.8. Other Sources of Oil

The VOC's present in the crude or refined hydrocarbons escape to the atmosphere during all phases of production, transportation, and consumption. They are then deposited into surface waters through wet and dry deposition and gas absorption. In both coastal and offshore areas, the greatest amount of VOC release to the atmosphere is during the consumption of petroleum, and sources include emissions during internal combustion, from power generating plants, and from industrial manufacturing. In the offshore OCS, 8,400 bbl (1,200 tonnes) are released to the western GOM and 11,200 bbl (1,600 tonnes) are released to the eastern GOM (NRC, 2003). These totals include emissions of VOC from petroleum consumption from shore-based, coastal, and marine activities, which are then transported and deposited in the offshore waters.

On occasion, aircraft carry more fuel than they can safely land with so fuel is jettisoned into offshore marine waters. The amount of 1,120 bbl (160 tonnes) per year was estimated for the combined offshore western and eastern GOM.

Air pollution issues have prompted the USEPA to address the incomplete combustion of fuel and fuel additives in two-stroke engines, including outboard engines, lawn mowers, chain saws, and jet skis. The increased population in coastal areas uses an increased number of recreational water vessels such as motor boats and jet skis. *Oil in the Sea* (NRC, 2003) was able to quantify losses of petroleum hydrocarbons from recreational vessels to the coastal waters of the western and eastern GOM as 5,390 bbl (770 tonnes per year). It is interesting to note that the amount of petroleum hydrocarbons released from recreational vessels is about equal to the amount released by spills from tank vessels or coastal facilities.

4.2. IMPACT-PRODUCING FACTORS AND SCENARIO—ACCIDENTAL EVENTS

The National Environmental Policy Act (NEPA) requires Federal agencies to consider potential environmental impacts of a proposed action as part of agency planning and decisionmaking. Through the NEPA process, actions that could result in impacts, including those impacts that have a very low probability of occurrence, but that the public considers important, controversial, or may have severe consequences are analyzed. The accidental events that fall into this category and are addressed in this section are oil spills, losses of well control, vessel collisions, and spills of chemicals or drilling fluids.

4.2.1. Oil Spills

Large oil spills associated with OCS activities are low-probability events. Public input through scoping meetings and Federal and State agencies' input through consultation and coordination indicate that oil spills continue to be a major issue. This section analyzes the risk of spills that could occur as a result of the proposed action. **Chapter 4.1.3.3.4** 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.

4.2.1.1. Spill Prevention

Beginning in the 1980's, MMS established comprehensive pollution prevention requirements that include redundant safety systems, as well as inspection and testing requirements to confirm that these devices are working properly (**Chapter 1.5**). An overall reduction in spill volume has occurred over the past 40 years while oil production has generally increased. The MMS attributes this improvement to MMS operational requirements, ongoing efforts by the oil and gas industry to enhance safety and pollution prevention, and the evolution and improvement of offshore technology.

Part of those safety systems are SSSV's and downhole safety valves (DSV's). Should a platform be damaged, these valves "shut-in" production flow to prevent pollution events until the production can be safely reestablished. During Hurricanes Ivan, Katrina and Rita, these valves performed successfully (Watson, 2005; USDOI, MMS, 2005g).

4.2.1.2. Overview of Spill Risk Analysis

There are many factors that MMS evaluates to determine the risk of impact occurring from an oil spill. Estimated information includes likely spill sources, likely spill locations, likely spill sizes, the likelihood and frequency of occurrence for different size spills, timeframes for the persistence of spilled oil, volumes of oil removed due to weathering and cleanup, and the likelihood of transport by wind and waves resulting in contact to specified environmental features. This section of the EIS addresses the likelihood of spill occurrence, transportation of oil slicks by winds and waves, and the probability of an oil spill contacting sensitive environmental resources. Sensitivity of the environmental resources and potential effects are addressed in the analyses for the specific resources of concern (**Chapter 4.3**).

The MMS uses data on past OCS production and spills, along with estimates of future production, to evaluate the risk of future spills. Data on the numbers, types, sizes, and other information on past spills were reviewed to develop the spill scenario for analysis in this EIS. The spill scenario provides the set of assumptions and estimates of future spills; the type, frequency, quantity, and fate of the spilled oil for specific scenarios; and the rationale for the scenario assumptions or estimates. The spill scenario accounts for spill response and cleanup activities and the estimated time that the spill remains floating on the water.

The MMS uses two numerical models to calculate the likely trajectory and weathering of spills and analyzes the historical database to make other oil-spill projections. Estimates are based on historical spills and do not consider the effect of the recent retirement of older platforms and pipelines in preventing spills. A description of the trajectory model, called the OSRA (oil spill risk analysis) model, and its results are summarized in this SEIS and are published in a separate report (Ji et al., in preparation). The OSRA model simulates thousands of spills launched throughout the GOM OCS and calculates the probability of these spills being transported and contacting specified environmental resources. The OSRA modeling results in a numerical expression of risk based on spill rates, projected oil production, and trajectory modeling. Version III of the oil-weathering model used by MMS was released in June 2004 (Reed et al., 2005).

4.2.1.3. Past OCS Spills

Spill events can occur during almost any stage of exploration, development, or production on the OCS. In addition to the possibility of crude oil spills, chemical, diesel, and other oil-product spills can occur in association with OCS activities. Oil spills occur as a result of many causes, e.g., equipment malfunctions, ship collisions, pipeline breaks, human error, or severe storms. Many spills that have occurred were not directly attributable to the oil-extraction process but were related to the support activities necessary for recovery and transportation of the resource. 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.

4.2.1.3.1. Offshore Spills

The MMS spill-event database includes records of past spills from activities that MMS regulates. These data include oil spills >1 bbl that occurred in Federal waters from OCS facilities and pipeline operations. Spills from facilities include spills from drilling rigs, drillships, and storage, processing, or production platforms that occurred during OCS drilling, development, and production operations. Spills from pipeline operations are those that have occurred on the OCS and are directly attributable to the transportation of OCS oil.

The most recent, published analysis of trends in OCS spills 1985-1999 was used to project future spill risk for this EIS (Anderson and LaBelle, 2000). Data for this period reflect recent spill prevention and occurrence conditions. The 15-year record was chosen because it reflects how the spill rates have changed while still maintaining a significant portion of the record.

Chapter 4.1.3.3.4.2 discusses the cause and volume of spills that resulted from the recent hurricanes—Ivan in 2004 and Katrina and Rita in 2005.

The final volume of oil spilled due to Hurricane Ivan is not yet available because a pipeline segment remains buried by a mudslide. Similarly, the spill volumes due to Hurricanes Katrina and Rita are not final because repairs and removal are ongoing. However, using this very preliminary data and employing the same methodology as in Anderson and LaBelle (2000), MMS calculated spill rates based on the 1991-2005 15-year dataset. This dataset includes a pipeline spill from Hurricane Ivan, a pipeline spill from Hurricane Katrina, and both a platform and a pipeline spill from Hurricane Rita. The spill rate methodology treats each hurricane as an "event," so that if there is more than one spill of ≥1,000 bbl during a hurricane, all spills are counted as one event of the size of the sum of those volumes. Using this methodology, the two pipeline spills of 1,812 and 1,551 bbl during Hurricane Rita become one pipeline spill of 3,363 bbl, and the three platform spills of 2,000, 1,494, and 1,572 bbl during Hurricane Rita become one platform spill of 5,066 bbl. The calculations show that the pipeline spill occurrence rate for spills ≥1,000 bbl based on 1991-2005 data would decline to 1.26 spills per BBO handled as compared with 1.38 spills per BBO handled based on the 1985-1999 data. The platform spill occurrence rate for spills ≥1,000 bbl would increase to 0.14 spills per BBO handled as compared with less than 0.13 spills per billion bbl handled based on the 1985-1999 data (Anderson, personal communication, 2006).

Of the five hurricane-related spills of ≥1,000 bbl in 2005 currently identified, two are based on "worst case estimates" and may be reduced below the 1,000 bbl threshold as more information becomes available. One hurricane-related pipeline spill of ≥1,000 bbl in 2004 remains a "worst-case estimate" rather than confirmed volume. The estimation of the spillage associated with these hurricanes will not be complete until all operators have completed recovery efforts associated with the repair and/or have completed decommissioning of all the damaged structures. Some of the petroleum currently counted as spilled may yet be recovered from intact tanks, and additional damages may yet be discovered by the operators. These repair, recovery, and decommissioning activities will continue in 2007. In addition to spills, the numerator of the OCS spill occurrence rates, one must consider the volume of oil handled, the denominator of the spill rates. From 1985 to around 1995, OCS production was on the order of a third of a BBO per year. Since around 1995, OCS production has been more on the order of half a BBO or more. The pipeline spill rate has been pretty consistent over time. The platform spill(s) ≥1,000 bbl due to Hurricane Rita are the first since 1980. A huge amount of production has occurred between spills. Therefore, MMS feels that the 1985-1999 spill rates, which are used for this EIS, are appropriate.

Table 4-10 presents oil spills for seven different spill-size groupings for the period 1985-1999. Data are provided on the total number of spills, number of spills by operation, total volume of oil spilled, and the spill rate calculated from data on historical spills and production. The average spill size and median spill size during this period are given for each spill-size category.

Tables 4-11 and 4-12 provide information on OCS oil and chemical spills ≥1,000 bbl that have occurred offshore in the GOM for the entire period that records have been kept (1964-present). These data are divided into two groups based on whether the spills were from accidents associated with facility operations or pipeline transportation. The data show that since 1985 there were no facility spills ≥1,000 bbl of crude oil, although seven spills of SBF, diesel, or chemicals did occur. Seven of the 13 pipeline spills ≥1,000 bbl during the period 1985-present were crude oil spills. Pipeline spills result from damage caused by anchors, fishing trawls, mudslides, and hurricanes. Some of the spill volumes are estimates and the actual release volume will be updated in the future.

The MMS data records do not include spills ≤1 bbl, but data on these small spills are available from the USCG Marine Safety Information System. Also not included in the MMS database are spills that have occurred in Federal waters from OCS barging operations and from other service vessels that support the OCS oil and gas industry. These data are included in the USCG record of all spills; however, the USCG database does not include the source of oil (OCS versus non-OCS) or in the case of spills from vessels, the type of vessel operations; such information is needed to determine if a particular spill occurred as a result of OCS operations.

4.2.1.3.2. Coastal Spills

Spills have occurred in coastal waters at shoreline storage, processing, or transport facilities supporting the OCS oil and gas industry. Coastal spills have occurred in State offshore waters and in navigation channels, rivers, and bays from barges and pipelines carrying OCS-produced oil. Records of spills in coastal waters and State offshore waters are maintained by the USCG (USDOT, Coast Guard, 2007), but the database does not identify the source of the oil (OCS versus non-OCS). The MMS's GOM Region only maintains records on spill events related to the OCS oil industry that occur in Federal waters.

A pipeline carrying oil from a shore base to a refinery may be carrying oil stored from both State and OCS production; imported oil might also be commingled in the pipeline. Therefore, there is no database available that contains all past spills that have occurred in State offshore or coastal waters directly as a result of OCS oil and gas development. Because of the lack of historic spill data, coastal spills from OCS operations are calculated as a proportion of all coastal spills discussed in **Chapter 4.3.3.4.1**. Information on past coastal spills that have occurred in the GOM area is found in **Chapter 4.1.3.3**.

4.2.1.4. Characteristics of OCS Oil

The physical and chemical properties of oil greatly affect how it will behave on the water surface (surface spills) or in the water column (subsea spills), the persistence of the slick on the water, the type and speed of weathering process, the degree and mechanisms of toxicity, the effectiveness of containment and recovery equipment, and the ultimate fate of the spill residues. Crude oils are a mixture of hundreds of different compounds. Hydrocarbons account for up to 98 percent of the total composition. The chemical composition of crude oil can vary significantly from different producing areas; thus, the exact composition of oil being produced in OCS waters varies throughout the Gulf.

The API gravity is a measurement of the density of the oil. The API gravity is calculated from the specific gravity; the lower the specific gravity, the higher the API gravity and the lighter the oil will be. Density is one of the most important physical characteristics of crude oil. The density of oil determines whether it will sink or float, or whether it will collect sediment (heavier oils tend to collect sediment) and sink. The density of oil is one of the key factors in predicting whether spilled oil will entrain water and form emulsions.

There are 26 oils identified in the GOM (Environment Canada, 2006). The API gravities of 91 plays are identified in the MMS 1995 National Assessment (Lore et al., 1999). The MMS data atlas presents an average of the many reservoirs contained in each play. In an MMS study that analyzed the API gravities (Trudel et al., 2001) of these 67 plays, the range of the API gravities was 22.8^{o}-58.6^{o}. It is expected that a typical oil spilled as a result of an accident associated with the proposed action would be within the range of 30^{o}-35^{o} API. The oil at the light end of the range would have little asphaltenes, would not emulsify, and would not form tarballs. The oil at the heavier end of the range would more likely emulsify and form tarballs.

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

This section addresses the risk of spills ≥1,000 bbl that could occur from accidents associated with activities resulting from the proposed action.

4.2.1.5.1. Estimated Number of Offshore Spills ≥1,000 bbl and Probability of Occurrence

The number of spills ≥1,000 bbl estimated to occur as a result of the proposed action is provided in **Table 4-13**. The mean number of spills estimated for the proposed action is less than one spill (range equal to 0.15-0.21). The range of the mean number of spills reflects the range of oil production volume estimated as a result of the proposed action. The mean number of future spills ≥1,000 bbl is calculated by multiplying the spill rate for spills ≥1,000 bbl (1.51) by the volume of oil estimated to be produced as a result of the proposed action.

Figure 4-3 provides the probability of a particular number of offshore spills ≥1,000 bbl resulting from the proposed action during the 40-year analysis period.

For the proposed action, there is a 14-19 percent chance of one or more spills ≥1,000 bbl occurring. Of that percentage, there is a 13-17 percent chance of exactly one spill ≥1,000 bbl occurring, and a 1-2 percent chance of exactly two spills ≥1,000 bbl occurring. There is an 81-86 percent chance of zero spills ≥1,000 bbl occurring.

Spill rates for all of the spill-size categories are provided in **Table 4-10**. Spill rates 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.

A published paper by MMS authors provides more information on OCS spill-rate methodologies and trends (Anderson and LaBelle, 2000). A discussion of how the range of resource estimates was developed is provided in **Chapter 4.1.1.1**.

4.2.1.5.2. Most Likely Source of Offshore Spills ≥1,000 bbl

Figures 4-3 indicate the probabilities of one or more spills ≥1,000 bbl occurring from an OCS facility or pipeline operations related to the proposed action. The data used in **Table 4-10** (1985-1999) show that the most likely cause of a spill ≥1,000 bbl is a pipeline break at the seafloor. The hurricanes of 2004 and 2005 (Ivan, Katrina, and Rita) resulted in seven spills ≥1,000 bbl, including one crude spills, three condensate spills, two refined oil spills, and one chemical (methanol) spill.

4.2.1.5.3. Most Likely Size of an Offshore Spill ≥1,000 bbl

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 4-10**). Based on these median sizes, MMS estimates that the most likely size of a spill ≥1,000 bbl from the proposed action would be 4,600 bbl.

4.2.1.5.4. Fate of Offshore Spills ≥1,000 bbl

ASA SIMAP Oil Spill Model

The MMS uses various publicly available and purchased models to numerically model potential spill fate and effects to (1) estimate the likely amount of oil remaining on the ocean surface as a function of time, (2) predict the composition of any remaining oil, and (3) determine the extent and severity of possible shoreline oiling. **Table 4-14** summarizes the environmental scenarios in the EPA and the ASA SIMAP model's results for a typical Gulf of Mexico oil. Information on the ASA SIMAP model can be found in French McCay (2001) and at the ASA web site (ASA, 2007). The scenario parameters used for the weathering model runs are discussed below and provided in the notes at the bottom of **Table 4-14.**

To select a Gulf of Mexico oil that would be representative of a typical oil from the proposed Sale 224 area, the discoveries in and around the Sale 181 area were examined. Most of the producible discoveries in the Sale 181 area are gas discoveries. Oil discoveries with API 22° to 38° have been found west of the Sale 181 area. The MMS used South Louisiana Crude, API 34.5° as a surrogate for oils in the Sale 224 area. The MMS used the volume identified as the median pipeline spill size for spills ≥ 1,000 bbl during 1985-1999 of 4,600 bbl (658.21 MT) (Anderson and LaBelle, 2000). The spill scenario modeled was a surface leak over a 24-hour period. The MMS used a point at the northernmost boundary of the Sale 224 area located 131 mi (211 km) offshore Louisiana as the modeled spill location.

Assumptions used in **Table 4-14** are presented in the notes at the bottom of the table. Additional assumptions for calculating the oil volumes removed as a result of dispersant use and mechanical recovery efforts for the 4,600-bbl spill scenario are listed below.

- The spills occurred and were reported at 6 a.m.
- Spill-response efforts were conducted during daylight hours only. An 11-hr operational window was assumed for the winter scenario and a 12-hr operational window was assumed for the summer scenario.
- Sea-state conditions: waves were 3-4 ft.
- Mechanical response equipment (i.e., fast-response units having a USCG de-rated skimming capacity of 3,400 bbl/day) was procured from Clean Gulf Associates Cooperative, Venice, Louisiana.
- Mechanical removal efficiency was conservatively assumed to be 10 percent (U.S. Congress, Office of Technology Assessment, 1990).
- Dispersant application aircraft was deployed for all of the scenarios from Houma, Louisiana. This location also served as the staging location for loading dispersants. Two aircraft from this location were deployed, one DC3 and one DC4. However, in these modeled scenarios, dispersant application using Marine Spill Response Corporation (MSRC) equipment is not expected to significantly affect the timing or amounts of oil dispersed that is reflected in **Table 4-14** since dispersant application was not initiated until 24 hr after the spill occurred.
- A dispersant effectiveness rate of 30 percent was assumed for the treated oil. (S.L. Ross Environmental Research Ltd., 2000).

Persistence

The persistence of an offshore oil slick is strongly influenced by how rapidly it spreads and weathers and by the effectiveness of oil-spill response in removing the oil from the water surface.

As part of the risk analysis of an offshore spill ≥1,000 bbl, MMS estimated the expected persistence time of the spill, specifically, how long it might last as a cohesive mass on the surface of the water, capable of being tracked and moved by winds and currents. **Table 4-14** provides a mass balance over time for a likely spill related to the proposed action.

Spreading

The GOM oils having API gravities between 30° and 35° will float, except under turbulent mixing conditions such as during a large storm offshore. Once spilled, it is expected that all GOM oils would rise and reach the surface of the open Gulf. On the sea surface, the oil would rapidly spread out on the water surface, forming a slick that is initially a few millimeters (mm) in thickness in the center and much thinner around the edges. The rate of spreading depends upon the viscosity of the spilled oil, whether or not the oil is released at the water surface or subsurface, and whether the spill is instantaneous or continuous for some period. The spilled oil would continue to spread until its thickest part is about 0.1 mm (0.004 in). Once it spreads thinner than 0.1 mm (0.004 in), the slick would begin to break up into small patches, forming a number of elongated slicks, with an even thinner sheen trailing behind each patch of oil.

Table 4-14 provide an estimate of the areal extent of a typical oil slick for different times after a spill event.

Weathering

Immediately upon being spilled, oil begins reacting with the environment. This process is called weathering. A number of processes alter the chemical and physical characteristics of the original hydrocarbon mixture, which reduces the oil mass over time. 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 photo-oxidation of specific compounds creating new components that are often more soluble, and biodegradation. Weathering and the existing meteorological and oceanographic conditions determine the time that the oil remains on the surface of the water, and the characteristics of the oil at the time of contact with a particular resource also influence the persistence time of an oil slick. Oil-spill cleanup timing and effectiveness would also be determining factors.

Chemical, physical, and biological processes operate on spilled oil to change its hydrocarbon compounds, reducing many of the components until the slick can no longer continue as a cohesive mass floating on the surface of the water. By spreading out, the oil's more volatile components are exposed to the atmosphere and up to about two-thirds of the oil evaporates rapidly.

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; many GOM oils do not (Jefferies, 1979).

The MMS uses the SINTEF model to numerically model weathering processes to (1) estimate the likely amount of oil remaining on the ocean surface as a function of time and (2) predict the composition of any remaining oil. **Table 4-14** summarizes the model's results for a typical oil and the environmental scenarios in the EPA.

Information on the SINTEF model can be found in Daling et al. (1997), Reed et al. (2000), and Prentki et al. (2004). The scenario parameters used for the weathering model runs are provided in the notes at the bottom of **Table 4-14**.

Seafloor Release

All evidence to date indicates that accidental oil discharges that occur at the seafloor (e.g., from a loss of well control or a pipeline break) would rise in the water column, surfacing almost directly over the source location. All known reserves in the Gulf to date have specific gravities and chemical characteristics that would preclude oil slicks from sinking. Evidence from direct observation and remote imagery from space indicates oil slicks originating from natural seeps in the GOM occur on the sea surface almost directly above the known seep locations. It is estimated that 980,000 bbl of oil is released to the GOM annually from natural seeps (NRC, 2003). Shipboard observations during submersible operations noted the surface expression of rising oil at a horizontal distance of 100 m (328 ft) from the origin of the seep on the bottom (MacDonald et al., 1995). A study in Norway, which intentionally released oil with chemical characteristics similar to GOM OCS oils at depth (844 m) and simulated blowout conditions, provided direct evidence that such an oil spill quickly rises to the surface. Within an hour after release, the oil appeared on the surface within a few hundred meters (horizontally) of the release site (Johansen et al., 2001).

4.2.1.5.5. Transport of Spills ≥1,000 bbl by Winds and Currents

Using the OSRA model, MMS estimates 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.

The OSRA model simulates the trajectory of a point launched from locations mapped onto a gridded area. The gridded area represents an area of the GOM, and the point's trajectory simulates a spill's movement on the surface of water using modeled ocean current and wind fields. The model uses temporally and spatially varying, numerically computed ocean currents and winds.

The OSRA model can simulate a large number of hypothetical trajectories from each launch point. Spill trajectories are launched once per day from each origin point and are time stepped every hour until a statistically valid number of simulations have been run to characterize the risk of contact. The simulated oil spills for this EIS were "launched" from the geographically appropriate subset of approximately 4,000 points uniformly distributed 6-7 mi (10-11 km) apart within the Gulf OCS. This spacing between launch points is sufficient to provide a resolution that created a statistically valid characterization of the entire area (Price et al., 2001).

The model tabulates the number of times that each trajectory moves across or touches a location (contact) occupied by polygons mapped on the gridded area. These polygons represent locations of various environmental features. The OSRA model compiles the number of contacts to each environmental feature that results from all of the modeled trajectory simulations from all of the launch points for a specific area. Contact occurs for offshore features if the trajectory simulation passes through the polygon. Contact occurs for land-based features if the trajectory simulation touches the border of the feature. The simulation stops when the trajectory contacts the lines representing the land/water boundary or the borders of the domain. The probability of contact to an environmental feature is calculated by dividing the number of contacts by the number of trajectories started at various launch locations in the gridded area.

The output from this component of the OSRA model provides information on the likely trajectory of a spill by wind and current transport, should one occur and persist for the time modeled in the simulations; the calculations for this EIS were modeled for 10 days. Because the analysis of the fate of a likely OCS spill (**Chapter 4.2.1.6.4**) showed that a slick would not persist on the water surface beyond 10 days, the OSRA model simulations were analyzed up to 10 days. All contacts that occurred during this period were tabulated.

A detailed description of the OSRA model used in this analysis is provided separately in a published report (Ji et al., in preparation). This report, including its figures and tables, will be available from the MMS Internet site (http://www.mms.gov).

4.2.1.5.6. Length of Coastline Affected by Offshore Spills ≥1,000 bbl

Table 4-14 provides MMS's estimates of the length of shoreline that could be contacted if a spill representative of the size category spill ≥1,000 bbl occurred as a result of an accident associated with a proposed action. The length of shoreline contacted is dependent upon many factors including the original spill size, location, and duration, winds and currents, and the volume of oil removed by natural weathering and offshore cleanup operations prior to the slick making shoreline contact.

The shoreline length contacted is a simple arithmetic calculation based on the width of the remaining slick at the time that it could contact the shoreline. The calculation assumes that the slick will be carried 30 m (98 ft) inshore of the shoreline, either onto the beachfront up from the water's edge or into the bays and estuaries, and will be spread out at uniform thickness of 0.01 mm (0.004 in); this assumes that no oil-spill boom is used. The maximum extent of shoreline affected by a typical spill ≥1,000 bbl is estimated to be 11-20 mi (1832 km) of shoreline, assuming such a spill were to reach land 96-240 hr after the spill started. Because the slick spread and thinned out over time as it was transported, shoreline coverage would be patchy rather than continuous. Oil would be present on about 20 percent of the shoreline within the 11- to 20-mi length. Some redistribution of the oil due to longshore currents and further smearing of the slick from its original landfall could also occur.

4.2.1.5.7. Likelihood of an Offshore Spill ≥1,000 bbl Occurring and Contacting Modeled Locations of Environmental Resources

A more complete measure of spill risk was calculated by multiplying the probability of contact generated by the OSRA model by the probability of occurrence of one or more spills ≥1,000 bbl as a result of the proposed action. This provides a risk factor that represents the probability of a spill occurring as a result of the proposed action and contacting the resource of concern. These numbers are often referred to as "combined probabilities" because they combine the risk of occurrence of a spill from OCS sources and the risk of such a spill contacting sensitive environmental resources.

The combined probabilities are provided for each resource of concern in **Figures 4-4 through 4-15**. A discussion of spill risk to the resources is provided in **Chapter 4.2.1.8**.

To account for the risk of spills occurring from the transportation of oil to shore, generalized pipeline corridors originating within each of the offshore cluster areas and terminating at major oil pipeline landfall areas were developed. The oil volume estimated to be produced as a result of the proposed action within each cluster area was proportioned among the pipeline corridors. The mean number of spills and the probability of contact of spills from each pipeline corridor were then calculated and combined with the risk of spills occurring and contacting resources from OCS facility development and production operations to complete the analysis.

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

The following section addresses the risk of spills <1,000 bbl resulting from the proposed action. To discuss spills <1,000 bbl, information is broken into size groups shown in **Table 4-10**.

The OSRA model examined spill risk from different water depths in the EPA (Price et al., 2001). The results indicated that there is a reduced likelihood that a spill occurring in deep water could be transported to shore based only on physical oceanography and wind transport. The OSRA model results do not factor in the likelihood of whether the spilled oil would persist as a slick for this time period. The surface slick may dissipate naturally over time or be cleaned up prior to reaching coastal waters. Thus, only the largest of slicks are expected to remain on the surface of the water long enough for a significant quantity of oil to reach coastal resources.

Analysis of historical data shows that most offshore OCS oil spills have been ≤1 bbl (**Figure 4-16**). 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.

4.2.1.6.1. Estimated Number of Offshore Spills <1,000 bbl and Total Volume of Oil Spilled

The number of spills <1,000 bbl estimated to occur over the next 40 years as a result of the proposed action is provided in **Table 4-13**. The number of spills is estimated by multiplying the oil-spill rate (**Table 4-10**) for each of the different spill size groups by the projected oil production as a result of the proposed action (**Table 4-1**). As spill size increases, the occurrence rate decreases and so the number of spills estimated to occur decreases.

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 150-850 bbl of oil is estimated from spills <1,000 bbl as a result of the proposed action.

4.2.1.6.2. Most Likely Source and Type of Offshore Spills <1,000 bbl

Most spills <1,000 bbl would likely occur from a mishap on a production facility, most likely related to a failure related to storage of oil. Analysis of the 24 offshore oil spills >50 and <1,000 bbl that occurred between 1985 and 1999 showed that 42 percent were diesel spills, 25 percent were condensate spills, and 21 percent were crude oil spills. The remaining spills were hydraulic fluids (2 spills) and diesel fuel or mineral oil-based drilling muds (2 spills). The most likely type of spill <1,000 bbl as a result of the proposed action is a diesel spill.

4.2.1.6.3. Most Likely Size of Offshore Spills <1,000 bbl

Table 4-13 provides the most likely volume of oil estimated to be spilled for each of the spill-size groups. The average spill size is used for spills with size <1 bbl. For the larger spill size ranges, the median spill size calculated for each category from MMS historical records is used (**Table 4-10**). During the 40-year analysis period, 97 percent of spills <1,000 bbl estimated to occur as a result of the proposed action would be ≤1 bbl.

4.2.1.6.4. Persistence, Spreading, and Weathering of Offshore Oil Spills <1,000 bbl

It is expected that slicks from spills <1,000 bbl will persist a few minutes (<1 bbl), a few hours (<10 bbl), or a few days (10-1,000 bbl) on the open ocean. Spilled oil would rapidly spread out, evaporate, and weather, quickly becoming dispersed into the water column. Most spills <1,000 bbl are expected to be diesel, which dissipates very rapidly. Diesel is a distillate of crude oil and does not contain the heavier components that contribute to crude oil's longer persistence in the environment.

4.2.1.6.5. Transport of Spills <1,000 bbl by Winds and Currents

To be transported by winds and currents, an oil slick must remain a drifting cohesive mass. Only spills >50 bbl have a chance of remaining a cohesive mass long enough to be transported any distance.

4.2.1.6.6. Likelihood of an Offshore Spill <1,000 bbl Occurring and Contacting Modeled Locations of Environmental Resources

Because spills <1,000 bbl are not expected to persist as a slick on the surface of the water beyond a few days and because spills on the OCS would occur at least 3-10 nmi from shore, it is unlikely that any spills would make landfall prior to breaking up. For an offshore spill <1,000 bbl to make landfall, the spill would have to occur proximate to State waters (defined as 3-12 mi (4.8-19.3 km) from shore). If a spill were to occur proximate to State waters, only a spill >50 bbl would be expected to have a chance of persisting long enough to reach land. Spills >50 and <1,000 bbl size are very infrequent. Should such a spill occur, the volume that would make landfall would be expected to be extremely small (a few barrels). These assumptions are supported by a previous analysis of 3-day trajectory model runs, previous weathering analyses, and historical records of spill incidents.

4.2.1.7. Risk Analysis for Coastal Spills

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. The MMS projects that all (100%) oil produced as a result of the proposed action will be brought ashore via pipelines to oil pipeline shore bases, stored at these facilities, and eventually transferred via pipeline or barge to Gulf coastal refineries. Because 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 OCS spill risk in coastal waters was assumed to be proportional to the volumes of oil handled. The OCS-related coastal spills was estimated by multiplying the total number of spills that have occurred by the ratio of the volume of oil produced from OCS operations to the volume of oil handled by all oil-related activities—State oil and gas production, and import oil activities. Tank barge and tank ship state-to-state transported oil volumes were not included. Spills classified as due to an unknown source were conservatively assumed to be related to Federal oil and gas. As a result, half of the coastal spills that could be attributed to offshore oil and gas were spills from an unknown source. Based on this analysis, which was completed using 2001 oil volumes, spills related to OCS operations occurring in the coastal area of the Gulf are estimated to be about 10 percent of all coastal spills occurring in Gulf coastal waters.

4.2.1.7.1. Estimated Number and Most Likely Sizes of Coastal Spills

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 the USCG (Dickey, 2006). The number of GOM coastal spills from eight sources associated with State or Federal offshore production and international importation was determined from the data. The sources that were counted are fixed platforms, MODU's, offshore marine facilities, OSV's, offshore pipelines, tank barges, tank ships, and unknown sources. The number of spills of crude oil produced in Federal water was assumed to occur at the same proportion to the total number of spills as the volume of OCS produced oil, proportional with the total volume comprised of production on the OCS and in State waters and importation of crude oil. **Chapter 4.1.3.3** provides more information on oil spills from these other operations. The effect of the replacement of aged pipelines with new pipelines would be reflected in the spill data. The range was obtained by performing the calculation with national data and with GOM data.

In 2001, a total of 270 spills occurred in coastal GOM, of which roughly 80 percent were from the source types associated with State or Federal offshore oil production, oil importation, as well as 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 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 BBO.

For the Sale 224 proposed action, 0.1-0.14 BBO of oil production is projected to occur over a 34-year production period. Given an estimated coastal spill rate of 57-74 spills per BBO, it is estimated that 6-12 spills of OCS oil will occur in the coastal area (**Table 4-15**). One spill >1 but <50 bbl and one spill ≥50 bbl but <1,000 bbl were estimated. Less than one spill ≥1,000 bbl is estimated. The assumed spill size within the three smallest spill size categories was determined by using the mean spill size for a spill ≤1 bbl and median spill size for larger, less frequently recorded spills to coastal GOM from 1986 to 2001.

4.2.1.7.2. Likelihood of Coastal Spill Contact with Various Resources

The coastal spill rate is based on historical spills and the projected amount of oil production. For the purpose of this analysis, coastal spills are assumed to occur where oil production is brought to shore.

It is projected that the majority of oil production for the proposed action will be brought to shore in eastern Louisiana, from Atchafalaya Bay to east of the Mississippi River. Based on this assumption the majority of coastal spills are projected to occur in this area.

4.2.1.8. Risk Analysis by Resource

This section summarizes MMS's information on the risk to resources analyzed in this SEIS from oil spills and oil slicks that could occur as a result of the proposed action. The risk results are based on MMS's estimates of likely spill locations, sources, sizes, frequency of occurrence, physical fates of different types of oil slicks, and probable transport that are described in more detail in the preceding spill scenarios. For offshore spills, this analysis presents combined probabilities, which include both the likelihood of a spill from the proposed action 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 under each resource category in **Chapter 4.3**. The coastal spill risk is estimated from the historic rate, not a probability.

The term "oil spill" is a term that has several meanings. It may be used to describe the actual action of spilling oil. It is often used interchangeably with "oil slick." In this EIS, "oil spill" is used to describe an event that has a life history—it has a "birth" (the action of spilling) and is subjected to physical processes such as "aging" (weathering). Therefore, the oil spill can be described as undergoing life history stages, which include the following: slick formation, spreading, photolysis and evaporation, dissolution of water-soluble components, oil-in-water dispersion, adsorption to particles, microbiological degradation, vertical and horizontal diffusion, sedimentation, and resurfacing of larger oil droplets. Some of these stages are processes, while others describe the physical status of the spilled hydrocarbons.

Risk to sensitive environmental resources does not disappear when the "slick" disappears. After a slick disperses, hydrocarbons continue to persist in the sea for decades or longer. Marine organisms are exposed to these hydrocarbons in the waters where they reside, as well as through the prey that they consume. For example, FWS biologists from Texas have recently commented to MMS that they are still finding tarballs, probably from the *Ixtoc* oil spill in Mexico that occurred decades ago, washing up on Padre Island National Seashore (PINS), a nesting beach for endangered Kemp's ridley sea turtles. Not far away is the Aransas National Wildlife Refuge, which is critical habitat to the endangered whooping crane. Sea turtle hatchlings that evacuate nests on PINS are at risk of ingesting or becoming fouled with these tarballs. Whooping cranes are also at risk of contact as they forage in estuarine and bay waters along the Coastal Bend region of Texas. During foraging forays, they may ingest or become fouled with tarballs. If parent birds become fouled by tarballs, they may subsequently foul the nest or their offspring. They may even feed their offspring prey contacted by tarballs.

Prior to washing up on beaches, tarballs persist in the sea. They may remain neutrally buoyant and suspended in the water column, or they may settle on the seafloor. Numerous marine organisms (including endangered and threatened cetaceans, manatees, and sea turtles) feed and ingest materials found in the water column or on the seafloor. These animals are at risk of ingesting oil or consuming prey contaminated or fouled by residual hydrocarbons introduced from an oil spill. The risk of exposure to marine protected species and their prey may last decades. The risk of exposure to tarballs or persistent hydrocarbons from an oil spill in the sea is less than the risk associated with exposure to an oil slick.

Analysis of Spill Risk to Air Quality

Oil exposed to the atmosphere has the potential to contribute to air pollutants through evaporation of the volatile components of the oil. The number of spills estimated to occur as a result of the proposed action and the contribution of spills to the total volume of volatile hydrocarbons is presented in **Chapter 4.2.1**.

Analysis of Spill Risk to Water Quality

The potential for spills to affect the quality of GOM coastal and marine waters is dependent on the frequency and volume of spills.

Risk from Offshore Spills

The MMS estimates that about 150-20,500 bbl of oil would be spilled in offshore waters over the 40-year life of the proposed action. These volumes include volumes from spill incidents in all size groups.

Risk from Coastal Spills

Approximately 6-12 spills are estimated to occur within Gulf coastal waters from activities supporting the proposed action; most (about 95%) of these spills would be ≤1 bbl. The most likely locations of the estimated <1 to 2 coastal spills >1 bbl would be proximate to the major oil pipeline shore facilities.

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 coastal waters. Few offshore spills 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. Should a slick from such a spill reach coastal waters, the volume of oil remaining in the slick is expected to be small.

Analysis of Spill Risk to Sensitive Coastal Environments

Sensitive coastal environments located in the GOM consist primarily of coastal barrier beaches, wetlands, and seagrass communities (**Chapter 3.2.1**).

Risk from Offshore Spills ≥1,000 bbl

Because of the widespread distribution of sensitive coastal environments along the Gulf Coast, specific resource locations were not analyzed by the OSRA model trajectory simulations. 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 4-4** show the GOM coastal counties and parishes having a risk >0.5 percent of being contacted within 10 days by an offshore spill ≥1,000 bbl occurring as a result of the proposed action. All counties and parishes except Plaquemines Parish have a <0.5 percent probability of a spill ≥1,000 bbl occurring and contacting (combined probability) their shorelines within 10 days. If a spill of 4,600 bbl of Sale 224 oil were to occur and make contact with a a sensitive coastal environment in Louisiana, up to 20 mi (32 km) of shoreline could be impacted by patchy coverage (**Table 4-14).**

Risk from Offshore Spills <1,000 bbl

For 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 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.

Risk from Coastal Spills

Approximately 6-12 spills are estimated to occur within Gulf coastal waters from activities supporting the proposed action. Most (about 95%) of these spills would be ≤1 bbl. The most likely locations of the estimated <1 to 2 coastal spills >1 bbl would be proximate to the major oil pipeline shore facilities.

Based on the assumption that spill occurrence is proportional to the volume of oil handled, sensitive coastal environments located from Atchafalaya Bay to east of the Mississippi River, including Barataria Bay, have the greatest risk of being contacted by spills from operations related to the proposed action.

Risk from Offshore Spills

All evidence to date indicates that oil discharges that occur at the seafloor from a pipeline or losses of well control would rise in the water column, surfacing almost directly over the source location (**Chapter 4.2.1.5.4**). Therefore, a subsurface oil spill would have to occur very close to a benthic community for rising oil to contact the benthic organisms. For the proposed action, there is a 13-18 percent chance that one or more pipeline spills may occur. Of that percentage, there is a 12-16 percent chance of exactly one pipeline spill ≥1,000 bbl occurring, and a 1-2 percent chance of exactly two pipeline spills ≥1,000 bbl occurring as a result of the proposed action. There is an 82-87 percent chance of no spills ≥1,000 bbl occurring as a result of the proposed action. For the proposed action, 0-1 losses of well control are estimated to occur. The likelihood that a pipeline spill or losses of well control would occur near a chemosynthetic community is extremely low, especially with consideration that NTL 2000-G20 prohibits drilling or pipeline emplacement within 1,500 ft (457 m) of potential chemosynthetic communities.

The likelihood of weathered oil components from a surface slick reaching a deepwater chemosynthetic community in any measurable concentrations is very small.

Analysis of Spill Risk to Marine Mammals

Risk from Offshore Spills ≥1,000 bbl

Spills occurring in or being transported through coastal waters as a result of the proposed action may contact groups of bottlenose dolphin, Atlantic spotted dolphin, or the West Indian manatee. **Figure 4-7** depicts the locations of marine mammal habitats in coastal waters that were analyzed by the OSRA model. **Figure 4-7** also provides the probabilities of a spill ≥1,000 bbl occurring from the proposed action and the slick reaching identified marine mammal coastal habitats within 10 days. The OSRA modeling results indicate that the probability of an oil spill ≥1,000 bbl occurring as a result of the proposed action and the slick reaching Texas coastal waters within 10 days is <0.5 percent. Coastal waters of Louisiana west of the Mississippi River have a <0.5 percent risk of being contacted within 10 days by a slick resulting from an offshore spill ≥1,000 bbl related to the proposed action. There is a <0.5-1 percent risk of a spill occurring from the proposed action and the slick contacting Louisiana coastal waters east of the Mississippi River mouth within 10 days. There is a <0.5 percent risk of a spill occurring from the proposed action and the slick contacting Mississippi coastal waters within 10 days, and a <0.5 percent risk of contacting Alabama coastal waters. The OSRA model projected a <0.5 percent chance of a slick from a spill ≥1,000 bbl reaching the Florida coastal waters within 10 days as a result of any proposed action.

Figure 4-8 shows the geographic locations analyzed by the OSRA model to estimate the risk of oil-spill occurrence and contact to areas predictably used by manatees. The probability of a spill ≥1,000 bbl occurring from the proposed action and the slick reaching manatee areas within 10 days is <0.5 percent.

Risk from All Offshore Spills

About 150-20,500 bbl of oil are estimated to be spilled in offshore waters over a 40-year period from the estimated 350-500 spill events as a result of the proposed action; most (about 95%) of these spills would be ≤1 bbl. These volumes include volumes from one spill incident in the size group ≥1,000 bbl and one spill incident in the size group ≥10,000 bbl. While <1 spill is estimated for some sizes of spills (**Table 4-13**), there is always a finite chance of any size spill occurring. Therefore, the possibility of at least one spill of each size is included in the upper spill volume estimates.

Risk from Coastal Spills

Approximately 6-12 spills are estimated to occur within Gulf coastal waters from activities supporting the proposed action; most (about 95%) of these spills would be ≤1 bbl. The most likely locations of the estimated <12 coastal spill >1 bbl would be proximate to the major oil pipeline shore facilities.

Analysis of Spill Risk to Sea Turtles

Risk from Offshore Spills ≥1,000 bbl

Spills occurring as a result of the proposed action and oil slicks migrating through coastal waters could reach coastal sea turtle habitats. **Figure 4-10** maps the locations analyzed by the OSRA model in calculating the risk of an oil slick contacting the general, mating, and nesting habitats of sea turtles. The table below provides the geographic areas and months used for the OSRA model. Working with FWS, MMS determined the months (listed in the table below) when sea turtles used the identified coastal habitats. The model results present the likelihood of slicks reaching the identified locations only during these months.

State	Geographic Area Type	Habitat Use	Seasonality
LA	Chandeleur Islands	Nesting	April-November
LA	State coastal waters	General	year round
LA	Chandeleur Islands	Mating	March-July
MS-AL	Coastal beaches	Nesting	April-November
MS-AL	State coastal waters	Mating	March-July
MS-AL	State coastal waters	General	year round
FL Panhandle	Coastal beaches	Nesting	April-November
FL Panhandle	State coastal waters	Mating	March-July
FL Panhandle	State coastal waters	General	year round
FL peninsula	Coastal beaches	Nesting	April-November
FL Peninsula	State coastal waters	Mating	March-July
FL Peninsula	State coastal waters	General	year round
Tortugas	Coastal beaches	Nesting	April-November
Tortugas	State coastal waters	Mating	March-July
Tortugas	State coastal waters	General	year round

Figure 4-10 provides the likelihood of an offshore spill ≥1,000 bbl occurring from the proposed action and reaching the identified coastal sea turtle habitats within 10 days during the identified months of use.

The OSRA modeling results indicate that there is a <0.5 percent probability that a spill ≥1,000 bbl occurring as a result of the proposed action and the slick reaching Texas waters used by sea turtles as general coastal habitat within 10 days after a spill event. There is a <0.5 percent chance that one or more spills would occur and the slick reaching Texas waters within 10 days after the spill occurrence during mating season. There is a <0.5 percent chance that a spill ≥1,000 bbl would occur from the proposed action and the slick reaching shore within 10 days during Texas's sea turtle nesting season.

The probability of an offshore oil spill ≥1,000 bbl occurring as a result of the proposed action and the slick reaching Louisiana coastal waters used by turtles as general coastal habitat within 10 days ranges from <0.5 to 2 percent. The Chandeleur Islands is the only area in Louisiana considered sea turtle habitat for mating and nesting; there is <0.5 percent chance that this habitat would be contacted by slick from an offshore spill ≥1,000 bbl occurring as a result of the proposed action.

The OSRA model results show that there is a <0.5 percent chance that coastal areas in Mexico and Florida, when serving as sea turtle habitat, would be contacted by an oil slick resulting from an offshore spill ≥1,000 related to the proposed action. There is a <0.5 percent chance that coastal areas in Mississippi and Alabama, when serving as sea turtle habitat, would be contacted by an oil slick resulting from an offshore spill ≥1,000 related to the proposed action. There is a <0.5 percent chance that coastal areas in Mississippi and a <0.5 percent chance that coastal areas in Alabama, when serving as sea turtle habitat, would be contacted by an oil slick resulting from an offshore spill ≥1,000 bbl occurring as a result of the proposed action.

Tables 4-14 provides MMS estimates of the likely size and remaining volumes of oil slicks of a "typical" EPA oil for several time increments after a spill occurs.

Risk from All Offshore Spills

The MMS estimates that about 150-20,500 bbl of oil would be spilled in offshore waters from an estimated 350-500 spills over the 40-year life of the proposed action; most (about 97%) of these spills would be ≤1 bbl. These volumes include volumes from 1 spill incident in the size class of ≥1,000 bbl and one in the size class of ≥10,000 bbl. While <1 spill is estimated for some sizes of spills (**Table 4-13**), there is always a finite chance of any size spill occurring. Therefore, the possibility of at least one spill of each size is included in the upper spill volume estimates.

For 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 50-1,000 bbl are estimated to occur as a result of the proposed action, and a 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.

Risk from Coastal Spills

Approximately 6-12 spills are estimated to occur within Gulf coastal waters from activities supporting the proposed action; most (about 95%) of these spills would be ≤1 bbl. The most likely locations of the estimated <1-2 coastal spill >1 bbl would be proximate to the major oil pipeline shore facilities.

Analysis of Spill Risk to Alabama, Choctawhatchee, St. Andrew, and Perdido Key Beach Mice, and Salt Marsh Vole

Risk from Offshore Spills ≥1,000 bbl

Figure 4-11 provides the results of MMS's analysis of the risk of a spill ≥1,000 bbl occurring offshore and reaching endangered beach mice habitat within 10 days as a result of the proposed action. There is a <0.5 percent chance that one or more offshore spills ≥1,000 bbl would occur and contact the shoreline inhabited by the Alabama, Choctawhatchee, St. Andrew, and Perdido Key beach mice during the life of the proposed action.

Risk from Offshore Spills <1,000 bbl

For 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 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.

Risk from Coastal Spills

Few, if any, coastal spills are estimated to occur in Alabama or Florida coastal waters as a result of the proposed action because OCS oil is not barged or pipelined to shore in Alabama or Florida, the states where the beach mice are found.

Analysis of Spill Risk to Marine Birds

Risk from All Offshore Spills

About 150-20,500 bbl of oil are estimated to be spilled in offshore waters over a 40-year period from the estimated 350-500 spill events as a result of the proposed action; most (about 97%) of these spills would be ≤1 bbl. These volumes include volumes from 1 spill incident in the size group ≥1,000 bbl and one spill incident in the size group ≥10,000 bbl. While <1 spill is estimated for some sizes of spills (**Table 4-13**), there is always a finite chance of any size spill occurring. Therefore, the possibility of at least one spill of each size is included in the upper spill volume estimates.

For spills ≥1,000 bbl, there is a 1-2 percent chance of two spills, and a <0.5 percent chance of three spills occurring over the 40-year life of the proposed action.

Analysis of Spill Risk to Coastal Birds

The risk of contact to coastal birds from spills related to proposed action operations is dependent upon the likelihood that a spill occurs and the likelihood that the spilled oil reaches the shore areas inhabited or used by these birds.

Risk from Offshore Spills ≥1,000 bbl

The risk of contact to coastal birds from offshore spills ≥1,000 bbl is dependent upon (1) the likelihood that oil spills occurring from proposed action operations could be transported to the shoreline identified as coastal bird habitats and (2) oil-spill contact occurs during the period that specific coastal birds are present in the area. **Figures 4-12 through 4-15** identify the shoreline areas representing identified coastal bird type habitat that were analyzed for spill risk. The following table lists the coastal bird types and the periods when the birds are expected to occupy identified habitats that were used for this OSRA model run.

Coastal Bird Type	When Birds Occupy Identified Habitat Areas
Brown pelican	year round
Whooping crane	November-April
Bald eagle	year round
Piping plover	July-May

Figures 4-12 through 4-15 also provide the results of MMS's model trajectory simulation. Probabilities shown represent the likelihood that a spill ≥1,000 bbl would occur offshore as a result of the proposed action and the slick would reach various coastal bird habitats during the periods when the birds are known to use the area and within 10 days after the spill incident. The probabilities of occurrence and contact within 10 days for all species and habitats modeled range between <0.5 and 2 percent.

In addition to accounting for wind and current transport and risk of spill occurrence, the combined probabilities incorporate the length of time each coastal bird type occupies the identified habitat. For example, the whooping crane occupies the identified habitat for 6 months out of the year. The chance of a spill occurring offshore and the slick reaching this habitat within 10 days during those 6 months is calculated to be <0.5 percent. In contrast, the bald eagle is found along the Gulf's shoreline year round; thus, the risk of spill occurrence and contact is higher (1-2% from the proposed action).

Tables 4-14 provides MMS estimates of the likely size and remaining volumes of oil slicks of a "typical" EPA oil for several time increments after a spill occurs.

Risk from Offshore Spills <1,000 bbl

About 150-20,500 bbl of oil is estimated to be spilled in offshore waters over a 40-year period from the estimated 350-500 spill events as a result of the proposed action; most (about 97%) of these spills would be ≤1 bbl. These volumes include volumes from 1 spill incident in the size group ≥1,000 bbl and one spill incident in the size group ≥10,000 bbl. While <1 spill is estimated for some sizes of spills (**Table 4-13**), there is always a finite chance of any size spill occurring. Therefore, the possibility of at least one spill of each size is included in the upper spill volume estimates.

For 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 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.

Risk from Coastal Spills

Approximately 6-12 spills are estimated to occur within Gulf coastal waters from activities supporting the Sale 224 proposed action; most (about 95%) of these spills would be ≤1 bbl. The most likely locations of the estimated <1 -2 coastal spill >1 bbl would be proximate to the major oil pipeline shore facilities.

Based on the assumption that spill occurrence is proportional to the volume of oil handled, bird populations located near the coastal waters of the eastern Louisiana, from Atchafalaya Bay to east of the Mississippi River, including Barataria Bay, have the greatest risk of being contacted by spills from operations related to the proposed action.

Analysis of Spill Risk to Gulf Sturgeon

In 1996, Gulf sturgeon occurred from the Mississippi River to Charlotte Harbor in western Florida (Patrick, personal communication, 1996). **Figure 4-9** shows the critical habitat. The juvenile and subadult Gulf sturgeon, at a minimum, seasonally use the nearshore coastal waters and could potentially be at risk from both coastal and offshore spills.

Risk from Offshore Spills ≥1,000 bbl

Figure 4-9 provides the results of the analysis of the risk of a spill ≥1,000 bbl occurring offshore as a result of the proposed action and reaching the known locations of the Gulf sturgeon within 10 days after the spill event. The likelihood of a spill ≥1,000 bbl occurring within the Sale 224 area and reaching critical habitat of the Gulf sturgeon within 10 days after the spill incident is <0.5 percent for both Unit 8 and Units 9-14.

Risk from All Offshore Spills

About 150-20,500 bbl of oil are estimated to be spilled in offshore waters over a 40-year period from the estimated 350-500 spill events as a result of the proposed action; most (about 97%) of these spills would be ≤1 bbl. These volumes include volumes from 1 spill incident in the size group ≥1,000 bbl and one spill incident in the size group ≥10,000 bbl. While <1 spill is estimated for some sizes of spills (**Table 4-13**), there is always a finite chance of any size spill occurring. Therefore, the possibility of at least one spill of each size is included in the upper spill volume estimates.

For 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 coastal waters. Few offshore spills 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. Should a slick from such a spill reach coastal waters, the volume of oil remaining in the slick is expected to be small.

Risk from Coastal Spills

As discussed in **Chapter 4.1.2.1.1**, very few of the estimated 6-12 coastal spills resulting from the proposed action are likely to occur east of the Mississippi River due to the reduced number of shore bases and oil pipeline landfalls. No coastal spills are projected to occur in Mississippi, Alabama, or Florida coastal waters as a result of the proposed action. The risk analysis assumes coastal spills to occur where oil production is brought to shore. It is projected that the majority of oil production for the proposed action will be brought to shore in eastern Louisiana, from Atchafalaya Bay to east of the Mississippi River. Based on this assumption the majority of coastal spills are projected to occur in this area. For further information on projected coastal spill estimations, see **Chapter 4.2.1.7.1.**

Analysis of Spill Risk to Fish Resources, Essential Fish Habitats, and Commercial Fisheries

The EFH for the GOM includes all estuarine and marine waters and substrates from the shoreline to the seaward limit of the U.S. EEZ. Coastal areas that are considered EFH include wetlands and areas of submerged vegetation. Live-bottom features and their biotic assemblages are also considered EFH. Any spill that occurs as a result of the proposed action will contact EFH.

Risk from Offshore Spills ≥1,000 bbl

Figure 4-3 shows that there is a 1-2 percent chance of two spills ≥1,000 bbl occurring from the proposed action over the next 40 years.

Risk from All Offshore Spills

The MMS estimates that about 150-20,500 of oil would be spilled in offshore waters from an estimated 350-500 spills over the 40-year life of the proposed action; most (about 97%) of these spills would be ≤1 bbl. These volumes include volumes from one spill incident in the size class of ≥1,000 bbl and one in the size class of ≥10,000 bbl. While <1 spill is estimated for some sizes of spills (**Table 4-13**), there is always a finite chance of any size spill occurring. Therefore, the possibility of at least one spill of each size is included in the upper spill volume estimates.

Risk from Coastal Spills

Approximately 6-12 spills are estimated to occur within Gulf coastal waters from activities supporting the proposed action; most (about 95%) of these spills would be ≤1 bbl. The most likely locations of the estimated <1 to 2 coastal spills >1 bbl would be proximate to the major oil pipeline shore facilities.

Based on the assumption that spill occurrence is proportional to the volume of oil handled, the most likely locations of the <1-2 coastal spills >1 bbl estimated to occur from operations related to the proposed actions are the coastal locations proximate to the major oil pipeline shore facilities. Sensitive coastal resources located within the coastal waters east of the Mississippi River, including Barataria Bay, have the greatest risk of being contacted by spills related to the proposed action's support operations.

Analysis of Spill Risk to Recreational Beaches

The following table lists the major recreational beach areas and the timeframes analyzed for spill risk.

Recreational Beaches	Major Seasonal Use
Louisiana	
Beaches	April-November
Alabama/Mississippi	
Gulf Islands	April-November
Gulf Shores	April-November
Florida	
Panhandle Beaches	April-November
Big Bend Beaches	April-November
Southwest Beaches	April-November
Ten Thousand Islands	April-November

Risk of Offshore Spills ≥1,000 bbl

Figure 4-5 provides the results of the analysis of the risk of a spill ≥1,000 bbl occurring offshore as a result of the proposed action and reaching major recreational beach areas. The likelihood of a spill ≥1,000 bbl occurring from the proposed action and reaching a Texas recreational beach area within 10 days is <0.5 percent.

The likelihood of a spill ≥1,000 bbl occurring from the proposed action and reaching recreational beaches in Louisiana within 10 days is <0.5-2 percent. If an oil spill of 4,600 bbl resulting from proposed Sale 224 oil were to occur and make contact with a recreational beach in Louisiana, up to 20 mi (32 km) of shoreline could be impacted by patchy coverage (**Table 4-15**).

The likelihood of a spill ≥1,000 bbl occurring from the proposed action and reaching recreational beaches in Mississippi or Alabama within 10 days is <0.5 percent. There is a <0.5 percent chance of a spill ≥1,000 bbl occurring from the proposed action and reaching recreational beaches in Florida within 10 days.

Risk from Coastal Spills

Approximately 6-12 spills are estimated to occur within Gulf coastal waters from activities supporting the proposed action; most (about 95%) of these spills would be ≤1 bbl. The most likely locations of the estimated <1 to 2 coastal spills >1 bbl would be proximate to the major oil pipeline shore facilities.

Analysis of Spill Risk to Archaeological Resources

Since possible locations of historic and prehistoric resources are widespread along the Gulf Coast, specific resource locations were not analyzed by the OSRA model trajectory simulations.

Risk from Offshore Spills ≥1,000 bbl

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 an offshore spill reaching archaeological resources. **Figure 4-4** shows the GOM coastal counties and parishes having a risk >0.5 percent of being contacted within 10 days by an offshore spill ≥1,000 bbl occurring as a result of the proposed action. Most counties and parishes have a <0.5 percent probability of a spill ≥1,000 bbl occurring and contacting (combined probability) their shorelines within 10 days. Only Plaquemines Parish in Louisiana has a greater risk (1%) of a spill occurring and contacting its shoreline within 10 days as a result of the Sale 224 proposed action.

Table 4-15 provides MMS estimates of the likely size and remaining volumes of oil slicks of a "typical" EPA oil spill.

Risk from Coastal Spills

Approximately 6-12 spills are estimated to occur within Gulf coastal waters from activities supporting the proposed action; most (about 95%) of these spills would be ≤1 bbl. The most likely locations of the estimated <1 to 2 coastal spills >1 bbl would be proximate to the major oil pipeline shore facilities.

4.2.2. Losses of Well Control

A loss of well control (LWC) is the uncontrolled flow of a reservoir fluid that may result in the release of gas, condensate, oil, drilling fluids, sand, or water. Loss of well control is a broad term that includes very minor up to the most serious well-control incidents, while blowouts are considered to be a subset of more serious incidents with greater risk of oil spill or human injury. Historically, most LWC's have occurred during development drilling operations, but LWC's can happen during exploratory drilling, production, well completions, or workover operations. The LWC may occur during drilling between zones in the wellbore or may occur at the seafloor. One-third of LWC's were associated with shallow gas flows. Most LWC's last for a short duration, with half lasting less than a day.

From 1992 to 2005, a total of 62 LWC's have occurred in the GOM OCS. Since 2000, the LWC rate has remained constant at 6 per 1,000 well starts. For this SEIS, a LWC rate of 6 per 1,000 well starts is used. However, only 5-15 exploration and delineation wells, and only 15-20 development well are projected. Therefore, the chance of a LWC is very low.

Loss of well control may result in the release of synthetic drilling fluid or loss of oil. From 1996 to 2005, 21 percent of LWC's resulted in spilled oil or SBF, or released gas or condensate. Of the 62 LWC's that have occurred during this period, the following 10 resulted in oil, condensate, or SBF release:

Year	Amount Spilled	Water Depth
2004	5.4 bbl condensate and oil	7 m (23 ft)
2004	11 bbl crude	1,175 m (3,855 ft)
2003	0.02 bbl condensate	60 m (197 ft)
2003	10 bbl condensate	9 m (30 ft)
2002	350 bbl crude	15 m (50 ft)
2002	0.5 bbl condensate	NA
2001	1 bbl SBF	393 m (1,290 ft)
2000	0.5 bbl of oil	94 m (309 ft)
2000	806 bbl SBF and 150-200 bbl of crude oil	678 m (2,223 ft)
1998	1.5 bbl of condensate	16 m (51 ft)

In 1997, an MMS-funded study on the fate and behavior of oil well blowout (S.L. Ross Environmental Research Ltd., 1997). Oil well blowouts generally involve two fluids—crude oil (or condensate) and natural gas. A highly turbulent zone occurs within a few meters of the discharge point and then rapidly loses momentum with distance. In water depths <300 m, the flow of natural gas determines the initial dimensions of oil slicks from subsea blowouts. As the gas rises, it entrains oil and water in the vicinity and carries them to the surface. In these water depths, currents have little effect compared with the plume's velocity. In deeper water (>300 m) with lower temperatures and higher pressures, gas may form hydrates and the volume of gas may be depleted through dissolution into the water. Larger droplets will reach the surface faster and closer to the source, while smaller droplets will be carried farther by the currents before reaching the surface.

Severe subsurface LWC's could resuspend and disperse abundant sediments within a 300-m (984-ft) radius from the LWC site. The fine sediment fraction could be resuspended for more than 30 days. The coarse sediment fraction (sands) would settle at a rapid rate within 400 m (1,312 ft) from the LWC site, particularly in a 30-m (98-ft) water depth and a 35-cm/s (14 in/s) loss of well control scenario.

Prior to the 1980's, blowouts were the leading cause of fatalities on the OCS. The most recent blowout-related fatality occurred in 2001.

The MMS requires the use of blowout preventers (BOP's), which are a special assembly of heavy-duty valves installed on top of a well which can be closed to prevent high-pressure oil or gas from escaping from the wellhole during drilling operations. The BOP systems are tested at specific times: (1)

when installed, (2) before 14 days have elapsed since the last BOP pressure test, and (3) before "drilling out" each string of casing or a liner (30 CFR 250.407), in order to reduce the risk of failure.. An estimated 0-1 LWC events could occur from activities resulting from the proposed action.

4.2.3. Vessel Collisions

The MMS data show that, from 1996 to 2005, there were 129 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 Area, spilling 1,500 bbl. Diesel fuel is the product most frequently spilled, while corrosion inhibitor, hydraulic fluid, lube oil, and methanol have also been released as the result of a vessel collision.

Safety fairways, traffic separation schemes, and anchorages are the most effective means of preventing vessel collisions with OCS structures. In general, fixed structures such as platforms and drilling rigs are prohibited in fairways. Temporary underwater obstacles, such as anchors and attendant cables or chains attached to floating or semisubmersible drilling rigs, may be placed in a fairway under certain conditions. A limited number of fixed structures may be placed at designated anchorages. The USCG's requirements for indicating the location of fixed structures on nautical charts and for lights, sound-producing devices, and radar reflectors to mark fixed structures and moored objects also help minimize the risk of collisions. In addition, the USCG 8th District's Local Notice to Mariners (monthly editions and weekly supplements) informs GOM users about the addition or removal of drilling rigs and platforms, locations of aids to navigation, and defense operations involving temporary moorings. Marked platforms often become aids to navigation for vessels (particularly fishing boats and vessels supporting offshore oil and gas operations) that operate in areas with high densities of fixed structures.

The majority of the proposed Lease Sale 224 area is considered deep water. The National Offshore Safety Advisory Committee (NOSAC, 1999) examined collision avoidance measures between a generic deepwater structure and marine vessels in the GOM. The NOSAC offered three sets of recommendations: (1) voluntary initiatives for offshore operators; (2) joint government/industry cooperation or study; and (3) new or continued USCG action. The NOSAC (1999) proposes that oil and gas facilities be used as aids-to-navigation because of their proximity to fairways, fixed nature, well-lighted decks, and inclusion on navigational charts. Mariners intentionally set and maintain course toward these facilities, essentially maintaining a collision course. Unfortunately, most deepwater facilities do not install collision avoidance radar systems to alert offshore facility personnel of a potentially dangerous situation. The NOSAC estimates that 7,300 large vessels (tankships, freight ships, passenger ships, and military vessels) pass within 35 mi (56 km) of a typical deepwater facility each year. This estimate resulted in approximately 20 transits per day for the 13 deepwater production structures existing in 1999. The NOSAC found the total collision frequency to be approximately one collision per 250 facility-years (3.6×10^{-3} per year). The NOSAC estimated that, if the number of deepwater facilities increases to 25, the estimated total collision frequency would increase to one collision in 10 years. A cost-benefit analysis within the report did not support the use of a dedicated standby vessel for the generic facility; however, the analysis did support the use of a radar system on deepwater facilities if the annual costs of the system were less than or equal to $124,500.

The OCS-related vessels could collide with marine mammals, turtles, and other marine animals during transit. To limit or prevent such collisions, NMFS provides all boat operators with "Whalewatching 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 probably varies 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.

Chapter 3.3.5.7.3 discusses damage to platforms from recent hurricanes. Platforms destroyed by hurricane force winds and waves become potential obstructions to offshore operators and mariners in the GOM. Currently, there are 114 platforms in the GOM that were destroyed by Hurricanes Ivan, Katrina, and Rita and have not been removed. The operators of the destroyed platforms are required to comply with Coast Guard regulations and must buoy the sites. The Coast Guard also publishes a weekly notice to mariners listing the locations of damaged platforms. In November 2005, there were three separate incidents of vessels striking submerged platforms. All incidents resulted in potential pollution events, and one of the vessels sank. A barge transporting Fuel Oil #6 from Houston, Texas, to Tampa, Florida, struck a submerged platform about 30 mi (48 km) off the Texas coast and sank in November 2005. The spilled fuel oil was denser than water and sank to the seafloor. Oil from both the vessel and seafloor was recovered. Although the event is still under investigation, an estimated 74,900 bbl of Fuel Oil #6 was not recovered. To prevent any further incidents in regard to collisions with submerged or destroyed platforms, MMS, in December 2005, published a safety alert that provided the location of all facilities that were destroyed by Hurricanes Katrina and Rita.

4.2.4. Chemical and Drilling-Fluid Spills

Chemicals are used to condition drill muds in completions, stimulation, and workover processes and during production. Chemicals are stored offshore in quantities related to their uses. Only two chemical spills of ≥1,000 bbl have occurred between 1964 and 2005. 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 hydrate formation is a possibility, but spill volumes are anticipated to remain the same because of advances in subsea processing.

A study of chemical spills from OCS activities determined that only two chemicals could potentially impact the marine environment—zinc bromide and ammonium chloride (Boehm et al., 2001). Both of these chemicals are used for well treatment or completion and therefore are not in continuous use; thus, the risk of a spill for these chemicals is very small. Most other chemicals are either nontoxic or used in small quantities.

Zinc bromide is of particular concern because of the toxic nature of zinc. The study modeled a spill of 45,000 gallons of a 54-percent aqueous solution, which would result in an increase in zinc concentrations to potentially toxic levels. Direct information on the toxicity of zinc to marine organisms is not available; however, the toxicity of zinc to a freshwater crustacean (*Ceriodaphnia dubia*) indicated that exposure to 500 ppb zinc results in measurable effects. One factor not considered in the model is the rapid precipitation of zinc in marine waters, which would minimize the potential for impact.

Ammonium chloride was modeled using potassium chloride as a surrogate. The model looked at a spill of 4,717 kg (10,400 lb) of potassium chloride powder. The distribution of potassium would overestimate the distribution of ammonia released during a spill. The model indicated that, close to the release point, ammonia concentrations could exceed toxic levels for time scales of hours to days. Additional information on the degradation of ammonia in seawater would be needed for a more complete evaluation.

In a study of sublethal effects of production chemicals on fish associated with platforms, the simultaneous exposure to methanol and ethylene glycol had a greater effect than exposure to either chemical alone. Swimming performance was the outcome studied (Baltz and Chesney, 2005).

Synthetic-based fluids have been used since the mid 1990's. Their discharge is prohibited and their use is regulated by MMS and USEPA. Three SBF spills of ≥1,000 bbl of base fluid occurred between 2001 and 2004 (**Table 4-16**). No SBF spills ≥1,000 bbl of base fluid have occurred between 2004 and the present. Between 5 and 20 synthetic-based fluid releases are anticipated each year, with the majority being <50 bbl in size (**Table 4-17**). 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 and are of particular concern when SBF's are in use (**Table 4-17**). Each of the three releases occurred as a result of unplanned riser disconnect or failure. The number of disconnects is expected to remain the same as activity increases in deep water. However, the rate is expected to decrease because each accident is investigated and the cause is determined and publicized so that it may be prevented in the future.

In recent history, the Federal OCS oil and gas facilities in the Gulf of Mexico have been exposed to three of the most intense Atlantic hurricanes on record. The extraordinary levels of structural damage caused initially by the three recent Category 5 storms caused an extraordinary loss of containerized chemicals that had been on the structures prior to their destruction. Other than the temporary contribution to debris in the Gulf of Mexico by the chemical containers, there were no accounts of environment damage caused by the release of the lost chemicals. Mud slides, submerged and drifting rigs and debris can damage pipelines and supply lines on the seafloor. A loose anchor that fractured a subsea methanol distribution line was the apparent cause of a 4,834-bbl methanol release that occurred over a 3-month period following Hurricane Ivan. Hurricane-related chemical and synthetic-based fluid releases may occur during the hurricane or afterwards when operations are brought back online.

The Nation's record for safe and clean offshore natural gas and oil operations is excellent. To maintain and improve upon this excellent record, MMS continually seeks operational improvements that will reduce the risks to offshore personnel and to the environment. The MMS constantly reevaluates its procedures and regulations to ensure safe and clean operations, as well as to increase awareness of their importance.

4.2.5. Spill Response

4.2.5.1. MMS Spill-Response Responsibilities and Initiatives

To ensure that industry maintains effective oil-spill-response capabilities, MMS

- receives immediate notification for exploration- and production-related spills >1 bbl—all spills require notification to USCG, and MMS 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;
- ensures that operator's 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.

4.2.5.2. Offshore Response and Cleanup Technology

A number of cleanup techniques are available for response to an oil spill. Open-water response options include mechanical recovery, chemical dispersion, *in-situ* burning, or natural dispersion. Although bioremediation was at one time considered for use in open water, studies have shown that this technique is not an effective spill-response option in open water because of the high degree of dilution of the product and the rapid movement of oil in open water. Effective use of bioremediation requires that the products remain in contact with the oil for extended periods of time.

Single or multiple spill-response cleanup techniques may be used in abating a spill. Typically, multiple techniques are utilized. The cleanup technique(s) 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. The offshore use of mechanical or chemical cleanup or other means to prevent landfall is preferable to shoreline cleanup. It is expected that oil found in the proposed lease sale area would be medium-weight oil.

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. In a typical offshore oil-spill scenario, a boom is deployed in a V, J, or U configuration to gather and concentrate oil on the surface of the water. The oil is gathered in the wide end of the boom (front) and travels backward toward the narrow apex of the boom (back). The skimmer is positioned at the apex of the boom, where the oil is the thickest. The skimmer recovers the oil by sucking in the top layer via a weir skimmer, or the oil adheres to and is removed from a moving surface (i.e., an oleophylic skimmer). The oil is then pumped from the skimmer to temporary storage on an attendant vessel or barge, the latter of which serves as the skimming platform. When this on-board storage is full, the oil must be pumped into a larger storage vessel.

Mechanical oil-spill-response equipment that is contractually available to the operators through Oil Spill Removal Organization (OSRO) membership or contracts would be called out to respond to an offshore spill in the proposed lease sale area. Each individual operator's response to a spill would differ according to the location of the spill, the volume and source of the spill, the OSRO under contract, etc. At this time, in the GOM, there are three major OSRO's that can respond to spills in the open ocean: (1) Clean Gulf Associates, (2) Marine Spill Response Corporation, and (3) National Response Corporation. The equipment owned by these OSRO's is strategically located near the busier port areas throughout the Gulf to service the oil and gas exploration and production operators and, in some cases, the marine transportation industry. Numerous smaller OSRO's that stockpile additional shoreline and nearshore response equipment are also located throughout the Gulf coastal area.

It is expected that the oil-spill-response equipment needed to respond to an offshore spill in the proposed lease sale area could be called out from one or more of the following oil-spill equipment base locations located closest to the proposed lease area: New Orleans, Fort Jackson, and Venice, Louisiana; Pascagoula, Mississippi; Theodore and Mobile, Alabama; or Pensacola, Ft. Lauderdale, Panama City, and Tampa, Florida. Additional oil-spill-response equipment can be procured from the following locations as needed: Corpus Christi, Aransas Pass, Houston, La Porte, Ingleside, Port Arthur, and Galveston, Texas; or Lake Charles, New Iberia, Belle Chase, Cameron, Cocodrie, Morgan City, Sulphur, Houma, and Fourchon, Louisiana. 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 assumed that 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).

Should an oil spill occur 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. This allows normal wind and wave action to break the oil into tiny droplets, which are dispersed into the upper portion of the water column. Natural processes then break down these droplets much quicker than they would if the oil were allowed to remain on the water surface.

Dispersant use must be in accordance with the Regional Response Teams' (RRT) Pre-approved Dispersant Use Manual and any conditions outlined within a RRT 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 as discussed more fully below.

The use of chemical agents on oil spills in the coastal zone is prohibited without prior approval of the Federal On-Scene Coordinator (FOSC), usually the USCG Captain of the Port, in consultation with the State and affected federal agencies, pursuant to the National Contingency Plan. The Federal Region IV RRT, with the concurrence of State and Federal agencies, and in accordance of the National Oil and Hazardous Substances Pollution Contingency Plan, granted preauthorization to the FOSC for dispersant use as defined by the Region IV RRT Ocean and Coastal Waters Dispersant Use Policy. This RRT IV Dispersant Use Policy includes pre-authorization agreements, consistent with the National Contingency Plan, which permit the use of dispersants in specifically designated areas. Within pre-approved areas, further consultation by the USCG On-Scene Coordinator (OSC) is not required, as long as the appropriate RRT agencies are immediately notified and the relevant protocols are followed. The pre-approval to authorize the use of dispersants provided by this policy is in effect for the pre-designated USCG OSC only.

In general, pre-authorization exists 3 mi (4.8 km) seaward of any land providing that the water depth is at least 10 m (33 ft) deep. Some special management areas are, however, excluded from pre-authorization. Three zones, areas designated in this policy document as green, yellow, and red zones, have been established to delineate locations and conditions under which dispersant application operations may take place in waters of Federal Region IV.

The "green zone" is defined as any offshore water within federal Region IV in which all of the following conditions apply: (1) the waters are not classified within a "yellow" or red" zone; (2) the waters are at least 3 mi (4.8 km) seaward of any shoreline; and (3) the waters are at least 10 m (33 ft) in depth. Within the green zone, no further approval, concurrence or consultation on the part of the USCG OSC with USEPA, DOC, DOI, and the affected state(s) is required. The USCG will, however, make every reasonable effort to continuously evaluate the application of dispersants within the "green zone" and will allow RRT IV agencies and the affected states the opportunity to comment.

Florida state waters extend seaward into the GOM to a distance of 9 mi (14.5 km) whereas all other State coastal waters in RRT IV, including Florida's east coast, extend seaward to a distance of 3 mi (4.8 km). No case-by-case approval will be required or considered necessary from USEPA, DOI, DOC or the State of Florida for waters greater than 10 m (33 ft) in depth that extend seaward in excess of 3 mi (4.8 km) on Florida's west coast unless otherwise designated as meeting a criteria for a case-by-case zone.

The "yellow zone" is defined as waters requiring case by case approval. "Yellow zone" waters are those that (1) fall under State or special Federal management jurisdiction and includes any waters designated as marine reserves, National Marine Sanctuaries, National or State Wildlife Refuges, units of National Park Service, or proposed or designated critical habitats; (2) are within 3 mi (4.8 km) of a shoreline, and/or fall under State jurisdiction (however, refer to the preceding paragraph for the specific exclusion of this provision by the State of Florida); (3) are less than 10 m (33 ft) in depth; or (4) are in mangrove or coastal wetland ecosystems, or directly over living coral communities, which are in less than 10 m (16 km) of water. Coastal wetlands include submerged algal beds and submerged seagrass beds. If the USCG OSC believes that dispersants should be applied within the yellow zone, a request for authorization must be made to the RRT IV representatives of the USEPA, DOI, DOC, and the affected state(s). The OSC is only granted authority to conduct dispersant operations in the "yellow zone" when concurrence has been given by USEPA and the affected state(s), after consultation with DOI and DOC.

In the "red zone," dispersant use would be prohibited unless human health and safety or emergency conditions existed. The Region IV RRT has not currently designated any areas as "red zone" areas but retains the right to include areas for exclusion in the future. States may, through Letters of Agreement, designate future "red zone" areas falling under their jurisdiction.

In any designated zone, dispersants will only be used when they are expected to prevent or minimize substantial threat to the public health or welfare, or to mitigate or prevent environmental damage. If a decision is made to use dispersants, the USCG OSC will immediately notify the RRT members representing the USEPA, DOI, DOC, and the affected states. The use of dispersants will be discontinued if so requested by any of the aforementioned agencies or the affected states. Prior to commencing application operations, an onsite survey will be conducted, in consultation with natural resource specialists, to determine if any threatened or endangered species are present in the projected application area or are at potential risk from any of the proposed dispersant operations. When dispersant application is proposed in a pre-approved area that is adjacent to or very near a more shallow area (less than 10 m (33 ft)), due consideration will be given to the trajectory of the dispersed oil. If State or Federal resources in adjacent shallow areas would be at risk, consultation with the resources trustee must be conducted.

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 Coolidge, Arizona. The dispersants will come from locations primarily in Texas, Louisiana, and Mississippi. 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 SEIS assumes that dispersant application will be effective on 20-50 percent (S.L. Ross Environmental Research Ltd., 2000) of the treated oil.

Should an oil spill occur during a storm, 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, a specialized boom that has been constructed to withstand the high temperatures from burning oil. Fire resistant booms are used to isolate the oil from the source of the slick. The oil in the fire-boom is then ignited and allowed to burn. 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.

For oil to ignite on water, it must be at least 2-3 mm (0.07-0.12 in) thick. Most oils must be contained with fireproof booms to maintain this thickness. Oils burn at a rate of 3-4 mm (0.12-0.16 in) per minute. Most oils will burn, although emulsions may require treatment before they will burn. Water in the oil will affect the burn rate; however, recent research has indicated that this effect will be marginal. One approximately 200-m (656-ft) length of fire resistant boom can contain up to 355 bbl (11,000 gallons) of oil, which takes about 45 minutes to burn. In total, it would take about 3 hr to collect this amount of oil, tow it away from a slick, and burn it (Fingas, 2001). Response times for bringing a fire-resistant boom onsite would vary, dependent on the location of the equipment, the staging area, and the spill site.

Should an oil spill occur during a storm, *in-situ* burning would occur following the storm. *In-situ* burning would not be possible while storm conditions continued.

Natural Dispersion

In some instances, 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 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 when the potential damage caused by a cleanup effort could cause more damage than the spill itself.

4.2.5.3. 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 United States is accomplished through a mandated set of interrelated plans. The ACP represents the third tier of the National Response Planning System and was mandated by OPA 90. The ACP's cover subregional geographic areas. 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 FOSC's 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.

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. 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.

Shoreline Cleanup Countermeasures

The following assumptions regarding the cleanup 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. 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 its Geographic Response Plans. In the event of an actual spill, the ACP applicable to the potentially impacted area would be utilized by the responsible party. As stated in **Chapter 4.2.1.5.4**, for this analysis it is expected that a typical oil spilled as a result of an accident associated with the proposed action would be within the range of 34.5° API. Since the following discussion is intended to address the most likely spill scenario discussed in **Chapter 4.2.1.5.4** and **Table 4-14**, cleanup countermeasures for a medium weight oil are all that are included in the discussion:

- *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 a medium-weight oil, the 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 re-oiling of birds is possible. Chemical treatment, burning, and bacterial addition as 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 a coarse sand/gravel beach with a 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 a 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.

4.3. ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS OF THE PROPOSED SALE AND ALTERNATIVES—ROUTINE, ACCIDENTAL, AND CUMULATIVE ANALYSES

4.3.1. Impacts on Air Quality

Routine Impacts

The following routine activities associated with the 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 from surface oil slicks; and fugitive emissions. Supporting materials and discussions are presented in **Chapters 3.1.1** (description of the coastal air quality status of the Gulf coastal area), **4.1.1.6** (air emissions), and **4.1.1.9** (hydrogen sulfide). The parameters of this analysis are 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 oxide (NO_x) emissions. Nitrogen oxide, a by-product of all combustion processes, is 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 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. The CO 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**) result 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.

Volatile organic compounds (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 stills.

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. The U.S. is concerned about particles that are 10 µm in diameter or smaller because those are the particles that generally pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs and cause serious health effects. The U.S. 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.
- "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.

The PM_{10} 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.

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, and can 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 (**Chapter 4.1.1.6**) shows that emissions of NO_x are the most prevalent pollutant of concern. These emission estimates are based on a drilling scenario of a 3,674-m (12,055-ft) hole during exploration activities and a 3,050-m (10,000-ft) hole during development activities. 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 (**Chapter 4.1.1.6**) are provided from the 2000 emission inventory of OCS sources compiled by MMS (Wilson et al., 2004). This compilation was based on information from a survey of 3,154 platforms from 93 companies, which represented an 85 percent response rate. 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., 2004).

Flaring is the venting and/or 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 MMS operating regulations provide for some limited volume, short duration flaring, or venting of some natural gas volumes upon approval by MMS. These operations may occur for short periods (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. Emissions from flaring were included in the modeling analysis (since platform emissions included flaring along with all other sources).

The OCS emissions in tons per year for the criteria pollutants for the proposed action are indicated in **Table 4-18.** 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 production start relatively quickly, leading to increased 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 MMS regulations (30 CFR 250.303) establish 1-hr and 8-hr significance levels for CO. A comparison of the projected emission rate to the MMS 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 GOM Air Quality Study (GMAQS). The GMAQS indicated that OCS activities have little impact on ozone exceedance episodes in coastal nonattainment areas including the Port Arthur/Lake Charles and Baton Rouge areas. Total OCS contributions to the exceedance (greater than 120 parts per billion (ppb)) episodes studied were less than 2 ppb. In the GMAQS, the model was also run using double emissions from OCS petroleum development activities. The resulting attributable ozone concentrations during modeling exceedance episodes were still small, ranging from 2 to 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 as well (Systems Applications International Corporation et al., 1995). Additionally, 30 CFR 250.303(f)(2) requires that, if a facility would significantly impact (defined as exceeding the MMS significance levels) an onshore nonattainment area, then it would have to reduce its impact fully through the application of the best available control technology (BACT) and possibly through offsets as well. The new 8-hr ozone standard (0.085 ppm) has been fully implemented as of November 2005. It is more stringent than the previous 1-hr standard, but it did not result in more areas being classified as nonattainment for ozone. In response to the new ozone standard, 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-hr 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 at locations where the standard was exceeded. 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 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 by the State of Louisiana (Marine Vapor Recovery Act, 1996: LAC: 33:III.2108).

The MMS studied the impacts of offshore emissions using the OCD Model. Receptors were set at Breton Island along the coastline and also a short distance inland in order to capture coastal fumigation. The modeling results are reported in **Tables 4-19 and 4-20**. The results are also compared with the federally allowable increases in ambient concentrations as regulated by 30 CFR 250.45(g) and 40 CFR 51.166(c).

Tables 4-19 and 4-20 list 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. The tables show that the proposed lease sale alone would result in concentration increases that are well within the maximum allowable limits for Class I and Class II areas. 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 small. Emissions from activities resulting from the proposed action would be substantially below the maximum allowable limits for a Class II area.

Suspended particulate matter is important because of its potential in degrading the visibility in national wildlife refuges or recreational parks designated as PSD Class I areas. The impact depends on emission rates and particle size. Particle size represents the equivalent diameter (diameter of a sphere) that would have the same settling velocity as the particle. Particle distribution in the atmosphere has been characterized as being largely trimodal (Godish, 1991), with two peaks located at diameters smaller than 2 μm and a third peak with diameters larger than 2 μm. Particles with diameters of 2 μm or larger settle very close to the source (residence time of approximately ½ day, Lyons and Scott, 1990). For particles smaller than 2 μm, which do not settle fast, wind transport determines their impacts. Projected PM_{10} concentrations are expected to have a low impact on the visibility of PSD Class I areas.

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. 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. Visibility is considered an important resource in the Breton National Wilderness Area, a Federal Class I area. Since future air emission from all sources in the area are expected to be about the same level or less, it is expected that the impact on visibility due to the presence of fine particulates would be minor.

The Breton National Wilderness Area is a Class I air quality area administered by FWS. Under the Clean Air Act, MMS would notify FWS and NPS if emissions from proposed projects may impact the Breton Class I area. Mitigating measures, including low-sulphur diesel fuels and stricter air emissions monitoring and reporting requirements, are required for sources that are located within 100 km (62 mi) of the Breton Class I Area and that exceed emission levels agreed upon by the administering agencies.

Summary and Conclusion

Emissions of pollutants into the atmosphere from the routine activities associated with the 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. The proposed action would have only a very 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 I areas.

Accidental Impacts

Accidents, such as oil spills, blowouts and pipeline ruptures, are another source of emissions related to OCS operations. Once pollutants are released into the atmosphere, atmospheric transport and dispersion processes begin circulating the emissions. Transport processes are carried out by the prevailing net wind circulation. During summer, the wind regime in the EPA is predominantly onshore at mean speeds of 3-5 m/sec (6.7-11.2 mph). Average winter winds are predominantly offshore at speeds of 4-8 m/sec (8.9-17.9 mph).

Dispersion depends on emission height, atmospheric stability, mixing height, exhaust gas temperature and velocity, and wind speed. For emissions inside the atmospheric boundary layer, the vertical heat flux, which includes effects from wind speed and atmospheric stability (via air-sea temperature differences), is a better indicator of turbulence available for dispersion (Lyons and Scott, 1990). Heat flux calculations in the EPA (Florida A&M University, 1988; Hanna et al., 2006) indicate an upward flux year-round, being highest during winter and lowest in summer.

The mixing height is very important because it determines the space available for spreading the pollutants. The mixing height is the height, above the surface of spill through which vigorous vertical mixing occurs. Vertical mixing is most vigorous during unstable conditions; the boundary layer is found to be unstable over 90 percent of time over the Gulf of Mexico (Hanna et al., 2006). Vertical motion is suppressed during stable conditions; these stagnant conditions generally result in the worst periods of air quality. Although mixing height information throughout the GOM is scarce, measurements were conducted near Panama City (Hsu, 1979) and at the Vermilion offshore oil platform and the South Marsh Island offshore oil platform (MacDonald et. al., 2004; Hanna et al., 2006). The results 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). 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.

The accidental release of hydrocarbons or chemicals from the 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 $PM_{2.5}$.

A summer-time oil spill (assumed size of 4,600 bbl) from a pipeline break at a location 131 mi (210 km) off Louisiana was modeled for a period of 10 days (**Table 4-14**). At the end of 52 hr, the resultant slick had been completely dissipated. Twenty-nine percent (1,342 bbl) of the slick was lost because of evaporation. The contribution of oil-spill emissions to the total VOC emission is small, about 0.5 percent.

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 PAH were low. It appeared that a major portion of these compounds was consumed in the burn.

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-hr average concentration rather than a 1-hr 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.

Blowouts are accidents related to OCS oil and gas activities and are defined as an uncontrolled flow of fluids from a wellhead or wellbore. The air pollutant emissions from blowouts depend on the amount of oil and gas released, the duration of the accident, and the occurrence or not of fire during the blowout. The duration of most blowouts is short duration, and half of blowouts lasted less than half a day.

Blowouts may result in the release of synthetic drilling fluid or loss of oil. From 1992 to 2005, less than 10 percent of blowouts have resulted in spilled oil, which ranged from 1.5 to 200 bbl. It is estimated that 0-1 blowouts could occur from activities resulting from the proposed action. The presence of H_2S within formation fluids occurs sporadically throughout the GOM OCS, which may be released during an accident. There has been some evidence that petroleum from deepwater plays contain significant amounts of sulfur. Encounters with H_2S in oil and gas operations have caused injury and death throughout the U.S., but none, to date, in the GOM region. The H_2S concentrations in the OCS vary from as low as a fraction ppm to as high as 650,000 ppm. The concentrations of H_2S found to date are generally greatest in the eastern portion of the CPA. The Occupational Safety and Health Administration's permissible exposure limit for H_2S is 20 ppm, which is 30 times lower than the "immediately dangerous to life and health" of 100 ppm set by the National Institute for Occupational Safety and Health. At about 500-700 ppm, loss of consciousness and possible death can occur in 30-50 minutes. H_2S is a toxic gas; at lower concentrations, it is readily recognized by the "rotten egg" smell. Accidents involving high concentrations of H_2S could result in deaths as well as environmental damage.

Summary and Conclusion

Accidents involving high concentrations of H_2S could result in deaths as well as environmental damage; however, there is no evidence of H_2S being present in the Lease Sale 224 area. Furthermore, regulations are in place to reduce the risk of impacts from H_2S. Other emissions of pollutants into the atmosphere from accidental events as a result of the 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.

Cumulative Impacts

The proposed action for the OCS Program, GOM region, for 2007-2046 is shown in Table 4-4 of the Final Multisale EIS (USDOI, MMS, 2007a), which presents the numbers of exploration, delineation, and development wells; platforms installed; and service-vessel trips. The estimates are based on the portion of the resources assumed to be leased, discovered, developed, and produced as a result of the proposed action and upon logical sequences of events that incorporate past experience, current conditions, and foreseeable development strategies. A profusion of historical databases and information derived from oil and gas exploration and development activities are available to MMS and were used extensively. The undiscovered, unleased, conventionally recoverable resource estimates for the proposed action are expressed as low to high range. The range reflects a range of projected economic valuations of the produced oil and gas.

In the cumulative analysis, the total cumulative emissions from existing sources, the proposed sale, and potential future sales are combined and the area analyzed is the entire GOM. Onshore emissions are considered in the analysis for perspective, since the combined effect of all emissions in the coastal region affects the air quality of the states bordering the Gulf.

Onshore emission sources include power generation, industrial processing, manufacturing, refineries, commercial and home heating, and motor vehicles. Nationwide, NO_x emissions have decreased about 12 percent from 1993 to 2002, while SO_2 emissions have decreased about 31 percent (USEPA, 2003). Emissions of VOC's have decreased 25 percent from 1993 to 2002 and PM_{10} emissions have decreased by 22 percent. However, the changes vary by region and, in the last decade, some Gulf Coast States have observed an increase in SO_2 or NO_x emissions, while others have seen a decrease (emission tabulations by State may be found at http://www.epa.gov/air/data/geosel.html).

In the O_3 nonattainment areas, which include the Baton Rouge area in Louisiana, emissions of NO_x and VOC are being reduced through the State Implementation Plan (SIP) process in order for those areas to achieve compliance with the national O_3 standard. Prior to the revocation of the 1-hr O_3 standard in 2004, Baton Rouge was classified marginal nonattainment. While the 1-hr O_3 standard no longer applies, the same emission controls will remain in effect while the State is developing their plan to reach compliance with the new 8-hr standard. Baton Rouge is marginal nonattainment. Moderate nonattainment areas are required to comply with the 8-hr standard by 2010, while marginal areas have to meet the standard by 2007. Ozone levels in the Baton Rouge area have remained steady over the 1995-

2005 period, while the number of exceedances of the O_3 standard has been in a general downward trend. This shows that emission reduction measures have been effective in reducing O_3 levels.

The USEPA has promulgated a series of measures to reduce regional and nationwide emissions. In 1999, USEPA established emission rules for commercial marine engines. That same year emission standards were promulgated for small engines such as leaf blowers, lawn mowers, and tractors. In 2002, USEPA established regulations for large industrial engines, off-road recreational vehicles, and diesel marine engines for recreational boats. In May 2004, USEPA promulgated the Clean Air Nonroad Diesel Rule, which sets new emission limits on nonroad diesel engines. This rule will phase in standards for NO_x, PM_{10}, and SO_2. Along with this rule, USEPA issued a Notice of Intent to propose more stringent emission standards for marine vessels and locomotives.

In 2000, Phase 2 of the Acid Rain Rule (Title IV) went into effect. Under this rule, emissions of SO_2 and NO_x from power plants in the eastern half of the U.S. are projected to continue a downward trend over the next decade. In 2005, USEPA finalized the Clean Air Interstate Rule that applies to 28 states (including all of the Gulf Coast States) and the District of Columbia. This rule will place additional limitations on NO_x and SO_2 emissions from power plants. The USEPA projections indicate that by 2015 the total SO_x emissions from power plants in the five Gulf Coast States will decrease by over 40 percent compared with 2003 levels, while NO_x emissions will decrease by over 50 percent.

The effects of these various regulations and standards would tend to result in a steady, downward trend in future air emissions. This trend should be realized in spite of continued industrial and population growth. The States are required to implement SIP's to reduce emissions in the O_3 nonattainment areas. The Baton Rouge area is classified marginal nonattainment for O_3 and is required to meet the O_3 standard by June 2007.

Table 4-21 lists the yearly average emissions associated with all future OCS oil and gas activities in the Central and Western GOM. The table presents the emissions calculated from the inventory of all OCS activities (USDOI, MMS, 2001a). The emissions estimate is more conservative than that in the year of 2000 by Wilson et al. (2004). When we compare the future projected OCS emissions with 2000 emissions, there is a small increase in NO_x emissions, a slight decrease in SO_2 and PM_{10} emissions, and a significant increase in CO and VOC emissions. There are other emissions on the OCS that are not associated with oil/gas activities, and these include emissions from commercial marine vessels, commercial and recreational fishing, tanker lightering, military vessels, and natural sources such as oil or gas seeps. These activities are likely to increase in the future, but new USEPA emission standards for marine vessels would, to some extent, counteract the associated emissions increase.

The MMS performed a cumulative air quality modeling analysis of platform emissions in a portion of the GOM in 1992 (USDOI, MMS, 1997). The modeling incorporated a 40-percent increase in emissions above the 1992 levels to account for growth in oil and gas development. Predicted concentrations were well within the NAAQS and the PSD Class II maximum allowable increases. It is still not known whether the PSD increments have been exceeded in the Breton Class I area as one needs to consider the cumulative effect of all other emission sources in the area with respect to the baseline year. In an attempt to address this question, MMS has a modeling study underway to estimate the contribution of OCS emissions to concentrations of NO_2 and SO_2 in the Breton Class I area.

The impacts of OCS activities on onshore air quality are discussed in detail in Section IV.D.1.e.(4) of the Lease Sale 181 FEIS (USDOI, MMS, 2001a) and are hereby incorporated by reference. Tables IV-55 and IV-56 of the Lease Sale 181 FEIS list the predicted contributions to onshore pollutant concentrations from activities associated with the proposed lease sale and compares them with the maximum allowable increases over a baseline concentration established under the air quality regulations. While the tables show that the OCS Program by itself would result in concentration increases that are well within the maximum allowable limits, a direct comparison between the two sets of figures is not possible because of unknown baseline concentration. However, MMS is addressing FWS concerns with scientific study, now underway, to determine the pollutant increment status at BNWA. The initial results show that the NO_2 and SO_2 increments for BMWA are well below the PSD maximum allowable increments. In addition, MMS consults with the FWS, which is the Federal land manager of the Breton Class I area, for plans within 100 km (62 mi) of Breton that exceed a certain emission threshold.

Ozone modeling was performed using a preliminary Gulfwide emissions inventory for 2000 to examine the O_3 impacts with respect to the 8-hr O_3 standard of 80 ppb. 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 at locations where the standard was exceeded by 1 ppb or less. The projected emissions for the cumulative case would be about the same as the emissions used in the modeling. The contributions to O_3 levels would therefore be similar. As emissions within the nonattainment areas are expected to decrease further in the future, the cumulative impacts from the OCS oil/gas program on O_3 levels would likely be reduced.

Gaseous and fine particulate matter in the atmosphere can potentially degrade atmospheric visibility. Existing visibility in the eastern U.S., including the Gulf States, is impaired because of fine particulate matter containing primarily sulfates and carbonaceous material. High humidity is an important factor in visibility impairment in the Gulf coastal areas. The absorption of water by the particulate matter makes them grow to a size that enhances their ability to scatter light and, hence, aggravate visibility reduction. The estimated natural mean visibility in the eastern U.S. is 60-80 mi (97-129 km) (Malm, 1999). On the basis of data presented by Malm et al. (2000), the observed mean visual range is about 24-30 mi (38-48 km) in coastal Louisiana, Mississippi, and Alabama. In the Gulf Coast States, about 60-70 percent of the human-induced visibility degradation is attributed to sulfate particles, while about 20 percent of the visibility degradation is from organic or elemental carbon particles. About 8 percent of the visibility impairment is attributed to nitrate particles (Malm et al., 2000).

Visibility degradation in large urban areas can be especially pronounced during air pollution episodes. In some severe cases, it may hinder navigation by boats and aircraft. Degraded visibility also adds to the perception by the observer of bad air quality even when monitors do not record unhealthful pollutant levels.

A study of visibility from platforms off Louisiana revealed that significant reductions in Louisiana coastal and offshore visibility are almost entirely due to transient occurrences of fog (Hsu and Blanchard, 2005). Episodes of haze are short-lived and affect visibility much less. Offshore haze often appears to result from plume drift generated from coastal sources. The application of visibility screening models to individual OCS facilities has shown that the emissions from a single facility are not large enough to significantly impair visibility. It is not known to what extent aggregate OCS sources contribute to visibility reductions; however, the effects from OCS sources are likely to be very minor because offshore emissions are substantially smaller than the onshore emissions.

In July 1999, USEPA published final Regional Haze Regulations to address visibility impairment in the Nation's national parks and wilderness areas (64 FR 35714). These regulations established goals for improving visibility in Class I areas through long-term strategies for reducing emissions of air pollutants that cause visibility impairment. The rule requires States to establish goals for each affected Class I area to improve visibility on the haziest days and to ensure no degradation occurs on the clearest days. Since visibility impairment involves considerable cross-boundary transport of air pollutants, States are encouraged to coordinate their efforts through regional planning organizations. Louisiana is part of the Central States Regional Air Planning Association. Mississippi, Alabama, and Florida are members of the Visibility Improvement State and Tribal Association of the Southeast. The regional planning organizations are required to submit their first implementation plan in 2008. Subsequent plans are to be submitted at 10-year intervals.

The Regional Haze Regulations, along with the rules on O_3 and acid rain, should result in a lowering of regional emissions and improvement in visibility. Projected emissions from all cumulative OCS activities are not expected to be substantially different from 2000 emissions. The contribution of OCS emissions to visibility impairment would be very minor.

Impacts from oil spills for the cumulative case would be similar to those presented in the Final Multisale EIS (USDOI, MMS, 2007a). Since impacts from individual spills would be localized and temporary, the magnitude of impacts would be no different from those associated with the proposed action.

Summary and Conclusion

Emissions of pollutants into the atmosphere from the activities associated with the cumulative scenario 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 cumulative OCS activities are estimated to be within Class II PSD allowable increments.

The modeling results indicate that all concentrations are below the maximum allowable PSD increments except 24-hr SO_2 and annual NO_2 for the Class I area. However, potential cumulative impacts to the Breton Wilderness Class I Area are unknown due to the baseline problem (described above). The initial results of a recent study indicate that onshore impacts on air quality from emissions from cumulative OCS activities are estimated to be within Class I PSD allowable increments.

Portions of the Gulf Coast have ozone levels that exceed the Federal air quality standard, but the cumulative contribution from the proposed action is very small. Ozone levels are on a declining trend because of air pollution control measures that have been implemented by 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 cumulative contribution to visibility impairment from the proposed actions is also expected to remain very small.

The conclusions above only consider the impact on air quality from OCS sources. If the onshore sources are considered, there may be considerable adverse effects on ozone concentration and on visibility. Thus, the OCS contribution to the air quality problem in the coastal areas is small, but total impact from onshore and offshore emissions may be significant to the ozone nonattainment areas in the parishes near Baton Rouge, Louisiana.

Onshore impacts from the proposed action are well within the PSD Class I allowable increment. The incremental contribution of the proposed action to the cumulative impacts is not significant and is not expected to alter onshore air quality classifications.

4.3.2. Impacts on Water Quality

The routine activities associated with the 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;
- service-vessel discharges; and
- nonpoint-source runoff.

4.3.2.1. Coastal Waters

Routine Impacts

In coastal waters adjacent to the service bases, the water quality would be impacted by the discharges from the service vessels in port. The types of discharges and regulations were discussed in **Chapters 4.1.1.4.8 and 4.1.2.2.2**. 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. The USCG Ballast Water Management Program may apply to some vessels and is designed to prevent the introduction on non-indigenous (invasive) species. The discharges would affect the water quality locally. Estimates of the volume of bilge and ballast water that may be discharged are not available.

Supporting onshore facilities 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**. All point-source discharges are regulated by the USEPA, which is the agency responsible for coastal water quality, or the USEPA-authorized State agency. The USEPA NPDES storm water effluent limitation guidelines control storm-water discharges from support facilities. Nonpoint-source runoff, such as rainfall, which has drained from infrastructure such as a public road, may contribute hydrocarbon and trace-metal pollutants. Data are not available to make estimates of the impact from this type of discharge.

During the course of the preparation of this SEIS, MMS reevaluated baseline conditions for factors potentially affecting coastal water quality, including hurricane effects. The MMS has concluded that it is likely that there were hurricane-induced changes to the baseline conditions within the nearshore waters. Examples of some changes include salt water intrusion from the storm surge and the transport of chemical and biological contaminants from land-based sources into coastal waters due to hurricane related coastal flooding. However, once the short-term effects of the hurricanes passed, pre-hurricane conditions were reestablished. These short-term, nearshore changes were not exacerbated by the OCS Program, and the impacts of the proposed action to coastal water quality has not changed.

Summary and Conclusion

The primary routine impacts to water quality in coastal waters are point-source and storm water discharges from support facilities, vessel discharges, and nonpoint-source runoff. The impacts to coastal water quality from the proposed action should be minimal as long as all existing regulatory requirements are met.

Accidental Impacts

Accidental events associated with the proposed action that could impact water quality include spills of oil and refined hydrocarbons, spills of chemicals or drilling fluids, and collisions and LWC that result in spills. The accidental release of SBF and blowouts would most likely not impact coastal waters due to the distance of the Sale 224 area to coastal waters.

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., movement of oil and rate and nature of weathering), which, in turn, depends on oceanographic and meteorological conditions at the time. The various fractions within the crude behave differently in water. The lighter ends are more water soluble and would contribute to acute toxicity. As the spill weathers, the aromatic components 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.

The ability of coastal waters to assimilate spilled oil is affected by the shallowness of the environment. The National Academy of Sciences (NRC, 2003) and Boesch and Rabalais (1987) have reviewed the fate and effects of spilled oil. In general, the impacts to water quality are greatest when a spill occurs in a confined area where it persists for a long period of time. In an environment where the oil can be dispersed or diluted, the impacts are reduced. Spills of opportunity are few and difficult to sample on short notice. The evaluation of impacts from a large spill on water quality is based on qualitative and speculative information. Large volumes of water are unavailable to dilute suspended oil droplets and dissolved constituents. 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 may be removed from the water column. Oil contains toxic aromatic compounds such as benzene, toluene, xylenes, naphthalenes, and polynuclear aromatic hydrocarbons, which are soluble to some extent in water. The effect of these compounds on water quality depends on the circulation in the coastal environment, the composition of the spilled oil, and the length of time the oil is in contact with the water. 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. This, however, is very unlikely due to the low probability of occurrence and small nature of projected nearshore spills and weathering of the spills.

A major hurricane can result in a greater number of coastal oil and chemical spill events with increased spill volume. As occurred in 2005, damage to infrastructure would delay response to spills and flooding may increase the dispersion of the spills. Although extensive flooding and oil spillage did occur in coastal areas because of the hurricanes, testing performed in coastal waters revealed only minor and short-lived declines in water quality (USEPA, 2006a).

Summary and Conclusion

Oil spills that occur in or reach coastal waters are not expected to significantly impact water quality. Due to the characteristics of spilled substances, oceanographic conditions, depth of the water and natural processes, impacts to coastal water quality are expected to be short term in duration and minor in extent. Chemical spills are expected to have temporary localized impacts on coastal water quality.

Cumulative Impacts

As described previously in this chapter, the impacts from the proposed action could affect coastal water quality. There are also a number of existing and future OCS activities that are not part of the proposed action and non-OCS activities that are ongoing or reasonably expected to take place in the Gulf in the foreseeable future that could affect water quality. Activities of the proposed action would incrementally add to the overall cumulative impact to water quality.

Routine and ongoing OCS-related activities that can impact coastal water quality include service-vessel operations, and supporting infrastructure discharges. Routine oil and gas activities potentially degrade water quality through the addition of hydrocarbons, trace metals, and suspended sediment. Accidental spills of chemicals or oil will also impair water quality temporarily.

Existing and future non-OCS activities occurring in the GOM that would affect water quality include the transportation of oil, gas, and commodities, and the activities of other Federal agencies, such as the DOD. Discharges from domestic and foreign commercial and military vessels would adversely affect the quality of water in the GOM.

The water quality of coastal environments will be affected by cumulative input of hydrocarbons and trace metals and turbidity or sediment resuspension from activities that support oil and gas extraction. These activities include bilge water from service vessels and point and non-point source discharges from supporting infrastructure. Discharges from service vessels are regulated by USCG to minimize cumulative impacts. The USEPA regulates point-source discharges. The USEPA has authorized the Gulf Coast States to administer the State NPDES programs. Additionally, the Gulf Coast States evaluate water quality through the Total Maximum Daily Load (TMDL) program (303d) and the Water Quality Assessment program (305b). The purpose of these programs is to determine the amount of pollution that can enter a waterbody without resulting in the waterbody's inability to meet standards and to ensure that a waterbody is supporting its designated use. 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 from Sale 224 will adversely impact the overall water quality of the region.

Inflows from rivers such as the Mississippi River or Apalachicola River influence coastal water quality. When inflows transport constituents that degrade water quality, such as suspended sediments or nutrients, adverse effects can result.

Dredging and channel erosion can add to the suspended load of local waterways. Support vessels as well as other activities such as commercial fishing and shipping use the waterways. Due to the minimal incremental increase in service vessel trips between 2009 and 2048, degradation of water quality in the waterways is expected to be negligible.

Accidental releases of oil or chemicals would degrade water quality during the spill and after until the spill is either cleaned up or natural processes disperse the spill. The effect on coastal water quality from spills estimated to occur from the proposed action (a 4,600-bbl offshore spill projected to reach coastal waters) are expected to be minimal relative to the cumulative effects from hydrocarbon inputs from other sources such as river outflow, industrial discharges, and bilge water releases as discussed in the National Research Council's report *Oil in the Sea* (NRC, 2003). An analysis of the source of spills identified that, for coastal spills ≥1,000 bbl, the source has been OCS oil 25 percent of the time. The hurricanes of 2004 and 2005 were not included in this calculation. The cumulative impacts to coastal water quality would not be changed over the long term as a result of the proposed action.

A major hurricane can result in a greater number of coastal oil and chemical spill events with increased spill volume. As occurred in 2005, damage to infrastructure would delay response to the spills, and flooding may increase the dispersion of the spills. Flood waters either from a hurricane or other climatic event will transport available contaminants from the flooded lands to rivers and eventually coastal waters. Dilution and mixing minimize the ecological effects of these flood waters even though advisories may be issued to protect any flood victims or first responders.

Summary and Conclusion

Water quality in coastal waters will continue to be impacted by supply vessel usage and infrastructure discharges. Due to the limited activity associated with the proposed EPA Lease Sale, as well as the distance from shore, the proposed action would only add a small increment to the cumulative impacts to coastal water quality. The minor incremental contribution of the proposed action to the cumulative impacts to coastal water quality is expected to be negligible as long as all regulations are followed.

4.3.2.2. Marine Waters

Routine Impacts

Drilling Muds and Cuttings

The drilling of exploratory and development wells results in the discharges of drilling fluids, called "muds," and cuttings. Although muds and cuttings have different characteristics, their impacts are discussed together since they are simultaneously discharged when water-based fluid (WBF) is used. Only cuttings wetted with SBF are permitted for discharge when SBF is used. The USEPA NPDES permits restrict the type and amount of mud and cuttings that can be discharged. The Sale 224 area is under the jurisdiction of USEPA Region 4. The MMS estimates that the proposed action would result in 5-15 exploratory and delineation wells and 15-20 development wells drilled over the life of the proposed action. It is assumed that 80 percent of the wells will be drilled with SBF and 20 percent will be drilled with WBF.

Most studies of cuttings volumes generated when drilling with WBF have determined a cuttings volume in the range of 1,500-2,500 bbl of cuttings generated per well (USEPA, 1993; Avanti Corporation, 1997). The volume of WBF used and the assumed discharge per well is about 7,000-9,700 bbl (USEPA, 1993). The following cuttings volumes were determined in studies prior to the permitting of SBF use: 565 bbl for a shallow development well; 855 bbl for a deep development well; 1,184 bbl for a shallow exploratory well; and 1,901 bbl of cuttings for a deep exploratory well (USEPA, 2000). Drilling as a result of the proposed action in Sale 244 with WBF would create 8,000-21,000 bbl of cuttings and 28,000-68,000 bbl of WBF waste depending upon the well depth and washout rate (USEPA, 1993; Avanti Corporation, 1997; USEPA, 2000). Drilling as a result of the proposed action with SBF would create 11,500-36,500 bbl of cuttings. Although the discharge of SBF fluid is not permitted, the discharge of cuttings containing a small percentage of adhered SBF is permitted.

The fate and effects of WBF and cuttings have been extensively studied throughout the world (Engelhardt et al., 1989). The primary environmental concerns associated with WBF are the increased turbidity in the water column, alteration of sediment characteristics because of the addition of coarser material from the cuttings, and trace metals. Occasionally, formation fluids may be discharged with the cuttings, adding hydrocarbon contamination, which may require treatment before discharge. The WBF are rapidly dispersed in the water column immediately after discharge, and the solids descend to the seafloor (Neff, 1987). The greatest effects to the benthos are within 100-200 m (328-656 ft), primarily due to the increased coarsening of the sediment by cuttings. Most of the components of the WBF have low toxicity with the exception of some trace metals. Barium is the major element in the mud because of the required large amounts of barite used, but trace amounts of chromium, copper, cadmium, mercury, lead, and zinc are also present. The trace mercury concentrations in barite are bound in sulfur compounds and are not available for biological methylation or subsequent bioconcentration (Trefrey et al., 2002). Significant elevations of all these metals except chromium were observed within 500 m (1,640 ft) of six GOM drilling sites on the continental shelf (Boothe and Presley, 1989). The USEPA guidelines limit the levels of cadmium and mercury in stock barite to 3.0 mg per kilogram (kg) and 1.0 mg/kg (dry weight), respectively. A study of chronic impacts from oil and gas activities (Kennicutt, 1995) determined that metals from discharges, including mercury and cadmium, were localized to within 150 m (492 ft) of the structure. The highest levels of metal contaminants were attributed to a platform where discharges are shunted to within 10 m (33 ft) of the bottom.

Cuttings wetted with SBF do not disperse readily in the water column and, therefore, are not expected to adversely affect water quality. The greater the percentage of SBF removed from the cuttings prior to discharge, the more the discharge disperses similarly to WBF and WBF cuttings. Since the SBF settle very close to the discharge point, the local sediments are affected. The primary effects are the alteration of sediment grain size, the addition of organic matter, which can result in temporary, localized anoxia while the SBF degrade, and the smothering of benthic organism. In a study of shelf and slope locations where cuttings wetted with SBF had been discharged, the cuttings were deposited within a 100- to 250-m distance from the discharge point (CSA, 2004). The cuttings were identifiable in the impacted sediment because they were a different grain size and composition from the naturally occurring sediment. Elevated barium concentrations due to barite were also present. The SBF's are synthesized hydrocarbons rather than a petroleum product and initially the area is organically enriched. Over time, bacteria and fungi decompose the SBF. During biodegradation, oxygen is depleted and anaerobic processes take over. In comparison to background sediments, the SBF-enriched, surficial sediments become anoxic and indicators of anaerobic respiration, such as sulfide and ammonia, increase in concentration. As SBF concentrations decrease, the impacted sediments begin to recover. Bioaccumulation tests also indicate that SBF and their degradation products should not significantly bioaccumulate. It is expected that discharged cuttings should degrade within 3-5 years after cessation of discharge (Neff et al., 2000; CSA, 2004).

Information on the potential toxic effects of SBF constituents and cuttings on various benthic organisms is limited and essentially nonexistent for deepwater taxa. However, CSA (2004) conducted sediment toxicity tests with sediments collected near discharge points. Most of the sediment samples within 250 m (820 ft) of the discharge locations had amphipod survival exceeding 75 percent and were considered nontoxic. At sites where multiple samples had amphipod survival rates less than 50 percent, sediment toxicity and SBF concentrations were correlated. Although the full areal extent and depth of these sediments are not known, the potential impacts are expected to be localized and short term. Taking into account that these areas would occupy a minuscule portion of the available seafloor in the deepwater Gulf of Mexico, these impacts are not considered significant since the sensitive communities (e.g., chemosynthetic communities) are avoided.

The MMS recently completed a field study of four drilling sites located on the slope in water depths of 1,033-1,125 m (3,389-3,691 ft) (CSA, 2006). Sample collection before and after exploration or development drilling documented the drilling-related changes to sediment at near-field and far-field locations. Sediment barium concentrations were typically enriched by greater than 10 fold at near-field versus far-field samples as a result of drilling. The average Viosca Knoll Block 916 pre-drilling sediment barium concentration was 0.09-0.1 percent barium and increased by 30-fold following drilling. Concentrations of other metals—Hg, Zn, As, and Pb—were elevated in 6-15 percent of near-field samples relative to far-field samples. An increase in sediment SBF due to the discharge of SBF-wetted cuttings was noted, although discharges had ceased 5 months to 2 years prior to sample collection. Due to logistics, no samples were able to be collected immediately following cessation of dicharges. Therefore, no data were collected to determine initial concentrations of barium and other metals. Elevated TOC and anoxic conditions corresponded with the presence of SBF. Concentrations of TOC were typically about one-third greater in near-field sediments relative to far-field sediments. Sediment profile photography showed microbial mats at more near-field sites corresponding to organic enrichment from drilling discharges. At present, there are no plans to collect more samples from the CSA 2006 study locations to document pollutant biodegradation and redistribution over time.

Produced Water

Produced water is the largest waste stream generated in oil and gas production. Produced water would impact water quality by adding hydrocarbons, trace metals, and biochemical oxygen demand to the environment. As discussed in **Chapter 4.1.1.4.2**, the volume of produced water discharged from a facility ranges from 2 to 150,000 bbl/day (USEPA, 1993). The MMS scenario predicts that 87 percent of development wells will actually produce. Therefore, of the 15-20 development wells drilled, an estimated 13-17 wells will produce. From 2001 to 2005, the reported volume has averaged 0.084 MMbbl of produced water per well per year. Consequently, the proposed action is projected to introduce 1.1-1.5 MMbbl of produced water per year. The amount of oil and grease resulting from the proposed action can be estimated from the projected annual produced-water volume. Assuming the produced water consistently contains a monthly oil and grease average of 29 mg/L (the NPDES permit limit for oil and grease), the volume of added hydrocarbons would be 10-20 thousand pounds of oil and grease per year as the result of the proposed action.

The MMS estimates that one production structure would be installed as the result of the proposed action (**Table 4-2**). This structure is expected to receive and treat greater volumes of produced water from multiple wells than structures in shallower waters. Discharges from workovers and other activities are generally mixed with the produced water and therefore must meet the same criteria. The USEPA discharge requirements, including discharge configuration to achieve adequate mixing, a passing toxicity test result, and a maximum oil and grease concentration limit, control the characteristics of the produced water discharges. The USEPA Region 4 limits the maximum amount of produced water that can be discharged under the general permit to 8000 bbl/day.

Several studies have been conducted to evaluate the effects of produced-water discharges from platforms on the surrounding water column, sediments, and biota (e.g., Rabalais et al., 1991; Kennicutt, 1995; CSA, 1997b). The GOOMEX study (Kennicutt, 1995) examined the effects of discharges at three natural gas platforms. Effects, including increased hydrocarbons, trace metals, and coarser grain size sediments from muds and cuttings, were observed within 150 m (492 ft) of the platforms. Localized hypoxia was observed during the summer months and was attributed to stratification of the water column and increased organic material near the platform. The distribution of contaminants was patchy and there were several variables that could contribute to the observations, specifically sand from cuttings, hydrocarbons, and trace metals in the porewater.

A bioaccumulation study (CSA, 1997c) examined trace metals and hydrocarbons in several fish and invertebrate species near platforms on the continental shelf. The produced-water discharge and ambient seawater were also analyzed for the same compounds. Of the 60 target chemicals, two (arsenic and cadmium) were measured in the edible tissues of mollusks at levels above the USEPA risk-based concentrations. The target organic compounds were not present in most tissue samples above the target level. However, radium isotopes were measured in 55 percent of the samples, but at low concentrations.

Measurements of radium in formation water range from 40 to 1,000 picoCuries/liter (pCi/l). These values are greater than marine waters; however, when formation waters are discharged offshore, the radium is rapidly diluted to ambient concentrations (Reid, 1980).

The amount of oxygen-demanding pollutants in produced water was determined for produced water discharged into the hypoxic zone (Veil et al., 2005) as a requirement for the reissued NPDES general permit. Existing hypoxia models were used to analyze the potential incremental impacts to the hypoxia from produced-water discharges. The USEPA determined that the potential impact of the hypoxia from produced-water discharges was insignificant (USEPA 2006e).

Platform Installation and Removal

The MMS estimates that one platform would be removed using explosives or other methods as a result of the proposed action (**Table 4-2**). As with installation, platform removal would also result in localized sediment disturbance and an increase in turbidity within the water column. During explosive removal, gaseous by-products including carbon dioxide, nitrogen, and carbon monoxide would be released. The increase of gaseous by-products from explosives in the water would cause very short-term, minor alterations to the dissolved gas concentrations in the water in the immediate area of the explosion. Abrasive cutting removal uses seawater and an abrasive, either copper slag or industrial garnet. These abrasives are inert solids that would be deposited on the seafloor along with metal cuttings. The presence of abrasive grit from platform removal would cause very short-term, minor increases in turbidity in the area of activity.

Other Impacting Activities

The installation of pipelines can increase the local total suspended solids in the water. These activities result in only a temporary adverse effect on water quality.

Supply-vessel traffic affects water quality through discharges of bilge water, ballast water, and domestic and sanitary wastes. Bilge water and sanitary wastes are treated before discharge. Ballast water is uncontaminated water but may come from a source with properties, such as lower or higher salinity, different from those of the receiving waters. Estimates of the volumes of these discharges are not available.

During the course of the preparation of this SEIS, MMS reevaluated baseline conditions for factors potentially affecting marine water quality, including hurricane effects. The MMS has concluded that it is likely that there were hurricane-induced changes to the baseline conditions of marine waters due to spills and resuspension. However, once the short-term effects of the hurricanes passed, pre-hurricane conditions were reestablished. These short-term changes were not exacerbated by the OCS Program and the impacts of the proposed action to marine water quality has not changed.

Summary and Conclusion

During exploratory activities, the primary impacting sources to marine water quality are discharges of drilling fluids and cuttings. During installation activities, the primary impacting sources to water quality are sediment disturbance and 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. During platform removal, sediment disturbance, gaseous by-products of explosives, or abrasive grit from cutting are the impacting discharges. Impacts to marine waters from the proposed action should be minimal as long as regulatory requirements are followed.

Accidental Impacts

Oil Spills

The Gulf of Mexico has numerous natural hydrocarbon seeps as discussed in **Chapters 3.1.2.2 and 4.1.3.3.1.** The marine environment can be considered adapted to handling small amounts of oil released over time. Most of the oil spills that may occur as a result of the proposed action are expected to be ≤1 bbl (**Table 4-13**).

An oil spill ≥1,000 bbl at the water surface may result from a platform accident. Subsurface spills would occur from pipeline failure or a loss of well control. Most of the oil from a subsurface spill would likely rise to the surface and would weather and behave similarly to a surface spill, dependent upon a number of factors, particularly the characteristics of the released oil and oceanographic conditions. However, some of the subsurface oil may also get dispersed within the water column, as in the case of the *Ixtoc I* seafloor blowout. Evidence from an experiment in the North Sea indicates that oil released during a deepwater blowout would quickly rise to the surface and form a slick (Johansen et al., 2001). Impacts from a deepwater oil spill would occur at the surface where the oil would be mixed into the water and dispersed by wind waves.

Once the oil enters the ocean, a variety of physical, chemical, and biological processes act to disperse the oil slick, such as spreading, evaporation of the more volatile constituents, dissolution into the water column, emulsification of small droplets, agglomeration sinking, microbial modification, photochemical modification, and biological ingestion and excretion. The water quality of marine waters would be temporarily affected by the dissolved components and small oil droplets that do not rise to the surface or are mixed down by surface turbulence. Dispersion by currents and microbial degradation remove the oil from the water column or dilute the constituents to background levels.

The most likely oil-spill scenario for spills ≥1,000 bbl is a 4,600-bbl spill from a pipeline. The volume of oil is small relative to the amount of oil that enters the GOM through natural seeps; however, this represents a large quantity over a short period of time. Because the GOM is a large body of water, the toxic constituents, such as benzene, as well as the heavier semi-volatiles and PAH's, are expected to rapidly disperse to sublethal concentrations.

Chemical Spills

A recent 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 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 for time scales of hours to days.

Accidental Releases of Synthetic Drilling Fluids

Weighting agents like barite and other clay materials are mixed with the SBF to increase the weight of the drilling muds. As a result of the increased specific gravity of SBF, an accidental release of synthetic-based drilling fluids would be expected to sink to the seafloor in the area immediately at and adjacent to the release site. Localized anoxic conditions at the seafloor would be expected to occur. This would be short term, lasting until the SBF decomposed.

Collisions

A collision may result in the spillage of crude oil, refined products such as diesel, or chemicals. 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 will evaporate and biodegrade within a few days. Since collisions occur infrequently (USDOI, MMS, 2007d), the potential impacts to marine water quality are not expected to be significant.

Loss of Well Control

A loss of well control (LWC) includes events with no surface expression or impact on water quality to events with a release of oil or drilling fluids. A LWC event may result in localized suspension of sediments, thus affecting water quality temporarily. Results from a recent simulated experiment of a deepwater blowout indicated that the oil rose from 850 m (2,789 ft) to the surface in approximately 1 hour.

The term blowout has never had an official regulatory definition. It is commonly understood to be an uncontrolled release to the surface of a formation fluid from a well being drilled. A blowout can result in rig damage, fires, and personal injury. A blowout is a type of loss of well control event. A loss of well control is defined as an uncontrolled loss of formation or other fluid to a subsurface formation or to the surface (*Federal Register*, 2006b).

Since LWC events and blowouts are rare events and of short duration, potential impacts to marine water quality are not expected to be significant.

Summary and Conclusion

Smaller spills (<1,000 bbl) are not expected to significantly impact water quality in marine waters. Due to the characteristics of spilled substances, oceanographic conditions, depth of the water and natural processes, impacts to marine waters from larger spills are expected to be short term in duration and minor in scope. Chemical spills, the accidental release of SBF, and blowouts are expected to have temporary localized impacts on water quality.

A major hurricane can result in a greater number of oil and chemical spill events with increased spill volume. As occurred in 2005, damage to infrastructure would delay response to spills, and wind and wave action may increase the dispersion of the spills. Minor and short-lived declines in water quality may result from hurricane-related spills.

Cumulative Impacts

Water quality in marine waters will be impacted by the discharges from drilling, production, and removal activities. Sources not related to oil and gas activities that can impact marine water quality include bilge water discharges from large ships and tankers; coastal pollutants that are transported away from shore, including agricultural, industrial and urban runoff, river input, sewerage discharges, and industrial discharges; cruise ship and military vessel discharges; and natural seepage of oil and trace metals.

Drilling activities add drilling mud and cuttings to the environment. From the MMS database, about 1,200 wells are spudded each year. A projected 15-20 wells will be drilled in support of the proposed action in the Lease Sale 224 area. The total OCS Program is projected to result in the drilling of 10,486-12,526 wells in the WPA and 28,191-32,811 wells in the CPA from 2007 to 2046.

The proposed action is projected to result in one production structure. A total of 2,958-3,262 structures may be added from the Gulfwide OCS Program between 2007 and 2046 (USDOI, MMS, 2007a). At the same time, structures are being removed. An estimated 5,997-6,097 structures will be removed Gulfwide between 2007 and 2046 (USDOI, MMS, 2007a); most removal being in water depths less than 60 m (197 ft) (i.e., on the continental shelf). At present, approximately 4,000 structures exist offshore.

The impacts from drilling and production would be related to increased water turbidity in the vicinity of the operations and the addition of soluble contaminants to the water column and alterations to sediment composition within 1 km (0.62 mi) of the well from muds and cuttings. The additional impact to water quality from the proposed action would be expected to be small compared with those derived from non-OCS activities that are much more extensive. Studies thus far indicate that as long as discharge regulations are followed, impacts to the marine environment from drilling activities are not significant.

The NRC report (2003) on oil in the sea determined that seeps are the largest source of petroleum hydrocarbons to offshore waters. Oil spills in the GOM also adversely affect water quality. Nearly 85 percent of the 29 million gallons of petroleum that enter North American ocean waters each year as a result of human activities comes from land-based runoff, polluted rivers, airplanes, and small boats and jet skis; less than 8 percent comes from tanker or pipeline spills. Oil exploration and extraction are responsible for only 3 percent of the petroleum that enters the sea. Another 1.5 MMbbl (47 million gallons) seep into the ocean naturally from the seafloor (NRC, 2003).

Limited information is available on the levels of trace metals in Gulf of Mexico marine waters and the sources of trace-metal contamination. The USEPA (1993) conducted detailed analyses of trace metal concentrations in discharges and used the data to establish criteria for the discharge of drilling wastes.

Accidental spills of chemicals and oil are expected to impact water quality on a temporary basis and only close to the spill. Winds, waves, and currents should rapidly disperse any spill and reduce impacts.

Hurricanes may cause fuels and chemicals stored on platforms to enter the water when the structure is damaged or toppled. Structures that are blown off station may drag anchors and damage pipelines and subsea lines to release oil and chemicals. Loss of well control has not occurred as the result of hurricanes because of the built-in safety features. When a platform or pipeline is damaged and production is shut-in due to a hurricane, no produced water is generated or discharged.

Summary and Conclusion

Cumulative impacts on the water quality of the marine environment result from the addition of discharges from exploratory and production activities to a relatively pristine environment. The incremental contribution of the proposed action to the cumulative impacts to marine water quality is expected to be negligible.

4.3.3. Impacts on Sensitive Coastal Environments

Impacts to the general vegetation and physical aspects of coastal environments by activities resulting from routine, accidental, and cumulative activities associated with the proposed action are considered in **Chapter 4.3.3**. Potential impacts to barrier islands seaward of the barrier-dune system are considered in the coastal barrier beaches and associated dunes analysis. Potential impacts to barrier islands landward of the barrier-dune system are considered in the wetlands analysis. Impacts to animals that use these environments, the recreational value of beaches, and archaeological resources found there are described in impact analysis sections for those specific resources.

The major, non-accidental, 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, port facilities, processing facilities, pipelines, and pipeline-support facilities. The MMS has no direct regulatory authority over potential impact-producing factors or mitigation activities that may occur or as a result of the proposed action in the States' coastal zones.

4.3.3.1. Coastal Barrier Beaches and Associated Dunes

Routine Impacts

This section considers impacts from routine activities associated with the proposed action to the physical shape and structure of barrier beaches and associated dunes. The primary impact-producing activities associated with the proposed action that could affect barrier beaches and dunes include navigation channel use (vessel traffic) and dredging and the use of support infrastructure in these coastal areas. The following sections describe the sources and types of these potential impacts.

Vessel Traffic and Dredging

Vessel traffic and navigation channels projected to be used in support of the proposed action are discussed in **Chapter 4.1.1.** Current navigation channels will not change as a result of the proposed action and no new navigation channels will be required by the proposed action. In addition the minimal increase in vessel traffic associated with the proposed action is not expected to create the need for additional maintenance dredging or dredged material disposal requirements since the additional traffic represents only a small part of the vessel traffic in the existing OCS navigation channels.

The proposed sale is projected to generate 375-500 trips annually as compared with the existing vessel traffic to Port Fourchon (**Table 4-2**). The projected number of trips resulting from the proposed action will be less than 1 percent of the existing vessel traffic. Waves generated by boats, ships, barges, and other vessels erode unprotected shorelines and accelerate erosion in areas already affected by natural erosion processes. Much of the service-vessel traffic that is a necessary component of OCS activities uses the channels and canals along the Louisiana coast. 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. There are no new estimates of navigation canal widening rates for the Gulf region. However, USGS (Johnston and Cahoon, in preparation) found that canal widening rates have slowed rather than increased in recent years as a result of increased bank stabilization efforts. Thus, the canal widening rates established by Johnson and Gosselink (1982) are considered overestimates. The OCS-related navigation canals are assumed to generally widen at an average rate of 1.5 m/yr (4.9 ft/yr), or 300 ha (741 ac) of landloss per year for the 2,000 km (1,243 mi) of OCS-related navigation channels.

No new navigation channel is projected to be constructed as a result of the proposed action. In the near future, the channel leading to Port Fourchon, Louisiana, Belle Pass, is expected to be deepened to accommodate larger vessels, some of which will be OCS-related. Mitigating adverse impacts is the responsibility of the party causing the impact (e.g., government agency, company, or individual) in accordance with requirements set forth by the appropriate Federal and State permitting agencies. The MMS has no direct regulatory responsibility or authority over onshore activities that cause canal-related land loss or over mitigation requirements and opportunities.

Based on the proximity of available navigation channels and sea lanes connecting the proposed sale area to the Port Fourchon service area there would be minimal chance for vessel generated or channel maintenance activities to negatively affect the barrier islands or beaches.

Continued Use of Support Infrastructure

In the past, OCS-related facilities were built in the vicinity of barrier shorelines. The use of some existing facilities in support of the 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 in the vicinity. They may also cause the accumulation of sediments updrift of the structures, sediments that might have alleviated erosion downdrift of the structure. These induced erosion impacts would be most damaging in some local areas. In deltaic Louisiana where the sediment supply is critically low, these impacts may be distributed much more broadly. These impacts will last as long as the interruption of the sediment drift continues, which may continue after the structure is removed if the hydrodynamics of the area are permanently modified.

There are no barrier island complexes that would be directly affected in or near the Port Fourchon area from either potential jetty improvements required to extend the life of existing facilities or protect modifications to the facilities. However, since the trip numbers projected for the proposed action are minimal (approximately 0.3% of the total OCS activity), no additional wetland erosion is anticipated as a result of this minimal increase in vessel traffic (projected as 375-500 trips per/year).

No pipeline landfalls are projected as a result of the proposed action. The proposed action will likely use existing pipelines near the proposed sale area and associated facilities that are currently capable of receiving additional product without further modification or construction activities. Based on the current analysis there should be no impacts to barrier islands or barrier beaches from pipeline emplacement.

Effects on coastal barrier beaches and associated dunes associated with dredging from the proposed action are expected to be at most minimal, since all of the navigation channels associated with the service-vessel traffic are not in the proximity of the barrier beaches. The construction of the one platform projected for the proposed action is, at a minimum, 125 mi (200 km) from on shore beaches and barrier beaches; thus, any dredging activity associated with this construction would not affect the barrier resources.

There are no processing plants projected to be constructed as a result of the proposed action. Due to the absence of nearshore or onshore infrastructure, no impacts are predicted for the beaches or habitat associated with these areas. Should one be constructed, it will most likely be an expansion of an existing facility in Louisiana (Port Fourchon), where the large majority of the infrastructure exists for receiving oil and gas from the CPA.

Summary and Conclusion

In summary, effects to coastal barrier beaches and associated dunes from navigation channel use, dredging, and continued use of infrastructure in support of the proposed action are expected to be restricted to temporary and localized disturbances. The proposed action is not expected to cause significant impacts to barrier beaches due to the distance of these shoreline beaches and barrier islands from navigation approaches. No new coastal infrastructure and only one production structure are projected for the proposed action. Due to the proximity of the proposed production structure to barrier islands and beaches (nearest beach is approximately 125 mi (200 km)) no impacts are expected. Existing facilities originally built inland may, through natural erosion and shoreline recession, 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 very localized impacts on adjacent barrier beaches downdrift of the channel due to sediment deprivation. Based on use, the proposed action would account for a very small percentage of these impacts, which would occur whether the proposed action is implemented or not.

In conclusion, the proposed action is not expected to adversely alter barrier beach configurations beyond existing, ongoing impacts in very 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 can mitigate adverse impacts upon those localized areas.

Since no construction on barrier beaches and dunes is projected, no impacts would result.

Accidental Impacts

The level of impacts from oil spills depends on many factors, including the type, rate, and volume of oil spilled and the weather and oceanographic conditions at the time of the spill, geographic location and season, and oil-spill response and cleanup preparedness. These parameters would determine the quantity of oil that is dispersed in the water column; the degree of weathering, evaporation, and dispersion of the oil before it contacts a shoreline; the actual amount, concentration, and composition of the oil at the time of the shoreline contact; and a measure of the toxicity of the oil. These factors would determine whether that oil spill will cause heavy long-lasting biological damage, comparatively little damage or no damage, or some intermediate degree of damage. **Chapter 4.2** provides estimates of the number of oil spills that might result from the proposed action, as well as oil slick dispersal and weathering characteristics.

Figure 4-3 provides the probability of an offshore spill ≥1,000 bbl occurring and contacting counties and parishes around the Gulf.

Chapter 3.2.1.1 contains a physical description of the coastal barriers. For spilled oil to move into and across dunes and beach ridges like those discussed above, strong southerly winds must persist for an extended time prior to or immediately after the spill to elevate water levels. Strong winds would also accelerate oil-slick dispersal, spreading, and weathering, thereby reducing impact severity at a landfall site. Significant dune contact by a spill associated with the proposed activity is considered very unlikely except during abnormally high water levels. A study in Texas showed that oil disposal on sand and vegetated sand dunes had little deleterious effects on the existing vegetation or on the recolonization of the oiled sand by plants (Webb, 1988).

The total number of coastal spills related to the proposed action is provided in **Table 4-15**. Based on an MMS analysis of USCG data on all coastal spills (U.S. Coast Guard data, 1984-2004), approximately 41 percent of coastal spills occur offshore in open and sheltered State waters, only 2 percent of spills occur in Federal offshore waters and 57 percent of the spills will occur in inland waters. Should oil related to the proposed action be spilled into State offshore waters from a vessel or pipeline, the probability of such a spill contacting land would be generally higher than probabilities projected for spills that may occur in Federal waters. The probability of contact is dependent on the meteorological and Gulf current conditions at the time of the spill, as well as the location of the spill.

Cleanup of large volumes of oil from barrier beaches can affect beach stability if large quantities of sand are removed. To some degree, any sand removal will result in a new beach profile at the site of removal. Beach profiles adjust in response to wind- and water-induced movements of available sand volume. The net result of these changes could range from no noticeable change to accelerated rates of shoreline erosion. Increased erosion rates are of greatest concern at sand-starved, eroding beaches, as found along the Louisiana Gulf Coast or at the beaches of southern Bay and northern Gulf Counties in Florida. State governments around the northern Gulf have recognized these problems and have established policies to limit sand removal by cleanup operations.

Some beached oil and tarballs may penetrate or be buried to various depths under the sand, depending upon the viscosity of the oil; wind and wave energies; and the temperature, wetness, and nature of the sand. Some of this oil may be beneath the reach of cleanup methods and may remain in the sand.

The impacts of oil spills on barrier beaches resulting from activities associated with the proposed action are described in detail in Section IV.D.1.e.(1)(a) of the Lease Sale 181 FEIS (USDOI, MMS, 2001a) and are hereby incorporated by reference. Should an oil spill occur from within the proposed lease area or the primary transportation area, the combined probabilities for the spill contacting environmental features are described in Section 4.2 and are listed in Tables IV-27 through IV-36. The probabilities of oil spills occurring in the proposed Lease Sale 224 area are very low. The OSRA analysis identified Louisiana Beach Areas, the Chandeleur Islands, Mississippi/Alabama Gulf Islands, Alabama Gulf Shores, and the Florida Panhandle Beach Areas as having probabilities of <0.5 percent for a spill occurrence and contact within 10 days. Since 1980, OCS-related spills in the Gulf of Mexico ≥1,000 bbl have ranged in size from 1,211 to 15,576 bbl (Table IV-20). Sufficient time would exist after a spill within the Lease Sale 224 area for response activities and natural weathering to remove the slick prior to contact with any barrier beaches.

In most cases, mechanical cleanup methods would be used. Beach sand removal would be minimized and assumed to cause no permanent effects on barrier beach stability. Within a few months to 2 years after cleanup, the disturbed beach configuration would adjust to approximately pre-disturbance conditions. This adjustment would be slower in Louisiana and southern Bay and northern Gulf Counties of Florida than elsewhere. The adjustment would be accelerated if removed sand was replaced.

Oil, tarballs, and other fractional components of oil that remain in the sand after cleanup could remain for several years and would be released periodically when storms and high tides resuspend or flush through beach sediments. During days when sand temperatures are raised sufficiently, tarballs buried near the surface of the beach sand may liquefy and oil may seep to the surface.

Inland spills are assumed to not impact barrier beaches or dunes significantly, unless they occur in the vicinity of a tidal inlet due to the elevations and slope of the barrier island beaches in the EPA. Resulting impacts would occur as discussed above.

Summary and Conclusion

The proposed action presents a low probability of a spill that might occur and then contact barrier beaches. The nearest shoreline or barrier beach is located 125 mi (200 km) from the offshore production platform. The transportation of produced products will be accomplished entirely by pipeline. The probabilities of oil spills ≥1,000 bbl reaching offshore State waters within 10 days ranges from <0.5 percent for all State waters within the EPA excepting the Louisiana central offshore waters with a probability range of 1-2 percent and the Louisiana eastern offshore waters ranging from <0.5 to 1 percent. Should a spill occur as a result of the proposed action, the areas with the highest probabilities of contact are the Chandeleur Islands of Louisiana; Baldwin County, Alabama; and Escambia and Santa Rosa Counties, Florida. Should a spill occur from the pipeline system that transports oil resulting from the proposed action, the barrier beaches of the eastern Mississippi River Delta and Chandeleur Islands in Louisiana; Jackson County, Mississippi; and Mobile County, Alabama, have the highest probabilities of being contacted. Mechanical cleanup at sea is assumed to collect up to 10 percent of the oil, and approximately 30 percent is assumed to be chemically dispersed, thereby reducing the probability and severity of beach contact. Mechanical cleanup onshore would occur with minimal sand removal. Should offshore spill cleanup proceed as prescribed, impacts would be minimal to insignificant. Therefore, no significant, long-term impacts to the physical shape and structure of barrier beaches and associated dunes are expected to occur for more than 2 years as a result of accidental spills related to the proposed action. The proposed action is not expected to adversely alter barrier beach or dune configurations significantly.

Cumulative Impacts

This cumulative analysis considers major factors added to the proposed action that may impact barrier beaches and dunes in the cumulative activity area. These factors could include natural processes, the OCS Program, State oil and gas activities, private development projects and activities, navigation channels, and recreational activities. Except in a few incidences where land building is involved, each of these activities may either induce or accelerate erosion of beaches or dunes.

Natural Land Building and Movement

At one time, the Mississippi River was the most influential direct and indirect source of sediments to coastal landforms. However as a result of flood control works and channel training activities along the river and at the river mouth, sediment supplies needed to create, maintain, and supply sediment required for growth, and the creation of river deltas and coastal barriers was greatly diminished. Only highly erodable sediments, if any, are now reaching the coastal areas. Consequently, barrier beaches of the Mississippi Delta have the greatest rates of erosion and landward retreat on earth. This rapid landward retreat will continue into the foreseeable future.

The barrier landforms in the States of Mississippi, Alabama, and Florida are not directly dependent on a fluvial (river) source of sand. Rather, these islands appear to be nourished by the sandy barrier platforms beneath them (Otvos, 1980). These landforms include the Dog Keys of Mississippi Sound; Santa Rosa Island, Florida; and the mainland beaches between the mouth of Mobile Bay, Alabama, and Cape San Blas, Florida. Typically, the sand drift moves these islands and mainland barrier features westward. Hence, the eastern ends of the islands are generally eroding, while their westward ends are building. The exceptions to this are Grand Isle and Eastern Chenier Caminada in Louisiana and the coastal area from Mexico Beach to Cape San Blas, Florida, which are moving eastward.

Storms and Beach Stabilization Efforts

Hurricanes will continue to place significant erosional pressures on beaches and dunes that generate quick and tumultuous impacts. Storms that are generated by cold fronts also generate similar, less-intense erosional pressures repeatedly over the fall, winter, and spring. The local governments of Santa Rosa Island and the Destin area in Florida, in association with COE, built dunes to protect the developed regions of those areas and to reinitiate natural dune development where the dunes were severely damaged by Hurricane Opal in 1995 (*Pensacola News Journal*, 1998a).

During the mid-1980's, COE contracted with the State of Louisiana and Jefferson Parish, Louisiana, governments to replenish beach sand on Grand Isle after Hurricane Juan. During the 1990's, the State of Louisiana and the Federal Government joined in a partnership through the Coastal Wetlands Protection, Planning and Restoration Act (CWPPRA) to address and, where possible, correct the deterioration of wetlands and barrier islands along Louisiana's Deltaic Gulf Coast and elsewhere. Several projects to stabilize or replenish these islands have been executed; more are being planned.

Large numbers and varieties of stabilization techniques and structures have been applied along the Louisiana, Alabama, and Florida barrier coasts to abate erosion. In association with MMS, the States of Louisiana, Alabama, and Florida have pursued the use of sands dredged from Federal waters to restore and nourish barrier beaches and islands. Generally, efforts to stabilize barrier shorelines using hard, engineered structures have trapped sediment on the updrift sides of the structures, accelerating erosion on their downdrift sides. Since 1980, dune and beach stabilization have been better accomplished by using more natural applications such as sand dunes, beach nourishment, vegetative plantings, and avoidance.

The proposed action will not increase destabilization of coastal dune or barrier beaches. No coastal roads will be built, no barrier beaches will be dredged for landfalls, no beach construction will be needed, no new navigation canals will be dredged, and the likelihood of OCS-related oil spills coming ashore is very low.

Land Development

Most barrier beaches in Louisiana and Mississippi are relatively inaccessible for recreational use because they are located at a substantial distance offshore or are in coastal areas with limited road access.

Several highways were built into the barrier-dune fields in Alabama and Florida, and were constructed somewhat parallel to the beach, through the dune fields, or immediately behind them over associated coastal flats (USDOI, FWS, 1982a and b). These networks of roads and eventual developments have totally altered the hydrology and ability for constructive sediment transport, beach stabilization, and erosion control along these beaches. Local beachside communities now realizing the importance of barrier beaches as storm protection are emphasizing environmentally friendly planning in these sensitive beach areas. Both local and State regulatory authorities are now assessing and providing guidance on construction compatible with beach preservation in these areas.

Many communities along these roads have come to realize that barrier beaches and dune systems are important to their economies, safety, and regional aesthetics. Population increases along the barrier coasts will inevitably and cumulatively increase adverse impacts on the barrier dunes in areas where road access is made available. Florida and Alabama have taken measures to reduce these impacts. Picking sea oats and other dune vegetation is illegal. Vehicular traffic is restricted. Where foot traffic across the dunes is popular, boardwalks may be required. Developments in the dune fields are required to mitigate many of their adverse impacts. There is no incremental contribution of the proposed action to impacts on barrier dunes or beaches through coastal road access and use since there will be no new or expanded onshore infrastructure associated with the proposed action.

Navigation Channels

From a cumulative standpoint, the proposed action will represent small percentages of vessel traffic in the area between Port Fourchon, Louisiana; Morgan City, Louisiana; and Panama City, Florida. Most OCS-related trips in the cumulative activity area would use the channels that serve Venice, Louisiana; Theodore, Alabama; and Pascagoula Mississippi. With continued OCS-related oil and gas development in Federal waters off Mississippi, Alabama, and the Florida Panhandle, the use of these channels by OCS-related activities may increase. At the barrier beaches, most of these channels have been heavily jettied and have been maintained at deeper than natural depths for several decades.

No new navigation channels that may impact barrier beaches or related dunes are expected to result from non-OCS-related activities. The basis for this assumption is the large number of existing navigation channels that can accommodate additional navigation needs. Many new inland, navigation canals will likely be dredged to accommodate the onshore oil and gas industry, developers, and transportation interests, which may, in turn, increase navigational traffic and water flow between the Gulf and inland waterways. As the Louisiana coast continues to subside and erode, many new natural, tidal channels will be opened to the Gulf and between inland waterbodies.

Some channels to the Gulf may be deepened or widened to accommodate deeper-draft and wider cargo vessels. Many existing tidal channels will also deepen and widen naturally to accommodate continually increasing tidal prisms. An increasing tidal prism increases the strength and duration of the ebbing flow through a tidal pass, which, in turn, tends to offset littoral sediment drift more strongly towards the Gulf, into deeper water. Movement of these sediments into deeper water reduces the availability of sediments to the beach system. The barrier beach downdrift of the enlarging channel then begins to erode. This has been a problem for the sediment-poor barrier beaches of the Mississippi River Deltaic Plain.

Deepening or widening of channels to accommodate vessel traffic will transform the bar and inlet portion of channels into sediment sinks that will accelerate erosion downdrift of the channel. Additional maintenance dredging may then be necessary. Placement of the dredged materials offshore can cause navigational hazards and reduce the availability of sediments to the beach system.

Summary and Conclusion

In the cumulative activity area, the greatest impacts to beaches and dunes would occur in deltaic Louisiana, where coastal erosion is very high as a result of a variety of natural and manmade circumstances. Of the manmade activities in deltaic Louisiana, petroleum production and transportation activities have contributed greatly to coastal erosion.

Generally, modern techniques for the installation of pipeline landfalls pose little to no direct threat to barrier beaches or dunes. Dredging that will occur in deltaic Louisiana as a result of both projected OCS-related and non-OCS-related pipeline landfalls will most likely contribute to the hydrodynamic changes there and at least minimally will contribute to the deterioration of related barrier beaches.

Major dune-impacting developments in Florida and Alabama are roads and canals constructed into and behind barrier-dune fields. These roads encourage residential and commercial developments and a variety of recreational activities that have adversely impacted sand dunes and beaches. Florida and Alabama have taken measures to reduce impacts to barrier dunes. The barrier systems of Louisiana and Mississippi are not generally accessible, except by boat.

State regulations concerning oil cleanups on beaches require that sand removal be minimized. The disturbed beach configuration is projected to adjust to approximately pre-disturbance conditions within a few months to 2 years after cleanup. This adjustment would be slower for deltaic Louisiana than in other areas due to the limited sand supply. The adjustment would be accelerated if the removed sand was replaced.

No construction of new navigation channels through barrier beaches and related dunes are projected to support either OCS or non-OCS activities. Some existing channels may be deepened or widened to accommodate deeper draft vessels or greater traffic volumes that will support a variety of activities. Most of these channels have jettied entrances to reduce channel shoaling. Typically, the channels and their related jetties serve as sediment sinks that cause some accelerated erosion down drift of these structures.

Proposed Lease Sale 224, due to the distance from shore, will only add a small increment to the pressures of the cumulative activities on the area.

4.3.3.2. Wetlands

Routine Impacts

This section considers impacts to coastal wetlands and marshes from routine activities associated with the proposed action. The primary impact-producing activities associated with the proposed action that could affect wetlands and marshes include pipeline maintenance, navigation channel use (vessel traffic) and maintenance dredging, disposal of OCS-related wastes, and use and modification 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 navigational traffic, dredged material disposal that prevents necessary sedimentary processes, saltwater intrusion that changes the hydrology leading to unfavorable conditions for wetland vegetation, and vulnerability to storm damage from eroded wetlands. No pipeline landfalls are projected as a result of the proposed action. The following sections describe the sources and types of these potential impacts.

Circumstances and disturbances to wetlands due to the use of navigation channels are discussed in detail in Sections IV.A.1.b, IV.B.1.i and j, IV.B.1.a, and IV.C.3 of the Lease Sale 181 FEIS. For the activities that are projected to result from this proposed action, it is projected that 375-500 service-vessel trips would occur annually, or approximately 15,000-20,000 trips over the 40-year life of the project.

Vessel traffic is expected to be heaviest in the navigation channels supporting Port Fourchon, Louisiana. Dredging related to maintenance of these navigation channels may have impacts upon wetlands is described in **Chapters 4.1.2.1.6 and 4.1.3.2.3**. Wetlands located along the banks of natural or dredged channels have been heavily degraded by past dredging, bank stabilization, and industrial development along the channel banks.

Dredging

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 deposits material on existing dredged-material disposal banks and disposal areas; the effects of dredged-material disposal banks on wetland drainage is expected to continue unchanged, although there may be some localized and minor exacerbation of existing problems. Typically, some dredged 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. In both cases, areas impacted are considered small.

The COE's New Orleans District annually removes approximately 90 million yd^3 of dredged material from 10 Federal navigation channels throughout coastal Louisiana. Approximately 27 million yd^3 (25-35%) of this material is used for coastal wetland restoration projects (Creef and Mathies, 2002). As a result of the tremendous wetlands landloss in the Louisiana coastal region, the beneficial use of dredge spoils is expected to increase. Executive Order 11990 requires that material from maintenance dredging be considered for use as a sediment supplement in deteriorating wetland areas to enhance and increase wetland acreage, where appropriate. Disposal of dredged material for marsh enhancement has been done only on a limited basis. Given the "mission statement" of COE, which requires it to take environmental impacts into consideration during its decisionmaking processes, increased emphasis has been placed on the use of dredged material for marsh creation. Maintenance dredging will also temporarily increase turbidity levels in the vicinities of the dredging and disposal of materials, which can impact emergent wetlands, seagrass communities, and associated habitats.

Navigational Channels and Vessel Traffic

Vessel traffic that may support the proposed action is discussed in **Chapter 4.1.1.8.4.** Navigation channels projected to be used in support of the proposed action are discussed in **Chapter 4.1.2.1.6**. Navigation channels that support the OCS Program are listed in **Table 3-30**.

Approximately 3,200 km (1,988 mi) of OCS-related navigation canals, bayous, and rivers are found in the coastal regions around the Gulf, exclusive of channels through large bays, sounds, and lagoons. No new navigation channels are expected to be dredged/constructed as a result of the proposed action. Deepwater activities are anticipated to increase, requiring the use of larger service vessels for efficient operations. This may put a substantial emphasis on shore bases associated with deeper channels. Some of the ports that have navigation channels deep enough to accommodate deeper-draft vessels may expand the port infrastructure to accommodate these deeper-draft vessels. An example of a significant expansion of a service base is Port Fourchon in coastal Louisiana. Port Fourchon has deepened the existing channel and has dredged additional new channels to facilitate this expansion. At present, the entrance to Port Fourchon (Belle Pass Channel) is maintained at 29 ft. The inland channel in the port is 26 ft and Bayou Lafourche is maintained at 24 ft. The FEMA has funded the dredging of several sites that were silted by Hurricanes Katrina and Rita.

Disposal of OCS-Related Wastes

Produced sands, oil-based or synthetic-based drilling muds and cuttings, and some fluids from well treatment, workover, and completion activities will be transported to shore for disposal. Sufficient disposal capacity exists at the disposal site near Lacassine, Louisiana (EIA LA-1) and at other disposal sites under development or projected for future development in Subareas LA-1, LA-2, and MA-1 (**Chapter 4.1.2.1.5**). Discharging OCS-related produced water into inshore waters has been discontinued. All OCS-produced waters are discharged into offshore waters in accordance with NPDES permits or transported to shore for injection. Produced waters are not expected to affect coastal wetlands (**Chapter 4.1.1.4.2**).

Because of wetland protection regulations, no new waste disposal site will 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 4.1.2.1** and **Table 3-32**). State and Federal permitting agencies discourage the placement of new facilities and the expansion of existing facilities in wetlands. Any impacts upon wetlands are mitigated by the owners of the facilities. There are no new onshore facilities proposed for the proposed action at this stage of planning. If additional capacity is indicated by further study the plans are to modify or expand existing facilities. These expansions or modifications will be investigated and regulated by the appropriate State and Federal regulatory agencies.

Because of wetland protection regulations, no new waste disposal site will 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. No effects to coastal wetlands from disposal of OCS-related wastes associated with the proposed action are expected.

Summary and Conclusion

The proposed action will not require any new navigational canals or new onshore pipeline construction. Vessel traffic associated with the proposed action is expected to contribute minimally to the erosion and widening of navigation channels and canals. Alternative dredged-material, disposal methods can be used to enhance and create coastal wetlands. Overall, wetland impacts associated with this project is expected to be negligible in scope and short term in duration.

During the course of the MMS re-evaluation of baseline conditions of wetlands in the preparation of this SEIS, MMS has documented that there have been hurricane-induced changes to the baseline conditions of the wetlands. The exposed nature of wetlands increases the potential for hurricane effects. Although the effects of the hurricanes were moderate to severe in some areas, the effects of the proposed action on wetlands would be negligible because (1) no pipeline landfalls are projected to occur as a result of the proposed action, and (2) no new navigation channels are expected to result from the proposed action. The proposed action is expected to contribute minimally to the need for maintenance dredging of existing navigation channels. The changes in the baseline condition of the wetlands would not exacerbate or increase the potential effects of the proposed action. The kinds, levels, or locations of impacts described in the above analysis sections leads MMS to project potential impacts to wetlands to be short term and minimal in scope.

Accidental Impacts

Oil spills that may be associated with the proposed action are described and discussed in **Chapter 4.2.1**. The probabilities and circumstances of an offshore spill impacting the coast are discussed in **Chapters 4.2.1.5 and 4.2.1.6**. Oil-spill response is described in **Chapter 4.2.5.**

Numerous investigators have studied the immediate impacts of oil spills on wetland habitats in the Gulf area. Often, seemingly contradictory conclusions are generated from these impact assessments, which can be explained by differences in oil concentrations contacting vegetation, the chemical composition of the oil spilled, vegetation type and density, season of year, preexisting stress level on the vegetation, soil types, water levels, weather, and numerous other factors. In overview, the data suggest that vegetation that is lightly oiled will experience plant die-back, followed by recovery without replanting. Therefore, most impacts to vegetation are considered to be short term and reversible (Webb et al., 1985; Alexander and Webb, 1987; Lytle, 1975; Delaune et al., 1979; Fischel et al., 1989). The probabilities of an offshore spill ≥1,000 bbl occurring and contacting the shoreline and beaches within 10 days are small (**Figures 4-4 and 4-5**). In addition, the proximity (nearest landfall 125 mi (200 km)) and topography and slope of the beaches are such that the wetlands in most areas are behind a protective dune or beach ridge. During major tropical storms a number of these barrier beach systems as well as the shoreline beaches can be overwashed. In coastal Louisiana, the critical concentration of oil and diesel fuel that results in long-term impacts to wetlands is assumed to be 0.1 liter per square meter (l/m^2). This concentration will cause mortality of most contacted vegetation; 35 percent of the affected area will recover within 4 years. Concentrations less than this will cause die-back of the aboveground vegetation for one growing season, but limited mortality.

Wetlands in Mississippi, Alabama, and western Florida occur on a more stable substrate and receive more inorganic sediment per unit of wetland area than wetlands in Louisiana. These wetlands have not experienced the extensive alterations caused by canal dredging and rapid submergence rates that affect wetlands in Louisiana. Hence, these wetlands are not as stressed. In addition, the wetlands of Alabama and Florida are protected from Gulf waters by barrier islands and beaches. The works of Webb and his colleagues (Webb et al., 1981 and 1985; Alexander and Webb, 1983 and 1985) have been used in this analysis to evaluate and project wetland impacts of spills along the Mississippi, Alabama, and Florida coasts. The critical oil concentration here is assumed to be 1.0 l/m^2 (Alexander and Webb, 1983). Concentrations below this will result in short-term, aboveground, die-back for one growing season. Concentrations above this will result in longer-term impacts to wetland vegetation, including plant mortality extensive enough to require recolonization.

Estuaries have a greater suspended particulate load and greater microbial population; therefore, oil degrades more rapidly there (Lee, 1977). Oil that penetrates deeply into the sediments is less available for dissolution, oxidation, or microbial degradation. If buried, oil may be detectable in the sediments for 5 years or more, depending upon the circumstances. If a spill contacts wetlands that are exposed to wave and tidal actions, erosion will be accelerated, as documented by Alexander and Webb (1987). Based upon the above research, permanent loss of 10 percent of the affected wetland area is assumed to result from accelerated erosion in Louisiana after 10 years; 6 percent is assumed for the remaining area of potential impact from the proposed action.

The probability of an oil spill ≥1,000 bbl occurring and contacting Plaquemines Parish, Louisiana, within 10 days is 1 percent, and this is highest for all coastal counties and parishes. The inland wetlands of Louisiana are not as protected by barrier shorelines and tidal currents as are those of Alabama and Florida.

Since 1980, OCS-related spills in the Gulf of Mexico ≥1,000 bbl have ranged in size from 1,211 to 15,576 bbl (Table IV-20 of the Lease Sale 181 FEIS; USDOI, MMS, 2001a). A hypothetical surface spill of 4,600 bbl from the Lease Sale 224 area was modeled in winter and summer conditions using the ASA SIMAP model. Taking into account weathering and response/cleanup, an oil slick that would go ashore between the 3rd and10th days after a spill may contain 7-11 bbl of oil. The oil would be in a broken, discontinuous slick and would result in patchy contact with 4-6 mi (6.5-10 km) of shoreline extended over 11-20 mi (18-32 km) of shoreline. If any remaining oil were to enter bays or estuaries, it would likely further disperse as the waters of these bays and other estuaries are warmer and contain much more suspended particulate matter than Gulf waters, which accelerate slick dispersion. Elevated tides or strong southerly winds would be needed to deliver any remaining oil into vegetated wetlands located behind the narrow inland beaches or farther inland where there are no inland beaches, as seen in Louisiana. The topography of the shoreline beaches and barrier islands, especially along the Alabama and Florida coast, have well-developed dunes and beach ridges that provide protection to the wetlands and intermittent marshes located behind these landforms. This topography, combined with increasing beach slopes in these areas, prevents overwash for all except extreme storms, therefore minimizing the potential for oiling of these areas. Strong southerly winds and tidal currents would also further disperse the oil. For these reasons, no offshore spills related to the proposed action are projected to significantly contact inshore wetlands. Should a contact occur, oiling will be very light and spotty with short-term impacts to vegetation.

A spill resulting from a vessel collision or pipeline related to the proposed action is very unlikely. Should such an event occur, it could cause greater adverse impacts to wetlands than other types of spills because such a spill may occur away from spill containment systems of a port and in the immediate vicinity of wetlands. Stream, tidal, wind, and traffic currents can quickly spread slicks either through a canal or over open waters and then into bordering or flooded contiguous wetlands. Strong winds, waves, and currents needed to elevate water levels high enough to deposit an oil slick over inland wetland vegetation will further breakup and disperse a slick in proportion with the increased energy levels and water surface turbulence. In these situations, a large area of wetlands may be contacted in a spotty pattern and with generally low concentrations of spilled materials.

Summary and Conclusion

If offshore spills related to the proposed action occur, they are expected to cause light, localized impacts to inland, vegetated wetlands. Large inland spills that result from the proposed action are not anticipated. If any occur, they will most likely be located at service bases or other support facilities and would not be expected to affect wetlands. A spill resulting from a vessel collision or pipeline directly related to the proposed action is very unlikely. If one occurs, the degree of impacts to wetlands would depend on the spill's proximity to spill containment systems of a port, cleanup operations, and the spill's proximity to surrounding wetlands.

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 proposed action would be expected to be minimal in scope and short term in duration.

During the course of the MMS re-evaluation of baseline conditions of wetlands in the preparation of this SEIS MMS has documented that there have been hurricane-induced changes to the baseline conditions of the wetlands. The exposed nature of wetlands increases the potential for hurricane effects. Although the effects of the hurricanes were moderate to severe in some areas, the effects of the proposed action on wetlands would be negligible because (1) no pipeline landfalls are projected to occur as a result of the proposed action, (2) no new navigation channels are expected to result from the proposed action, and (3) the potential for an oil spill occurring and contacting wetlands is very low. The changes in the baseline condition of the wetlands would not exacerbate or increase the potential effects of the proposed action. No additional acreage would be impacted by the OCS Program because of the baseline changes in wetlands. The kinds, levels, or locations of impacts described in the above analysis sections leads MMS to project potential impacts to wetlands to be short-term and minimal in scope.

Cumulative Impacts

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. This analysis includes, by reference, the cumulative effects of prior OCS activities within the potential area of influence of the proposed action and addresses those activities associated with the CPA (USDOI, MMS, 2007a) and the Lease Sale 181 FEIS (USDOI, MMS, 2001a) that may be potentially affected by the proposed action. The cumulative effects of these past sales will be considered in relation to the additional impacts generated by the currently proposed action for Lease Sale 224 in the EPA. The effects of pipelines, canal dredging, vessel traffic, and oil spills on wetlands in the EPA are described in Section IV.D.1.a.(1)(b) of the Lease Sale 181 FEIS. Other impact-producing factors relevant to the cumulative analysis are discussed below.

The incremental contribution of proposed Lease Sale 224 to the cumulative impacts on coastal wetlands is expected to be very small. Activities associated with the proposed action require no additional navigation canals, no pipeline landfalls, and no increase in channel maintenance of existing channels. The use of existing onshore processing and transfer facilities as well as using existing pipelines in established transportation corridors eliminates the need for dredging or construction activities that would result in additional wetland losses as a result of the proposed action. The proposed action will use existing disposal sites approved for receiving OCS-related wastes; therefore, no additional wetlands will be needed for this purpose.

Wetland losses due to past and future onshore oil and gas exploration and production are anticipated to continue with a small portion of these losses attributable to OCS activities. Existing OCS support facilities, located primarily in Louisiana, are expected to require some level of dredging, channel deepening, and maintenance of access canals. All of these activities may result in the continued loss of, or accelerated loss of, coastal wetlands. At present, wetland loss in Louisiana is attributed to subsidence, salt-water intrusion, and lack of sediment sources, vessel traffic, dredged material disposal, and lack of erosion resistant sediment. Various estimates of the total, relative direct and indirect impacts of pipeline and navigation canals on wetland loss vary from 9 percent (Britsch and Dunbar 1993) and 33 percent (Penland et al., 2001a and b) to estimates of greater than 50 percent (Turner et al., 1982; Bass and Turner, 1997; Scaife et al., 1983). A 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% of overall wetland loss).

Wetland contacts by oil and chemical spills can occur from a number of sources. **Chapter 4.1.3.3** provides an estimate of future spill risk. This cumulative scenario discusses petroleum and products spills from all sources, inclusive of the OCS Program, imports, and State production. Spills related to vessel collisions have a low probability of occurrence. Should such a spill occur, it is projected to occur in the vicinity of the service base or in a channel accessing the service base. If a slick results from a collision, it would be driven and dispersed over the canal or bay by winds, vessel traffic, and currents. The oil stresses the wetland communities, making them more susceptible to saltwater intrusion, drought, disease, and other stressors (Ko and Day, 2004). Oil slicks associated with the EPA that contact land are expected to come ashore on barrier islands; however, due to sea conditions, weather, and travel distance to land, it is expected that the oil has weathered to the degree that most of the toxic components of the oil have been neutralized or minimized before coming ashore. Should an oil slick reach shore, the turbulence of tidal water passing through most tidal passes would breakup the slick, thereby accelerating dispersion and weathering. For the majority of these situations, light oiling of vegetated wetlands may occur, contributing 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. Offshore spills from non-OCS sources are assumed to display similar spill dispersion and weathering characteristics to that of OCS-related spills. Coastal OCS spills could occur as a result of pipeline accidents and barge or shuttle tanker accidents during transit or offloading. The frequency, size, and distribution of all coastal spills are provided in **Chapter 4.1.3.3**. Impacts of OCS coastal spills are also discussed in **Chapter 4.2.1.** 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** (USDOI, MMS, 2007). The majority of oil spills occurs in inland waters and is the result of pipeline breaks, vessel collisions, or the transfer of product at onshore service or production bases. Most of the projected inland spills from previous lease sales are at service bases, and the oil or diesel spill is normally contained to the site or that portion of the navigation channel adjacent to the facility. Most banks and “work yards” of these service facilities have the potential for great impact, but the damage would normally affect only the narrow margins of wetlands in front of the upland or hardened banks. The degree of damage would depend largely upon the species, community, and density of plants that make up these margins. Should an oil spill directly related to proposed Lease Sale 224 occur and reach inshore, it would, to a very small degree, contribute to the cumulative effect of all OCS- and non-OCS-related, oil-spill effects upon the described coastal resources.

Although no new pipeline and navigation channel construction is proposed for Lease Sale 224, future construction associated with OCS activity would be subject to current regulatory programs, modern construction techniques and mitigations or any new techniques for minimizing wetland impacts that might be developed in the future. Between 70 and 110 new pipeline landfalls from all OCS activities are projected with an assumed distribution of about 60 percent in Louisiana, 5 percent in Mississippi, and 35 percent in Alabama. The current MMS/USGS pipeline study is continuing to develop models that will aid in quantifying habitat loss associated with OCS activities. The currently proposed action associated with Lease Sale 224 is less than 2-4 percent of the OCS impacts that will occur during the lease period.

Although Lease Sale 224 is 125 mi (200 km) from nearest landfall, the areas of concerned described in the Final Multisale EIS and Lease Sale 181 FEIS were much closer to the wetland resources. Spills that occur in or near Chandeleur or Mississippi Sounds could potentially impact wetland habitat in or near the Gulf Islands National Seashore and the Breton National Wildlife Refuge and Wilderness Area. Because of their natural history, these areas are considered areas of special importance, and they support endangered and threatened species. These areas were severely impacted by Hurricane Katrina in August 2005. Because the inlets that connect Mississippi Sound with the marsh-fringed estuaries and lagoons within the islands are narrow, a small percentage of the oil that contacts the Sound side of the islands will be carried by the tides into interior lagoons. 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 will either be injected or disposed of in Gulf waters and will not affect coastal wetlands (**Chapter 4.1.1.4.2**). The barrier islands and beaches within the area of influence of the proposed action are not only farther removed (125 mi (200 km)) from potential oil-spill sources than the beaches in the previous lease sales noted above, these islands are also characterized by beach ridges and dune systems combined with overall higher elevations and slopes that act as protective barriers for the wetlands that are located landward of the beach front. The OSRA model runs for the proposed action (Lease Sale 224) indicate that the probability of a ≥1,000 bbl offshore spill occurring and reaching any of barrier island or recreational beaches is <0.5 percent.

The cumulative effects of human and natural activities in the coastal area have severely degraded the deltaic processes and 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, Mississippi, Alabama, and Florida, but at slower rates. The incremental contribution of any single proposed action or any single recent lease sale to the cumulative impacts on coastal wetlands is expected to be minimal.

Wetland loss rates in coastal Louisiana are well documented to have been as high as 10,878 ha/yr (42 mi^2/yr) during the late 1960's. Studies have shown that the landloss rate in coastal Louisiana for the period 1972-1990 slowed to between an estimated 6,475 ha/yr (25 mi^2/yr) (Louisiana Coastal Wetlands Conservation and Restoration Task Force, 1993) and 9,072 ha/yr (35 mi^2/yr) (USDOI, GS, 1998). It was estimated in 2000 that coastal Louisiana would continue to lose land at a rate of approximately 2,672 ha/year (10 mi^2/yr) over the next 50 years. Further, it was estimated that an additional net loss of 132,794 ha (512 mi^2) may occur by 2050, which is almost 10 percent of Louisiana's remaining coastal wetlands (Barras et al., 2003). However, in 2005 Hurricanes Katrina and Rita caused 217 mi^2 (138,880 ac) of land change (primarily wetlands to open water) (Barras, 2006). The cumulative effects of human and natural activities in the coastal area have severely degraded the deltaic processes and shifted the coastal area from a condition of net land building to one of net landloss (USACOE, 2004c).

Development pressures in the coastal regions of Louisiana, Mississippi, Alabama, and Florida have caused the loss of large areas of wetlands. In coastal Louisiana, oil and gas exploration and development resulted in the loss of wetlands through dredging for pipeline placement and access channels. In all coastal states, especially Mississippi, Alabama, and Florida, agricultural, residential, and commercial developments have been responsible for most wetlands losses. In the area between the Pearl River in Mississippi and Cape San Blas in Florida, canal dredging primarily accommodates commercial, residential, and recreational developments. In Florida, recreational and tourist developments have been particularly destructive. These trends are expected to continue. During the period of 2001-2040, between 248,830 and 346,590 ha (614,872 and 856, 442 ac) of wetland will be lost from the Louisiana coastal zone; 1,600-2,000 ha (3,954-4942 ac) will be lost from the Mississippi coastal zone. Wetland losses in the coastal zones of Alabama and Florida are assumed to be comparable with those in Mississippi. Increasing population and commercial pressures on the Gulf Coast are also causing pressures to expand ports and marinas there. The channel activities that will impact wetlands most will be navigational traffic, disposal of dredged materials, and development along the channels.

Overview of Existing Mitigation Techniques and Results

Existing regulations and permitting procedures indicate that development-related projects that affect wetlands are under a more detailed evaluation than years ago and that compensatory mitigation is required for wetland losses. Federal and State regulatory agencies require permit applicants to avoid wetland impacts to the greatest degree possible, minimize impacts to affected wetlands, and provide compensatory mitigation for unavoidable wetland impacts. Linear projects such as pipelines are designed to minimize damages given the particular setting and equipment to be installed. **Table 4-22** highlights and summarizes technical evidence for the use of various mitigating processes associated with pipeline construction, canals, dredging, and dredged material placement. The mitigation methods listed are the most common applied by the permitting agencies to minimize wetland impacts. The MMS is not a permitting agency of onshore pipelines, canals, dredging, and dredged material placement.

While land loss will continue from saltwater intrusion, the State of Louisiana along with COE has implemented freshwater diversion projects to minimize the effect of this saltwater induced landloss. Landloss will continue from vessel traffic; however, based on the minimal increase in traffic caused by the proposed action, loss would be negligible. The proposed action will not likely 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. Disposal of OCS wastes and drilling by-products will be delivered to existing facilities no additional wetland acres will be utilized.

Summary and Conclusion

The cumulative effects of human and natural activities in the coastal area have altered the deltaic processes and shifted the coastal area from a condition of net land building to one of net landloss (USACOE, 2004c). The proposed action would cause a minor incremental contribution to impacts on wetlands due to wake-induced erosion, channel maintenance, and accidental oil spills. Since these wetland degrading actions would continue due to existing OCS and non-OCS related activities and the expected impacts on wetlands from the proposed project are negligible, the cumulative effect of the proposed action is expected to be minimal.

During the course of the MMS re-evaluation of baseline conditions of wetlands in the preparation of this SEIS, MMS has documented that there have been hurricane-induced changes to the baseline conditions of the wetlands. The exposed nature of wetlands increases the potential for hurricane effects. Although the effects of the hurricanes were moderate to severe in some areas, the effects of the proposed action on wetlands would be negligible because (1) no pipeline landfalls are projected to occur as a result of the proposed action, (2) no new navigation channels are expected to result from the proposed action, and (3) the potential for an oil spill occurring and contacting wetlands is very low. The changes in the baseline condition of the wetlands would not exacerbate or increase the potential effects of the proposed action. No additional acreage would be impacted by the OCS Program because of the baseline changes in wetlands. The kinds, levels, or locations of impacts described in the above analysis sections leads MMS to project potential impacts to wetlands to be short term and minimal in scope.

4.3.3.3. Submerged Vegetation (seagrass)

Seagrasses in the area that could be affected by the proposed action are generally restricted to bays and shallow areas behind barrier islands in Mississippi and Chandeleur Sounds. Most beds of submerged aquatic vegetation located between the Southwest Pass of the Mississippi River and Cape San Blas, Florida, are inland of the barrier shorelines. Lower-salinity beds of submerged vegetation are found farther inland and discontinuously throughout the coastal zone of this area (Section III.B.1.c of USDOI, MMS, 2001a). Fairly extensive beds of dense seagrass may be found in estuarine areas behind the barrier islands throughout the Eastern Gulf. Sparse and patchy seagrass beds occur as far as 112 km (70 mi) offshore of the Florida Big Bend area (Zieman and Zieman, 1989) in water depths of at least 20 m (66 ft) (CSA, 1985 and 1987). Most submerged vegetation in this region usually remains submerged because of the micro-tidal regime of the northern Gulf. Only during extremely low, wind-driven tidal events would large acreages of beds be exposed to the air. Even then, their roots and rhizomes remain buried in the water bottom (Section III.B.2.c of USDOI, MMS, 2001a). Activities that may result from the proposed action and that could adversely affect submerged vegetation beds include oil spills, spill response and cleanup, maintenance dredging of navigational channels, and vessel traffic.

Routine Impacts

Maintenance Dredging

No new navigation channels are expected to be dredged as a result of the proposed action. Maintenance dredging schedules vary from yearly to rarely and will continue indefinitely. Deepwater activities are anticipated to increase, which will likely require greater use of larger service vessels for efficient operations and may cause greater use of shore bases associated with deeper channels. A very small portion of overall maintenance dredging would be attributable to the proposed action.

Light attenuation is responsible for most landscape-level losses of seagrass. The amount of light reaching a seagrass bed on the water bottom is the crucial factor determining seagrass meadow extent and productivity. Reduced light has been linked to reductions of both seagrass cover and productivity (Orth and Moore, 1983; Kenworthy and Haunert, 1991; Dunton, 1994; Czerny and Dunton, 1995). Dredging has been determined to be one of the major causes of light reduction that results in changes in seagrass cover, composition, and biomass. Changes in species composition are usually the result of natural processes (i.e., succession), but they can be caused by moderation of salinity resulting from dredging and increased saltwater intrusion. Changes in species composition resulting from dredging activities may affect resource availability for some fish and waterfowl that use seagrass habitat as nursery grounds.

For estuarine species that thrive in salinities of about 0.5-25 ppt, elevated turbidity due to dredging may not pose a significant problem because they have adapted to turbid, estuarine conditions. However, it could be a problem for seagrass beds in higher salinities and even for freshwater submerged aquatic vegetation that require clearer waters. Significantly reduced water clarity or shading for longer than about 4 days will decrease chlorophyll production. If such conditions continue for longer than about 2 weeks, plant density in the bed will begin to decrease. If plant density reduces significantly, further increases in turbidity will occur as the root, thatch, and leaf coverage decline.

While increased dredging in the Port Fourchon area may result, in a very small part, due to the proposed action, seagrass beds are not commonly found in that area. The area around Fourchon, Louisiana, typically has highly turbid waters that do not support the growth of seagrass beds. The proposed action is not expected to contribute to maintenance dredging for inshore navigation in any measurable degree. Adherence to coastal regulations is expected to limit impacts on seagrass resources to a low level.

Vessel Traffic

Navigation traffic that may support the proposed action is discussed in **Chapter 4.1.2.1.6**. Almost all of the vessel traffic expected to be generated as a result of the proposed action is projected to come through Bayou Lafourche. The port of Fourchon, Louisiana, on Bayou Lafourche, is one of the primary service bases for GOM mobile rigs and is a major platform service base. Deepwater activities require the use of large service vessels for efficient operations. Port Fourchon has already expanded its port infrastructure to accommodate these deeper-draft vessels. The FEMA has funded the dredging of several sites that were silted by Hurricanes Katrina and Rita. Port Fourchon has deepened the existing channel and has dredged additional new channels to facilitate expansion. At present, the entrance to Port Fourchon (Belle Pass Channel) is maintained at 29 ft (8.8 m). The inland channel in the port is 26 ft (7.9 m) and Bayou Lafourche is maintained at 24 ft (7.3 m). No new navigation channels are expected to be dredged as a result of the proposed action.

Prop wash of navigation channels by vessel traffic dredges up and resuspends sediments, increasing the turbidity of nearby coastal waters. The proposed action would contribute to a very small percentage of traffic through Belle Pass and Bayou Lafourche. There are no seagrass beds associated with Bayou Lafourche, Port Fourchon, or Belle Pass. Therefore, the proposed action is expected to have no impact on seagrass communities.

Summary and Conclusion

Most seagrass communities located between the Southwest Pass of the Mississippi River and Cape San Blas, Florida, are inland of the barrier shorelines. Because of the location of most seagrass communities, inshore oil spills pose the greatest threat (**Chapter 4.2.1.8**).

Maintenance dredging will not have a substantial impact on existing seagrass habitat because no new channels are expected to be dredged as a result of the proposed action.

During the course of the preparation of this SEIS, MMS has concluded that there have been hurricane-induced changes to the baseline conditions, particularity in the nearshore areas where seagrass communities may have been badly damaged. The determination of tropical storm effects are complicated by the broad scope of the changes in some areas combined with the short-term effect of the storms. Any alterations in the baseline condition of seagrass communities due to the recent hurricanes would not exacerbate or increase the potential effects of the proposed action. Although hurricane effects upon seagrass may be considered moderate to severe in some localized areas, the effect of the proposed action upon seagrasses would be negligible. The loss of seagrass through natural causes does not expand or cause the minor effects of the proposed action to become more harmful. Seagrass beds were already absent from the Lafourche/Port Fourchon area, where vessel traffic for the proposed action is expected to transit.

Accidental Impacts

Accidental impacts associated with the proposed action that could adversely affect seagrass beds include oil spills associated with the transport and storage of oil (**Chapter 4.2.1**). The degree of impact from oil spills depends on the location of the spill, oil slick characteristics, water depth, currents, and weather. Due to the distance and weathering of any spilled oil, offshore oil spills that occur in the proposed action area are much less likely to contact seagrass communities than are inshore spills and the seagrass beds are generally protected by barrier islands, peninsulas, sand spits, and currents. Spills that affect inshore seagrass communities are likely to be small coastal spills.

Some oils can emulsify; suspended particles in the water column will adsorb oil in a slick, decreasing the oil's suspendability and causing some of the oil to be dispersed downward into the water column. Typically, seagrass communities reduce water velocity among the vegetation as well as for a short distance above it, promoting sedimentation. Minute oil droplets, whether or not they are bound to suspended particulate, may adhere to the vegetation or other marine life, may be ingested by animals, or may settle onto bottom sediments. In all of these situations, oil has a limited life because it will be degraded chemically and biologically. Microbes, which are found in all marine environments, are considered the greatest degraders of oil (Zieman et al., 1984). Because estuaries have a greater suspended particulate load and greater microbial population, oil degrades more rapidly there (Lee, 1977). Oil that penetrates deeply into the sediments is less available for dissolution, oxidation, or microbial degradation. If buried, oil may be detectable in the sediments for 5 years or more, depending upon the circumstances.

The cleanup of slicks in shallow or protected waters (less than 5 ft deep) may be performed using johnboats or booms, anchors, and skimmers mounted on boats or shore vehicles. Activities over seagrass beds should be closely monitored to avoid digging into the bed. Wheeled or treaded vehicles should be prohibited. Cleanup methods using other vehicles that dig into the water bottom of the bed (e.g., boat anchors, boat bottoms, props, and booms that require water depths greater than that available over the bed) should not be used. Vehicles and equipment that require minimum water depths of about 6-10 in should be used instead. Personnel assisting in oil-spill cleanup in water shallower than 3-4 ft may readily wade through the water to complete their tasks (**Chapter 4.2.5**), but wading in seagrass beds is to be minimized. Repeated wading in a single path can cause significant damage. The probability of one or more oil spills ≥1,000 bbl occurring as a result of the proposed action ranges from 14 to 19 percent. The probabilities of a spill ≥1,000 bbl occurring and contacting environmental features are described in **Chapter 4.2.1.5**. The total estimated number of spill events over the 40-year life of the proposed action is 346-486 offshore spills (**Chapters 4.2.1.5 and 4.2.1.6**). Spills that could occur in coastal waters from proposed action support operations are estimated at 6-12 spills for the proposed action.

The risk of an offshore spill ≥1,000 bbl occurring and contacting coastal counties and parishes was calculated by MMS's oil-spill trajectory model. Counties and parishes are used as an indicator of the risk of an offshore spill reaching sensitive coastal environments. **Figure 4-4** provide the results of the OSRA model that calculated the probability of a spill ≥1, 000 bbl occurring offshore as a result of the proposed action and reaching a Gulf Coast county or parish. The probabilities are very small. Plaquemines Parish, Louisiana, has a 1 percent risk of an OCS offshore spill ≥1,000 bbl occurring and contacting its shoreline. For all other counties and parishes on the Gulf Coast, the risk is <0.5 percent.

Inland seagrass beds are generally protected from offshore spills by barrier islands, shoals, shorelines, and currents. These beds are generally more susceptible to contact by inshore spills, which have a low probability of occurrence. Inshore vessel collisions may release fuel and lubricant oils, and pipeline ruptures may release crude and condensate oil. In the Deltaic Plain region of the Gulf, seagrass beds remain submerged due to the micro-tides that occur there. During calm weather, oil on the sea surface would not contact most seagrasses directly. Rough weather can produce increased mixing that would bring oil below the surface and result in oil contacting seagrass communities directly. Their regenerative roots and rhizomes are buried in the water bottom, where they are further protected (**Chapter 3.2.1.3**). Should an oil slick pass over these seagrass communities, damage would occur if an unusually low tide were to occur, causing contact with seagrass. A slick could pass over and remain over a submerged bed of vegetation in a protected embayment during typical fair-weather conditions. This would reduce light levels in the bed. If light reduction continues for several days, chlorophyll content in the leaves will be reduced (Wolfe et al., 1988), causing the grasses to yellow and reducing their productivity. Shading by an oil slick of the sizes described should not last long enough to cause mortality, depending upon the slick thickness, currents, weather, and the nature of the embayment. In addition, a slick that remains over seagrass beds in an embayment will also reduce or eliminate oxygen exchange between the air and the water of the embayment. Oxygen depletion is a serious problem for seagrasses (Wolfe et al., 1988). If currents flush little oxygenated water between the embayment and the larger waterbody and if the biochemical oxygen demand (BOD) is high, as it would be in a shallow water bed of vegetation, and then enhanced by an additional burden of oil, the grasses and related epifauna will be stressed and perhaps suffocated. In this situation, the degree of suffocation will depend upon the reduced oxygen concentration and duration of those conditions. Oxygen concentrations and their duration depend upon currents, tides, weather, temperature, percentage of slick coverage, and BOD.

Should weather conditions or currents increase water turbulence sufficiently, a substantial amount of oil from the surface slick will be dispersed downward into the water column. There it will adsorb to suspended particles in the water column, becoming less buoyant. Submerged vegetation reduces water velocity, promoting sedimentation among the vegetation. Typically, this oily sedimentation will not cause long-term or permanent damage to the seagrass communities. Some dieback of leaves would be expected for one growing season. In a severe case where high concentrations of hydrocarbons are mixed into the water column, the diversity or population of epifauna and benthic fauna found in seagrass beds could be impacted. Seagrass epiphytes are sessile plants that grow attached to their seagrass host; they play an important role in the highly productive seagrass ecosystem. The small animals, such as amphipods, limpets and snails, would likely show more lethal effects than the epiphytic plant species. Some fauna are more susceptible to oil impacts than others. No permanent loss of seagrass habitat is projected to result from the spill unless an unusually low tidal event allows direct contact between the slick and the vegetation. Seagrass stands usually recover from oil impacts in about a year, with subsequent rapid colonization by fauna. However, it may take as much as 5-10 years of community succession before faunal composition resembles pre-impact conditions (Chan, 1977; Zieman et al., 1984; NRC, 1985 and 2003; Proffitt and Roscigno, 1996).

No significant burial of the oil is expected to occur from any one spill. Oil measured at some depth usually means the area is impacted by chronic oil contamination, new sediments are spread over the area, or heavy foot or other traffic works the oil into the bottom sediment. Scarring may occur if an oil slick is cleaned up over a shallow submerged aquatic vegetation bed where vessels, booms, anchors, and personnel on foot would be used and scar the bed. As mandated by OPA 90, seagrass beds and live-bottom communities are expected to receive individual consideration during spill cleanup.

Summary and Conclusion

Should a spill ≥1,000 bbl occur offshore from activities resulting from the proposed action, the seagrass communities with the highest probabilities of contact within 10 days would be Plaquemines Parish, Louisiana, with a 1 percent probability. Because of the location of most submerged aquatic vegetation, inshore spills pose the greatest threat. Such spills may result from either vessel collisions that release fuel and lubricants or from pipelines that rupture. Under certain conditions, a slick could reduce dissolved oxygen in an embayment and cause stress to the bed and associated organisms due to reduced oxygen conditions. These light and oxygen problems can correct themselves once the slick largely vacates the embayment and light and oxygen levels are returned to pre-slick conditions. These events are unlikely, as the nearshore spills are much smaller in volume and weather quickly. Should they occur, these impacts would be considered short term in duration and minor in scope.

Although the probability of their occurrence is low, the greatest threat to inland, seagrass communities would be from an inland spill resulting from a vessel accident or pipeline rupture. Although a resulting slick may cause minor impacts to the bed, equipment and personnel used to clean up a slick over shallow seagrass beds may generate the greatest direct impacts to the area. Associated foot traffic may work oil farther into the sediment than would otherwise occur. Scarring may occur if an oil slick is cleaned up over a shallow submerged aquatic vegetation bed where vessels, booms, anchors, and personnel on foot would be used and scar the bed. Close monitoring and restrictions on the use of bottom-disturbing equipment would be needed to avoid or minimize those impacts.

During the course of the preparation of this SEIS, MMS has concluded that there have been hurricane-induced changes to the baseline conditions, particularity in the near-shore areas where seagrass communities may have been badly damaged. The determination of tropical storm effects are complicated by the broad scope of the changes in some areas combined with the short-term effect of the storms, Any alterations in the baseline condition of seagrass communities due to the recent hurricanes would not exacerbate or increase the potential effects of the proposed action. Although hurricane effects upon seagrass may be considered moderate to severe in some localized areas, the effect of the proposed action upon seagrass would be negligible. The loss of seagrass through natural causes does not expand or cause the minor effects of the proposed action to become more harmful. Seagrass beds were already absent from the Lafourche/Port Fourchon area, where vessel traffic for the proposed action is expected to transit.

Cumulative Impacts

Water Controls

Leveeing and deepening of the Mississippi River has affected submerged vegetation beds in the Mississippi and Chandeleur Sounds by reducing freshwater flows and flooding into those estuaries, changing the salinity regime. Because of increased salinities, some species of submerged vegetation have shifted to areas farther inland, where sediment conditions are not as ideal. The original beds were then subjected to salinities too high for their physiology. In turn, freshwater flow increased around the mouths of rivers that were modified for flood control; hence, beds of submerged vegetation may have become established farther seaward where conditions were favorable, displacing species that preferred higher salinity. These adjustments have occurred in the cumulative activity area. In addition, when high-water stages in the Mississippi River cause the opening of the Bonnet Carre' Spillway to divert flood waters into Lake Pontchartrain, this freshwater eventually flows into Mississippi and Chandeleur Sounds, lowering salinities there. In the past, spillway openings have been associated with as much as a 16 percent loss in seagrass 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 in the area. Reduced salinities there have induced a large increase in the acreage of submerged freshwater vegetation. Seagrasses may then reestablish in regions that were previously too saline for them.

Oil Spills

Because of the usual floating nature of oil and the regional microtidal range, oil spills alone would typically have very little impact on seagrass beds because floating oil would not come in contact with the submerged seagrass. Increased wave action can increase impacts to submerged vegetation and the community of organisms that reside in these beds by forcing oil from the slick into the water column. Unusually low tidal events would also increase the risk of oil having direct contact with the vegetation. Even then, epifauna residing in these vegetation beds would be more heavily impacted than the vegetation itself.

Based on information presented in Sections IV.D.1.a.(1)(b) and (c) of the Lease Sale 181 FEIS (USDOI, MMS, 2001a), oil spills from inland oil-handling facilities and navigation traffic have a greater potential for impacting wetlands and submerged vegetation. Oil spilled in Federal offshore waters is not projected to significantly impact submerged aquatic vegetation. Given the large number of oil wells and pipelines in eastern coastal Louisiana and the volumes of oil piped through that area from the OCS, the risk of oil-spill contacts to the few seagrass beds in that vicinity would be higher than elsewhere in the cumulative activity area.

Oil-spill impacts to seagrasses are discussed in general in Section IV.D.1.a.(1)(c) of the Lease Sale 181 FEIS (USDOI, MMS, 2001a). Oiling of submerged vegetation would result in die-back of the vegetation and associated epifauna, which would be replaced for the most part in 1-2 growing seasons, depending upon the season in which the spill occurs. However, it may take as much as 5-10 years of community succession before faunal composition resembles pre-impact conditions. Although little or no direct mortality of seagrass beds is expected as a result of oil-spill occurrences, contact of seagrasses with crude or refined oil products has been implicated as a causative factor in the decline of seagrass beds and in the observed changes in species composition within them (Eleuterius, 1987). The cleanup of slicks in shallow, protected waters (less than 5 ft (1.5 m) deep) can cause significant scarring and trampling of submerged vegetation beds.

Scarring

The scarring of seagrass beds is an increasing concern in Florida. Scarring most commonly occurs in seagrass beds that occur in water depths shallower than 2 m (6 ft), as a result of boats of all classes operating in water that is too shallow for them. Boat propellers, and occasionally keels, plow though shallow water bottoms, tearing up the roots, rhizomes, and whole plants, leaving a furrow that is devoid of seagrasses. Other causes include anchor drags, trawling, and trampling (Sargent et al., 1995; Preen, 1996).

Although the greatest scarring of seagrasses has resulted from smaller boats operating in the vicinities of the greatest human population and boat registration densities, the greatest single scars have resulted from commercial vessels. The Panhandle area, west of Cape San Blas, Florida, has had little moderate or severe scarring, and the area also has fewer acres of seagrasses. Scarring may have a more critical effect on habitat functions in areas with less submerged vegetation.

A few local governments of the Florida Panhandle have instituted management programs to reduce scarring. These programs include education, channel marking, increased enforcement, and limited-motoring zones. Initial results indicate that scarring can be reduced.

Dredging

Dredge and fill activities are the greatest threats to submerged vegetation (Wolfe et al., 1988). Existing and projected lengths of OCS-related pipelines and OCS-related dredging activities are described in Sections IV.B.1.h and j, and III.A.2.a and b of the Lease Sale 181 FEIS (USDOI, MMS, 2001a). The dynamics of how these activities impact submerged vegetation is discussed in Section IV.D.1.a.(1)(c) of the Lease Sale 181 FEIS. The main impacts to submerged vegetation generated by dredging include removal, burial, oxygen depletion, and increased turbidity. Turbidity is most damaging to beds in waterbodies that are enclosed, have relatively long flushing periods, and contain bottom sediments that are easily suspended for long periods of time

As discussed in Section IV.B.1.h. of the Lease Sale 181 FEIS (USDOI, MMS, 2001a), the cumulative length of pipelines carrying petroleum produced in State territories is unknown. The cumulative length of cables through the cumulative activity area is also unknown. Only a very small percentage of existing and future pipeline and cable lengths is believed to be in the vicinity of submerged vegetation.

Impacts caused by installing new navigation channels are greater than those for pipeline installation. New canal dredging causes a much wider and deeper footprint. Much more material and fine materials are disturbed; hence, turbidity in the vicinity of canal dredging is much greater, persists for longer periods of time, and turbidity extends over greater distances and acreages. New canals and related disposal of dredged material also cause significant changes in regional hydrodynamics and associated erosion. Significant secondary impacts include wake erosion resulting from navigational traffic. New canals can also induce additional development.

Most impacts to lower-salinity species of submerged vegetation by new channel dredging within the cumulative activity area have occurred in Louisiana. This will continue to be the case in the foreseeable future. Similarly, most impacts to higher-salinity species of submerged vegetation have occurred in Florida, where beds have been much more abundant. Reduction of submerged vegetation in the bays of Florida is largely attributed to increased turbidity, primarily due to dredge and fill activities (Wolfe et al., 1988). Channel dredging to facilitate, create, and maintain waterfront real estate, marinas, and waterways will continue to be a major impact-producing factor. Shoreline development often causes changes in the wave regime, increasing the energy level of waves impacting the water bottom and resulting in the loss of seagrass beds at that location.

The waterway maintenance program of COE has been operating in the cumulative activity area for decades (USDOI, MMS, 2001a). Impacts generated by initial channel excavations are sustained by regular maintenance activities performed every 2-5 years or perhaps less frequently. The patterns of submerged vegetation have adjusted accordingly. Maintenance activities are projected to continue into the future regardless of the OCS activities. If the patterns of maintenance dredging change, then the patterns of submerged vegetation distribution may also change.

In areas where typical spoil banks are used to store dredged materials, the usual fluid nature of mud and subsequent erosion causes spoil bank widening, which may bury nearby waterbottoms and submerged vegetation and increase turbidity in the area. Those waterbottoms may become elevated, converting some nonvegetated waterbottoms to shallower waterbottoms that may become vegetated due to increased light at the new soil surface. Some of these waterbottoms may also be converted to wetlands, or even uplands, by the increased elevation.

Plans for installation of new linear facilities and maintenance dredging are reviewed by a variety of Federal, State, and local agencies, as well as by the interested public for the purposes of receiving necessary government approvals. Mitigation may be required to reduce undesirable impacts. The most effective mitigation for direct impacts to submerged vegetation beds is avoidance with a wide berth around them. Turbidity can also be controlled by using turbidity curtains.

Summary and Conclusion

Under the cumulative scenario, impacts associated with the proposed action must be considered with respect to all actions that may have impacted or will impact seagrass communities. The proposed action is far removed from any seagrass communities and is not expected to contribute to any measurable degree to associated cumulative impacts. Cumulative effects include hydrologic management projects, such as the large, water control structures associated with the Mississippi River that influence salinities in coastal areas, which in turn influence the locations of submerged vegetation. Where flooding or other freshwater flow to the sea is reduced, regional average salinities generally increase. Beds of submerged vegetation adjust their locations based on their salinity needs. If the appropriate salinity range for a species is located where other environmental circumstances are not favorable, the new beds will be either not as large, not as dense, or they may not colonize there at all.

For the region between the Mississippi River and Bay County, Florida, inshore oil spills generally present greater risks of adversely impacting submerged vegetation than do offshore spills. Oil spills alone would typically have very little impact on beds of submerged vegetation. Usually, epifauna residing within the submerged vegetation is much more heavily impacted than the vegetation. The cleanup of slicks while the slick is over shallow, protected waters that are less than 5 ft deep can cause significant scarring and trampling of submerged vegetation beds.

Beds of submerged vegetation can be scarred by anchor drags, trampling, trawling, and boats operating in water that is too shallow for their keels or propellers. These actions remove or crush plants. The greatest scarring results from smaller boats operating in the vicinities of larger populations of humans and registered boats. A few local governments have instituted management programs to reduce scarring.

Dredging causes problems for beds of submerged vegetation. These actions dig up, bury, and smother plants; decrease oxygen in the water; and reduce the amount of sunlight that reaches the plants. Dredging generates the greatest overall risk to submerged vegetation and is largely accredited with the decline of submerged vegetation in the bays of the Florida Panhandle. Within the cumulative activity area, most dredging that impacts lower salinity submerged vegetation has occurred in Louisiana. No new pipeline landfalls are projected as a result of the proposed action.

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. The oil and gas industry and land developers perform most new dredging in the cumulative activity area. Maintenance dredging of navigation channels may sustain the impacts of original dredging.

In general, the proposed action could cause a minor incremental contribution to impacts to submerged vegetation due to dredging, boat scarring, and possibly oil spills. Because channel maintenance, land development, and flood control will continue, with only minor impacts attributable to OCS activities, the proposed action would cause no significant incremental contribution to these activities or to their impacts upon submerged aquatic vegetation beds.

During the course of the preparation of this SEIS, MMS has concluded that there have been hurricane-induced changes to the baseline conditions, particularity in the nearshore areas where seagrass communities may have been badly damaged. The determination of tropical storm effects is complicated by the broad scope of the changes in some areas combined with the short-term effect of the storms. Any alterations in the baseline condition of seagrass communities due to the recent hurricanes would not exacerbate or increase the potential effects of the proposed action. Although hurricane effects upon seagrass may be considered moderate to severe in some localized areas, the effect of the proposed action upon seagrasses would be negligible. The loss of seagrass through natural causes does not expand or cause the minor effects of the proposed action to become more harmful. Seagrass beds were already absent from the Lafourche/Port Fourchon area, where vessel traffic for the proposed action is expected to transit.

4.3.4. Impacts on Sensitive Offshore Benthic Resources

Chemosynthetic Deepwater Benthic Communities

Routine Impacts

Section IV.D.1.a.(2)(b) of the Lease Sale 181 FEIS (USDOI, MMS, 2001a) describes in detail the routine impacts associated with OCS-related activities. The following information summarizes and supplements the material provided by the previous EIS.

Chemosynthetic communities are found in water depths greater than 400 m (1,312 ft). Of the 60+ known communities, only a single community is known from the Eastern Gulf of Mexico; southeast of the proposed sale area along the base of the escarpment at about 26˚ N. latitude where the first chemosynthetic community in the GOM was discovered in 1984 (Paull et al., 1984). The levels of projected impact-producing factors for deep water offshore are shown in **Table 4-2**.

Physical

The greatest potential for adverse impacts on deepwater chemosynthetic communities from routine activities associated with the proposed action would come from those OCS-related, bottom-disturbing activities associated with pipelaying, anchoring, and structure emplacement. Considerable localized mechanical damage could be inflicted upon the bottom by routine OCS drilling activities. However, the physical disturbance by structures related to a drilling operation itself affects a small area of the sea bottom. Only templates or relatively small subsea structures would be used in the Sale 224 area. The water is too deep for any conventional bottom-founded platforms.

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 severe disturbances to small areas of the seafloor. The areal extent and severity of the impact are related to the size of the mooring anchor and the length of chain resting on the bottom. Excessive scope and the movement of the mooring chain could disturb a much larger bottom area than an anchor alone, depending on the variety of prevailing wind and current directions. Many oil and gas support operations involving ships and boats would not result in anchor impacts on deepwater chemosynthetic communities because the vessels would tie-up directly to rigs, platforms, or mooring buoys. In addition, there are drillships, construction barges, and pipelaying vessels operating in the GOM that rely on dynamic positioning rather than conventional anchors to maintain their position during operations (anchoring would not be a consideration in these situations).

Normal pipelaying activities in deepwater areas could destroy areas of chemosynthetic organisms if not avoided (it is assumed that 0.32 ha (0.79 ac) of bottom is disturbed per kilometer of pipeline installed). Since pipeline systems are not as established in deep water as in shallow water, new installations are required, which will tie into existing systems. Pipelines will also be required to transport product from subsea systems to fixed platforms. Pipelaying activities will very likely be accomplished using dynamically positioned vessels throughout the deep Sale 224 area.

In addition to physical impacts, structure removals and other bottom-disturbing activities could resuspend bottom sediments. The potential effects of resuspended bottom sediments are similar to those from the discharge of muds and cuttings discussed below. In deep water, the probability that infrastructure will be left on the seabed is likely higher. As one example, the ConocoPhillips Joliet platform was the first TLP in the GOM and was installed in 1986 at a depth of 537 m (1,762 ft) in Green Canyon Block 184. The subsea template will be left in place after severing the tendons connecting the floating structure. This option will virtually eliminate all bottom-disturbing impacts. The well-studied Bush Hill is located only about 1.26 nmi (2.33 km) from the TLP bottom template.

The impacts from bottom-disturbing activities directly on chemosynthetic communities are expected to be extremely rare because of the application of protective measures required by NTL 2000-G20. Should they occur, these impacts could be quite severe to the immediate area affected, with recovery times as long as 200 years for mature tube-worm communities, with the possibility of the community never recovering.

Discharges

A major new deepwater effects study funded by MMS was completed in 2006, *Effects of Oil and Gas Exploration and Development at Selected Continental Slope Sites in the Gulf of Mexico* (CSA, 2006). This project included determinations of the extent of muds and cuttings accumulations resulting from both exploratory and development drilling at three sites in approximately 1,000 m (3,281 ft) of water. Geophysical and chemical measurements indicated that a layer of cuttings and muds several centimeters thick was deposited within the 500-m (1,640-ft) radius of what was termed near-field stations. A combination of a smooth seafloor (little backscatter on sidescan-sonar records) and a high amplitude response at the seafloor on high-resolution, subbottom profiles was used to identify areas of probable drilling mud deposition. Areas where sidescan sonar showed high reflectivity extending in a radial pattern around the well sites were interpreted as cuttings. Generally, areas mapped as drilling muds were identified within about 100 m (328 ft) of wellsites. Areas mapped as cuttings typically extended several hundred meters from well sites, with the greatest distance of about 1 km (0.6 mi) observed at two study sites. Geophysically mapped cuttings zones ranged from 13 to 109 ha (32 to 269 ac) in area, with larger zones observed at post-development sites.

Discretionary samples taken in likely mud/cuttings areas provided information about the thickness of muds and cuttings at a few stations. Sediment cores indicated accumulations of 2-4 cm (1-2 in) using concentrations of barium, total organic carbon, and lead 210 (^{210}Pb). These data suggest that some smothering of benthic organisms may occur in the immediate vicinity of the drilling. Larger, motile species would not be impacted as they would move from the impacted area.

Reservoir Depletion

Based on current information, it is not possible to determine whether reduced reservoir pressure would actually reduce the seepage (as observed onshore) or whether there may be enough oil already in the conduit to the surface to continue adequate levels of seepage for long periods, perhaps thousands of years or more. In the case of the well-studied, Bush Hill community in Green Canyon Block 184, there has been no detectable change in community composition resulting from extraction of the hydrocarbon reserves by the nearby ConocoPhillips Joliet production field over the last 20 years. The Jolliet platform is scheduled to be removed in the near future after having extracted all economically recoverable hydrocarbons from the same source location that is connected to the Bush Hill community. The distribution of chemosynthetic communities is known to occur in association with precise levels and types of chemical gradients at the seafloor; alterations to these gradients in either the near or distant future may potentially impact the type and distribution of the associated biological community.

NTL 2000-G20 has been a measure for the protection of chemosynthetic communities since February 1, 1989. Now, NTL 2000-G20 makes mandatory the search for and avoidance of dense chemosynthetic communities (such as Bush Hill-type communities) or areas that have a high potential for supporting these community types, as interpreted from geophysical records. The NTL is exercised on all applicable leases and is not an optional protective measure. Under the provisions of this NTL, lessees operating in water depths greater than 400 m (1,312 ft) are required to conduct geophysical surveys of the area of proposed activities and to evaluate the data for indications of conditions that may support chemosynthetic communities. If such conditions are indicated, the lessee must either move the operation to avoid the potential communities or provide photo documentation of the presence or absence of dense chemosynthetic communities of the Bush Hill type. Requirements for specific separation distances between potential high-density chemosynthetic communities and both anchors (250-500 ft, 76-152 m) and drilling discharge points (1,500 ft, 457 m) have been included in the newest revision of the NTL. If such communities are indeed present, no drilling operations or other bottom-disturbing activities may take place in the area; if the communities are not present, drilling, anchoring, etc. may proceed. To date, in almost all cases, operators have chosen to avoid any areas that show the potential to support chemosynthetic communities. The basic assumptions underlying the provisions of this mitigation measure are (1) that dense chemosynthetic communities are associated with gas-charged sediments and oil or gas seeps, (2) that the gas-charged sediment zones or seeps have physical characteristics that will allow them to be identified by geophysical surveys, and (3) that dense chemosynthetic communities are not found in areas where gas-charged sediments or seeps are not indicated on the geophysical survey data. These assumptions have not been totally verified. A definitive correlation between the geophysical characteristics recorded by geophysical surveys and the presence of chemosynthetic communities has not been proven; however, the associations have proven to be very reliable in most all situations encountered to date, particularly on the upper continental slope.

The reliability of correlation between remote-sensing signatures and the presence of high-density communities may be reduced or different on the lower slope of the GOM. A new major study is ongoing at the time of this writing (May 2007) to investigate specifically this concern. Funded by both MMS and NOAA's Office of Ocean Exploration, this 4-year project will explore for and study chemosynthetic communities located deeper than 1,000 m (3,281 ft). As new information becomes available, the NTL will be further modified as necessary.

Summary and Conclusion

Chemosynthetic communities are susceptible to physical impacts from structure placement (including templates or subsea completions), anchoring, and pipeline installation. The provisions of NTL 2000-G20 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 impacting activities.

If the presence of a high-density community were missed using existing procedures, potentially severe or catastrophic impacts could occur due to contact or raking of the sea bottom by anchors and anchor chains and partial or complete burial by muds and cuttings including those associated with pre-riser discharges or some types of riserless drilling. 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 would permanently prevent reestablishment in the same locations.

The proposed action is expected to cause no damage to the ecological function or biological productivity of either low-density chemosynthetic communities or the rarer, widely scattered, high-density, Bush Hill-type chemosynthetic communities, as there is no expected suitable chemosynthetic community habitat located in the Sale 224 area.

During the course of this reevaluation of the baseline conditions for factors potentially affecting chemosynthetic deepwater benthic communities, including hurricane effects, MMS has concluded that there could have been hurricane-induced changes to benthic communities on the OCS. The deepwater nature of chemosynthetic resources essentially eliminates the possibility of hurricane effects in contrast to shallow-water communities. The effects of the proposed action (i.e., burial, resuspension of sediments, and structure emplacement) on the benthic communities would be negligible since physical disturbances to the resources are effectively offset by avoidance criteria set forth in NTL 2000-G20. Since no chemosynthetic communities are expected to occur in the proposed sale area, no impacts to these kinds of deepwater benthic resources are expected as a result of the proposed action.

Accidental Impacts

Accidental events associated with the proposed action that could impact chemosynthetic communities are limited primarily to blowouts. A blowout at the seafloor could create a crater and could resuspend and disburse large quantities of bottom sediments within a 300-m (984-ft) radius from the blowout site, and thus organisms located within that distance. The application of avoidance criteria for chemosynthetic communities required by NTL 2000-G20 should preclude the impact of a blowout to a distance of at least 457 m (1,500 ft). In addition, there are no suitable habitat areas for chemosynthetic communities within the Sale 224 area.

Impacts to chemosynthetic communities from any oil released would be a remote possibility. All known reserves in the GOM to date have specific gravity characteristics that would preclude oil from sinking immediately after release at a blowout site. The potential for weathered components from a surface slick reaching a chemosynthetic community in any measurable volume would be very small.

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 distant communities are located. Oil spills at the surface would tend not to sink. All evidence to date indicates that accidental oil discharges that occur at the seafloor from a pipeline or blowout would rise in the water column, surfacing almost directly over the source location (**Chapter 4.2.1.5.4**), and thus not impacting the benthos. The risk for weathering components from a surface slick reaching the benthos in any measurable concentrations would be very small.

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), 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 would permanently prevent reestablishment, particularly if hard substrate required for recolonization was buried.

As the result of the proposed action, 0-1 blowout is estimated. The application of avoidance criteria for chemosynthetic communities required by NTL 2000-G20 should preclude any impact from a blowout at a minimum distance of 457 m (1,500 ft), which is beyond the distance of expected benthic disturbance. There are no suitable habitat areas for chemosynthetic communities within the Sale 224 area.

The risk of various sizes of oil spills occurring as a result of the proposed action is presented in **Table 4-13.** The probability of oil in any measurable concentration reaching depths of 400 m (1,312 ft) or greater is very small.

Summary and Conclusion

Chemosynthetic communities could be susceptible to physical impacts from a blowout depending on bottom-current conditions and if they occurred in the Sale 224 area, but there is likely no suitable conditions for them anywhere in the area. The provisions of NTL 2000-G20 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 emplacement.

Potential accidental impacts from the proposed action are not expected to cause damage to the ecological function or biological productivity of either low-density chemosynthetic communities or the rarer, widely scattered, high-density, Bush Hill-type chemosynthetic communities, as there are no suitable habitat areas expected in the proposed sale area.

During the course of this reevaluation of the baseline conditions for factors potentially affecting chemosynthetic deepwater benthic communities, including hurricane effects, MMS has concluded that there could have been hurricane-induced changes to benthic communities on the OCS. The deepwater nature of chemosynthetic resources essentially eliminates the possibility of hurricane effects in contrast to shallow-water communities. The effects of the proposed action (i.e., blowouts and accidental spills) on the benthic communities would be negligible since physical disturbances to the resources are effectively offset by avoidance criteria set forth in NTL 2000-G20. Since no chemosynthetic communities are expected to occur in the proposed sale area, no impacts to these kinds of deepwater benthic resources are expected as a result of the proposed action.

Nonchemosynthetic Deepwater Benthic Communities

Routine Impacts

Section IV.D.1.a.(2)(b) of the Lease Sale 181 FEIS (USDOI, MMS, 2001a) describes in detail the routine impacts associated with OCS-related activities. The following information supplements the material provided by the previous study.

Physical

The greatest potential for adverse impacts from routine activities associated with the proposed action on nonchemosynthetic communities would come from those OCS-related, bottom-disturbing activities associated with pipelaying, anchoring, and structure emplacement. As described in the previous section for chemosynthetic communities, considerable localized mechanical damage could be inflicted upon nonchemosynthetic communities by routine OCS drilling activities. However, the physical disturbance by structures related to a drilling operation itself affects a small area of the sea bottom. Only templates or relatively small subsea structures would be used in the deep Sale 224 area. The water is too deep for any conventional bottom-founded platforms.

Anchors from support boats and ships (or from any buoys set out to moor vessels), floating drilling units, pipelaying vessels, and pipeline repair vessels also cause severe disturbances to small areas of the seafloor with the areal extent related to the size of the mooring anchor and length of chain that would rest on the bottom. Excessive scope (length) and movement of the mooring chain could disturb a much larger area of the bottom than would an anchor alone, depending on the prevailing wind and current directions. The use of other anchoring technologies such as suction pile anchors would reduce the impacted area. Anchoring will 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). 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 large in relation to the area inhabited by fragile hard corals or other organisms that rely on exposed hard substrate.

As described in the previous section for chemosynthetic communities, normal pipelaying activities in deepwater areas could destroy large areas of benthic communities (it is assumed that 0.32 ha (0.79 ac) of bottom is disturbed per kilometer of pipeline installed); although, without consideration of chemosynthetic organisms, there are no differences between this activity in deep water as compared to shallow-water operations below 200 ft (61 m) where pipeline burial is not required.

In addition to direct physical impacts, structure removals and other bottom-disturbing activities could resuspend bottom sediments. The potential effects of resuspended bottom sediments are similar to those from the discharge of muds and cuttings discussed below.

Discharges

Information regarding the impacts of drilling muds and cuttings can also be found in **Chapter 4.3.2.2**. Some information about the effects of the surface discharge of drilling fluids (muds) and cuttings at a well in 565 m (1,854 ft) of water has been reported by Gallaway and Beaubien (1997), as well as a major new study looking at both exploratory and production drilling in water depths of 1,000 m (3,281 ft) (CSA, 2006). The latter study found drilling mud accumulations ranging up to several hundred meters away from wells in thickness ranging from 2 to 4 cm (1 to 2 in).

Impact from muds and cuttings are also expected from two additional sources: (1) initial well drilling prior to the use of a riser to circulate returns to the surface; and (2) the potential use of various riserless drilling techniques in the deep sea. Burial by sediments or rock fragments originating from drilling muds and cuttings discharges could smother and kill almost all community components of benthic organisms, with the exception of highly motile fish and possibly some crustaceans such as shrimp capable of moving away from the impacted area. Depending on the organism type, just a few centimeters of burial could cause death. The damage would be both mechanical and toxicological. Some types of macrofauna could burrow through gradual accumulations of overlying sediments depending on the toxicological effects of those added materials. Information on the potential toxic effects on various benthic organisms is limited and essentially nonexistent for deepwater taxa.

It can be expected that detrimental effects due to burial would decrease exponentially with distance from the origin. The physical properties of the naturally occurring surface sediment (grain size, porosity, and pore water) could also be changed as a result of discharges such that recolonizing benthic organisms would be comprised of different species than inhabited the area previous to the impact. Although the impacts could be considered severe to the nonmotile benthos in the immediate area affected, they would be considered very temporary. Due to the proximity of undisturbed bottom with similar populations of benthic organisms ranging in size from microbenthos to megafauna, these impacts would be very localized and reversible at the population level and are not considered significant.

Carbonate outcrops and deepwater coral communities not associated with chemosynthetic communities, such as the deepwater coral "reef" or habitat first reported by Moore and Bullis (1960) and later by Schroeder (2002), are considered to be most at risk from oil and gas operations. Because deepwater corals require hard substrate, existing communities completely buried by some amount of sediment would likely never recover. Burial of previously exposed hard substrate would prevent future recolonization until some event that excavated the substrate again. As mentioned earlier, there may be exposed hard substrate from portions of the Florida Escarpment carbonate platform with potential associated attached communities.

Effluents other than muds or cuttings from routine OCS operations in deep water would be subject to rapid dilution and dispersion and are not projected to reach the seafloor at depths greater than 100 m (328 ft).

As a result of the proposed action, only one oil and gas production structure is estimated to be installed between 2008 and 2047. Physical disturbance or destruction of a limited area of benthos or to a limited number of megafaunal organisms, such as brittle stars, sea pens, or crabs, would not result in a major impact to the deepwater benthos ecosystem as a whole. Surface discharge of muds and cuttings, as opposed to seafloor discharge, would reduce or eliminate the impact of smothering the benthic communities on the bottom.

Under the current review procedures for chemosynthetic communities, carbonate outcrops are targeted as one possible indication (surface anomaly on 3D seismic survey data) that chemosynthetic seep communities could be nearby. Unique communities that may be associated with any carbonate outcrops or other topographical features could be identified via this review along with the chemosynthetic communities. Typically, all areas suspected of being hard bottom are avoided as a geological hazard for any well sites. Any proposed activity in water depth greater than 400 m (1,312 ft) would automatically trigger the NTL 2000-G20 evaluation described above. It is also likely that any hard bottom in the proximity of the escarpment would be avoided due to geological hazards resulting from extreme variations in bathymetry.

Summary and Conclusion

Some impact to soft-bottom benthic communities from drilling and production activities would occur as a result of physical impact from structure placement (including templates or subsea completions), anchoring, and installation of pipelines, regardless of their locations. Megafauna and infauna communities at or below the sediment/water interface would be impacted from the muds and cuttings normally discharged at the seafloor at the start of every new well prior to riser installation. The impact from muds and cuttings discharged at the surface are expected to be low in deep water. Drilling muds would not be expected to reach the bottom beyond a few hundred meters from the surface-discharge location, and cuttings would be dispersed. Even in situations where 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, in a matter of days for bacteria and probably less than 1 year for most all macrofauna species.

The proposed action is expected to cause little damage to the ecological function or biological productivity of the widespread, typical deep-sea benthic communities. Impacts to other hard-bottom communities are expected to be avoided because it is also likely that any hard bottom in the proximity of the escarpment would be avoided due to geological hazards resulting from extreme variations in bathymetry.

During the course of this reevaluation of the baseline conditions for factors potentially affecting nonchemosynthetic deepwater benthic communities, including hurricane effects, MMS has concluded that there could have been hurricane-induced changes to benthic communities on the OCS. The deepwater nature of the benthic resources in this area essentially eliminates the possibility of hurricane effects in contrast to shallow-water communities.

Accidental Impacts

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, thus destroying 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 megafaunal organisms, such as brittle stars, sea pens, or 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.

Oil and chemical spills are not considered to be a potential source of measurable impacts to nonchemosynthetic deepwater benthic communities because of the water depths at which these communities are located. Oil spills at the surface would tend not to sink. All evidence to date indicates that accidental oil discharges that occur at the seafloor from a pipeline or blowout would rise in the water column, surfacing almost directly over the source location (**Chapter 4.2.1.5.4**), and thus not impacting the benthos. The risk for weathering components from a surface slick reaching the benthos in any measurable concentrations would be very small.

Deepwater coral habitats and other potential hard-bottom communities not associated with chemosynthetic communities appear to be relatively rare. These unique communities are distinctive and similar in nature to protected pinnacles and topographic features on the continental shelf. 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, but adherence to the provisions of NTL 2000-G20 should prevent all but minor impacts to hard-bottom communities beyond 454 m (1,500 ft). Under the current review procedures for chemosynthetic communities, carbonate outcrops (high reflectivity surface anomalies on 3D seismic survey data) are targeted as one possible indication that chemosynthetic seep communities are present. Any unique nonchemosynthetic communities that may be associated with carbonate outcrops or other topographical features would be avoided via this review, along with the chemosynthetic communities. 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 depth greater than 400 m (1,312 ft) would automatically trigger the NTL 2000-G20 evaluation described above.

As the result of the proposed action, 0-1 blowout is estimated. Resuspended sediments caused from a blowout will have minimal impacts on the full spectrum of soft-bottom community animals, including the possible mortality of a few megafaunal organisms such as a crab or shrimp.

The risk of various sizes of oil spills occurring as a result of the proposed action is presented in **Table 4-13**. The probability of oil in any measurable concentration reaching depths of 400 m (1,312 ft) or greater is very small.

Summary and Conclusion

Accidental events resulting from the proposed action are expected to cause little damage to the ecological function or biological productivity of the 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. Even in situations where substantial burial of typical benthic communities occurred, recolonization from populations from neighboring substrate would be expected over a relatively short period of time for all size ranges of organisms, in a matter of hours to days for bacteria and probably less than 1 year for most all macrofauna species.

Deepwater coral habitats and other potential hard-bottom communities not associated with chemosynthetic communities will likely be avoided due to the geological hazards in the proximity of the escarpment where some hard substrate could be exposed.

Accidental events from the proposed action are expected to cause little damage to the ecological function or biological productivity of the widespread, typical, deep-sea benthic communities.

During the course of this reevaluation of the baseline conditions for factors potentially affecting nonchemosynthetic deepwater benthic communities, including hurricane effects, MMS has concluded that there could have been hurricane-induced changes to benthic communities on the OCS. The deepwater nature of the benthic resources in this area essentially eliminates the possibility of hurricane effects in contrast to shallow-water communities.

Cumulative Impacts

Both chemosynthetic communities and nonchemosynthetic deepwater resources will be combined in this chapter. Section IV.D.1.e.(2)(b) of the Lease Sale 181 FEIS (USDOI, MMS, 2001a) and Chapter 4.5.4.2 of the Final Multisale EIS (USDOI, MMS, 2007a) describes cumulative impacts in detail. Cumulative factors considered to impact the deepwater benthic communities of the GOM include both oil- and gas-related and non-oil- and gas-related activities. The latter type of impacting factors includes activities such as fishing and trawling, and large-scale factors such as 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. None of these taxa occur in the Sale 224 area.

Oil- and gas-related activities include pipeline and platform emplacement activities, anchoring, accidental seafloor blowouts, drilling discharges, and explosive structure removals. This analysis considers the effects of these cumulative factors related to the proposed action and to future OCS sales.

Other regional sources of cumulative impact to deepwater benthic communities would be possible but are considered unlikely to occur. Essentially no anchoring from non-OCS-related activities occurs at the water depths where these communities are found. 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 or significant nonchemosynthetic community such as a coral community.

One potentially significant large-scale source of impact could be potential effects of carbon sequestration in the deep sea as proposed by some international groups as a technique to reduce atmospheric carbon dioxide. Boyd et al. (2000) reported the successful iron fertilization of the polar Southern Ocean resulting in a large drawdown of carbon dioxide for at least 13 days and a massive plankton bloom for 30 days. A more recent evaluation of those Southern Ocean experiments have pointed out that there was limited evidence that there was any large quantities of carbon actually transported to the deep ocean (Buesseler and Boyd, 2003). Buesseler and Boyd go on to say that ocean iron fertilization may not be a cheap and attractive option if impacts on carbon export and sequestration are as low as observed to date. Recent papers also have highlighted the potential serious consequences of large scale CO_2 sequestration. Seibel and Walsh (2001) report extensive literature on the physiology of deep-sea biota indicating that they are highly susceptible to the CO_2 and pH excursions likely to accompany deep-sea CO_2 sequestration. The impacts of even very small excursions of pH and CO_2 could have serious, even global, deep-sea ecosystem impacts. Kita and Ohsumi (2004) suggest that sequestration of anthropogenic CO_2 could help reduce atmospheric CO_2, but they also summarized the potentially substantial biological impact on marine organisms.

On another side of this issue, a number of papers have identified a serious risk resulting from not reducing atmospheric CO_2 to shallow-water benthic organisms, particularly those with calcium carbonate shells and corals (Shirayama and Thornton, 2005; Kleypas et al., 1999; Barry et al., 2005). Corals, including deepwater species, rely on the saturation state of the carbonate mineral aragonite for calcification. Increases of CO_2 in marine waters have a direct impact on pH levels, which also decreases the aragonite saturation state with potentially severe impacts on coral growth. One issue raised in Barry et al. (2005) and Shirayama and Thornton (2005) is consideration of the trade-off between shallow-water interests and deep-sea habitats. Considering only the impacts to deep-ocean ecosystems for the decision to sequester large volumes of CO_2 deep-sea does not take into account the possible catastrophic damage of increasing global temperatures, including impacts to coral reefs and all benthic organisms with calcium carbonate shells. Total greenhouse gas emissions have increased by 16 percent to a CO_2 equivalent of 7.8

billion tons between 1990 and 2004 (USEPA, 2006d). Substantial additional research is needed before any large-scale actions would take place.

The greatest potential for cumulative adverse impacts to occur to the deepwater benthic communities, both chemosynthetic and nonchemosynthetic, 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.

As exploration and development continue on the Federal OCS, activities have moved into the deeper water areas of the GOM. Exploratory drilling technology now has the ability to drill in the deepest parts of the GOM. With this trend comes the certainty that increased development will occur on discoveries throughout the entire depth range of the EPA; these activities will 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 will 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 required under NTL 2000-G20. Activity levels related to the OCS Program for 2008-2047 in the EPA are shown in **Table 4-2**. For the EPA deepwater offshore areas, an estimated 5-15 exploration and delineation wells and 15-20 development wells are projected to be drilled, and 1 production structure is projected to be installed from 2008 to 2047. Approximately 0-1 blowout accident is projected.

Routine discharges of drilling muds and cuttings have been documented to reach the seafloor in water depths greater than 400 m (1,312 ft), but these discharges are distributed across wider areas and in thinner accumulations than they would be in shallower water depths. 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 because of their physical separation and great water depths.

A major new deepwater effects study funded by MMS was completed in 2006—*Effects of Oil and Gas Exploration and Development at Selected Continental Slope Sites in the GOM* (CSA, 2006). This project included determinations of the extent of muds and cuttings accumulations resulting from both exploratory and development drilling at three sites in approximately 1,000 m (3,281 ft) of water. Geophysical and chemical measurements indicated that a layer of cuttings and muds several centimeters thick was deposited within the 500-m (1,640-ft) radius of what was termed near-field stations. Generally, areas mapped as drilling muds were identified within about 100 m (328 ft) of wellsites. Areas mapped as cuttings typically extended several hundred meters from wellsites.

The majority of deepwater chemosynthetic communities are of low density and are widespread throughout the deepwater areas of the Gulf. Low-density communities may occasionally sustain minor impacts from discharges of drill muds and cuttings or resuspended sediments. These impacts are most likely to be sublethal in nature and would be limited in areal extent. The frequency of such impact is expected to be low. Physical disturbance to a small area would not result in a major impact to the ecosystem. The consequences of these impacts to these widely distributed low-density communities are considered to be minor with no change to ecological relationships with the surrounding benthos.

High-density, Bush Hill-type communities are widely distributed but few in number and limited in size. They have a high-standing biomass and productivity. High-density chemosynthetic communities would be largely protected by NTL 2000-G20, which serves to prevent impacts by requiring avoidance of potential chemosynthetic communities identified by association with geophysical characteristics or by requiring photodocumentation to establish the presence or absence of chemosynthetic communities prior to approval of the structure or anchor placements. Numerous new communities were recently discovered and explored using the submersible *Alvin* in 2006 as part of a new MMS study (USDOI, MMS, 2006h). These new communities were targeted using the same procedures integral to the biological review process and the use of NTL 2000-G20 targeting areas of potential community areas to be avoided by impacting oil and gas activities. Current implementation of these avoidance criteria and understanding of potential impacts indicate that high-density communities should be protected from burial by pre-riser discharges of muds and cuttings at the bottom and burial by muds and cuttings discharges from the surface.

Small impacts are expected to occur infrequently, but the impacts from bottom-disturbing activities, if they occur, could be quite severe to the immediate area affected. If it occurred, the disturbance of a Bush Hill-type environment could lead to the destruction of a community from which recovery would occur only over long intervals (200+ years for a mature tube-worm colony and 25-50 years for a mature mussel community) or would not occur at all. Similar recovery periods would be required if severe impacts occurred to well-developed, deepwater coral habitats (e.g., *Lophelia*). The severity of such an impact is such that there may be incremental losses of productivity, reproduction, community relationships, overall ecological functions of the community, and incremental damage to ecological relationships with the surrounding benthos.

In cases where high-density communities are subjected to greatly dispersed discharges or resuspended 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 with recovery occurring within 2 years. 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 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.

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. The distance of separation provided by the adherence of NTL 2000-G20 would protect both chemosynthetic and nonchemosynthetic communities from the direct effects of deepwater blowouts. Subsea structure removals are not expected in water depths >800 m (2,625 ft), in accordance with 30 CFR 250, which includes all of the proposed lease sale area.

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 the water depth. Oil spills from the surface would tend not to sink. Oil discharges at depth or on the bottom would tend to rise in the water column and similarly not impact the benthos. In the case of chemosynthetic communities, there is also reason to expect that animals are resistant to at least low concentrations of dissolved hydrocarbons in the water, as communities are typically found growing in oil-saturated sediments and in the immediate vicinity of active oil and gas seeps.

Deepwater coral and other hard-bottom communities not associated with chemosynthetic communities are also expected to be protected by general adherence to NTL 2000-G20 and the shallow hazards NTL 2007-G01 due to the avoidance of areas represented as hard bottom on surface anomaly maps derived from 3D seismic records. Biological reviews are performed on all deepwater plans (exploration and production) and pipeline applications; these reviews include an analysis of maps and avoidance of hard-bottom areas, which are also one of several important indicators for the potential presence of chemosynthetic communities. The unusual case represented by possible exposed hard bottom from the Florida Escarpment would also be avoided due to the geological hazards.

Summary and Conclusion

Impacts to deepwater communities in the GOM 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 (Bush Hill-type) communities; the widely distributed low-density communities would not be at risk. The provisions of NTL 2000-G20 require surveys and avoidance prior to drilling or pipeline installation and will greatly reduce the risk.

Activities unrelated to the OCS Program include fishing and trawling. Because of the water depths in the Sale 224 area and no commercially valuable fishery species, these activities are not expected to impact deepwater benthic comminutes. Regionwide and even global impacts from CO_2 buildup 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.

The activities considered under the cumulative scenario are not expected to cause damage to the ecological function or biological productivity of either low-density chemosynthetic communities or the rarer, widely scattered, high-density, Bush Hill-type chemosynthetic communities due to the lack of suitable habitat in the Sale 224 area.

The cumulative impacts on nonchemosynthetic benthic communities are expected to cause little damage to the ecological function or biological productivity of the expected typical communities existing on sand/silt/clay bottoms of the deep GOM. Large motile animals would tend to move, and recolonization from populations from neighboring substrates would be expected in any areas impacted by burial. Similar to chemosynthetic communities, the cumulative impacts on deepwater coral or other high-density, hard-bottom communities are expected to cause little damage to ecological function or biological productivity.

The incremental contribution of the proposed action to the cumulative impact 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. Adverse impacts will be limited but not completely eliminated by adherence to NTL 2000-G20.

4.3.5. Impacts on Marine Mammals

Potential direct or indirect effects on marine mammal species may occur from routine activities associated with the proposed action. The major impact-producing factors affecting marine mammals as a result of routine OCS activities include the degradation of water quality from operational discharges; noise generated by helicopters, vessels, operating platforms, and drillships; vessel traffic; explosive structure removals; seismic surveys; blowouts, oil spills, and marine debris from service vessels and OCS structures.

Section IV.D.1.a.(5) of the Lease Sale 181 FEIS (USDOI, MMS, 2001a) and Chapter 4.3.5 of the Final Multisale EIS (USDOI,MMS, 2007c) describe in detail the impacts associated with OCS-related activities. The following information supplements the material provided by the previous study.

Routine Impacts

Discharges

The primary operational waste discharges generated during offshore oil and gas exploration and development are drilling fluids, drill cuttings, produced water, deck drainage, sanitary wastes, and domestic wastes. During production activities, additional waste streams include produced sand and well treatment, workover, and completion fluids. Minor additional discharges occur from numerous sources; these discharges may include desalination unit discharges, blowout preventer fluids, boiler blowdown discharges, excess cement slurry, and uncontaminated freshwater and saltwater. The USEPA, through general permits issued by the USEPA Region that has jurisdictional oversight, regulates all waste streams generated from offshore oil and gas activities.

The Lease Sale 181 FEIS and the Final Multisale EIS detail specific contaminants and their effects on marine mammals. Adequate baseline data are not available to determine the significant sources of contaminants that accumulate in Gulf cetaceans or their prey, due to the fact that many cetacean species are wide ranging animals and contaminants are introduced into the GOM from a variety of national and international watersheds. Some industry-generated effluents are routinely discharged into offshore marine waters. Marine mammals may have some interaction with these discharges. Indirect effects to marine mammals through prey exposure to discharges are expected to be sublethal. Because OCS discharges are diluted and dispersed in the offshore environment, direct impacts to marine mammals are expected to be negligible.

Aircraft

The Lease Sale 181 FEIS and the Final Multisale EIS, in the sections listed above, describe sounds expected as a result of OCS activity and their effect on marine mammals. Aircraft overflights in proximity to cetaceans can elicit a startle response. The effects appear to be transient, and there is no indication that long-term displacement of whales occur. Absence of conspicuous responses to an aircraft does not show that the animals are unaffected; it is not known whether these subtle effects are biologically significant (Richardson and Würsig, 1997). Helicopter operations (take-offs and landings) projected for the proposed action are 75-125 operations per year, or approximately 3,000-5,000 over the life of the proposed action. The FAA Advisory Circular 91-36C encourages pilots to maintain higher than minimum altitudes (noted below) over noise-sensitive areas. Corporate helicopter policy 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. In addition, guidelines and regulations issued by NMFS under the authority of the Marine Mammal Protection Act do include provisions specifying helicopter pilots to maintain an altitude of 1,000 ft (305 m) within 100 yd (91 m) of marine mammals. It is expected that about 10 percent of helicopter operations would occur at altitudes below the specified minimums listed above as a result of inclement weather.

Vessel Traffic

The Lease Sale 181 FEIS and the Final Multisale EIS, in the sections listed above, described impacts associated with marine vessels expected as a result of OCS activity and their effect on marine mammals. Primary impacts include noise and collisions. Service-vessel round trips projected for the proposed action are 375-500 trips (**Table 4-2**) per year, or approximately 15,000-20,000 over the life of the proposed action. Noise from service-vessel traffic may elicit a startle and/or avoidance reaction from marine mammals 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. Long-term displacement of animals from an area is also a consideration.

Increased ship traffic could increase the probability of collisions between ships and marine mammals, resulting in injury or death to some animals. The MMS has issued regulations and guidelines to minimize the chance of vessel strike to marine mammals with proposed protected species lease stipulations and NTL 2007-G04, "Vessel Strike Avoidance and Injured/Dead Protected Species Reporting."

It is possible that manatees could occur in coastal areas where vessels traveling to and from the leased sites could affect them. Fertl et al. (2005) found manatees to be most common in estuarine and river mouth habitats and rare in the open ocean. A manatee present where there is vessel traffic could be injured or killed by a vessel strike (Wright et al., 1995). In 1995, an oil crew workboat struck and killed a manatee in a canal near coastal Louisiana (Fertl et al., 2005). Inadequate hearing sensitivity at low frequencies may be a contributing factor to the manatees' inability to detect effectively boat noise and to avoid collisions with boats (Gerstein et al., 1999).

Drilling and Production Noise

The Lease Sale 181 FEIS and the Final Multisale EIS, in the sections listed above, described impacts associated with drilling and production noise expected as a result of OCS activity and their effect on marine mammals.

A total of 5-15 exploration and delineation wells and 15-20 development wells are projected to be drilled as a result of the proposed action. A maximum of one platform is projected to be installed as a result of the proposed action. Exploration, delineation, and production structures, as well as drillships, produce an acoustically wide range of sounds at frequencies and intensities that can be detected by cetaceans. Some of these sounds could mask cetaceans' reception of sounds produced for echolocation and communication. Human-made sounds may affect the ability of marine mammals to communicate and to receive information about their environment (Richardson et al., 1995). Such noise may interfere with or mask the sounds used and produced by these animals and thereby interfere with their natural behavior. These sounds may frighten, annoy, or distract marine mammals and lead to physiological and behavioral disturbances. Energetic consequences would depend on whether suitable food is readily available. Of the animals responding to noise, females in late pregnancy or lactating would probably be most affected. Human-made noise may cause temporary or permanent hearing impairment in marine mammals if the noise is strong enough. Such impairment would have the potential to diminish the individual's chance for survival.

Structure Removals

The area subject to this proposed action has not been considered for explosive removals by recent ESA consultation; therefore, explosive removal of the proposed platform is not an option at this time. However, impacts resulting from explosive removal would be addressed and MMS would re-initiate consultation or begin new consultation proceedings should explosive removal be considered for this area.

The Lease Sale 181 FEIS and the Final Multisale EIS, in the sections listed above, describe impacts associated with structure removal expected as a result of OCS activity and its effect on marine mammals. Should explosive removal be required, the analysis provided in these FEIS's would apply. Any new information would be subject to consultation proceedings.

To date, there are no documented "takes" of marine mammals resulting from explosive removals of offshore structures.

Seismic Surveys

The Lease Sale 181 FEIS (USDOI, MMS, 2001a) and the Final Multisale EIS (USDOI, MMS, 2007a), in the sections listed above, describe impacts associated with seismic surveys expected as a result of OCS activity and its effect on marine mammals.

Since completion of the Lease Sale 181 FEIS, MMS conducted annual research cruises under the SWSS program through 2005. Data analysis and the publication of a synthesis report, including the various facets of SWSS, is ongoing. A detailed report of the research conducted from 2002 through 2004 has been published (Jochens et al., 2005). Experiments were designed to investigate the sound exposure level at which behavioral changes began to occur. **Chapter 4.3.5** (Impacts to Marine Mammals, Seismic Surveys) provides a detailed description of this study.

The MMS completed a programmatic EA on G&G permit activities in the GOM (USDOI, MMS, 2004) and is currently in consultation with NMFS for rulemaking under the MMPA and the associated ESA procedure. The PEA includes a detailed description of the seismic surveying technologies, energy output, and operations. This document is hereby incorporated by reference.

Seismic surveys use a high-energy noise source. Although the output of airgun arrays is usually tuned to concentrate low-frequency energy, a broad frequency spectrum is produced, with significant energy at higher frequencies (e.g., Goold and Fish, 1998). These energies encompass the entire audio frequency range of 20 Hz to 20 kHz (Goold and Fish, 1998) and extend well into the ultrasonic range up to 50 kHz.

Baleen whales seem quite tolerant of low- and moderate-level sound pulses from distant seismic surveys but exhibit behavioral changes in the presence of nearby seismic activity (Richardson et al., 1995). Goold (1996) found that acoustic contacts with common dolphins in the Irish Sea dropped sharply as soon as seismic activity began, suggesting a localized disturbance of dolphins. No obvious behavior modifications relative to the seismic activity were recorded during the majority of the small odontocete observations made during marine mammal monitoring carried out during a 3D seismic survey offshore California in late 1995 (Arnold, 1996). There was also no observable behavior modification or harassment of large whales attributable to the sound effects of the survey (Arnold, 1996). Sperm whales displayed no observable horizontal avoidance to seismic surveys in the GOM during SWSS experiments. However, these observations were based on very few exposures <160 dB re-1µPa-m. Also, these experiments were carried out in an area with substantial human activity, and the whales are not naive to human-generated sounds.

Marine Debris

The Lease Sale 181 FEIS and the Final Multisale EIS, in the sections listed above, describe impacts associated with marine debris expected as a result of OCS activity and its effect on marine mammals. Many types of materials, including plastics, are used during drilling and production operations. Some of this material is accidentally lost overboard where marine mammals could consume it or become entangled in it. Industry directives for reducing marine debris and MMS's guidelines through its NTL 2007-G03 for maintaining awareness of the problem and eliminating accidental loss continue to minimize industry-related trash in the marine environment.

In recent years, there has been increasing concern about manmade debris (discarded from offshore and coastal sources) and its impact on the marine environment (e.g., Shomura and Godfrey, 1990; Laist, 1997). Both entanglement in and ingestion of debris has caused the death or serious injury of marine mammals (Heneman and the Center for Environmental Education, 1988; MMC, 1998).The MMS prohibits the disposal of equipment, containers, and other materials into coastal and offshore waters by lessees (30 CFR 250.40). Prohibition of the discharge and disposal of vessel- and offshore structure-generated garbage and solid waste items into both offshore and coastal waters was established January 1, 1989, via the enactment of MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which the USCG enforces.

Summary and Conclusion

Small numbers of marine mammals could be killed or injured by a chance collision with a service vessel; however, current MMS requirements and guidelines for vessel operation in the vicinity of protected species should minimize this risk (the proposed Protected Species Lease Stipulation and NTL 2007-G04). Marine mammal ingestion of industry-generated debris, which is accidentally released, is a concern. The debris awareness training, instruction, and placards required by the proposed Protected Species Lease Stipulation and NTL 2007-G03 should greatly minimize the amount of debris that is accidentally lost overboard by offshore personnel. Noise associated with the proposed action, including drilling noise, aircraft, and vessels may affect marine mammals by eliciting a startle response or masking other sounds. Seismic operations have the potential to harm marine mammals in close proximity to firing airgun arrays. The proposed protected species lease stipulations and the several mitigations, including onboard observers and airgun shut-downs for whales in the exclusion zone, included in 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. Contaminants in waste discharges and drilling muds might indirectly affect marine mammals through food-chain biomagnification. Although the scope and magnitude of such effects are not known, direct or indirect effects are not expected to be lethal.

Routine activities related to the proposed action, particularly when mitigated as required by MMS, 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 GOM.

During the course of the preparation of this SEIS, MMS has concluded that there have been hurricane-induced changes to the baseline conditions, particularity in the near-shore areas that some marine mammals may utilize. However, it is difficult to determine the effects of hurricanes on baseline conditions due to the unreliable estimate of immediate pre-storm population levels and uncertain recovery times. In addition, determination of tropical storm effects are further complicated by the broad scope of the habitat changes in some areas combined with the short-term effect of the storms. Any alterations in the baseline condition due to the recent hurricanes would not exacerbate or increase the potential effects of the proposed action. Although these effects upon marine mammals may be considered moderate to severe in some localized areas, the effect of the proposed action upon marine mammals would be negligible. The loss of suitable habitat through natural causes does not expand or cause the minor effects of the proposed action to become more harmful to marine mammals. No data exist to indicate that any of the marine mammal populations offshore were adversely affected by the storm.

Accidental Impacts

Accidental, unexpected industrial events associated with the proposed action could impact marine mammals. Such impacts would primarily be the result of blowouts, oil spills, and/or effects associated with the response to an oil spill. Section IV.D.1.a.(5) of the Lease Sale 181 FEIS (USDOI, MMS, 2001a) and Chapter 4.4.5 of the Final Multisale EIS (USDOI, MMS, 2007a) describe in detail the accidental impacts associated with OCS-related activities. The following information supplements the material provided by the previous study.

Blowouts

Improperly balanced well pressures that result in sudden, uncontrolled releases of fluids from a wellhead or wellbore are called blowouts. Blowouts can occur during any phase of development including exploratory drilling, development drilling, production, completion, or workover operations. In the event of a blowout, the eruption of gases and fluids may generate significant pressure waves and noise. It is speculated that the burst of sound may harass or injure marine mammals, depending on their proximity to the accident.

Oil Spills

Each major grouping of marine mammals (e.g., manatees and dugongs, and baleen and toothed whales) may be impacted by spilled hydrocarbons in different ways. The Lease Sale 181 FEIS and the Final Multisale EIS, in the sections listed above, describe impacts associated with oil spills expected as a result of OCS activity and its effect on marine mammals.

The most toxic components of oil generally evaporate quickly when a spill occurs. For this reason, lethal concentrations of oil with high toxicity leading to large-scale, marine life mortality are relatively rare, localized, and short-lived (ITOPF, 2006). Prolonged exposure to oil led to a decrease of certain blood parameters, changes in breathing patterns and gas metabolism, depressed nervous functions, and the appearance of skin injuries and burns (Lukina et al., 1996). Fresh crude oil or volatile distillates release toxic vapors that, when inhaled, can lead to irritation of respiratory membranes, lung congestion, and pneumonia. Subsequent absorption of volatile hydrocarbons into the bloodstream may accumulate into such tissues as the brain and liver, causing neurological disorders and liver damage (Geraci and St. Aubin, 1982; Hansen, 1985; Geraci, 1990). Marine mammals may also incur eye damage that leads to ulcers, conjunctivitis, or blindness. Such injury can result in starvation (AMSA, 2003). The probable effects on marine mammals swimming through an area of oil would depend on a number of factors, including ease of escape from the vicinity, the health of the individual animal, and its immediate response to stress (Geraci and St. Aubin, 1985).

Spilled oil can lead to the localized reduction, disappearance, or contamination of prey species. Prey species, such as zooplankton, crustaceans, mollusks, and fishes, may become contaminated by direct contact and/or by ingesting oil droplets and tainted food. Cetaceans may consume oil-contaminated prey (Geraci, 1990) or incidentally ingest floating or submerged oil or tar. In general, the potential for ingesting oil-contaminated prey organisms with petroleum-hydrocarbon, body-burden content is highest for benthic-feeding whales and pinnipeds. The potential is reduced for plankton-feeding whales and is lowest for fish-eating whales and pinnipeds (Würsig, 1990).

As noted by St. Aubin and Lounsbury (1990), there have been no experimental studies and only a handful of observations suggesting that oil may have harmed any manatees or dugongs. 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; AMSA, 2003). They may also suffer chronic long-term effects, such as liver problems, from the ingestion of oil or oiled plants. However, as manatees and dugongs have poorly developed pelage, they are less likely to suffer from adherence of oil.

It is impossible to know precisely which marine mammal species, population, or individuals will be impacted, to what magnitude, or in what numbers, since each species has unique distribution patterns in the Gulf and because of difficulties attributed to predicting when and where oil spills will occur over a 40-year period. The potential causes, sizes, and probabilities of oil spills that could occur during drilling, production, and transportation operations associated with the proposed action are presented in **Chapter 4.2.1**.

Table 4-8 lists estimates for spill magnitude and abundance for Gulf coastal waters as a result of the proposed action. Estimates of spill magnitude and abundance for Federal OCS waters as a result of the proposed action are given in **Table 4-10. Chapter 4.2.1.8** summarizes MMS's information on the risk to marine mammals analyzed in this SEIS from oil spills and oil slicks that could occur as a result of the proposed action. **Figure 4-7** also provides the probabilities of a spill ≥1,000 bbl occurring from the proposed action and the slick reaching identified marine mammal coastal habitats within 10 days.

During a blowout, the pressure waves and noise generated by the eruption of gases and fluids might be significant enough to harass or injure marine mammals, depending on the proximity of the animal to the blowout. There are 0-1 blowouts projected to occur from the proposed lease sale (**Table 4-2**). The effects of explosions and noise on marine mammals are discussed in this chapter.

Spill-Response Activities

Spill-response activities include the application of dispersant chemicals to the affected area (**Chapter 4.2.5**). Dispersant chemicals are designed to break oil on the water's surface into minute droplets, which then break down in seawater. Essentially nothing is known about the effects of oil dispersants on cetaceans, except that removing oil from the surface would reduce the risk of contact and render it less likely to adhere to skin, baleen plates, or other body surfaces (Neff, 1990). The acute toxicity of most oil dispersant chemicals is considered to be low relative to the constituents and fractions of crude oil and refined products, and studies have shown that the rate of biodegradation of dispersed oil is equal to or greater than that of undispersed oil (Wells, 1989). Biodegradation is another process used for removing petroleum hydrocarbons from the marine environment, utilizing chemical fertilizers to augment the growth of naturally occurring hydrocarbon-degrading microorganisms. Toxic effects of these fertilizers on cetaceans are presently unknown.

Summary and Conclusion

Accidental blowouts, oil spills, and spill-response activities resulting from the proposed action have the potential to impact marine mammals in the GOM. 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. Exposure to hydrocarbons persisting in the sea following the dispersal of an oil slick is likely to result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity; and increased vulnerability to disease) to marine mammals.

During the course of the preparation of this SEIS, MMS has concluded that there have been hurricane-induced changes to the baseline conditions, particularity in the nearshore areas that some marine mammals may utilize. However, it is difficult to determine the effects of hurricanes on baseline conditions due to the unreliable estimate of immediate pre-storm population levels and uncertain recovery times. In addition, determination of tropical storm effects are further complicated by the broad scope of the habitat changes in some areas combined with the short-term effect of the storms. Any alterations in the baseline condition due to the recent hurricanes would not exacerbate or increase the potential effects of the proposed action. Although these effects upon marine mammals may be considered moderate to severe in some localized areas, the effect of the proposed action upon marine mammals would be negligible. The loss of suitable habitat through natural causes does not expand or cause the minor effects of the proposed action to become more harmful to marine mammals. No data exist to indicate that any of the marine mammal populations offshore were adversely affected by the storm.

Cumulative Impacts

The cumulative analysis considers past, ongoing, and foreseeable future human and natural activities that may occur and adversely affect marine mammals in the same general area that may be affected by the proposed action. These activities include effects of the OCS Program (proposed actions, and prior and future OCS sales), State oil and gas activity, commercial shipping, commercial fishing, recreational fishing and boating activity, military operations, scientific research, and natural phenomena. Specific types of impact-producing factors considered in this cumulative analysis include noise from numerous sources, pollution, habitat degradation, vessel strikes, and ingestion and entanglement in marine debris.

The major impact-producing factors relative to the proposed action are described in this chapter. Sections providing supportive material for the marine mammals analysis include **Chapters 3.2.3** (description of marine mammals), **4.1.1.2** (exploration), **4.1.1.3** (development and production), **4.1.1.7** and **4.1.2.3** (offshore and coastal noise), **4.1.2.1** (coastal infrastructure), and **4.2.1** (spills). The MMS completed an EA on G&G activities (USDOI, MMS, 2004) and is currently in consultation with NMFS for MMPA rulemaking and the associated ESA consultation. The G&G EA is hereby incorporated by reference.

Virtually all of the marine mammal species in the Gulf have been exposed to OCS-industrial noise due to the rapid advance into GOM deep oceanic waters by the oil and gas industry in recent years;. It is believed that most of the industry-related noise is at lower frequencies than is detectable or is in the sensitivity range of most of the GOM marine mammal species. However, most of the information on marine mammal hearing is inferred, and there are reports of species reacting to sounds that were not expected to be audible.

Industry noise sources include seismic operations, fixed platforms and drilling rigs, drilling ships, low-flying aircraft, vessel traffic, and explosive operations, particularly for structure removal. **Chapter 4.1.1.7** and **Table 4-2** discuss and show the expected sources of many of these impacts for the OCS Program, as well as the expected sources from past, present, and future OCS-industry operations. Other groups such as the military (U.S. Navy and USCG) and other Federal agencies (USEPA, COE, and NMFS), dredges, commercial fishermen, and recreational boaters operate vessels and contribute to the ambient noise in the Gulf. Industry service boats are numerous and 15,000-20,000 round trips are expected as a result of the proposed action. Marine mammal avoidance guidelines listed in the Vessel Strike NTL should minimize the chance of marine mammals being subject to the increased noise level of a service vessel in very close proximity. Aircraft overflights are another source of noise and can cause startle reactions in marine mammals, including rapid diving, change in travel direction, and dispersal of marine mammal groups. There are 3,000-5,000 helicopter take offs/landings expected from this proposed action. Although air traffic well offshore is limited, the military, commercial, and private aircraft traverse the area. Flight level minimum guidelines from NMFS and corporate helicopter policy should help mitigate the industry-related flight noise, though lower altitudes near shore and as the helicopter lands and departs from rigs could impact marine mammals in close proximity to the structures or shore bases. Occasional overflights are not expected to have long-term impacts on marine mammals.

The OCS industry's drilling impacts were discussed in **Chapter 4.1.1**. Although much of the focus is on industry operations in deep water, there is still interest and activity in more shallow and even coastal waters for oil and gas production. Similarly, explosive structure removals put considerable sound into the ocean, and these can occur in Federal or State waters. The COE also engages in some explosive and pile-driving operations that create loud but temporary noise. Such COE activities are consulted on with NMFS, and mitigations are included, often similar to the mitigations employed by MMS in consultation with NMFS. Mitigations for explosive removals are stated in the applicable MMS NTL, and these will be fortified by programmatic rulemaking under the MMPA that is now in the final stages between NMFS and MMS. Observations to minimize the possibility of a marine mammal being near an explosive removal mitigate these loud but very brief noises.

Seismic exploration is the source of the loudest, and perhaps most controversial, OCS-industry activity. Details on seismic impacts on marine mammals are given in **Chapter 4.1.1.2.1,** and complete information is included in the G&G EA (USDOI, MMS, 2004). Seismic surveys are routinely conducted in virtually all water depths of the GOM, including the deep habitat of the endangered sperm whale. Noise and acoustic disturbance have been topics of great debate in the last several years, and there is general agreement that the use of sonar, particularly by the military, has in some cases been associated with very severe impacts to certain species of marine mammals in recent years. Seismic airgun sounds are often incorrectly lumped with sonar noise as sources of marine mammal disturbance. The MMS has petitioned NMFS for rulemaking under the MMPA for seismic operations, and NMFS is currently developing an EIS. In the interim, and in response to terms and conditions in the NMFS Biological Opinion for Lease Sale 184 in 2002, MMS developed mitigations for the seismic industry that require, among other things, dedicated marine mammal observers aboard all seismic vessels, gradual ramp-up of the airgun array, and shutdowns of airgun firing if a whale gets within 500 m (1,640 ft) of an active airgun array. Also, as reported in **Chapter 3.2.3**, current research by MMS and partners did not detect avoidance of seismic vessels or airguns by sperm whales. It is likely that the whales, which appear to generally remain in the northern Gulf year round, are habituated to seismic operations. However, other species may react very differently to seismic disturbances. Ongoing research will be required to detect any changes in species abundance or distribution, and even with research, such changes would likely be very difficult to establish on a small scale. Pollution of marine waters is another potentially adverse impact to marine mammals in the GOM. Information on drilling fluids and drill cuttings and produced waters that would be discharged offshore is discussed in **Chapter 4.1.1.4.1**. Effluents are routinely discharged into offshore waters and are regulated by USEPA NPDES permits. Marine mammals may periodically be exposed to these discharges. Direct effects to marine mammals are expected to be sublethal. Indirect effects via food sources are not expected because of dilution and dispersion of offshore operational discharges. Another OCS-industry form of pollution is oil spills. Impacts of these accidental events to marine mammals have been discussed in this chapter. Advances in oil-spill prevention technologies have greatly reduced the amount of oil that enters the marine environment accidentally. However, there is still the potential for an oil spill. Oil in the ocean can and does come from sources other than industry operations. Ships are known to illegally pump oily bilges into the environment. Mechanical failure on any type of vessel can lead to an oil spill, though usually small. Even natural seeps on the floor of the GOM can result in an oil slick or sheen on the surface (NRC, 2003).

Given the many sources of unchecked pollution in the Gulf, the amount of additional contaminant contributed by the oil and gas industry is negligible. Strict controls on discharges from structures and vessels, and cutting edge technology to minimize the possibility of an oil spill, and the extent of one should it occur, greatly reduce industry's contribution to ocean pollution.

Marine debris has an impact in the ocean. Plastics in particular, and from many different sources, pose a threat to the environment and a serious threat to marine mammals. The industry has implemented waste management programs and has greatly improved waste handling. More efficient gear packaging and better galley practices have significantly reduced the amount of waste generated offshore. Annual marine debris awareness training, as per the MMS NTL, targets the accidental loss of material from vessels and structures. With these practices in place and with being in compliance with applicable regulations and guidelines, the amount of marine debris contributed by the proposed action would be minimal.

Vessel strikes are a serious threat to marine mammals in the GOM. A collision between a marine mammal and a ship will result in injury and likely death. The increase in vessel traffic due to the proposed action would increase the probability of a vessel strike and the injury or death of some animals. The increased vessel traffic may alter behavior of marine mammals by avoidance, displacement, or attraction to the vessel. However, those effects are expected to be short-term. Industry-related vessels are only a part of the shipping activity in the Gulf. All manner of commercial shipping vessels, commercial fishing vessels, military ships, research ships, recreational craft, and others are always present in the Gulf. The MMS Vessel Strike NTL provides guidelines to avoid a vessel/mammal collision and to minimize harassment of mammals by vessels approaching too closely. Although OCS vessel traffic is a major component of the cumulative vessel impacts, professional piloting and regulatory guidelines minimize the impact of the OCS segment of vessel traffic. Very close approaches by recreational boats are likely major causes of stress in marine mammals, as is chasing and following. The presence of industry structure in the deep waters of the Gulf may indirectly be encouraging these interactions. Recreational fishing vessels run much farther out to get to the improved fishing at a structure. This also puts these vessels in oceanic marine mammal waters. Service-vessel crews that keep attention on the water and that intentionally avoid marine mammals should not pose a threat to marine mammal populations.

The Gulf has very little fishery interaction with marine mammals, compared with other areas. However, marine mammals can be injured or killed by commercial fishing gear. Mammals can either get hung on longline hooks or can be scooped into a net by a shrimp boat or groundfish vessel. There is also the chance of entanglement by lines from crab traps to buoys. Gillnets, which have now been banned in many places around the Gulf, have been reported to take marine mammals. Reports of these impacts are uncommon.

Scientific research can impact marine mammal species. Scientific seismic studies could have the same impact with the same very loud noise as industry seismic work. Tropical storms and hurricanes are normal occurrences in the Gulf and along the coast. Generally, the impacts have been localized and infrequent. However, in the last two years the GOM has been extremely hard hit by very powerful hurricanes. Few areas of the coast have not suffered some damage in 2004 and 2005, and activities in the Gulf have also been severely impacted. In 2004, Hurricane Ivan took a large toll on oil and gas structures and operations in the Gulf and caused widespread damage to the Alabama/Florida Panhandle coast. In 2005, Hurricanes Katrina, Rita, and Wilma reached Category 5 strength in the GOM. These storms caused damage to all five of the Gulf Coast States and damage to structures and operations both offshore and onshore. The actual impacts of these storms on the animals in the Gulf, and the listed species and critical habitat in particular, have not yet been determined and, for the most part, may remain very difficult to quantify. Examples of other impacts that may have affected species include oil, gas, and chemical spills from damaged and destroyed structures and vessels (although no large oil spills were reported, several lesser spills are known to have occurred), increased trash and debris in both offshore and inshore habitats, and increased runoff and silting from wind and rain. Not only are the impacts themselves difficult to assess, but the seasonal occurrence of impacts from hurricanes is also impossible to predict. Generally, the far offshore species and the far offshore habitat are not expected to have been severely affected in the long term. However, species that occupy more nearshore or inshore habitats may have suffered more long-term impacts.

Summary and Conclusion

The OCS- and non-OCS-related activities considered under the cumulative scenario could affect protected cetaceans and sirenians. These marine mammals could be impacted by the degradation of water quality resulting from operational discharges, vessel traffic, noise generated by platforms, drillships, helicopters and vessels, seismic surveys, explosive structure removals, oil spills, oil-spill-response activities, loss of debris from service vessels and OCS structures, commercial fishing, capture and removal, and pathogens. The cumulative impact on marine mammals is expected to result in a number of chronic and sporadic sublethal effects (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. Natural phenomenon, such as tropical storms and hurricanes, are impossible to predict, but they will occur in the GOM. Effects of the incremental contribution of the proposed action would make a minimal contribution to the combined OCS and non-OCS activities that may be deleterious to cetaceans occurring in the GOM.

During the course of the preparation of this SEIS, MMS has concluded that there have been hurricane-induced changes to the baseline conditions, particularity in the nearshore areas that some marine mammals may use. However, it is difficult to determine the effects of hurricanes on baseline conditions due to the unreliable estimate of immediate pre-storm population levels and uncertain recovery times. In addition, determination of tropical storm effects are further complicated by the broad scope of the habitat changes in some areas combined with the short-term effect of the storms. Any alterations in the baseline condition as a result of recent hurricanes would not exacerbate or increase the potential effects of the proposed action. Although these effects upon marine mammals may be considered moderate to severe in some localized areas, the effect of the proposed action upon marine mammals would be negligible. The loss of suitable habitat through natural causes does not expand or cause the minor effects of the proposed action to become more harmful to marine mammals. No data exist to indicate that any of the marine mammal populations offshore were adversely affected by the storm.

4.3.6. Impacts on Sea Turtles

Routine Impacts

The major impact-producing factors resulting from the routine activities associated with the proposed action that may affect loggerhead, Kemp's ridley, hawksbill, green, and leatherback turtles include water-quality degradation from operational contaminant discharges; noise from seismic exploration, helicopter and vessel traffic, operating platforms, and drillships; vessel collisions; explosive platform removals; and OCS-related trash and debris.

Section IV.D.1.a.(6) of the Lease Sale 181 FEIS (USDOI, MMS, 2001a) describes in detail the routine impacts associated with OCS-related activities. The following information supplements the material provided by the previous study.

Contaminants and Discharges

Produced waters, drill muds, and drill cuttings are routinely discharged into offshore marine waters and are regulated by USEPA NPDES permits. Most operational discharges, as regulated, are diluted and dispersed when released in offshore areas and are considered to have sublethal effects (API, 1989;

Kennicutt, 1995). Any potential that might exist for impact from drilling fluids would seem to be indirect, either by impact on prey items or possibly through ingestion via the food chain (API, 1989). Contaminants in drilling muds or waste discharge may biomagnify and bioaccumulate in the food web, which may kill or debilitate important prey species of sea turtles or species lower in the marine food web. Sea turtles may bioaccumulate chemicals such as heavy metals that occur in drilling mud. This might ultimately reduce reproductive fitness in the turtles, an impact that the already diminished population(s) cannot tolerate. Samples from stranded turtles in the GOM carry high levels of organochlorides and heavy metals (Sis et al., 1993).

Effluents are routinely discharged into offshore marine waters and are regulated by the USEPA's NPDES permits. Information on the contaminants that would be discharged offshore as a result of the proposed action is provided in **Chapter 4.1.1.4**. Turtles may be affected by these discharges. Very little information exists on the impact of drilling muds on Gulf sea turtles (Tucker and Associates, Inc., 1990).

Noise

There are no systematic studies published of the reactions of sea turtles to aircraft overflights; however, anecdotal reports indicate that sea turtles often react to the sound and/or the shadow of an aircraft by diving. It is assumed that aircraft noise can be heard by a sea turtle at or near the surface and cause the animal to alter its normal behavior pattern (Advanced Research Projects Agency, 1995). Drilling and production facilities produce an acoustically wide range of sounds at frequencies and intensities that could possibly be detected by turtles. Noise from service-vessel traffic may elicit a startle reaction from sea turtles and produce a temporary sublethal stress (NRC, 1990). Startle reactions may result in increased surfacings, possibly causing an increase in risk of vessel collision. Reactions to aircraft or vessels, such as avoidance behavior, may disrupt normal activities, including feeding. Important habitat areas (e.g., feeding, mating, and nesting) may be avoided because of noise generated in the vicinity. There is no information regarding the consequences that these disturbances may have on sea turtles in the long term. If sound affects any prey species, impacts to sea turtles would depend on the extent that prey availability might be altered.

Noise-induced stress has not been studied in sea turtles. Captive loggerhead and Kemp's ridley turtles exposed to brief audio-frequency vibrations initially showed startle responses of slight head retraction and limb extension (Lenhardt et al., 1983). Sound-induced swimming has been observed for captive loggerheads and greens (O'Hara and Wilcox, 1990; Moein et al., 1993; Lenhardt, 1994). Some loggerheads exposed to low-frequency sound responded by swimming towards the surface at the onset of the sound, presumably to lessen the effects of the transmissions (Lenhardt, 1994). Sea turtles have been observed noticeably increasing their swimming in response to an operating seismic source at 166 dB re 1μPa-m (McCauley et al., 2000). The potential direct and indirect impacts of sound on sea turtles include physical auditory effects (temporary threshold shift), behavioral disruption, long-term effects, masking, and adverse impacts on the food chain. Low-frequency sound transmissions could potentially cause increased surfacing and avoidance from the area near the sound source (Lenhardt et al., 1983; O'Hara and Wilcox, 1990; McCauley et al., 2000). Increased surfacing could place turtles at greater risk of vessel collisions and potentially greater vulnerability to natural predators.

Vessel Collisions

Data show that vessel strikes are a cause of sea turtle mortality in the Gulf (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 (n=16, 102) (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. In Florida, where coastal boating is popular, 18 percent of strandings documented between 1991 and 1993 were attributed to vessel collisions (Lutcavage et al., 1997). 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). The number of OCS-related vessel collisions with sea turtles offshore is unknown, but it is expected that some sea turtles will be impacted.

An estimated 15,000-20,000 service-vessel round trips are expected to occur between 2007 and 2046 as a result of the proposed action. Transportation corridors would be through areas where sea turtles have been sighted. Total helicopter operations are expected to be 3,000-5,000 (take-offs and landings) as a result of the proposed action. Noise from service-vessel traffic and helicopter overflights may elicit a startle reaction from sea turtles and there is the possibility of short-term disruption of activity patterns. It is not known whether turtles exposed to recurring vessel disturbance will be stressed or otherwise affected in a negative but inconspicuous way. Increased vessel traffic will increase the probability of collisions between vessels and turtles, potentially resulting in injury or death to some animals.

Explosive Platform Removals

A total of 5-15 exploration wells and 15-20 producing development wells are projected to be drilled as a result of the proposed action. A total of one platform is projected to be installed as a result of the proposed action. That one platform may be removed with explosives. These structures could generate sounds at intensities and frequencies that could be heard by turtles. There is some evidence suggesting that turtles may be receptive to low-frequency sounds, which is at the level where most industrial noise energy is concentrated. Potential effects on turtles include disturbance (subtle changes in behavior, interruption of activity), masking of other sounds (e.g., surf, predators, vessels), and stress (physiological).

Offshore structures serve as artificial reefs and are sometimes used by sea turtles (Gitschlag and Herczeg, 1994). The dominant species of turtle observed at explosive structure removals is the loggerhead, but leatherback, green, Kemp's ridley, and hawksbill have also been observed (Gitschlag and Herczeg, 1994; Gitschlag et al., 1997). Loggerheads may reside at specific offshore structures for extended periods of time (Rosman et al., 1987b; Gitschlag and Renaud, 1989). The probability of occupation by sea turtles increases with the age of the structures (Rosman et al., 1987b). Sea turtles probably use platforms as places to feed and rest. Offshore structures afford refuge from predators and stability in water currents, and loggerheads have been observed sleeping under platforms or beside support structures (Hastings et al., 1976; Rosman et al., 1987b; Gitschlag and Renaud, 1989). Only near the Chandeleur and Breton Islands were sea turtles positively associated with platforms (Lohoefener et al., 1989 and 1990).

Information about the effects of underwater explosions on sea turtles is limited. O'Keeffe and Young (1984) assumed that shock waves would injure the lungs and other organs containing gas, expected that ear drums of turtles would be sensitive, and suggested that smaller turtles would suffer greater injuries from the shock wave than larger turtles. The NMFS conducted several studies before and after an explosive platform removal to determine its effects on sea turtles in the immediate vicinity (Duronslet et al., 1986; Klima et al., 1988). Immediately after the explosion, turtles within 3,000 ft (914 m) of the platform were rendered unconscious (Klima et al., 1988), although they resumed apparently normal activity 5-15 minutes post-explosion (Duronslet et al., 1986). One of these turtles also sustained damage to the cloacal lining (it was everted) (Klima et al., 1988). Dilation of epidermal capillaries was a condition that continued for 3 weeks, after which time all turtles appeared normal. The effects on their hearing were not determined.

Impacts of explosive removals on sea turtles are not easily assessed, primarily because turtle behavior makes observations difficult. However, trained observers have documented very few turtles impacted by removal activities. The low number of turtles affected by the explosive removal of structures may be because of the few turtles that occur in harm's way at the time explosives are detonated, the effectiveness of the monitoring program established to protect sea turtles, and/ or the inability to adequately assess and detect impacted animals.

To minimize the likelihood of removals occurring when sea turtles may be nearby, and in consultation with NMFS, MMS issued NTL 2004-G06, which included guidelines for explosive platform removal to offshore operators. These guidelines include daylight-limited detonation, staggered charges, placement of charges 5 m (15 ft) below the seafloor, and pre- and post-detonation surveys of surrounding waters. With these existing protective measures (NMFS Observer Program and daylight-only demolition) in place, "take" of sea turtles during structure removals has been limited. Additionally, MMS published a programmatic EA on the explosive removal of structures in 2004 (USDOI, MMS, 2004) and petitioned NMFS for programmatic rulemaking under the MMPA for Explosive Removal of Structures (EROS). The NMFS Proposed Rule was published in the *Federal Register* on April 7, 2006, and the Final Rule is expected in the very near future. An ESA Section 7 consultation has been completed.

The area subject to this action has not been considered for explosive removals by the recent ESA consultation; therefore, explosive removal of the proposed platform is not an option at this time. However, impacts resulting from explosive removal will be addressed and MMS will re-initiate consultation or begin a new consultation proceedings should explosive removal be considered for this area.

Marine Debris

A wide variety of trash and debris is commonly observed in the Gulf. Marine trash and debris comes from a variety of land-based and ocean sources (Cottingham, 1988). Some material is accidentally lost during drilling and production operations. From March 1, 1994, to February 28, 1995, 40,580 debris items were collected in a 16-mi (26 km) transect made along the Padre Island National Seashore (Miller et al., 1995). The offshore oil and gas industry was shown to contribute 13 percent of the trash and debris found in the transect. Turtles may become entangled in drifting debris and ingest fragments of synthetic materials (Carr, 1987; USDOC, 1988; Heneman and the Center for Environmental Education, 1988). Entanglement usually involves fishing line or netting (Balazs, 1985). Once entangled, turtles may drown, incur impairment to forage or avoid predators, sustain wounds and infections from the abrasive or cutting action of attached debris, or exhibit altered behavior that threaten their survival (Laist, 1997). Both entanglement and ingestion have caused the death or serious injury of individual sea turtles (Balazs, 1985). Balazs (1985) compiled dozens of records of sea turtle entanglement, ingestion, and impaction of the alimentary canal by ingested plastics, although tar was the most common item ingested. The marked tendency of leatherbacks to ingest plastic has been attributed to misidentification of the translucent films as jellyfish. Lutz (1990) concluded that turtles will actively seek out and consume plastic sheeting. Ingested debris may block the digestive tract or remain in the stomach for extended periods, thereby lessening the feeding drive, causing ulcerations and injury to the stomach lining, or perhaps even providing a source of toxic chemicals (Laist, 1997). Weakened animals are then more susceptible to predators and disease; they are also less fit to migrate, breed, or nest successfully.

The MMS prohibits 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) prohibits the disposal of any plastics at sea or in coastal waters.

Sea turtles can become entangled in or ingest debris produced by exploration and production activities resulting from the proposed action. Leatherback turtles that mistake plastics for jellyfish may be more vulnerable to gastrointestinal blockage than other sea turtle species. The probability of plastic ingestion/entanglement is unknown.

Summary and Conclusion

During the course of the preparation of this SEIS, MMS has concluded that there have been hurricane-induced changes to the baseline conditions, particularity in the nearshore areas where habitat normally used for sea turtle nesting has been badly damaged. However, it is impossible to determine the effects of hurricanes on baseline conditions due to the unreliable estimate of pre-storm population levels and uncertain recovery times. In addition, determination of tropical storm effects are further complicated by the broad scope of the habitat changes in some areas combined with the short-term effect of the storms. Any alterations in the baseline condition of sea turtle habitat due to the recent hurricanes would not exacerbate or increase the potential effects of the proposed action. Although these effects upon sea turtle habitat may be considered moderate to severe in some localized areas, the effect of the proposed action upon sea turtles habitat would be negligible. The loss of suitable habitat through natural causes does not expand or cause the minor effects of the proposed action to become more harmful to sea turtles. No data exist to indicate that any of the turtle populations offshore were adversely affected by the storms.

Routine activities resulting from the proposed action that have a potential to harm sea turtles include degradation of water quality, noise, vessel collisions; and marine debris generated by service vessels and OCS facilities. Rapid dilution of the discharges should minimize impacts related to contaminants in waste discharges and drilling muds. The required seismic operation mitigations, particularly clearance of the impact area of sea turtles and marine mammals prior to ramp-up, and the subsequent gradual ramping up of the airguns, should minimize the impact of the rapid onset of, and close proximity to, very loud noise. Vessel traffic is a serious threat to sea turtles, and lethal effects are most likely to result from chance collisions with OCS service vessels. Diligence on the part of vessel operators as encouraged by the vessel strike mitigations should minimize vessel/sea turtle collisions. 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. Ingestion of plastic materials may have lethal effects to sea turtles. 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 sea turtles. The routine activities of the proposed action are unlikely to have significant adverse effects on the size and recovery of any sea turtle species or population in the GOM. Any effects upon sea turtles or sea turtle habitat resulting from the proposed action are expected to be negligible in scope and short-term in duration.

Accidental Impacts

This section discusses the impacts of accidental events associated with the proposed action on sea turtles. Section IV.D.1.a.(6) of the Lease Sale 181 FEIS (USDOI, MMS, 2001a) describes in detail the accidental (oil spill) impacts associated with OCS-related activities. The following information supplements the material provided by the previous study.

Blowouts

Improperly balanced well pressures that result in sudden, uncontrolled releases of fluids from a wellhead or wellbore are called blowouts. Blowouts can occur during any phase of development: exploratory drilling, development drilling, production, completion, or workover operations. In the event of a blowout, the eruption of gases and fluids may generate significant pressure waves and noise that may harass, injure, or kill sea turtles, depending on their proximity to the accident.

Oil Spills

In recent years, increased regulation and decreased tolerance of potentially harmful experimentation with endangered species has limited the available data on adverse impacts from events such as oil spills. Much of the best available science about the physiological response of sea turtles (and marine mammals) to oil exposure comes from studies and observations done in the 1990's and earlier. Also, decreasing oil-spill occurrence due to increased safety and security requirements for petroleum transport limits the number of field observations of the effects of spilled oil on sea turtles and other marine fauna.

When an oil spill occurs, the severity of effects and the extent of damage to sea turtles are affected by geographic location, hydrocarbon type, dosage, weathering, impact area, oceanographic and meteorological conditions, season, and life history stages of animals exposed to the hydrocarbons (NRC, 2003). All sea turtle species and life stages are vulnerable to the harmful effects of oil through direct contact or by fouling of their habitats and prey. Sea turtles accidentally exposed to oil or tarballs may suffer inflammatory dermatitis, ventilatory disturbance, salt gland dysfunction or failure, red blood cell disturbances, immune responses, and digestive disorders or blockages (Vargo et al., 1986; Lutz and Lutcavage, 1989; Lutcavage et al., 1995). Although disturbances may be temporary, long-term effects remain unknown, and chronically ingested oil may accumulate in organs. Direct contact with oil may harm developing turtle embryos. Exposure to hydrocarbons may be fatal, particularly to juvenile and hatchling sea turtles.

Turtles surfacing in an oil spill will inhale oil vapors. Any interference with operation of the lungs would probably reduce a sea turtle's capacity for sustained activity (aerobic scope) and its dive time, both effects decreasing the turtle's chance of survival.

Eggs, hatchlings, and small juveniles are particularly vulnerable if contacted (Fritts and McGehee, 1982; Lutz and Lutcavage, 1989). Female sea turtles crawling through tar to lay eggs can transfer the tar to the nest; this was noted on St. Vincent NWR in 1994 (USDOI, FWS, 1997). Potential toxic impacts to embryos will depend on the type of oil and degree of weathering, type of beach substrate, and especially upon the developmental stage of the embryo. Residues may agglutinate sand grains where eggs are deposited, later impeding hatchlings from successfully evacuating nests and ultimately leading to their death. Oil slicks, slicketts, or tarballs moving through offshore waters may foul sargassum mats that hatchling and juvenile sea turtles inhabit, which would conceivably result in the loss of sea turtle habitat or the "take" of sea turtles. High rates of oil contact in very young turtles suggest that bioaccumulation may occur over their potentially long lifespan. Exposure to hydrocarbons may begin as early as eggs are deposited in contaminated beach sand. A female coming ashore to nest might be fouled with oil or transport existing residues at the driftline to the nest. During nesting, she might push oil mixed with sand into the nest and contaminate the eggs (Chan and Liew, 1988). Assuming olfaction is critical to the process, oil fouling of a nesting area might disturb imprinting of hatchling turtles or confuse the turtles on their return migration after a 6- to 8-year absence (Geraci and St. Aubin, 1985; Chan and Liew, 1988).

Contact with hydrocarbons may not cause direct or immediate death, but cumulative sublethal effects such as salt gland disruption or liver impairment could impair the marine turtle's ability to function effectively in the marine environment (Vargo et al., 1986; Lutz and Lutcavage, 1989). Although many observed physiological insults are resolved in a 21-day recovery period, the impact of tissue oil intake on the long-term health and survival of sea turtles remains unknown (Lutcavage et al., 1995). There is evidence of bioaccumulation in sea turtles exposed for longer periods of time. After the Gulf of Iraq war, a stranded green turtle did not appear to have contacted hydrocarbons, but upon necropsy, was found to have large amounts of oil in its liver and stomach tissues (Greenpeace, 1992).

The primary feeding grounds for adult Kemp's ridley turtles in the northern and southern GOM are near major areas of coastal and offshore oil exploration and production (USDOC, NMFS, 1992). The nesting beach at Rancho Nuevo, Mexico, is also vulnerable and was indeed affected by the *Ixtoc* spill. The spill reached the nesting beach after the nesting season when adults had returned or were returning to their feeding grounds. It is unknown how adult turtles using the Bay of Campeche fared. It is possible that high hatchling mortality occurred that year in the oceanic waters of the Gulf as a result of the floating oil.

Spill-Response Activities

In addition to the impacts from contact with hydrocarbons, spill-response activities could adversely affect sea turtle habitat and cause displacement from suitable habitat to inadequate areas. Impacting factors might include artificial lighting from night operations, booms, machine and human activity, equipment on beaches and in intertidal areas, sand removal and cleaning, and changed beach landscape and composition. Some of the resulting impacts from cleanup could include interrupted or deterred nesting behavior, crushed nests, entanglement in booms, and increased mortality of hatchlings because of predation during the increased time required to reach the water (Newell, 1995; Lutcavage et al., 1997). The damage assessment and restoration plan/environmental assessment for the August 1993 Tampa Bay oil spill also noted that hatchlings that were restrained during the spill response were released on beaches other than their natal beaches, thus potentially losing them from the local nesting population (FDEP et al., 1997). Additionally, turtle hatchlings and adults may become disoriented and normal behavior disrupted by human presence as well as industrial activity. As mandated by OPA 90, seagrass beds and live-bottom communities are expected to receive individual consideration during spill cleanup. Required spill contingency plans include special notices to minimize adverse effects from vehicular traffic during cleanup activities and to maximize protection efforts to prevent contact of these areas with spilled oil. Loggerhead turtle nesting areas in the Chandeleur Islands, Cape Breton National Seashore, and central Gulf States would also be expected to receive special cleanup considerations under these regulations. Little is known about the effects of dispersants on sea turtles and, in the absence of direct testing, impacts are difficult to predict. Dispersant components absorbed through the lungs or gut may affect multiple organ systems and interfere with digestion, excretion, respiration, and/or salt-gland function. Inhalation of dispersant can interfere with function through the surfactant (detergent) effect. These impacts are similar to the empirically demonstrated effects of oil alone (Hoff and Shigenaka, 2003).

Since sea turtle habitat in the Gulf includes inshore, coastal, and oceanic waters, as well as numerous beaches in the region, sea turtles could be impacted by accidental spills resulting from operations associated with the proposed action. The potential causes, sizes, and probabilities of oil spills that could occur during drilling, production, and transportation operations associated with the proposed action are presented in **Chapter 4.2.1**.

The OSRA modeling results indicate that a large spill (≥1,000 bbl) occurring in Federal offshore waters stands less than a 0.5 percent probability of impacting any Gulf coastal sea turtle habitat including beach nesting and nearshore mating areas, with one exception. The Louisiana general coastal habitat east of the Mississippi River stands a 1-2 percent probability of contact with spilled oil as a result of Lease Sale 224 (**Figure 4-10**). Central Louisiana offshore waters have a 1-2 percent probability of contact with a large spill and all other State offshore waters have less than a 0.5 percent probability of such contact (**Figure 4-5**).

Because oil spills introduced specifically in coastal waters are assumed to impact adjacent lands, there is likelihood that spilled oil will impact sea turtle nesting beaches in these adjacent states. In Louisiana, loggerhead nesting beaches on the Chandeleur Islands are vulnerable to an oil spill originating in adjacent waters; however, the hurricane damage suffered by these islands in the last few years has likely rendered them unsuitable for nesting beaches. Depending on the timing of the spill's occurrence in coastal waters, its impact and resulting cleanup may interrupt sea turtle migration, feeding, mating, and/ or nesting activity for extended periods (days, weeks, months). Spills originating in or migrating through coastal waters of the eastern GOM may impact any of the five sea turtle species inhabiting the Gulf. Kemp's ridley is the most endangered sea turtle species and is strongly associated with coastal waters of Texas, Louisiana and the upper west coast of Florida. Also, green, hawksbill, loggerhead, and leatherback sea turtles use coastal waters of the eastern Gulf. Aside from the acute effects noted if sea turtles encounter an oil slick, the displacement of sea turtles to less suitable habitats from habitual feeding areas impacted by oil spills may increase vulnerability to predators, disease, or anthropogenic mortality. A high incidence of juvenile sea turtle foraging occurs along certain coastal regions of the Gulf Coast. The interruption of mating and nesting activities for extended periods may influence the recovery of sea turtle populations.

All neonate sea turtles undertake a passive voyage via oceanic waters following nest evacuation. Depending on the species and population, their voyage in oceanic waters may last 10 or more years. Beaches of the Caribbean Sea and GOM are used as nesting habitat, and hatchlings evacuating these nesting beaches emigrate to oceanic waters seaward of their nesting sites. Moreover, these journeys begin as pulsed events, with many hatchlings emerging and emigrating offshore at the same times. Oceanic OCS waters of the GOM are also inhabited by subadult and adult leatherback and loggerhead sea turtles; however, adults of any endemic sea turtle species may be found offshore. Consequently, intermediate to large spills occurring in these waters may impact multiple turtles, particularly neonate or young juvenile sea turtles associating with oceanic fronts or taking refuge in sargassum mats where oil slicks, decomposing residues, and tarballs are likely to accumulate. Large spills, particularly those flowing fresh hydrocarbons into oceanic and/or outer shelf waters for extended periods (days, weeks, months), pose an increased risk of impacting sea turtles inhabiting these waters.

There is an extremely small probability that a single sea turtle will encounter an oil slick resulting from a single, small spill. Increasing the size of a slick or factoring in the number of estimated spills over 40 years increases the likelihood that an animal will encounter a single slick during the lifetime of an animal; many sea turtle species are long-lived and may traverse throughout waters of the northern Gulf. The web of reasoning is incomplete without considering the abundance (stock or population) of each species inhabiting the Gulf. The likelihood that members of a sea turtle population (e.g., Kemp's ridley) may encounter an oil slick resulting from a single spill during a 40-year period is greater than that of a single individual encountering a slick during its lifetime. It is impossible to estimate precisely what sea turtle species, populations, or individuals will be impacted, to what magnitude, or in what numbers, since each species has unique distribution patterns in the Gulf and because of difficulties attributed to estimating when and where oil spills will occur over a 40-year period.

Spills of any size degrade water quality, and residuals become available for bioaccumulation within the food chain. Slicks may spread at the sea surface or may migrate underwater from the seafloor through the water column and never broach the sea surface. Regardless, a slick is an expanding but aggregated mass of oil that, with time, will disperse into smaller units as it evaporates (if at the sea surface) and weathers. **Chapter 4.2.1.6.4** details the persistence, spreading, and weathering process for offshore spills. As the slick breaks up into smaller units (e.g., slickets) and soluble components dissolve into the seawater, tarballs may remain within the water column. Tarballs may subsequently settle to the seafloor or attach to other particles or bodies in the sea. As residues of an oil spill disperse and commit to the physical environment (water, sediments, and particulates), sea turtles of any life history stage may be exposed via the waters that they drink and swim, as well as via the prey they consume. For example, tarballs may be consumed by sea turtles and by other marine organisms, and eventually bioaccumulate within sea turtles. Although sea turtles may (or may not) avoid oil spills or slicks, it is highly unlikely that they are capable of avoiding spill residuals in their environment. Consequently, the probability that a sea turtle is exposed to oil resulting from a spill extends well after the oil spill has dispersed from its initial aggregated mass.

In general, on a yearly basis, about 1 percent of strandings identified by the U.S. Sea Turtle Stranding Network were associated with oil (e.g., Teas and Martinez, 1992). Turtles do not always avoid contact with oil (e.g., Lohoefener et al., 1989). Contact with petroleum and consumption of oil and oil-contaminated prey may seriously impact turtles; there is direct evidence that turtles have been seriously harmed by petroleum spills. Oil spills and residues have the potential to cause chronic (longer-term lethal or sublethal oil-related injuries) and acute (spill-related deaths occurring during a spill) effects on turtles.

Due to spill response and cleanup efforts, much of an oil spill may be recovered before it reaches the coast. However, cleanup efforts in offshore waters may result in additional harm or mortality of sea turtles, particularly to neonates and juveniles. Oil spills and spill-response activities at nesting beaches, such as beach sand removal and compaction, can negatively affect sea turtles. Although spill-response activities such as vehicular and vessel traffic during nesting season are assumed to affect sea turtle habitats, further harm may be limited because of efforts designed to prevent spilled oil from contacting these areas. Increased human presence could influence turtle behavior and/or distribution, thereby stressing animals and making them more vulnerable to predators, the toxicological effects of oil, or other anthropogenic sources of mortality.

In the event of a blowout, the eruption of gases and fluids may generate significant pressure waves and noise that may harass, injure, or kill sea turtles, depending on their proximity to the accident. Fortunately, improvements in technology and equipment have greatly decreased the occurrence of blowouts. Due the very small number of wells proposed from the proposed action, no blowouts are projected.

Summary and Conclusion

Accidental blowouts, oil spills, and spill-response activities resulting from the proposed action 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 the harassment, harm, or mortality to sea turtles occurring in the northern Gulf. In most foreseeable cases, exposure to hydrocarbons persisting in the sea following the dispersal of an oil slick will result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity; 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. Any effects upon sea turtles resulting from the proposed action are expected to be negligible in scope and short term in duration.

During the course of the preparation of this SEIS, MMS has concluded that there have been hurricane-induced changes to the baseline conditions, particularity in the nearshore areas where habitat normally used for sea turtle nesting has been badly damaged. However, it is impossible to determine the effects of hurricanes on baseline conditions due to the unreliable estimate of pre-storm population levels and uncertain recovery times. In addition, the determination of tropical storm effects are further complicated by the broad scope of the habitat changes in some areas combined with the short-term effect of the storms. Any alterations in the baseline condition of sea turtle habitat due to the recent hurricanes would not exacerbate or increase the potential effects of the proposed action. Although these effects upon sea turtle habitat may be considered moderate to severe in some localized areas, the effect of the proposed action upon sea turtles habitat would be negligible. The loss of suitable habitat through natural causes does not expand or cause the minor effects of the proposed action to become more harmful to sea turtles. No data exist to indicate that any of the turtle populations offshore were adversely affected by the storm.

Cumulative Impacts

Section IV.D.1.e.(6) of the Lease Sale 181 FEIS (USDOI, MMS, 2001a) described in detail the major cumulative impacts associated with OCS-related activities. The following information supplements the material provided by the previous study.

This cumulative analysis considers the effects of impact-producing factors related to the proposed action along with impacts of other commercial, military, recreational, offshore, and coastal activities that may occur and adversely affect populations of sea turtles in the same general area of the proposed action. The combination of potential impacts resulting from the proposed action in addition to prior and future OCS sales, dredging operations, military operations, water quality degradation, natural catastrophes, pollution, recreational and commercial fishing, vessel traffic, beach nourishment, beach lighting, power plant entrainment, and human consumption affect the loggerhead, Kemp's ridley, hawksbill, green, and leatherback turtles found in the GOM.

Effluents are routinely discharged into offshore waters and are regulated by USEPA NPDES permits. Most operational discharges are diluted and dispersed when released in offshore areas and, due to the USEPA permit regulations on discharges, are considered to have little effect (API, 1989; Kennicutt, 1995). Any potential that might exist for impact from drilling fluids would more likely be indirect, either by impact on prey items or possibly through ingestion via the food chain (API, 1989). Contaminants in drilling mud discharge may biomagnify and bioaccumulate in the food web, which may kill or debilitate important prey species of sea turtles or species lower in the marine food web. This could ultimately reduce reproductive fitness or longevity in sea turtles.

Noise from service-vessel and helicopter traffic may cause a startle reaction from sea turtles and produce temporary stress (NRC, 1990). Helicopter traffic would occur on a regular basis. It is projected that a total of 3,000-5,000 OCS-related helicopter operations (take-offs and landings) would occur between 2008 and 2047 in the EPA (**Table 4-2**). The FAA's Advisory Circular 91-36C encourages pilots to maintain greater than minimum altitudes near noise-sensitive areas. Corporate helicopter policy 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. The OCS-related helicopters are not the only aircraft that fly over the coastal and offshore areas. The air space over the GOM is also used extensively by DOD for conducting various air-to-air and air-to-surface operations. Nine military warning areas and five water test areas are located within the Gulf (**Figure 2-1**). Additional activities, including vessel operations and ordnance detonation, also affect sea turtles.

Other sound sources potentially impacting sea turtles include seismic surveys and drilling noise. The potential impacts of anthropogenic sounds on sea turtles include physical auditory effects (temporary threshold shift), behavioral disruption, long-term effects, masking, and adverse impacts on prey species. Noise-induced stress has not been studied in sea turtles. Seismic surveys use airguns to generate sound pulses, which are a more intense sound than other nonexplosive sound sources. Seismic activities are expected to be primarily annoyance to sea turtles and cause a short-term behavioral response. However, sea turtles are included in the mitigations required of all seismic vessels operating in the GOM as stated in NTL 2007-G02, "Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program." The MMS has petitioned NMFS for programmatic rulemaking for seismic activities under the MMPA. The MMS has also requested consultation under the ESA with NMFS for seismic activities. The NMFS has awarded a contract for an EIS. It is expected that drilling noise will periodically disturb and affect turtles in the GOM. Based on the conclusions of Lenhardt et al. (1983) and O'Hara and Wilcox (1990), low-frequency sound transmissions (such as those produced by operating platforms) could cause increased surfacing and deterrence behavior from the area near the sound source.

Increased surfacing places turtles at greater risk of vessel collision. Vessel traffic, particularly supply boats running from shore bases to offshore structures, is one of the industry activities included in this proposed action. Collisions between service vessels or barges and sea turtles would likely cause fatal injuries. It is projected that 15,000-20,000 service-vessel round trips will occur between 2007 and 2046 as a result of the proposed action. In response to terms and conditions of previous NMFS Biological Opinions and in an effort to minimize the potential for industry-related vessel strikes to marine mammals and sea turtles, MMS issued NTL 2007-G04, "Vessel Strike Avoidance and Injured/Dead Protected Species Reporting" (and previous versions). Increased vessel traffic in the Gulf increases the probability of sea turtle ship strikes. Regions of greatest concern may be those with high concentrations of recreational boat traffic, such as the many coastal bays in the Gulf. Potential adverse effects from Federal vessel operations in the area of this proposed action include operations of the U.S. Navy, USCG, USEPA, NOAA, and COE.

Explosive discharges such as those used for MMS and COE structure removals can cause injury to sea turtles (Duronslet et al., 1986). Although sea turtles far from the site may suffer only disorientation, those near detonation sites could sustain fatal injuries. Injury to the lungs, intestines, and/or auditory system could occur. Other potential impacts include physical or acoustic harassment. Resuspension of bottom sediments, increased water turbidity, and mobilization of bottom sediments due to explosive detonation are considered to be temporary effects. Only one structure removal is estimated for this proposed action.

To minimize the likelihood of removals occurring when sea turtles may be nearby, MMS issued guidelines for explosive platform removal to offshore operators. These guidelines include daylight-limited detonation, staggered charges, placement of charges 5 m (15 ft) below the seafloor, and pre- and post-detonation surveys of surrounding waters. With these existing protective measures (NMFS Observer Program and daylight-only demolition) in place, "take" of sea turtles during structure removals has been limited. Additionally, MMS published a programmatic EA on explosive removal of structures in 2004 (USDOI, MMS, 2004) and petitioned NMFS for programmatic rulemaking under the MMPA for EROS. The NMFS Proposed Rule was published in the *Federal Register* on April 7, 2006, and the Final Rule is expected in the very near future. An ESA Section 7 consultation has been completed. In the interim, MMS consulted with NMFS and, based on the Biological Opinions from those Section 7 consultations, issued NTL 2004-G06, "Structure Removal Operations," to provide lessees with mitigation and reporting requirements.

Sea turtles may be seriously impacted by marine debris. Trash and flotsam generated by the oil and gas industry and other users of the Gulf (Miller and Echols, 1996) is transported around the Gulf and Atlantic via oceanic currents (Plotkin and Amos, 1988; Hutchinson and Simmonds, 1992). Turtles that consume or become entangled in trash or flotsam may become debilitated or die (Heneman and the Center for Environmental Education, 1988). Floating plastics and other debris, such as petroleum residues drifting on the sea surface, accumulate in sargassum drift lines commonly inhabited by hatchling sea turtles. Sea turtles, particularly leatherbacks, are attracted to floating plastic because it resembles food, such as jellyfishes. Ingestion of plastics sometimes interferes with food passage, respiration, and buoyancy and could reduce the fitness of a turtle or kill it (Carr, 1987; USDOC, NOAA, 1988; Heneman and the Center for Environmental Education, 1988; Lutz and Alfaro-Shulman, 1992). The MMS prohibits 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), prohibits the disposal of plastics at sea or in coastal waters. The MMS has also issued NTL 2007-G03 (and the prior versions) "Marine Trash and Debris Awareness and Elimination," to minimize inadvertant loss overboard of materials and personal belongings from vessels and structures.

Since sea turtle habitat in the Gulf includes both inshore and offshore areas, sea turtles are likely to encounter spills. The probability that a sea turtle is exposed to hydrocarbons resulting from a spill extends well after the oil spill has dispersed from its initial aggregated mass. Oil spills can adversely affect sea turtles by toxic ingestion or blockage of the digestive tract, inflammatory dermatitis, ventilatory disturbance, disruption or failure of salt gland function, red blood cell disturbances, immune responses, and displacement from important habitat areas (Witham, 1978; Vargo et al., 1986; Lutz and Lutcavage, 1989; Lutcavage et al., 1995). Sea turtles may become entrapped by tar and oil slicks and rendered immobile (Witham, 1978; Plotkin and Amos, 1988). Although disturbances may be temporary, turtles chronically ingesting oil may experience organ degeneration. Exposure to oil may be fatal, particularly to juvenile and hatchling sea turtles. Hatchling and juvenile turtles are particularly vulnerable to contacting or ingesting oil because currents that concentrate oil spills also form the habitat mats in which these turtles are sometimes found (Carr, 1980; Collard and Ogren, 1990; Witherington, 1994). Skin damage in turtles can result in acute or irritant dermatitis. A break in the skin barrier could act as a portal of entry for pathogenic organisms, leading to infection and debilitation (Vargo et al., 1986). Sea turtles sometimes pursue and swallow tarballs, and there is no conclusive evidence that wild turtles can detect and avoid oil (Odell and MacMurray, 1986; Vargo et al., 1986). Oil might have an indirect effect on the behavior of sea turtles. Assuming smell is necessary to sea turtle migration, oil-fouling of a nesting area may disturb the imprinting of hatchling turtles or confuse turtles during their return migration after a 6- to 8-year absence (Geraci and St. Aubin, 1985). The effect on reproductive success could therefore be significant.

When an oil spill occurs, the severity of effects and the extent of damage to sea turtles are affected by geographic location, oil type, oil dosage, impact area, oceanographic conditions, and meteorological conditions (NRC, 1985). Eggs, hatchlings, and small juveniles are particularly vulnerable upon contact (Fritts and McGehee, 1982; Lutz and Lutcavage, 1989). Potential toxic impacts to embryos will depend on the type of oil and degree of weathering, type of beach substrate, and especially upon the developmental stage of the embryo. Although many observed injuries and impacts to sea turtles were resolved in a 21-day recovery period, the impact of tissue oil intake on the long-term health and survival of sea turtles remains unknown (Lutcavage et al., 1995).

Oil-spill-response activities, such as vehicular and vessel traffic in coastal areas of seagrass beds and live-bottom communities, can alter sea turtle habitat and displace sea turtles from these areas. The effects on seagrass and reef communities have been noted (reviewed by Coston-Clements and Hoss, 1983). Impacting factors include artificial lighting from night operations, booms, machine and human activity, equipment on beaches and in intertidal areas, sand removal and cleaning, and changed beach landscape and composition. Some resulting impacts from cleanup could include interrupted or deferred nesting, crushed nests, entanglement in booms, and increased mortality of hatchlings because of predation during the extended time required to reach the water (Newell, 1995; Lutcavage et al., 1997; Witherington, 1999). As mandated by the OPA 90 (**Chapter 1.3**), these areas are expected to receive individual consideration during oil-spill cleanup.

The chief areas used by Kemp's ridleys (coastal waters less than 18 m (59 ft) in depth) overlap with that of the shrimp fishery (Renaud, 1995). A major source of mortality for loggerhead and Kemp's ridleys was capture and drowning in shrimp trawls (Murphy and Hopkins-Murphy, 1989). Crowder et al. (1995) reported that 70-80 percent of turtle strandings were related to interactions with this fishery. The NMFS has required the use of TED's in southeast U.S. shrimp trawls since 1989. In response to the increased numbers of dead sea turtles that washed up along the coasts of Texas, Louisiana, Georgia, and northeast Florida in 1994-1995 and coincident with coastal shrimp trawling activity, NMFS increased enforcement efforts (relative to TED's), which decreased the number of strandings. After concerns arose that TED's were not adequately protecting larger sea turtles, NMFS issued a Biological Opinion in 2002 that reported an estimated 62,000 loggerhead and 2,300 leatherback sea turtles had been killed as a result of interaction with the shrimp trawls. The Opinion also stated that 75 percent of the loggerhead sea turtles in the GOM were too large to be protected by the TED's. Subsequent regulation issued by NMFS in 2003 required larger openings to better protect the larger sea turtles. The use of TEDs is believed to reduce hard-shelled sea turtle captures by 97 percent. Even so, NMFS estimated that 4,100 turtles may be captured annually by shrimp trawling, including 650 leatherbacks that cannot be released through TED's, 1,700 turtles taken in try nets, and 1,750 turtles that fail to escape through the TED. Other fisheries and fishery-related activities are important sources of mortality but are collectively only one-tenth as important as shrimp trawling (NRC, 1990).

Dredge-and-fill activities occur in many of the coastal areas inhabited by sea turtles. Dredging operations affect turtles through accidental take and habitat degradation. The construction and maintenance of Federal navigation channels has been identified as a source of sea turtle mortality. Hopper dredges move relatively rapidly (compared with sea turtle swimming speeds) and can entrain and kill these species, presumably as the drag arm of the moving dredge overtakes the slower animal. Hopper dredging has caused turtle mortality in coastal areas (Slay and Richardson, 1988). Nearly all sea turtles entrained by hopper dredges are dead or dying when found (NRC, 1990). In addition to direct take, channelization of the inshore and nearshore areas can degrade foraging and migratory habitats via spoil dumping, degraded water quality/ clarity, and altered current flow.

Sand mining, beach renourishment, and oil-spill cleanup operations may remove sand from the littoral zone and temporarily disturb onshore sand transport, potentially disturbing nesting activities. The main causes of permanent nesting beach loss within the GOM are the reduction of sediment transport, rapid rate of relative sea-level rise, coastal construction and development, and recreational use of accessible beaches near large population centers.

The MMS has evaluated the use of sand resources for levee, beach, and barrier island restoration projects. Between 1995 and 2006, MMS provided over 23 million yd^3 of OCS sand for 17 coastal projects, restoring over 90 mi (145 km) of national coastline. As the demand for sand for shoreline protection increases, OCS sand and gravel has become an increasingly important resource. For example, the Louisiana Coastal Area Ecosystem Restoration Study estimated that about 60 million yd^3 of OCS sand from Trinity Shoal, Ship Shoal, and other sites will be needed for barrier island and shoreline restoration projects in the next 3-5 years. Use of these resources will require coordination with MMS for appropriate permits. Sea turtles are included in the potential impacts identified for sand dredging projects. Mitigation measures include requiring stipulations to protect sea turtles when it is determined that there is a likelihood of sea turtle presence within the area during the dredging operation and a trailing suction hopper dredge is used.

Tropical storms and hurricanes are a normal occurrence in the Gulf and along the coast. Generally, the impacts have been localized and infrequent. However, in 2004 and 2005 the GOM has been extremely hard hit by very powerful hurricanes. Few areas of the coast have not suffered some damage in 2004-2005 and activities in the Gulf have also been severely impacted. In 2004, Hurricane Ivan took a large toll on oil and gas structures and operations in the Gulf and caused widespread damage to the Alabama-Florida Panhandle coast. In 2005, Hurricanes Katrina, Rita, and Wilma reached Category 5 strength in the GOM. These storms caused damage to all five of the Gulf Coast States and damage to structures and operations both offshore and onshore. The actual impacts of these storms on the animals in the Gulf, and the listed species and critical habitat in particular, 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 will impact sea turtles that would have used those areas for nesting beaches. About 50 sea turtle nests along the Alabama coast are known lost. All 10 of the nests at Bon Secour National Wildlife Refuge in Alabama were destroyed. Breton Wildlife Refuge, part of the Chandeleur Islands off of Louisiana, lost approximately 50 percent of its landmass to Hurricane Katrina (Di Silvestro, 2006). Similar habitat loss is expected for the chain of islets. The Chandeleur Islands are known to be very important loggerhead nesting habitat. Oil, gas, and chemical spills from damaged and destroyed structures and vessels may have impacted sea turtles. (Although no large oil spills were reported, several lesser spills are known to have occurred.) Increased trash and debris in both offshore and inshore habitats affected sea turtles. About 200 loggerhead hatchlings could not get across the accumulated seagrass and debris washed ashore at Hutchinson Island, Florida, days after Hurricane Katrina hit. Most of the hatchlings were recovered and later released in the ocean (CBS News, 2005).

Summary and Conclusion

Under the cumulative scenario, impacts associated with the proposed action must be considered with respect to all actions in OCS waters that may have impacted or will impact sea turtles. These activities include structure installations, dredging, water quality and habitat degradation, OCS-related marine debris, vessel traffic, seismic surveys, explosive structure removals, oil spills, oil-spill-response activities, natural catastrophes, pollution, dredge operations, vessel collisions, commercial and recreational fishing, human consumption, beach lighting, and power plant entrainment. Turtle mortality due to service-vessel collision, plastic ingestion, oil spills, and explosive removal is reduced through mitigative measures. The incremental contribution of the proposed action to the numerous, cumulative impacts to sea turtles resulting from the proposed action are expected to be negligible in scope and short-term in duration.

Natural phenomenon, such as tropical storms and hurricanes, are impossible to predict, but they will occur in the GOM. During the course of the preparation of this SEIS, MMS has concluded that there have been hurricane-induced changes to the baseline conditions, particularity in the nearshore areas where habitat normally used for sea turtle nesting has been badly damaged. However, it is impossible to determine the effects of hurricanes on baseline conditions due to the unreliable estimate of pre-storm population levels and uncertain recovery times. In addition, determination of tropical storm effects are further complicated by the broad scope of the habitat changes in some areas combined with the short-term effect of the storms. Any alterations in the baseline condition of sea turtle habitat due to the recent hurricanes would not exacerbate or increase the potential effects of the proposed action. Although these effects upon sea turtle habitat may be considered moderate to severe in some localized areas, the effect of the proposed action upon sea turtles habitat would be negligible. The loss of suitable habitat through natural causes does not expand or cause the minor effects of the proposed action to become more harmful to sea turtles. No data exist to indicate that any of the turtle populations offshore were adversely affected by the storm.

4.3.7. Impacts on Alabama, Choctawhatchee, St. Andrew, and Perdido Key Beach Mice and the Florida Salt Marsh Vole

Routine Impacts

This section discusses the possible effects of activities associated with the proposed action on the Alabama, Choctawhatchee, St. Andrew, and Perdido Key beach mice, and the Florida salt marsh vole, which are designated as protected species under the Endangered Species Act of 1973 (Section I.B.4.c of

Lease Sale 181 FEIS and **Chapter 1.3** of this SEIS). These mice occupy restricted habitat behind coastal foredunes of Florida and Alabama (Ehrhart, 1978; USDOI, FWS, 1987). Documented beach mouse occurrences are on the Fort Morgan Peninsula in Gulf State Park (Perdido Key Unit), along Gulf Islands National Seashore in Topsail Park, and on Shell Island. Portions of these areas have been designated as critical habitat.

The Florida salt marsh vole occupies only a single tidal marsh located on Waccasassa Bay, Florida, about 90 mi (145 km) north of Tampa, Florida. Fossil voles indicate an ancient wide distribution over salt marshes in what is now the continental shelf, which is submerged by rising sea levels.

The major impact-producing factors associated with routine activities of the proposed action that may affect the mice include beach trash and debris, and the efforts undertaken for the removal of marine debris. Trash and debris may be mistakenly consumed by beach mice or entangle them. Efforts undertaken for the removal of marine debris or for beach restoration, such as sand replenishment, may temporarily scare beach mice, destroy their food resources such as sea oats, or collapse the tops of their burrows.

Major impact-producing factors and potential effects on the salt marsh vole are similar to those discussed above for beach mice.

Summary and Conclusion

Shore development and tropical storms have contributed to the loss of habitat used by the Alabama, Choctawhatchee, St. Andrew and Perdido Key beach mice, and the Florida salt marsh vole. The proposed action is not expected to contribute to additional habitat loss. Impacts resulting from the consumption of beach trash and debris are minimal. The proposed action would deposit only a small portion of the total debris that would reach the habitat. Efforts undertaken for the removal of marine debris may temporarily scare away beach mice, destroy their food resources, or collapse the tops of their burrows.

Accidental Impacts

This section discusses the possible effects of accidental events associated with the proposed action on the subject species. The potential probabilities, sizes, and causes of crude oil spills that could occur during drilling, production, and transportation operations associated with the development of the proposed Lease Sale 224 area are listed below. Direct contact with spilled oil can cause skin and eye irritation and subsequent infection for endangered beach mice. The fur will be matted and lose its insulation against heat and cold. Sweat glands, ear tissues, and throat tissues may be irritated or infected. The disruption of sight and hearing increases the vulnerability to predators. Other direct toxic effects may include asphyxiation from inhalation of fumes, oil ingestion, and food contamination. Indirect impacts from oil spills would include reduction of food supply, destruction of habitat, and fouling of nests. Impacts can also occur from spill-response activities. Vehicular traffic and other activities associated with oil-spill cleanup can degrade preferred habitat and cause displacement of mice from these areas unless properly regulated.

The probabilities of oil spills (≥1,000 bbl) resulting from proposed Lease Sale 224 occurring and contacting beach mouse habitat within 10 days is ≤0.5 percent for each subspecies of listed beach mouse.

There is no definitive information on the persistence of oil in the event that a spill were to contact beach mouse habitat. In Prince William Sound, Alaska, after the *Exxon Valdez* spill in 1989, buried oil has been measured in the intertidal zone of beaches, but no effort has been made to search for residual buried oil above high tide. Similarly, NRC (2003) makes no mention of studies of oil left above high tide after a spill. Regardless of the potential for persistence of oil in beach mouse habitat, a slick cannot wash over the fore dunes unless carried by a heavy storm swell. Beach mice retreat inland during tropical storms. The oiling of beach mice could result in an adverse effect depending upon the severity of the spill. However, impacts to beach mice due to oiling are unlikely given the chance of impact to the habitat is less than 0.5 percent.

Summary and Conclusion

Direct impacts to beach mice and Florida salt mash voles are unlikely due to the very low probability of a spill (≥1,000 bbl) occurring nearshore. In the unlikely event that an oil slick reached this habitat, oil-spill response and cleanup activities could result in impacts of undetermined severity and duration depending upon the degree that these activities are properly regulated and monitored. During the course of the preparation of this SEIS, MMS has concluded that there have been hurricane-induced changes to the baseline conditions, particularity in the nearshore areas where habitat normally used by mice and voles may have been badly damaged. However, it is impossible to determine the effects of hurricanes on baseline conditions due to the unreliable estimate of pre-storm population levels and uncertain recovery times. In addition, the determination of tropical storm effects are further complicated by the broad scope of the habitat changes in some areas combined with the short-term effect of the storms. Any alterations in the baseline condition of mice/vole habitat due to the recent hurricanes would not exacerbate or increase the potential effects of the proposed action. Although these effects upon habitat may be considered moderate to severe in some localized areas, the effect of the proposed action upon mice/vole habitat would be negligible. The loss of suitable habitat through natural causes does not expand or cause the minor effects of the proposed action to become more harmful to mice/voles.

Cumulative Impacts

This cumulative analysis considers the effects of OCS-related and non-OCS-related impact-producing factors as they pertain to (a) spills as a result of proposed Lease Sale 224, and prior and future OCS lease sales, as well as oil-spill cleanup activities with accompanying motorized traffic; (b) alteration and destruction of habitat by dredge-and-fill activities, residential and commercial coastal construction and associated vehicular traffic, and natural catastrophes; (c) predation and competition; and (d) beach trash and debris. The effects of the major impact-producing factors are described below. This analysis incorporates the discussion of the effects from these impact-producing factors on beach mice and the Florida salt marsh vole in Section IV.D.1.a.(8) of the Lease Sale 181 FEIS (USDOI, MMS, 2001a). Sections providing supportive material for the Alabama, Perdido Key, Choctawhatchee, and St. Andrew beach mice analysis include **Chapters 3.2.5** (description of Alabama, Perdido Key, Choctawhatchee, and St. Andrew beach mice, and the Florida salt marsh vole) and **Chapter 3.2.1.1** (coastal barrier beach and dune systems).

In the event of an oil spill, protection efforts to prevent contact of these areas with spilled oil are mandated by the Oil Pollution Act of 1990. Vehicular traffic associated with oil-spill cleanup activities has the potential to degrade preferred habitat and to cause displacement from these areas if not properly regulated.

Present beach mice habitat is no longer of optimal quality because of historical beach erosion, construction, and tropical storm damage. Dredge-and-fill activities occur throughout the nearshore areas of the United States and disrupt beach sand transport, which could affect coastal systems of dunes where beach mice live. Coastal construction and traffic can be expected to threaten beach mouse populations on a continual basis. Natural catastrophes including storms, floods, droughts, and hurricanes have the potential to substantially reduce or eliminate beach mice. Some of these are expected to occur and periodically contact beach mouse habitat. This problem may have increased following Hurricanes Ivan and Katrina because the storms washed large amounts of debris into the dune habitats. In addition, the reduction of food sources due to storm stress could lead animals to consume items not normally in their diet. Cleanup efforts to remove storm debris could result in serious negative impacts to beach mouse habitat if not properly regulated. No increment to habitat loss and degradation from cumulative impacts is expected from Sale 224 activities.

Predation from both feral and nonferal domestic cats and dogs and competition with common house mice also reduce and disturb their populations, but estimates of this mortality are unreliable (USDOI, FWS, 1987; Humphrey and Frank, 1992). No increment to predation or competition impacts is expected from Sale 224 activities. Trash and debris may be mistakenly consumed by beach mice or entangle them. Most trash and debris is expected to result from urban runoff. The incremental impact from Sale 224 activities is described above under “Routine Impacts” and is expected to be negligible.

The beach mouse has a maximum expected lifespan of 1 year, and disturbances are not expected to last for more than one or two generations, provided some relict population survives.

Summary and Conclusion

Cumulative activities have a potential to harm or reduce the numbers of Alabama, Choctawhatchee, St. Andrew, and Perdido Key beach mice, and the Florida salt marsh vole. Those activities include oil spills, oil-spill response activities, alteration and reduction of habitat, predation and competition, and beach trash and debris. The majority of OCS-related activities and events, as well as oil spills stemming from import tankering and prior and future OCS lease sales, are not expected to contact beach mice or their habitats. Cumulative activities posing the greatest potential harm are non-OCS activities (i.e., beach development and coastal spills) and natural catastrophes (i.e., hurricanes), which, in combination, could potentially deplete some beach mice populations to unsustainable levels, especially if reintroduction could not occur. The incremental contribution of the proposed action on beach mice and the salt marsh vole communities is expected to be negligible.

During the course of the preparation of this SEIS, MMS has concluded that there have been hurricane-induced changes to the baseline conditions, particularity in the nearshore areas where habitat normally used by mice and voles may have been badly damaged. However, it is impossible to determine the effects of hurricanes on baseline conditions due to the unreliable estimate of pre-storm population levels and uncertain recovery times. In addition, the determination of tropical storm effects are further complicated by the broad scope of the habitat changes in some areas combined with the short-term effect of the storms. Any alterations in the baseline condition of mice/vole habitat due to the recent hurricanes would not exacerbate or increase the potential effects of the proposed action. Although these effects upon habitat may be considered moderate to severe in some localized areas, the effect of the proposed action upon mice/vole habitat would be negligible. The loss of suitable habitat through natural causes does not expand or cause the minor effects of the proposed action to become more harmful to mice/voles.

4.3.8. Impacts on Coastal and Marine Birds

Routine Impacts

This section discusses the possible routine effects of the proposed action on coastal and marine birds of the Gulf of Mexico and its contiguous waters and wetlands. Major, potential impact-producing factors for marine birds in the offshore environment include air emissions, oil spills, oil-spill response activities, degradation of water quality, OCS-related helicopter and service-vessel traffic and noise, habitat loss or modification resulting from pipeline landfalls and coastal facility construction, and discarded trash and debris from service-vessels and OCS structures. No pipeline landfalls, onshore pipeline construction, coastal facility construction, or navigation canal dredging are expected under routine activities of the proposed action. Any effects are especially critical for intensively managed populations.

Noise

The transportation or exchange of supplies, materials, and personnel between coastal infrastructure and offshore oil and gas structures is accomplished with helicopters, aircraft, and boats and a variety of service vessels. It is projected that 3,000-5,000 helicopter operations related to Sale 224 would occur over the life of the proposed action; this is a rate of 75-120 annual helicopter operations. 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 15,000-20,000 service-vessel round trips related to Sale 224 would occur over the life of the proposed action; this is a rate of 375-500 service-vessels trips annually.

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. The degree of disturbance exhibited by groups of coastal birds to the presence of air or vessel traffic is highly variable, depending upon the bird species in question, type of vehicle, altitude or distance of the vehicle, the frequency of occurrence of the disturbance, and the season. Helicopter and service-vessel traffic related to OCS activities could sporadically disturb feeding, resting, or nesting behavior. Disturbance can also lead to a permanent desertion of active nests and even whole nest colonies, or of critical or preferred habitat, which could contribute to the relocation of a species or group to less favorable areas or to a decline of species through reproductive failure resulting from nest abandonment. Interruption of nesting activities such as nest building (sensitive to time budgets), foraging for food for nestlings (sensitive to time and energy budgets), and incubation of eggs and naked nestlings (sensitive to time budgets) may result in reduced breeding success, measured by the ratio of birds fledged per nest to eggs hatched from a clutch. Impacts to whole nesting colonies of seabirds would be especially serious. When birds are flushed prior to or during migration, the energy cost could be great enough that they might not reach their destination on schedule or they may be more susceptible to diseases (Anderson, 1995). However, in the scientific literature, the evidence is not conclusive that human disturbance affects reproductive success or colony site occupation among terns (Nisbet, 2000).

Waterfowl are more overtly responsive to noise than other birds and seem particularly responsive to aircraft, possibly because aerial predators frequently harass them (Bowles, 1995). The FAA and corporate helicopter policy advises 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.

The effect of low-flying aircraft within the vicinity of aggregations of birds on the ground or on the water typically results in mass disturbance and abandonment of the immediate area. However, pilots traditionally have taken great pride in not disturbing birds. Compliance to the specified minimum altitude requirements greatly reduces the effects of aircraft disturbance on coastal and marine birds. The regular presence of aircraft at sufficiently high altitudes results in acclimation of birds to routine noise. As a result of inclement weather, about 10 percent of helicopter operations would occur at altitudes somewhat below the minimums listed above. Although these incidents are seconds in duration and sporadic in frequency, they can disrupt coastal bird behavior and, at worst, possibly result in habitat or nest abandonment. Birds in flight over water typically avoid helicopters. Low-flying aircraft may temporarily disrupt feeding or flight paths, including low-altitude foraging trips where birds scan the ground for small prey or scan the water for schools of small pelagic fish. Routine presence and low speeds of service vessels within inland and coastal waterways would diminish the effects of disturbance from service vessels on nearshore and inland populations of coastal and marine birds.

Research has indicated that the heart rate of the common tern increased when initially disturbed by recorded sounds (aircraft and tern alarm calls); however, that response declined in intensity when the stimulus was repeated as little as 20 times (Nisbet, 2000). This high tolerance to various types of human disturbance have been reported frequently in terns and is attributable to habituation (Nisbet, 2000). Nisbet reported that species in which adverse effects (nesting cycle disturbance and increased predation) have been documented include pelicans and the double-crested cormorant. He found little evidence of effects on the productivity of gulls or herons. 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 occur.

Air Quality Degradation

Chapter 4.3.1 provides an analysis of the effects of the proposed action on air quality. 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). The major effects of air pollution 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 (Newman, 1979). Direct effects can be either acute, such as sudden mortality from hydrogen sulfide, or chronic, such as fluorosis from fluoride emissions. The magnitude of effect, acute or chronic, is a function of the pollutant, its ambient concentration, pathway of exposure, duration of exposure, and the age, sex, reproductive condition, nutritional status, and health of the animal at the time of exposure (Newman, 1980). For metals in air emissions, chemical composition as well as size of particulate compounds has been shown to influence the toxicity levels in animals. Particulate size affects the retention time and clearance from and deposition in the respiratory tract (Newman, 1981).

Levels of sulphur oxide (mainly SO_2) emissions from hydrocarbon combustion from OCS-related activities are a concern in relation to birds. Research specific to birds has elucidated both acute and chronic effects from SO_2 inhalation (Fedde and Kuhlmann, 1979; Okuyama et al., 1979). Due to their lack of tracheal submucosal glands, birds appear to have more tolerance for inhaled SO_2 than most mammals (Llacuna et al., 1993; Okuyama et al., 1979). This suggestion stems from laboratory investigations where the test subject was the domestic chicken and results from these studies are not necessarily applicable to wild bird species. Acute exposure of birds to 260 $\mu g/m^3$ SO_2 produced no alteration in heart rate, blood pressure, lung tidal volume, respiratory frequency, arterial blood gases, or blood pH. Exposure to 1,300 $\mu g/m^3$ SO_2 increased respiratory mucous secretion, and exposure to 13,000 $\mu g/m^3$ SO_2 caused rapid mortality (Fedde and Kuhlmann, 1979). Chronic (2 weeks) exposure of birds to 8.8 $\mu g/m^3$ SO_2 produced no apparent impact and very little change at the cellular level. Chronic exposure to 48 $\mu g/m^3$ SO_2 resulted in cellular changes characteristic of persistent bronchitis (Okuyama et al., 1979).

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 emissions can cause shifts in trophic structure that alter habitat structure and change local food supplies (Newman, 1980).

Air pollutants may cause a change in the distribution of certain bird species (e.g., Newman, 1977; Llacuna et al., 1993). Migratory bird species will avoid potentially suitable habitat in areas of heavy air pollution in favor of cleaner areas if available (Newman, 1979). The abundance and distribution of passerine birds, both active and sedentary, and migratory species, as well as nonpasserine and nonmigratory varieties, are also greatly affected by natural factors such as weather and food supply. Therefore, any reduction in the numbers of birds within a given locale does not have a diagnostic certainty pointing to air emissions (Newman, 1980).

Water Quality Degradation

Chapter 4.3.2 provides an analysis of the effects of the proposed action on water quality. Expected degradation of coastal and estuarine water quality resulting from 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. Operational discharges or runoff in the offshore environment could 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, so water quality may affect breeding success also (measured as the ratio of fledged birds per nest to hatched birds per nest).

Maintenance dredging operations remove several million cubic feet of material, resulting in localized impacts (primarily increased turbidity and resuspended contaminants) during the duration of the operations. Water clarity will decrease for a period of time within navigation channels used for vessel operations due to continuous sediment influx from bank erosion, natural widening, and reintroduction of dredged material back into surrounding waters. The proposed action would result in very small incremental contribution to the need for channel maintenance. Coastal and marine birds that feed exclusively within these locations would likely experience chronic, sublethal physiological stress. Some coastal and marine birds would experience a decrease in viability and reproductive success that would be indistinguishable from natural population variations.

Habitat Degradation

Habitat can be described as the physical environment that is comprised of the necessary ecological components to meet nesting and foraging requirements of avian species. The northern GOM and areas inland from it have a large diversity of habitats for birds of all types, including migrants, wintering birds, and breeding birds. The greatest negative impact to coastal and marine birds is loss or degradation of preferred or critical habitat. The extent of bird displacement resulting from habitat loss is highly variable between different species, based upon specific habitat requirements and the availability of similar habitat in the area. Habitat requirements for most bird species are incompletely known. Birds occupy more habitat types than any other class of vertebrates. Bird species with similar habitat may crowd each other, depending on the amounts of available habitat controlling bird population sizes versus other types of population regulation.

Seabird nesting colonies are especially sensitive and should always be avoided by construction activities. No onshore construction activities are planned for proposed Lease Sale 224.

Debris

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). Studies in Florida reported that 80 percent of brown pelicans showed signs of injury from entanglement with fishing gear (Clapp and Buckley, 1984). In addition, seabirds ingest plastic particles and other marine debris more frequently than do any other taxon (Ryan, 1990). Interaction with plastic materials may lead to permanent injuries and death. Ingested debris may have three basic effects on seabirds: irritation and blockage of the digestive tract, impairment of foraging efficiency, and release of toxic chemicals including lethal and chronically damaging substances (Ryan, 1990; Sileo et al., 1990a). The effects of plastic ingestion may last a lifetime 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). Some birds also feed plastic debris to their young, which could reduce survival rates and breeding success. Accumulation of plastic debris near foraging areas for seabird nesting colonies would be devastating to a whole cohort of fledging birds. 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). Sileo et al. (1990b) found that the prevalence of ingested plastic found within the gut of examined birds varied greatly among species. Species that seldom regurgitate indigestible stomach contents are most prone to the aforementioned adverse effects (Ryan, 1990). Within the GOM, these include the phalaropes, petrels, storm petrels, and shearwaters. It is expected that coastal and marine birds will seldom become entangled in or ingest OCS-related trash and debris as a result of MMS 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.

Structures

Every spring, migratory land birds, including neotropical passerines that cannot feed at the water surface or rest there, cross the GOM from wintering grounds in Latin America to breeding grounds north of the GOM. Some birds use offshore platforms as stopover sites for this migration, which may enhance fitness. 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." The maximum observed number of birds participating in these circulations at one time at one platform was measured at 1,260 individuals. Nocturnal circulation events were only recorded 73 times and on only five out of the nine platforms studied in the spring of 2000. No nocturnal circulation was recorded for the other four platforms. In some of the recorded events, only one bird was observed (Russell, 2005). More than 100 circulating birds were recorded for 18 of the 73 events. 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 due to starvation for the entire spring of 2000 study period (Russell, 2005). It is projected that one platform is projected to be installed as a result of proposed Lease Sale 224. Nocturnal circulation on this platform is expected 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 also results from the suggested sublethal stress in birds that dropped out of circulation observed on the platforms by Russell (2005). The advantage of stopovers is expected to make up for any losses to bird populations from the nocturnal circulations.

Summary and Conclusion

The majority of routine effects resulting from the proposed action on endangered/threatened and nonendangered/nonthreatened coastal and marine birds are expected to be negligible due to the small scope of the project (1 platform) and its distance from foraging and nesting habitat. Effects, if they should occur, would be considered sublethal and would result from exposure to OCS-related contaminants or discarded debris, temporary disturbances, and displacement of localized groups from impacted habitats. The OCS activities may result in stress to migratory species that may result in the failure of some individuals to reach their destination. Nocturnal circulation around the expected platform may create acute sublethal stress from energy loss, while stopovers on platforms would reduce energy loss. No significant habitat impacts are expected to occur directly from routine activities resulting from the proposed action. Impacts to birds as a result of the proposed action are expected to be minor in scope and short term in duration.

During the course of the preparation of this SEIS, MMS has concluded that there have been hurricane-induced changes to the baseline conditions, particularity in the nearshore areas where foraging and nesting habitat normally used by birds has been badly damaged. However, it is impossible to determine the effects of hurricanes on baseline conditions due to the unreliable estimate of pre-storm population levels and uncertain recovery times. In addition, determination of tropical storm effects are further complicated by the broad scope of the habitat changes in some areas combined with the short-term effect of the storms. Any alterations in the baseline condition of foraging and nesting habitat due to the recent hurricanes would not exacerbate or increase the potential effects of the proposed action. Although these effects upon bird habitat may be considered moderate to severe in some localize areas, the effect of the proposed action upon bird habitat would be negligible. The loss of suitable habitat through natural causes does not expand or cause the minor effects of the proposed action to become more harmful to sea turtles. No data exist to indicate that any of the bird populations offshore were affected adversely by the storm.

Accidental Impacts

Oil Spills

Birds listed as endangered or threatened are discussed along with nonlisted birds because the types of impacts are the same. Oil spills pose the greatest potential impact to coastal and marine birds. Pneumonia is not uncommon in oiled birds and can occur when birds, attempting to clean their feathers through preening, inhale droplets of oil. Exposure to oil can cause severe and fatal kidney damage (reviewed by Frink, 1994). Ingestion of oil might reduce the function of the immune system and, thus, reduce resistance to infectious diseases (Leighton, 1990). Ingested oil may cause toxic destruction of red blood cells and varying degrees of anemia (Leighton, 1990). Stress and shock enhance the effects of exposure and poisoning. It is not clear which, if any, of the pathological conditions noted in autopsies are directly caused by petroleum hydrocarbons or are a final effect in a chain of events with oil as initial cause and generalized stress as an intermediate cause (Clark, 1984). Low levels of oil could stress birds by interfering with food detection, feeding impulses, predator avoidance, territory definition, homing of migratory species, susceptibility to physiological disorders, disease resistance, growth rates, reproduction, and respiration.

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. Raptors, such as the bald eagle and peregrine falcon, feed upon weakened or dead birds (and fish, in the case of the eagle) and as a result may become physically oiled or affected by the ingestion of the oiled prey. Pelicans are active swimmers and plunge dive for prey. They are therefore susceptible to both physical oiling and secondary effects via ingestion of oiled prey (i.e., fish). Sensitive species include the endangered piping plover and the southeastern snowy plover. As for shorebirds, wading birds are very common on the vulnerable parts of the shoreline. Plovers congregate and feed along tidally exposed banks and shorelines, following the tide out and foraging at the water's edge. They have short stout bills and chase mobile prey rather than probing into the sediment with long slender bills like many birds of the sandpiper family. Plovers can physically oil themselves while foraging on oiled shores or secondarily contaminate themselves through ingestion of oiled intertidal sediments and prey. Passerines are almost nonexistent along the shoreline because of osmoregulatory constraints from highly-saline seawater and its food resources. Pelagic birds usually nest on oceanic islands and none of their nests were found in the area. Gulls and terns were abundant almost everywhere and could easily absorb local mortality that might result from a 6,300-bbl spill. These two larid taxa nest in abundance along the coast. Data on eagles' nests in Louisiana are available as counts per parish rather than per land segment. Counts of nests for coastal parishes are 0 for Cameron, 15 for St. Mary, 2 for Jefferson, 0 for Vermilion, 51 for Terrebonne, 1 for Plaquemines, and 2 for Iberia (Shiveley, personal communication, 2000).

Birds can ingest oil when feeding on contaminated food items or drinking contaminated water. Oil contamination will affect the prey upon which birds depend. Prey populations after the spill in the *Arthur Kill* shipping lane (January 1990, south coast of New York) had not returned to normal a year after the spill (Maccarone and Brzorad, 1995). In a simulated spill, oil resulted in mortality of deposit feeders and therefore increased the periphyton on the sediment surface (Chung et al., 2004). Water infiltration declined because it was blocked by oil on the seafloor. Redox potential became more negative, possibly killing infaunal prey of shorebirds. This macro-infauna, in the simulated oil spill, recovered when infiltration of oxygen-rich seawater into the first 1 cm (0.4 in) of sediment began, after about a month (Chung et al., 2004).

Geese and herbivorous ducks feed on plants at a lower trophic level than the other species of waterbirds and may not suffer damaging effects when oil is biomagnified, or at least not to the same degree (Maccarone and Brzorad, 1994). However, they still may have encountered lower food availability, owing to the localized destruction of aquatic vegetation. Birds, such as ibises, that sift through mud and other sediments for small invertebrates may be exposed to high toxin levels in the invertebrates (Maccarone and Brzorad, 1994). Chapman (1981) noted that oil on the beach from the *Ixtoc* spill caused habitat shifts by the birds. Many birds had to feed in less productive feeding habitats. Similar observations were made for wading birds after the *Arthur Kill* spill (Maccarone and Brzorad, 1995). Composition of prey populations changed after the spill. Shoreline vegetation may die after prolonged exposure to water contaminated with oil. Lush vegetation helps to conceal sparsely placed nests and their contents from potential predators. With the destruction of vegetation, aerial predators may have easier access to eggs and chicks (Maccarone and Brzorad, 1994). Many species have inherently low reproductive potential, slowing recovery from impacts. However, long-term studies show that seabirds only occasionally encounter breeding catastrophes, such as those that result from massive avian egg predation. Low reproductive potential is matched by low natural mortality. Birds that are heavily oiled are usually killed. 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. Lightly oiled birds can sustain tissue and organ damage from oil ingested during feeding and grooming or from oil that is inhaled. Stress, trauma, and shock enhance the effects of exposure and poisoning. Low levels of oil could stress birds by interfering with food detection, feeding impulses, predator avoidance, territory definition, homing of migratory species, susceptibility to physiological disorders, disease resistance, growth rates, reproduction, and respiration. Reproductive success can be affected by the toxins in oil. Indirect effects occur by the fouling of nesting habitat and by the displacement of individuals, breeding pairs, or populations to less favorable habitats.

The probabilities of oil spills (≥1,000 bbl) occurring and contacting bird habitat within 10 days are 1 percent for piping plovers, <0.5 percent for whooping cranes, 1 percent for brown pelicans, and 1-2 percent for bald eagles.

Oil-Spill Response and Cleanup Activities

Oil-spill cleanup methods often require heavy trafficking of beaches and wetland areas, application of oil dispersant and bioremediation chemicals, and the distribution and collection of oil containment booms and absorbent material. This activity and the presence of humans, along with boats, aircraft, and other technological creations, will also disturb coastal birds after a spill unless properly regulated. According to Nisbet (2000), studies show that seabirds are not easily disturbed by human activities. Investigations have shown that oil-dispersant mixtures pose a threat similar to that of oil to successful reproduction in birds (Albers, 1979; Albers and Gay, 1982). The external exposure of adult birds to oil/dispersant emulsions may reduce chick survival more than exposure to oil alone would; however, successful dispersal of a spill will generally reduce the probability of exposure of coastal and marine birds to oil

(Butler et al., 1988). It is possible that changes in the size of an established breeding population may also be a result of disturbance in the form of increased human activity for cleanup and monitoring efforts or to the intensified research activity after the oil spills (Maccarone and Brzorad, 1994). Studies are indicating that the rescue and cleaning of oiled birds makes no effective contribution to conservation, except conceivably for species with a small world population (Clark, 1978 and 1984). A growing number of studies indicate that current rehabilitation techniques may not be effective in returning healthy birds to the wild (Anderson et al., 1996; Boersma, 1995; Sharp, 1995 and 1996). However, a more recent study questions this conclusion. It states that more long-term rigorous studies of rehabilitated and released birds of various species relative to unoiled birds are needed (Russell et al., 2003). Methods of rehabilitation depend on the species. Different species require different treatment protocols. Success depends on the nature of the spill and the sophistication of the treatment protocols, which are constantly being updated by experience (Russell et al., 2003). Preventative methods, such as scaring birds from the path of an approaching oil slick or the use of booms to protect sensitive colonies in an emergency, have extremely limited applicability (Clark, 1984). Birds may habituate to the scare if it is always present. A new method is the use of unmanned (less expensive) scare techniques set off only when birds are detected near a spill. Detection is by a small unmanned radar placed near a slick and has not yet been tested on oil spills but it works in other tests (Ronconi et al., 2004).

Summary and Conclusion

Oil spills related to the proposed action may result in direct and indirect impacts to coastal and marine birds. 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. Accidental effects resulting from the proposed action on endangered/ threatened and nonendangered/nonthreatened coastal and marine birds are expected to be negligible due to the small scope of the project and its distance from foraging and nesting habitat. Effects, if they should occur, may be lethal, sublethal, or behavioral in nature and result from exposure to OCS-related contaminants. New research, experience, and testing will help the efficacy of rehabilitation of oiled birds and will probably improve scare methods that will keep birds away from an oil slick.

Dispersants used in spill cleanup activity can have toxic effects similar to oil on the reproductive success of coastal and marine birds. The air, vehicle, and foot traffic that takes place during shoreline cleanup activity can disturb nesting populations and degrade or destroy habitat if not properly regulated. These impacts, should they occur, are expected to be short term in duration and minor in scope.

During the course of the preparation of this SEIS, MMS has concluded that there have been hurricane-induced changes to the baseline conditions, particularity in the nearshore areas where foraging and nesting habitat normally used by birds has been badly damaged. However, it is impossible to determine the effects of hurricanes on baseline conditions due to the unreliable estimate of pre-storm population levels and uncertain recovery times. In addition, the determination of tropical storm effects are further complicated by the broad scope of the habitat changes in some areas combined with the short-term effect of the storms. Any alterations in the baseline condition of foraging and nesting habitat due to the recent hurricanes would not exacerbate or increase the potential effects of the proposed action. Although these effects upon bird habitat may be considered moderate to severe in some localized areas, the effect of the proposed action upon bird habitat would be negligible. The loss of suitable habitat through natural causes does not expand or cause the minor effects of the proposed action to become more harmful to birds. No data exist to indicate that any of the bird populations offshore were affected adversely by the storms.

Cumulative Impacts

Birds listed as threatened or endangered are discussed with nonlisted birds because types of impacts are the same. This cumulative analysis considers the effects of impact-producing factors related to proposed Lease Sale 224; prior and future OCS sales; State oil and gas activity; crude oil imports by tanker; and other commercial, military, and recreational offshore and coastal activities that may occur and adversely affect populations of nonendangered/nonthreatened and endangered/threatened birds. Air emissions; degradation of water quality; oil spills and spill-response activities; aircraft and vessel traffic and noise, including OCS helicopter and service-vessels; and trash and debris are OCS-related sources of potential adverse impacts. Non-OCS, impact-producing factors include habitat degradation; disease; bird watching activities; fisheries interactions; storms and floods; pollution of coastal waters resulting from municipal, industrial, and agricultural runoff and discharge; and collisions of coastal and marine birds with structures such as power line towers. Birds listed as endangered or threatened are discussed along with nonlisted birds because the types of impacts are the same.

Chapter 4.3.1 considers air emissions including 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 will 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 are below concentrations that could harm coastal and marine birds. Indirect impacts on coastal and marine birds due to direct impacts on air quality under the cumulative analysis will have a negligible effect on coastal and marine birds.

Degradation of coastal and inshore water quality resulting from factors related to proposed Lease Sale 224 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. There exists a wide variety of contaminant inputs into coastal waters bordering the Gulf of Mexico. 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. 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. Projected large oil spills represent an acute significant impact to coastal waters while small spills serve as a low-level, chronic source of petroleum contamination to regional coastal water quality. The greatest impact to coastal and marine birds is the extent of preferred or critical habitat loss resulting from oil spill and spill-response activities, urban and industrial development within coastal areas, and the erosion of areas bordering navigation channels from vessel usage. Historic census data show that many of these species are declining in numbers and are being displaced from areas along the coast (and elsewhere) as a result of the encroachment of their preferred habitat(s) by the aforementioned sources. 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.

Coastal and marine birds will likely experience chronic physiological stress from sublethal exposure to or intake of contaminants or discarded debris. This will 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), making them susceptible to infection and disease. The extensive oil and gas industry operating in the Gulf area has caused low-level, chronic petroleum contamination of coastal waters. Lethal effects are expected primarily from uncontained inshore oil spills and associated spill-response activities in wetlands and other biologically sensitive coastal habitats. Primary physical effects are oiling and the ingestion of oil, and secondary effects are the ingestion of oiled prey. The recruitment of birds through successful reproduction is expected to take up to many years, depending upon the species and existing conditions.

There are 75-125 helicopter operations projected annually as a result of the proposed action. 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 FAA (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 ft (610 m) 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 the 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.

There are 375-500 service-vessel trips projected to occur annually as a result of the proposed action. Service vessels will 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 will 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 (craft such as small recreational fishing boats and ski boats) are, in most cases, not required to comply with strict speed/wake restrictions. They 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.

Historic census data show that many of these species are declining in numbers and are being displaced from areas along the coast (and elsewhere) as a result of the encroachment of their preferred habitat(s) by the aforementioned sources. 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.

Coastal and marine birds are commonly entangled and snared in discarded trash and debris. Many species will 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 will seldom become entangled in or ingest OCS-related trash and debris as a result of MMS 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 remain a threat to individual birds within these areas.

Non-OCS, impact-producing factors include habitat degradation; disease; bird watching activities; fisheries interactions (Tasker et el., 2000); storms and floods; pollution of coastal waters resulting from municipal, industrial, and agricultural runoff and discharge; and collisions of coastal and marine birds with structures such as power line towers (Brown and Drewien, 1992; Avian Power Line Committee, 1994; California Energy Commission, 2005). Coastal storms and hurricanes can often cause deaths to coastal birds through collisions due to high winds; associated flooding destroys active nests. Nesting territories and colonial bird rookeries with optimum food and/or nest-building materials may also be lost. Elevated levels of municipal, industrial, and agricultural pollutants in coastal wetlands and waters expose resident birds to chronic physiological stress. 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). Vital habitat needs to be protected so that the life-support system continues for the birds and their prey. Habitat alteration has the potential to disrupt social behavior, food supply, and health of birds that occur in the Gulf of Mexico. Such activities may stress the animals and cause them to avoid traditional feeding and breeding areas or migratory routes. Commercial fisheries may accidentally entangle and drown or injure birds during fishing operations or by lost and discarded fishing gear. Competition for prey species may also occur between birds and fisheries.

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 will usually cause temporary disturbances and displacement of localized groups inshore. 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(s) in general.

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. It is expected that there will be little interaction between oil spills from the proposed action and coastal and marine birds.

The cumulative effect of all activities described in the cumulative analysis on coastal and marine birds 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, as exemplified in historic census data, and to stem from a net decrease in preferred and/or critical habitat.

During the course of the preparation of this SEIS, MMS has concluded that there have been hurricane-induced changes to the baseline conditions, particularity in the nearshore areas where foraging and nesting habitat normally used by birds has been badly damaged. However, it is impossible to determine the effects of hurricanes on baseline conditions due to the unreliable estimate of pre-storm population levels and uncertain recovery times. In addition, determination of tropical storm effects are further complicated by the broad scope of the habitat changes in some areas combined with the short-term effect of the storms. Any alterations in the baseline condition of foraging and nesting habitat due to the recent hurricanes would not exacerbate or increase the potential effects of the proposed action. Although these effects upon bird habitat may be considered moderate to severe in some localized areas, the effect of the proposed action upon bird habitat would be negligible. The loss of suitable habitat through natural causes does not expand or cause the minor effects of the proposed action to become more harmful to birds. No data exist to indicate that any of the bird populations offshore were adversely affected by the storm.

4.3.9. Impacts on Endangered and Threatened Fish

Routine Impacts

Potential impacts to the threatened Gulf sturgeon and their designated critical habitat from routine activities associated with the proposed action may occur from drilling and produced-water discharges, degradation of estuarine and marine water quality from runoff, vessel traffic, explosive removal of structures, and pipeline installation. Designated Gulf sturgeon critical habitat occurs in estuarine and riverine locations along the Gulf Coast east of the Mississippi River in Louisiana, Mississippi, Alabama, and Florida (**Chapter 3.2.7.1**). Critical habitat is defined as special geographic areas that are essential for the conservation of a threatened or endangered species and that may require special management and protection. Designated Gulf sturgeon critical habitat is confined to State waters. Most activities related to the proposed action will occur in Federal waters (structure placement, drilling, removal, etc); however, critical habitat may be impacted indirectly.

Offshore discharges of drilling muds and produced waters are expected to dilute to background levels within 1,000 m (3,281 ft) of the discharge point. These structures will be located well offshore of the designated critical habitat. Sturgeon are not known to be attracted to petroleum structures or activity, which is where the discharges would be the most concentrated. The evidence available from the literature or expert opinion is inconclusive on whether Gulf sturgeon avoid or are attracted to bottom disturbances. There is currently anecdotal information that may support each side. Studies done for COE by FWS (Paruka, personal communication, 2007) noted that tagged sturgeon purposely avoid shrimp trawlers when the trawlers were actively trying to trawl for the tagged fish. The bottom disturbances created by the trawl were actively avoided as the sweeps were made. However, the dredging associated with COE's beach nourishment project in the area near Panama City, Florida, was monitored by trawling the perimeter of the dredging activity, and Gulf sturgeon were collected. Minor degradation of estuarine water quality is expected in the immediate vicinity of shore bases and other OCS-related facilities as a result of routine effluent discharges and runoff. Rapid dilution is expected to negate any impact to critical habitat or Gulf sturgeon from these sources.

Service-vessel traffic running in and out of shore bases may create the potential for impact to Gulf sturgeon. Major shipping channels, as identified on standard navigation charts and marked by buoys, are excluded from critical habitat designation. Because Gulf sturgeon are bottom-feeders and are not known to be attracted to areas of activity or disturbance, the probability of a take due to vessel strike is extremely low. Dredging of navigation channels and other areas are considered as possible impacts to Gulf sturgeon critical habitat. Impacts to critical habitat would be subject to evaluation procedures outlined under Section 404 of the CWA. However, only a small amount of the routine dredging done in coastal areas will be directly or indirectly due to the proposed action.

Platform removal using explosives has the potential to injure or kill Gulf sturgeon in the near vicinity of a blast. Current data indicate that Gulf sturgeon generally remain in the estuarine regions near river mouths or in shallow Gulf waters. Critical habitat is in State waters, well inshore of the location of any oil or gas structure installed as a result of the proposed action. In the very unlikely event that a Gulf sturgeon was far enough offshore to be in the area of an impending structure removal, the associated disturbance and activity is expected to deter the fish from approaching the removal site.

Pipeline installation may have the greatest potential for impact to Gulf sturgeon and their critical habitat from the proposed action. Typical methods to lay pipeline can result in bottom and sediment disturbance, burial of submerged vegetation, reduced water clarity, reduced light penetration, and the resulting reduction of seagrass cover and productivity. However, all of the gas and oil production from the proposed action is expected to be mingled in existing pipelines with other OCS production at sea before going ashore. No new pipeline landfall or coastal pipeline construction is projected as a result of the proposed action; therefore, no impacts are expected to Gulf sturgeon or their critical habitat.

Summary and Conclusion

Since Gulf sturgeon are not known to frequent the proposed action area, potential impacts on Gulf sturgeon and the designated critical habitat are not expected to occur from drilling and produced-water discharges, degradation of estuarine and marine water quality by nonpoint runoff from estuarine OCS-related facilities, vessel traffic, explosive removal of structures, and pipeline installation. The dilution and low toxicity of this pollution is expected to result in the negligible impact of the proposed action on Gulf sturgeon. Vessel traffic will generally only pose a risk to Gulf sturgeon when leaving and returning to port. Major navigation channels are excluded from critical habitat. The Gulf sturgeon characteristics of bottom-feeding and general avoidance of disturbance make the probability of vessel strike extremely remote. If necessary, explosive removal of structures as a result of the proposed action will occur well offshore of Gulf sturgeon critical habitat and the riverine, estuarine, and shallow Gulf habitats where sturgeon are generally located. Impacts from routine activities resulting from the proposed action are expected to be minor, short term in duration, and to have negligible effects on Gulf sturgeon and its designated critical habitat.

Accidental Impacts

Gulf sturgeon critical habitat in the Gulf extends from Lake Borgne in Louisiana to the Suwannee Sound in Florida (**Chapter 3.2.7.1**). Although this is not the full range of occurrence of Gulf sturgeon, these areas constitute the most crucial habitat for the conservation of the Gulf sturgeon. The potential for impact to the critical habitat of the Gulf sturgeon by spilled oil is one of the greatest concerns for this resource. Oil spills are the OCS-related factor associated with the proposed action most likely to impact the Gulf sturgeon. The juvenile and subadult Gulf sturgeon, at a minimum, seasonally use the nearshore coastal waters and can potentially be at risk from both coastal and offshore spills. The probability of offshore spills ≥1,000 bbl reaching the near shore environment with discernable toxicity is ≤0.5 percent in the proposed sale area.

Oil can affect Gulf sturgeon by direct ingestion, ingestion of oiled prey, or the absorption of dissolved petroleum products through the gills. Upon any exposure to spilled oil, liver enzymes of adult fish oxidize soluble hydrocarbons into compounds that are easily excreted in the urine (Spies et al., 1982). Contact with or ingestion/absorption of spilled oil by adult Gulf sturgeon could result in mortality or sublethal physiological impacts including irritation of gill epithelium and disturbance of liver function. Behavior studies of other fish species suggest that adult sturgeon are likely to actively avoid an oil spill, thereby limiting the effects and lessening the extent of damage (Baker et al., 1991; Malins et al., 1982). Fish eggs and larvae, with their limited physiology and mobility, are killed when contacted by oil (Longwell, 1977).

Gulf sturgeon generally spend at least 6 months of the year in riverine and estuarine habitats inland from coastal waters and beaches. Spawning takes place when eggs are deposited in inland waters, and young Gulf sturgeon are believed to remain upstream for perhaps their first 2 years. The probability of spilled oil encroachment into an inland waterway is less than for the adjoining coastal area, and diminishes even further as one moves upstream. Spilled oil is very unlikely to impact adult and juvenile Gulf sturgeon and eggs when they are in the inland, riverine portion of their life cycle.

Because of the floating nature of oil and the small tidal range in the coastal Gulf, oil spills alone would typically have very little impact on benthic feeders such as the Gulf sturgeon. Unusually low tidal events, increased wave energy, or the use of oil dispersants increases the risk of impact with bottom-feeding and/or bottom-dwelling fauna. For this reason, dispersants are not expected to be used with coastal spills. Dispersants would likely be used for offshore spills and are expected to disperse about 65 percent of the volume of a spill. Winds and currents will also diminish the volume of a slick. For the Louisiana waters and beaches with a higher probability of oil-spill occurrence than the surrounding areas, the Mississippi River outflow would also serve to help breakup a slick that might otherwise contact the area. Spreading of the slick would reduce the oil concentrations that might impact the coastal Gulf sturgeon critical habitat.

The probability of spills ≥1,000 bbl estimated to occur as a result of the proposed action is provided in **Table 4-13**. **Figure 4-3** provides the probability of a particular number of offshore spills ≥1,000 bbl from the proposed action during the 40-year analysis period. For the proposed action, there is a 13-17 percent chance of exactly one spill ≥1,000 bbl occurring and a 1-2 percent chance of exactly two spills ≥1,000 bbl occurring. Based on median sizes, MMS estimates that the most likely size of a spill ≥1,000 bbl from the proposed action would be 4,600 bbl.

Figure 4-9 shows the area analyzed for oil spill impacts to Gulf Sturgeon critical habitat. The critical habitat is encompassed in this slightly larger area of Gulf sturgeon occurrence. The probability of an offshore oil spill ≥1,000 bbl occurring and contacting the area of known Gulf sturgeon locations is <0.5 percent. The risk of exposure of Gulf sturgeon to such a spill would be dependent on the species abundance and density, as well as the size and persistence of the slick.

In total, about 150-20,500 bbl of oil are estimated to be spilled in offshore waters over a 40-year period from the estimated 350-500 spill events as a result of the proposed action. Most (about 97%) of these spills would be ≤1 bbl. These volumes include volumes from one spill incident in the ≥1,000 bbl size group and one spill in the ≥10,000 bbl size group.

For 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 coastal waters. Few offshore spills are estimated to occur as a result of the proposed action, and a few of these slicks are expected to occur proximate to State waters. Should a slick from such a spill reach coastal waters, the volume of oil remaining in the slick is expected to be small.

The coastal waters inhabited by Gulf sturgeon and comprising the critical habitat are not expected to be at risk from coastal spills resulting from the proposed action. No coastal spills are projected to occur in Mississippi, Alabama, or Florida coastal waters as a result of the proposed action.

Several factors influence the probability of spilled oil contact with Gulf sturgeon or their critical habitat:

- The anadromous migrations and the spawning and lengthy habitations of inshore, riverine areas greatly diminish the probability of spilled oil contact with Gulf sturgeon.
- The floating nature of oil and the lack of large tidal ranges, as well as the influence of the Mississippi River outflow to help disperse slicks, diminishes the probability of significant impact of spilled oil on Gulf sturgeon or critical habitat.
- The very low probability of a large offshore oil spill contacting Gulf sturgeon critical habitat in all but the very westernmost area diminishes potential impact to Gulf sturgeon or alteration of critical habitat.
- The extremely low probability of a coastal spill impacting east of the Mississippi River, and thus the designated critical habitat, diminishes the probability of oil impacts to critical habitat.

Summary and Conclusion

The Gulf sturgeon could be impacted by oil spills resulting from the proposed action provided that contact is made with spilled oil. Should contact occur, measurable physiological effects would be dependent upon the degree of exposure. However, as described above, several factors affect the probability of spilled oil contacting Gulf sturgeon or it's critical habitat. Therefore, the likelihood of an adverse effect directly related to an accidental event resulting from this proposed lease sale upon Gulf sturgeon and/or its designated critical habitat is extremely low.

Cumulative Impacts

This cumulative analysis considers the effects of impact-producing factors related to (1) oil spills involving the proposed action and prior and future OCS sales; (2) dredge-and-fill operations and natural catastrophes that alter or destroy habitat, and (3) commercial fishing on the Gulf sturgeon. Sections providing supportive material for the Gulf sturgeon analysis include **Chapters 3.2.7.1** (description of Gulf sturgeon), **4.2** (oil spills), and **4.1** (other major onshore/coastal activities and non-OCS oil spills).

The Gulf sturgeon can be impacted by activities such as oil spills, alteration, and destruction of habitat, and commercial fishing. The effects from contact with spilled oil would be dependent upon the degree of exposure. Based upon the oil-spill probability analysis, should exposure occur, effects are expected to be sublethal and short term (less than 1 month).

Extant occurrences of Gulf sturgeon in 1993 extended from Lake Pontchartrain in southeastern Louisiana to Charlotte Harbor in western Florida (USDOI, FWS and Gulf States Marine Fisheries Commission, 1995). Although spawning may occur from the Pearl River in western Mississippi eastward, the most important spawning populations occur within the Florida Panhandle in the Apalachicola and Suwannee Rivers (Patrick, personal communication, 1996). Spawning grounds are located upriver in bottomland, hardwood forested wetlands that are flooded during winter, not within coastal wetlands (Barkuloo, 1988; Clugston, 1991).

The direct effects of spilled oil on Gulf sturgeon occur through the ingestion of oil or oiled prey and the uptake of dissolved petroleum through the gills by adults and juveniles. Contact with or ingestion/ absorption of spilled oil by adult Gulf sturgeon can result in mortality or sublethal physiological impact, especially irritation of gill epithelium and disturbance of liver function.

For spills ≥1,000 bbl, concentrations of oil below the slick are within the ranges that cause sublethal effects on marine organisms. The maximum observed concentration of 1.5 ppm was observed at a depth of 2 m (6.6 ft) below the slick from the 1979 *Ixtoc* blowout (McAuliffe, 1987). This value is within the range of LC_{50} values for many marine organisms. These values are typically 1-100 ppm for adults and subadults (Connell and Miller, 1980; Capuzzo, 1987). However, when considering exposure time beneath accidental spills, hydrocarbon composition, and the change in this composition during weathering, exposure doses (measured as ppm-hr) are assumed to be far less than doses reported to cause even sublethal effects (McAuliffe, 1987).

An offshore spill of ≥1,000 bbl as a result of the proposed action has a <0.5 percent probability of occurring and contacting Gulf sturgeon critical habitat. This size spill would also have a low probability of contact with demersal fish and its benthic habitat since the spill would be primarily a surface slick. The weathered surface slick would have minimal concentrations of toxic oil relative to exposure levels acceptable for the adult and subadult demersal species.

It is expected that the extent and severity of effects from oil spills will be lessened by active avoidance of oil spills by adult sturgeon. Sturgeons are demersal and would forage for benthic prey well below an oil slick on the surface. Adult sturgeon only venture out of the rivers into the marine waters of the Gulf for roughly 3 months during the coolest weather. This reduces the likelihood of sturgeon coming into contact with oil. Tarballs resulting from the weathering of oil "are found floating at or near the surface" (NRC, 2002), with no effects expected to demersal fishes such as the Gulf sturgeon.

Natural catastrophes and non-OCS activities such as dredge-and-fill may destroy Gulf sturgeon habitat. Natural catastrophes including storms, floods, droughts, and hurricanes can result in substantial habitat damage. Loss of habitat is expected to have a substantial effect on the reestablishment and growth of Gulf sturgeon populations.

Dredge-and-fill activities occur throughout the nearshore areas of the United States. They range in scope from propeller dredging (scarring) by recreational boats to large-scale navigation dredging and fill for land reclamation. Non-OCS operations, such as dredge-and-fill activities and natural catastrophes, indirectly impact Gulf sturgeon through the loss of spawning and nursery habitat.

Commercial fishing techniques such as trawling, gill netting, or purse seining, when practiced nonselectively, may impact species other than the target species. For example, Gulf sturgeon are a small part of the shrimp bycatch. It is estimated that for every 0.5 kg (1.1 lb) of shrimp harvested, 4 kg (8.8 lb) of bycatch is discarded (Sports Fishing Institute, 1989). The death of several Gulf sturgeon is expected from commercial fishing.

Landloss, foraging, and nursery habitats have been affected by Hurricane Katrina and other coastal tropical storms. Sturgeon biologist Phil Kirk with the COE Engineering Research and Development Lab and Howard Rogillio with the Louisiana Dept. of Wildlife and Fisheries indicated that the Pearl River population of Gulf sturgeon has declined. The acceptable range for annual mortality required to sustain the population in the Pearl River System was estimated in the range of 16-24 percent mortality. Based on personal communication with Phil Kirk (2007), it was noted that post-storm estimates for the Pearl River indicated an annual mortality for 2006 for Pearl River of 38 percent, which is within the range indicative of insufficient recruitment to maintain the current Pearl River population.

The FWS (50 CFR 17) identified the following activities that may destroy or adversely modify Gulf sturgeon critical habitat:

(1) Actions that would appreciably reduce the abundance of riverine prey for larval and juvenile sturgeon, or of estuarine and marine prey for juvenile and adult Gulf sturgeon, within a designated critical habitat unit. Such actions include dredging, dredged material disposal, channelization, in-stream mining, and land uses that cause excessive turbidity or sedimentation.

(2) Actions that would appreciably reduce the suitability of Gulf sturgeon spawning sites for egg deposition and development within a designated critical habitat unit. Such actions include impoundment, hard-bottom removal for navigation channel deepening, dredged material disposal, in-stream mining, and land uses that cause excessive sedimentation.

(3) Actions that would appreciably reduce the suitability of Gulf sturgeon riverine aggregation areas, also referred to as resting, holding, and staging areas, used by adult, subadult, and/or juveniles, believed necessary for minimizing energy expenditures and possibly for osmoregulatory functions. Such actions include dredged material disposal upstream or directly within such areas and other land uses that cause excessive sedimentation.

(4) Actions that would alter the flow regime (the magnitude, frequency, duration, seasonality, and rate-of-change fresh water discharge over time) of riverine critical habitat unit such that appreciably impaired for the purposes Gulf sturgeon migration, resting, staging, breeding site selection, courtship, egg fertilization, egg deposition,

and egg development. Such actions include impoundment, water diversion, and dam operations.

(5) Actions that would alter water quality within a designated critical habitat unit, including temperature, salinity, pH, hardness, turbidity, oxygen content, and other chemical characteristics, such that it is appreciably impaired for normal Gulf sturgeon behavior, reproduction, growth, or viability. Such actions include dredging; dredged material disposal; channelization; impoundment; in-stream mining; water diversion; dam operations; land uses that cause excessive turbidity; and release of chemicals, biological pollutants, or heated effluents into surface water or connected groundwater via point sources or dispersed nonpoint sources.

(6) Actions that would alter sediment quality within a designated critical habitat unit such that it is appreciably impaired for normal Gulf sturgeon behavior, reproduction, growth, or viability. Such actions include dredged material disposal, channelization, impoundment, in-stream mining, land uses that cause excessive sedimentation, and release of chemical or biological pollutants that accumulate in sediments.

(7) Actions that would obstruct migratory pathways within and between adjacent riverine, estuarine, and marine critical habitat units. Such actions include dam construction, dredging, point-source pollutant discharges, and other physical or chemical alterations of channels and passes that restrict Gulf sturgeon movement.

If any of the above were to occur and result in damage to Gulf sturgeon critical habitat, it is expected that the Gulf sturgeon will experience a decline in population sizes and a displacement from their current distribution that will last more than one generation.

Summary and Conclusion

The Gulf sturgeon and its critical habitat can be impacted by activities considered under the cumulative scenario, such as, oil spills, alteration and destruction of habitat, and commercial fishing. Adverse impacts to Gulf sturgeon critical habitat is expected from inshore alteration activities and natural catastrophes. If any of the above were to occur and result in damage to Gulf sturgeon critical habitat, it is expected that the Gulf sturgeon will experience a decline in population sizes and a displacement from their current distribution that will last more than one generation. Deaths of adult sturgeon are expected to occur from commercial fishing. The incremental contribution of the proposed action to the cumulative impact is negligible because of the very low probability of contact between sale-specific oil spills and the Gulf sturgeon and, should exposure occur, the effect would be sublethal and short term (less than 1 month).

4.3.10. Impacts on Fish Resources, Essential Fish Habitat, and Commercial Fishing

Routine Impacts

Sections IV.D.1.a.(10) and (11) of the Lease Sale 181 FEIS (USDOI, MMS, 2001a) described in detail the routine impacts associated with OCS-related activities. The following information summarizes and supplements the material provided by the previous document.

Because of water depths of over 800 m (2,625 ft) and the distance from shore in all of the sale area, there are no fish species located in the proposed sale area that are dependent on estuaries of the Central or Eastern Gulf. Due to the limited diversity and abundance of fish species at the water depths involved, a limited discussion and action analysis will be presented here. Sections IV.D.1.a.(10) and (11) of the Lease Sale 181 FEIS (USDOI, MMS, 2001a) present a more detailed impact analysis that considers shallower areas of this region from the continental shelf to the EEZ.

All of the fish species within the proposed Sale 224 area are dependent on offshore water quality and a variety of specific bottom types including hard substrate. Carbonate blocks and other related structures from the Florida Escarpment occur in numerous locations and could be considered unique habitat for fish if located in shallower water. It is not known if any fish species may be associated with exposed carbonate blocks at depths of nearly 3,000 m (9,842 ft) in a number of locations. A more likely scenario is that the hard substrate would be colonized by invertebrates, including deepwater corals, that would not normally occur on the typical soft-bottom habitats of that area. Corals have their own fisheries management plan, but this area lies outside the new designated EFH designations for corals in GMFMC (2005). Marine environmental degradation resulting from the proposed action, although indirect, has the potential to adversely affect fish resources; however, none of the proposed Lease Sale 224 area is designated as EFH for any fish or invertebrate species in GMFMC (2005). Only highly migratory species are managed in the sale area directly by NOAA.

Impact-producing factors that could affect fish resources and commercial fishing include infrastructure emplacement, anchoring, infrastructure removal, operational offshore waste discharges, blowouts, and spills. Impact-producing factors from routine offshore activities that could result in marine water quality degradation include platform and pipeline installation, platform removal, and the discharge of operational wastes (**Chapter 4.1.2.2**). Offshore accidents including blowouts and spills from platforms, service vessels, and pipelines could also occur and potentially alter offshore water quality (**Chapter 4.2.1**).

Drilling muds can contain materials, such as lead and cadmium, that in high concentrations are toxic to fishery resources; however, the discharge plume disperses rapidly, is very near background levels at a distance of 1,000 m (3,281 ft), and is usually undetectable at distances greater than 3,000 m (9,843 ft) (Kennicutt, 1995). A more recent synthesis report on mercury from oil and gas exploration and production by Neff (2002) concluded that the concentration of total mercury in sediments near almost all of the 30 platforms studied in the GOM is at or near natural background concentrations (about 0.1 ppm) and is rarely over 0.5 ppm. In addition, a key finding was that a large number of monitoring studies show that mercury concentrations in seafood from the GOM are similar to those of seafood from other parts of the world, including areas with little or no oil and gas operations. The amount of mercury entering the GOM from all offshore oil and gas facilities contributes only 0.3 percent of the mercury coming from the air and Mississippi River (Neff, 2002). Additional discussion of mercury in drilling muds can be found in **Chapter 4.1.14**.

Produced waters that are discharged offshore are diluted and dispersed to very near background levels at a distance of 1,000 m (3,281 ft) and are undetectable at a distance of 3,000 m (9,843 ft) from the discharge point. No detectable impacts would be expected at the bottom in these water depths of 800 to 3,200 m (2,625 to 10,499 ft) (CSA 1997c).

The area occupied by structures, anchor cables, and potential safety zones (excluding vessels larger than 100 ft (30 m)) associated with the proposed action would be unavailable to commercial fishermen and would cause space-use conflicts. An exploratory drilling rig would spend approximately 30-150 days onsite and would cause short-lived interference to commercial fishing. A major production facility could obtain special Coast Guard Safety Zone designation with a 500-m (1,640-ft) radius zone, requiring the exclusion of 78 ha (193 ac) of space for vessels larger than 100 ft (30.5 m) in length. The use of FPSO's is not projected for the proposed action, and the USCG has not yet determined what size of a navigational safety zone would be required for an FPSO during normal or offloading operations.

The attraction of highly migratory pelagic fish species to artificial structures in deepwater areas of the GOM is a consideration. The existing information on fish attracting devices (FAD's) indicates that several commercially and recreationally important species are being attracted to GOM offshore deepwater structures. Lessees are required to remove all structures and underwater obstructions from their leases in the Federal OCS within 1 year of the lease relinquishment or termination of all production in a lease block. Due to the water depths in the sale area, there is a higher likelihood that major infrastructure such as subsea completions might be left on the seabed as allowed by the Final Rule on Decommissioning Activities (30 CFR 250.1728), allowing the possibility of removal options in water depths greater than 800 m (2,625 ft).

The effects of the proposed action on marine water quality are analyzed in detail in **Chapter 4.3.2.2**. The major sources of routine discharges to marine waters associated with the proposed action are the temporary discharge of drilling muds and cuttings and the long-term discharge of produced-water effluent. Both of these discharges contain various contaminants of concern (e.g., trace metals and petroleum-based organics) that may have environmental consequences on localized marine water quality and aquatic life. Modern separation procedures leave a very small percent of associated drilling muds with drilling cuttings. Offshore discharges of drilling cuttings with associated muds are expected to dilute to background levels within 1,000 m (3,281 ft) of the discharge point. Produced-water discharges contain components and properties potentially detrimental to fish resources. Offshore discharges of produced water are expected to disperse and dilute to background levels within 1,000 m (3,281 ft) of the discharge point (CSA, 1997c).

The projected total number of platform installations resulting from the proposed action in the Sale 224 area is only one platform for all water depths. Almost immediately after a platform is installed, the structure would be acting as an artificial reef, particularly in the shallower portions of the structure. Corals have also been recently documented colonizing numerous platforms after approximately 10 years in areas with high, year-round water quality (Sammarco et al., 2004). Black corals (antipatharians) have also been reported on some structures (Boland and Sammarco, 2005). Depending on the type of structure involved (spar, TLP, etc), TLP tendons, well risers, and other similar structures could be colonized by a variety of corals even to the deepest depth of the proposed sale area (2,000 m, 6,562 ft).

Two large areas in the DeSoto Canyon Area have been designated by NMFS as swordfish nursery areas and are closed to longline fishing activities. The boundaries of the closed areas are described in **Chapter 3.3.1** and are shown on **Figure 3-5**. One of these includes an area north of 28° N. latitude that encompasses over half of the proposed Sale 224 area. Only 48 of the 134 total blocks lie outside the long-line exclusion area. Longline fishing could occur in those blocks of the proposed action south of 28° N. latitude, but some portion of these blocks bordering the closed area would also be avoided due to the extreme length of longline sets and time required for their retrieval. The CSA (2002) reported numerous records of pelagic longline sets throughout the proposed Sale 224 area prior to the establishment of the swordfish nursery areas.

Structure emplacements can act as FAD's and can result in the aggregation of highly migratory fish species. A number of commercially important highly migratory species, such as tunas and marlins, are known to congregate and be caught around FAD's. The attraction of pelagic highly migratory species to offshore structures will likely occur to some degree. Some positive impacts to commercial fishing resulting from fish aggregating around deepwater structures may be possible but the distance to shore will likely exclude most all fishing efforts in the proposed Sale 224 area.

Structure removal results in artificial habitat loss but there is a higher likelihood that major infrastructure such as subsea completions or TLP template (if used) might be left on the seabed after decommissioning. It is expected that structure removals would have a negligible effect on fish resources and if explosives were used at these depths, the fish resources near bottom would be limited. These activities kill only those fish proximate to the removal site.

Trenching for pipeline burial would not be required for any area. No new pipelines to shore are predicted. Very minor disturbance to fish resources would be expected for any transport pipeline installation that extended to an existing pipeline to shore. Underwater OCS obstructions such as pipelines could cause fishing gear loss and additional user conflicts, but none of the proposed action area occurs in water depths shallower than 800 m (2,625 ft) and no trawling activities or other bottom contact gears are expected.

Seismic surveys would occur in the proposed action area. Usually, fishermen are precluded from a very small area for several days. This should not impact the annual landings or value of landings for commercial fisheries in the GOM. The same GOM species can be found in many adjacent locations and GOM commercial fishermen do not fish in one locale. Gear conflicts between seismic surveys and commercial fishing are also mitigated by the Fisherman's Contingency Fund (**Chapter 1.3**). All seismic survey locations and schedules are published in the USCG *Local Notice to Mariners,* a free publication available to all fishermen. Seismic surveys would have a negligible effect on commercial fishing.

Hard-bottom areas made up of the exposed carbonate blocks at the edge of the Florida Escarpment would be avoided due to the extreme angle of the slope at those locations and the instability for traversing pipelines. At the expected level of impact, the resultant influence on fish resources would be negligible and indistinguishable from other natural population variations.

It is expected that marine environmental degradation from the proposed action would have little effect on fish resources or EFH. The impact of marine environmental degradation is expected to cause an undetectable decrease in fish populations. Recovery of fish resources can occur from 100 percent of the potential marine environmental degradation. Fish populations, if left undisturbed, will regenerate in one generation. Offshore hard bottoms are not expected to be impacted. Offshore discharges and subsequent changes to marine water quality will be regulated by USEPA NPDES permits. At the expected level of effect, the resultant influence on fish resources would be negligible and indistinguishable from natural population variations.

Summary and Conclusion

It is expected that marine environmental degradation that may occur from the proposed action would have little effect on fish resources. The impact of marine environmental degradation is expected to cause an undetectable decrease in fish resources. There are no commercially important benthic fish species in the proposed Sale 224 area. Additional hard substrate habitat provided by structure installation where no naturally occurring hard bottom exists in the photic zone will increase fish populations. Removal of any installed structure will eliminate that habitat except when decommissioning results in platforms being used as artificial reef material. Attraction of pelagic highly migratory species to offshore structures will likely occur to some degree. Fish resources are expected to recover from 100 percent of the expected marine environmental degradation. Fish populations, if left undisturbed, will regenerate in one generation.

Carbonate blocks and other related hard-bottom structures from the Florida Escarpment will be identified using the required biological review through the application of NTL 2000-G20 for chemosynthetic communities (could be considered deepwater coral "fisheries" habitat). These hard bottom sites would likely be avoided as geological hazards for structures and pipelines.

Activities such as OCS discharge of drilling muds and produced water would cause negligible impacts and would not deleteriously affect fish resources. At the expected level of impact, the resultant influence on fish resources would cause less than a 1 percent change in fish populations. As a result, there would be little disturbance to fish resources.

Activities such as seismic surveys would cause negligible and temporary impacts and would not deleteriously affect commercial fishing activities. Operations such as production platform emplacement would cause slightly greater impacts on commercial fishing with regard to pelagic longlining, but only if outside the longline exclusion zone. The proposed action is expected to result in less than a 1 percent change in activities, in pounds landed, or in the value of landings. At the expected level of impact, the resultant influence on commercial fishing would be indistinguishable from variations due to natural causes.

During the course of the preparation of this SEIS, MMS has concluded that there have been hurricane-induced changes to the baseline conditions in the nearshore areas where EFH and some fishery resources may have been severely affected. However, hurricane-related impacts did not occur to fisheries resources in the proposed action area due to its distance from shore and water depth. Any alterations in the baseline condition of EFH or fishery resources due to the recent hurricanes would not exacerbate or increase the potential effects of the proposed action.

Accidental Impacts

Sections IV.D.1.a.(10) and (11) of the Lease Sale 181 FEIS (USDOI, MMS, 2001a) described in detail the routine impacts associated with OCS-related activities. The following information supplements the material provided by the previous EIS.

Accidental events associated with the proposed action that could impact fish resources, EFH, and commercial fisheries include blowouts and oil or chemical spills (including bulk drilling muds). Due to the close association between the discussions and the proposed action analyses, the previously separate treatment of commercial fisheries has been combined in this section.

Blowouts

Subsurface blowouts have the potential to adversely affect fish resources and commercial fishing. A blowout at the seafloor could create a crater, and resuspend and disperse large quantities of bottom sediments within a 300-m (984-ft) radius from the blowout site, potentially affecting a limited number of fish in the immediate area. A blowout event, though highly unlikely, could cause damage to the nearby bottom and render the affected area closed to bottom commercial fisheries; however, there are no commercially viable benthic fish species in the proposed Lease Sale 224 area. The majority of mobile, deep-sea benthic or near-bottom fish taxa would be expected to leave (and not reenter) the area of a blowout before being impacted by the localized area of resuspended sediments.

Resuspended sediments may clog gill epithelia of finfish with resultant smothering. The settlement of resuspended sediments may directly smother deepwater invertebrates; however, coarse sediment should be redeposited within several hundred 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 (yards) depending on the particle size. Oil loss from a blowout is rare. Less than 10 percent of blowouts in recent history have resulted in spilled oil. Gas blowouts are less of an environmental risk, resulting in resuspended sediments and increased levels of natural gas for a few days very near the source of the blowout. Loss of gas-well control does not release liquid hydrocarbons into the water. Natural gas consists mainly of methane, which rapidly dissolves in the water column or disperses upward into the air.

Spills

The risk of oil spills from the proposed action is discussed in detail in **Chapter 4.2.1.** The risk characterization for proposed action spills and their characteristics, sizes, frequency, and fate are summarized in this chapter. Spills that may occur as a result of the proposed action have the potential to affect fish resources, EFH, and commercial fishing in the GOM. 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 geographic range of the pollutant effect depends on the mobility of the resource, the characteristics of the pollutant, and the tolerance of the resource to the pollutant in question. In this case, hydrocarbons are the primary pollutants of concern. The effects on and the extent of damage to fisheries resources and GOM commercial fisheries from a petroleum spill are restricted by time and location. The direct effects of spilled petroleum on fish occur through the ingestion of hydrocarbons or contaminated prey, through the uptake of dissolved petroleum products through the gills and epithelium by adults and juveniles, and through the death of eggs and decreased survival of larvae (NRC, 1985 and 2002). A detailed description of the effects of spilled oil on fish appears in Section IV. D.1.a.(10) of the Lease Sale 181 FEIS (USDOI, MMS, 2001a).

When contacted by spilled hydrocarbon, floating eggs and larvae, with their limited mobility and physiology, and most juvenile fish are killed (Linden et al., 1979; Longwell, 1977). Large numbers of fish eggs and larvae have been killed by oil spills. Sublethal effects on larvae, including genotoxic damage, have been documented from sites oiled from the *Exxon Valdez* (DeMarty et al., 1997). More recently, Peterson et al. (2003) reported long-term evidence of *Exxon Valdez* oil in Alaska, indicating an unexpected persistence of toxic subsurface oil and chronic exposures, even at sublethal levels, have continued to affect wildlife. They report on a number of changing paradigms in oil toxicology. One paradigm in relation to oil toxicity to fish emphasized that long-term exposure of fish embryos to weathered oil at very low levels of just parts per billion has population consequences through indirect effects on growth, deformities, and behavior with long-term consequences on mortality and reproduction. These impacts were especially relevant in the Alaska spill situation where oil in intertidal areas was sequestered in environments where degradation was suppressed by physical barriers to disturbance and oxygenation. Cold temperatures also played a major role in these environments.

If chemical spills occur, they would likely occur at the surface and most would rapidly dilute, affecting a small number of fish in a highly localized environment. Many of the chemical products that may be used offshore, such as methanol or hydrochloric acid, would chemically burn all exposed surfaces of fish that come in contact. The concentration of the chemical and the duration of exposure determine the extent of the chemical burn. Rapid dilution in seawater would limit the effects, and the impacts should be inconsequential.

Some recent work has looked at the impacts of the chemical additives ethylene glycol and methanol on Florida pompano behavior and swimming speeds (Baltz and Chesney, 2005). Behavioral observations showed that 2.1 percent ethylene glycol concentration was the lowest at which individuals displayed lethargic behavior relative to controls after 24 hr. Mean swimming speeds of the pompano declined by 13.5 percent. Swimming speeds were tested using a 1.07 percent concentration of methanol resulting in a 65 percent decline in swimming performance. It was speculated that these temporary behavioral impacts could have affected an individual's ability to avoid predators and feed effectively in the wild. There were no data presented as to the volume of a spill required to produce these kinds of concentrations more than a few meters away from the location of a spill. Although storage of large volumes of these chemicals make spills a possibility, they are extremely rare. In general, although these compounds may be toxic or have behavioral impacts, mobile fishes would likely avoid them as they do oil spills. Nonmotile fish and slow-moving invertebrates could be killed. The areal extent of the impacts would be highly localized and the impacts should be inconsequential.

One remaining type of spill could result from the accidental release of large volumes of drilling muds. This has occurred on occasion in deep water where drilling risers have failed and synthetic drilling fluids contained in the riser escaped to the seafloor (Boland et al., 2004). In recent instances, 600-800 bbl of synthetic drilling fluids were released. The fates and effects of such large point-source releases have not been studied to date, but a new project (Synthetic-Based Fluid Spill of Opportunity: Environmental Impact and Recovery (USDOI, MMS, 2007c)) is currently funded to do just that after the next event occurs. Gallaway and Baubien (1997) did report an increased abundance of fish, 3-10 times that expected, around the Pompano platform at 565 m (1,854 ft). The increase is thought to be related to organic enrichment from synthetic drilling mud discharges that resulted in an increase in the benthic animals on which the fish were likely feeding.

Healthy fishery stocks depend on EFH waters and substrate necessary to fish for spawning, breeding, feeding, and growth to maturity. Except for highly migratory species, new designations for EFH (**Chapter 3.2.8.2**) do not include waters from a depth of 100 fathoms (183 m or 600 ft) to the EEZ, which was previously considered EFH. This includes the proposed Lease Sale 224 area. The effect of accidental events from the proposed action on coastal wetlands and coastal water quality is analyzed in **Chapters 4.3.3.2 and 4.3.2.1**.

Loss of well control and resultant blowouts seldom occur on the Gulf OCS. The potential causes and probabilities of blowouts are discussed in **Chapter 4.2.2.** A blowout with hydrocarbon release has a low probability of occurring as a result of the proposed action. Only 1 blowout is expected for the entire proposed action area in the EPA. A blowout with oil release is not expected to occur. The blowout that could occur would cause limited impacts to localized areas. Given the exposure of the area to high levels of suspended sediments in the EPA and the low probability that a large blowout would occur, blowouts are not expected to significantly affect future water quality (EFH).

Risk of Offshore Spills

The potential sizes and numbers of petroleum spills estimated to occur during activities associated with the proposed action are discussed in **Table 4-13.** Information on spill response and cleanup is contained in **Chapter 4.2.5**. The most likely spill ≥1,000 bbl estimated to occur as a result of the proposed action is a pipeline break (**Figure 4-3**). Although there will be no new pipelines to shore, the probability of a pipeline spill is calculated using the combination of total production and transport through an existing line to shore over a timeframe of 40 years.

The persistence of oil in the environment depends on a variety of factors. It is estimated that slicks from spills would persist a few minutes (<1 bbl), a few hours (<10 bbl), or a few days (10-1,000 bbl) on the open ocean. Spilled oil would rapidly spread out, evaporate, and weather, quickly becoming dispersed into the water column. Based on past OCS spill records, most spills <1,000 bbl are estimated to be diesel, which dissipates very rapidly.

The probability of occurrence and oil-spill contact with specific offshore areas are included in **Figures 4-5 and 4-6**. The fisheries resources of particular interest in the Eastern GOM (Madison Swanson and Steamboat Lumps Marine Reserves and the Florida Middle Grounds) have less than a 0.5 percent chance for an oil spill ≥1,000 bbl occurring and contacting those resources.

The most likely source or cause of an offshore spill is also discussed in **Chapters 4.2.1.5.2 and 4.2.1.6.2.** The most frequently spilled oil has been diesel used to operate the facilities, not the crude being produced. Spills that contact coastal bays and estuaries in Louisiana 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 were calculated for the proposed action (**Figures 4-4**). For the proposed action, only one parish has a probability >0.5 percent of an oil spill occurring and contacting their shorelines within 10 days (Plaquemines, 1%). No Texas counties had a probability exceeding 0.5 percent (**Figure 4-4**).

Risk from Coastal Spills

There is a small risk of spills occurring during shore-based support activities (**Chapter 4.2.1.7**). The great majority of these will be very small. 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 spill would be recovered and what is not recovered would affect a very small area and dissipate rapidly. A total of 6-12 coastal spills of all sizes as a result of the proposed action are estimated to occur. It is also assumed that a petroleum spill would occasionally contact and affect nearshore and coastal areas of migratory GOM fisheries. These species are highly migratory and would actively avoid the spill area.

The effect of petroleum spills on fish resources as a result of the proposed action is expected to cause less than a 1 percent decrease in fish resources or standing stocks of any population.

At the expected level of impact, the resultant influence on fish populations from coastal spills related to the proposed action would be negligible and indistinguishable from natural population variations.

Commercial Fishing

Commercial fishermen would actively avoid the area of a blowout or spill. Even if fish resources successfully avoid spills, tainting (oily-tasting fish), public perception of tainting, or the potential of tainting commercial catches would prevent fishermen (either voluntarily or imposed by regulation) from initiating activities in the spill area (Law and Hellou, 1999). This, in turn, could decrease landings and/or the value of catch for several months. However, GOM species can be found in many adjacent locations. Only 48 of the 134 total blocks lie outside the longline exclusion area, and no commercial bottom fishery exists in the sale area. Commercial fishermen in the GOM do not fish in one locale and have responded to past petroleum spills, such as that in Lake Barre in Louisiana, without discernible loss of catch or income by moving elsewhere for a few months. In the case of a blowout, it is likely that commercial fishermen would actively avoid the immediate area of an active blowout, but the restriction of pelagic fishing activity (longlining) due to a blowout would not represent any additional area not already restricted due to the presence of offshore structures themselves.

Summary and Conclusion

Accidental events resulting from oil and gas development in the proposed action area have the potential to cause some detrimental effects on fisheries and commercial fishing practices. The effect of proposed-action-related oil spills on fish resources and commercial fishing is expected to cause less than a 1 percent decrease in standing stocks of any population, commercial fishing efforts, landings, or value of those landings. Any affected commercial fishing activity (longlining in the southern portion of the sale area) would recover within 3 months. At the expected level of impact, the resultant influence on fish populations and commercial fishing activities from the proposed action would be negligible and indistinguishable from variations due to natural causes. A subsurface blowout would have a negligible effect on GOM fish resources or commercial fishing.

At the expected level of impact, the resultant influence on fish populations and commercial fishing activities from the proposed action would be negligible and indistinguishable from variations due to natural causes. It is expected that coastal environmental degradation from the proposed action would have little effect on fish resources or EFH; however, wetland loss could occur as a result of a petroleum spill contacting inland areas, although contact probabilities are extremely low.

During the course of the preparation of this SEIS, MMS has concluded that there have been hurricane-induced changes to the baseline conditions in the nearshore areas where EFH and some fishery resources may have been severely affected. However, hurricane-related impacts did not occur to fisheries resources in the proposed action area due to its distance from shore and water depth. Any alterations in the baseline condition of EFH or fishery resources due to the recent hurricanes would not exacerbate or increase the potential effects of the proposed action.

Cumulative Impacts

Section IV.D.1.e.(10) and (11) of the Lease Sale 181 FEIS (USDOI, MMS, 2001a) described in detail the cumulative routine and accidental impacts associated with OCS-related activities. The following information supplements and summarizes the material provided by the previous study.

This cumulative analysis considers activities that could occur and adversely affect fish resources and EFH in the northern GOM during the years 2008-2047. These activities include effects of the OCS Program (the proposed action, and prior 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 coastal environmental degradation; marine environmental degradation; commercial and recreational fishing techniques or practices; hurricanes; removal of production structures; petroleum spills; subsurface blowouts; pipeline installation; and offshore discharges of drilling muds and produced waters. It should be noted that in the case of fish resources in the relatively small proposed Sale 224 area, the reasonable geographic boundaries for cumulative analysis are substantially different than for large—scale, Gulfwide lease sales.

Healthy fishery stocks depend on EFH waters and substrate necessary to fish for spawning, breeding, feeding, and growth to maturity. Due to the wide variation of habitat requirements for all life history stages for marine species (as described in **Chapter 3.2.8**), EFH for the GOM includes all coastal and marine waters and substrates from the shoreline to an offshore depth of 183 m (100 fathoms) for most managed species. The deepwater Sale 224 area, more than 125 mi (201 km) offshore, only has designated EFH for highly migratory species (i.e., swordfish, billfish, sharks, and tuna).

The effects of cumulative actions on coastal wetlands and coastal water quality are analyzed in detail in **Chapters 4.3.3.2 and 4.3.2.1**, respectively. Collectively, the adverse impacts from these effects are called coastal environmental degradation. Although presented here, the relationship of coastal cumulative impacts to fish resources is essentially completely detached from any association to the proposed Sale 224 area, which is located more than 125 mi (201 km) from any coast. There are no benthic fish species and no dominant pelagic species that occur in the sale area that would depend on coastal or wetland/estuary habitats. However, some components of the activities in the proposed sale area could have a cumulative impact near shore as well (e.g., vessel traffic), although no new pipelines to shore are anticipated. The effects of cumulative actions on marine water quality are analyzed in detail in **Chapters 4.3.2.2**. The direct and/or indirect effects from cumulative coastal and marine environmental degradation on fish resources and EFH are summarized and considered below.

The conversion of wetlands for agricultural, residential, and commercial uses has been substantial. The trend is projected to continue into the future, although at a slower rate in consideration of regulatory pressures. An impact to EFH is the cumulative effects on wetlands that are occurring as the Gulf Coast States' populations increase (GMFMC, 1998 and 2004a). Residential, commercial, and industrial developments that occur in EFH are directly impacted by dredging and filling coastal areas or by affecting the watersheds.

Canal dredging primarily accommodates commercial, residential, and recreational development. Increased population and commercial pressures on the coasts of Louisiana, Mississippi, Alabama, and Florida are also causing the expansion of ports and marinas there. Where new channels are dredged, wetlands would be adversely impacted by the channel, the disposal of dredged materials, and the development that it attracts.

The continuing erosion of project waterways maintained for navigation by COE and channels maintenance dredged by other interests for coastal oil and gas exploration and production is projected to adversely impact productivity of wetlands located adjacent to the maintained channels. The initial waterway and channel construction expanded the range of tidal influence and subsequent saltwater intrusion and caused hydrodynamic alterations that resulted in wetland erosion, accelerated sediment export, and the conversion of wetland habitat to open water. Maintenance dredging operations conducted on existing channels can allow the continuation of the previously described impacts, although the trend by State and COE regulatory authorities is to require the beneficial use for wetland creation of dredged material to minimize impacts related to channel maintenance. In addition, some project waterways maintained by COE have been armored in areas that experience a high rate of shoreline erosion, thereby, reducing the erosive effect of channel usage on adjacent wetland habitats. Secondary impacts are projected to generate the loss of wetlands over the next 30-40 years, primarily in Louisiana. Additional details of cumulative wetlands loss, including impacts from major storms such as the hurricanes of 2005, are detailed in **Chapter 4.3.3.2**.

Other factors that impact coastal wetlands include marsh burning, marsh-buggy/airboat traffic, and well-site construction. The practice of marsh buggy/airboat use in marsh areas is far less common than in years past. Tracks left by marsh buggies open new routes of water flow through relatively unbroken marsh and can persist for up to 30 years, thereby inducing and accelerating erosion and sediment export. Well-site construction activities include board roads, ring levees, and impoundments.

The incremental contribution of the proposed action (**Chapter 4.3.3.2**) would be a very small part of the cumulative impacts to wetlands.

The coastal waters of Louisiana, Mississippi, Alabama, and the Florida Panhandle are expected to continue to experience nutrient over enrichment, periods of low-dissolved oxygen, and toxin and pesticide contamination, resulting in the loss of both commercial and recreational uses of the affected waters. Fish kills, shellfish-ground closures, and restricted swimming areas would likely increase in numbers over the next 30-40 years (although some areas have seen improvements and re-opened for swimming, such as Lake Pontchartrain). Degradation of water quality is expected to continue because of contamination by point- and nonpoint-source discharges and spills due to eutrophication of waterbodies, primarily due to runoff and hydrologic modifications. Contamination of coastal waters by natural and manmade sources and accidental spills derived from both rural and urban sources would be both localized and pervasive. Increased turbidity from extensive dredging operations projected to continue within the coastal zone constitutes another type of pollution. Contamination from oil and hazardous substance spills should be primarily localized and not long term enough to preclude designated uses of the waters for more than short periods of time.

The incremental contribution of the proposed action (**Chapter 4.3.2.1**) would be an extremely small (if any) part of the cumulative impacts to coastal water quality. Degradation of coastal water quality is not 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 very small proportional amount of dredging would occur as a result of the proposed action.

The incremental contribution of the proposed action to the cumulative impacts on fisheries and EFH would be very small. The proposed action would add very slightly to the overall offshore water quality degradation through the disposal of offshore operational wastes and sedimentation/sediment resuspension from the single platform expected and 15-20 development wells drilled over a 40-year timeframe. Other activities of the proposed action potentially contributing to regional impacts would be the effects of petroleum spills and anchoring. The extent of these impacts would be limited by the implementation of the protective regulatory policies, including NTL's.

Municipal, agricultural, and industrial coastal discharges and land runoff would impact the health of marine waters. This degradation would cause short-term loss of the designated uses of some shallow offshore waters due to hypoxia and red or brown tide impacts and to levels of contaminants in some fish exceeding human health standards. Coastal sources are assumed to exceed all other sources, with the Mississippi River continuing to be the major source of contaminants to the north-central GOM area. Even with the increased understanding of the agricultural sources of nutrients moving down the Mississippi River and causing the hypoxic areas off Louisiana every year, there has been little accomplished leading to reductions in those sources. In the case of mercury, the amount of mercury entering the GOM from all offshore oil and gas facilities contributes only 0.3 percent of the mercury coming from the air and Mississippi River (Neff, 2002).

Offshore vessel traffic and OCS operations would contribute in a small way to regional degradation of offshore waters through spills and waste discharges. All spill incidents (OCS and others) and activities increasing water-column turbidity are assumed to cause localized water quality changes for up to three months for each incident. The incremental contribution of the proposed action to degradation of marine water quality would be extremely small.

It is expected that coastal and marine environmental degradation from the OCS Program and non-OCS activities would affect fish populations and EFH. The impact of coastal and marine degradation is expected to cause no more than a 10 percent decrease in fish populations or EFH. The incremental contribution of the proposed action to these cumulative impacts would be extremely small and almost undetectable.

Fishing

Commercial fishing activities that could impact the bottom in the proposed sale area are not expected. There are no commercially viable benthic fish species that occur in those water depths between 800 and 3,200 m (2,625 and 10,500 ft). Pelagic longlining that can occur in the southern portion of the sale area would directly impact captured fish only.

Structure Removals

Structure removals would result in artificial habitat loss. Only one structure is expected to be removed in the sale area as a result of the OCS Program in the EPA between 2009 and 2048. During the same timeframe only one structure would be installed as a result of the OCS Program in the EPA. Depending on the structure type, its removal will only affect those fish that are directly associated with it as an artificial reef. The portion of the platform that extends through the photic zone will likely attract large numbers of tunas and other highly migratory species that would move elsewhere after the structure is removed.

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 were to occur in coastal bays, estuaries, or 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. For eggs and larvae contacted by spilled diesel, the effect is expected to be lethal.

It is estimated that 400-650 coastal spills <1,000 bbl would occur along the northern Gulf Coast annually (**Table 4-8**). About 92 percent of these spills are projected to be from non-OCS-related activity. Of coastal spills <1,000 bbl, the assumed size is 6 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 zone of Texas, Louisiana, Mississippi, and Alabama but primarily within the Houston/Galveston area of Texas and the deltaic area of Louisiana. It is expected that small coastal oil spills from non-OCS sources would affect coastal bays and marshes essential to the well-being of fish resources and EFH.

It is estimated that one coastal spill ≥1,000 bbl from all sources would occur annually along the northern GOM (**Table 4-8**). About 75 percent of these spills are expected to be non-OCS-related activity (**Table 4-8**). One large coastal spill is projected to originate from OCS-related activity every 6 years. A large coastal spill that could occur from OCS-related activity would likely originate near terminal locations in the coastal zone of Louisiana, Mississippi, Alabama, or Florida but primarily within the deltaic area of Louisiana. It is expected that large coastal spills from non-OCS sources would affect coastal bays and marshes essential to the well-being of the fishery resources and EFH in the cumulative proposed lease sale area.

One large (≥1,000 bbl) offshore spill is projected to occur annually from all sources Gulfwide. Of these offshore spills, one is estimated to occur every year from the Gulfwide OCS Program (**Table 4-8**). A total of 1,500 to 1,800 smaller offshore spills (<1,000 bbl) are projected annually Gulfwide. Of these 450-500 would originate from OCS program sources. **Chapter 4.2.1.6** describes projections of future spill events in more detail. The OCS-related spills in the cumulative area are expected to cause a 1 percent or less decrease in fish resources. The impact of non-OCS-related spills in this area is expected to cause a 10 percent or less decrease in fish resources.

Sediment Resuspension, Muds, and Cuttings

Subsurface blowouts of both oil and natural gas wells have the potential to adversely affect commercial fishery resources. Loss of well control and resultant blowouts seldom occur on the GOM

OCS (6 blowouts per 1,000 well starts; <10% would result in some spilled oil). Considering the entire OCS Program from 2007 to 2046, it is projected that there would be 63-75 blowouts for all water depths in the WPA and 169-197 blowouts in the CPA. Sandy sediments would be redeposited quickly within 400 m (1,312 ft) of a blowout site, and finer sediments would be widely dispersed and redeposited within a few thousand meters (yards) over a period of 30 days or longer. It is expected that the infrequent subsurface blowout that may occur on the GOM OCS Gulfwide would have a negligible effect on offshore fish resources and the incremental contribution of the proposed action with a single projected blowout (or none) is also negligible.

Sediment would be resuspended during the installation of pipelines. Sandy sediments would be quickly redeposited within 400 m (1,312 ft) of the trench, and finer sediments would be widely dispersed and redeposited over a period of hours to days within a few thousand meters (yards) of the trench. Resuspension of vast amounts of sediments due to hurricanes also occurs on a regular basis in the northern GOM (Stone et al., 1996). The incremental contribution of the proposed action is essentially zero as no new related pipelines will be trenched.

Offshore discharges of drilling muds would dilute to very near background levels within 1,000 m (3,281 ft) of the discharge point and would have a negligible effect on fisheries. Biomagnification of mercury in large fish high in the food chain is a problem in the GOM but 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.

Produced Water

Produced-water discharges contain components and properties detrimental to fish resources. Produced-water discharges contain chemicals toxic to marine fishes; however, this is only at concentrations four or five orders of magnitude higher than those found more than a few meters from the discharge point. Limited petroleum and metal contamination of the upper water column would occur out to several hundred meters downcurrent from the discharge point. Offshore discharges of produced water would disperse, dilute to very near background levels within 1,000 m (3,281 ft) of the discharge point, and have a negligible effect on fisheries. Offshore discharges and subsequent changes to marine water quality would be regulated by a USEPA NPDES permits.

Hurricanes

Hurricanes may impact fish resources by destroying both coastal wetlands and offshore live-bottom and reef communities and by changing physical characteristics of inshore and offshore ecosystems. As a cumulative impacting factor, hurricanes certainly had a substantial impact on Gulf Coast commercial fisheries and EFH in 2005. Contrary to initial fears, however, the majority of significant fishery resource impacts were to nearshore costal and wetlands areas of Texas, Louisiana, Mississippi, and Alabama. Hurricanes Katrina and Rita did cause substantial infrastructure (artificial reef EFH) destruction offshore, but the actual impacts to fish resources and EFH were not significant. Even if the destroyed platforms were thought of as completely missing, the total number of destroyed platforms from both storms was 113 (**Chapter 3.3.5.7.3**), a similar number to the total number of structures decommissioned in a single year. Much of the material from the destroyed platforms remains in various conditions as functional fish habitat. Some of this debris will eventually be removed, but the habitat loss will be spread out over time.

Results of fisheries surveys conducted by NOAA in November 2005 indicate that offshore shrimp and bottom fish abundance was the same or higher than in the fall of 2004, with shrimp and other valuable species relatively abundant and widely distributed (USDOC, NOAA, 2005a). The surveys show some species, such as the commercially valuable and overfished red snapper, had a higher population in 2005 than in 2004. They also found that the Atlantic croaker population doubled in 2005. Collected samples were tested for toxins that might have been released into the marine ecosystem after hurricane flooding, such as PCB's, pesticides, and fire retardants. All samples show the levels of these compounds are well below Federal guidelines for safe seafood consumption. The samples also were tested for potential bacteria such as *E. coli*, which is associated with human fecal contamination. None of the samples harbored the bacteria, although other vibrio bacteria that normally inhabit the marine environment were found.

Studies conducted in Barataria Bay, Louisiana, post-Katrina/Rita also indicated shrimp and fish abundance at near normal levels and water temperatures and salinities near normal. Thus, it appears that shrimp and finfish resources of the northern Gulf fared much better during and after the hurricanes than did the fishing infrastructure that uses them (Hogarth, 2005). The impact to commercial fishing infrastructure, in general, was devastating but recovery is ongoing (**Chapter 4.3.10**). The proposed deepwater action area has essentially no direct ties to any areas or fisheries impacted by hurricanes.

LNG Facilities

One additional cumulative impacting factor has been recently introduced as a possible significant impact to fisheries and offshore habitats in the future. This factor is the possibility of multiple offshore facilities for the offloading and regasification of LNG and the potential use of Gulf sea water for the warming process to convert the cold LNG to gas (known as the "open loop" technique). Three possible impacts to fisheries have been raised for open loop systems: (1) the antifouling chemicals needed to inhibit fouling growth within the system; (2) cooling of surrounding Gulf water from released open loop seawater after utilized; and (3) entrainment of fish eggs and larva with expected 100 percent mortality. Only one open-loop LNG port facility (Gulf Gateway Energy Bridge) has been fully approved and is operational at the time of this writing. This facility consists of a submerged turret, and the first delivery was made in March 2005. This facility is located offshore Texas, a considerable distance from the proposed Sale 224 area.

The true impacts of an open-loop system have yet to be determined, primarily because of the lack of information regarding the seasonal and vertical stratification of fish eggs and larva in the water column in relationship to open-loop water intakes. Future research and monitoring that will be performed by the previously licensed facilities will help determine the necessity of using the expensive (up to $40 million per year) alternative of closed-loop systems. At this point in time, the cumulative impacts from future LNG facilities using an open-loop system will not be a consideration because of the likely continued permitting freeze.

Summary and Conclusion

Past, present, and future activities resulting from the OCS Program and non-OCS events in the northern GOM have the potential to cause detrimental effects on fish resources and EFH. Impact-producing factors of the cumulative scenario that are expected to affect Gulfwide fish resources and EFH include coastal and marine environmental degradation, overfishing, and to a lesser degree, coastal petroleum spills and coastal pipeline trenching. The cumulative effect of these activities has resulted in an influence on fish resources and EFH at an undetermined level not easily distinguished from effects due to natural population variations.

The incremental contribution of the proposed action's impacts on fish resources and EFH to the cumulative impact is negligible.(resulting in less than a 1% decrease in fish populations or EFH). The cumulative impact is expected to result in a less than 10 percent decrease in fish resource populations or EFH. It would require 2-3 generations for fishery resources to recover from 99 percent of the impacts.

During the course of the preparation of this SEIS, MMS has concluded that there have been hurricane-induced changes to the baseline conditions in the nearshore areas where EFH and some fishery resources may have been severely affected. However, hurricane-related impacts did not occur to fisheries resources in the proposed action area due to its distance from shore and water depth. Any alterations in the baseline condition of EFH or fishery resources due to the recent hurricanes would not exacerbate or increase the potential effects of the proposed action.

4.3.11. Impacts on Recreational Fishing

Routine Impacts

This section discusses the possible effects of routine activities associated with the proposed action on recreational fishing. Impact-producing factors associated with the proposed lease sale that could directly impact recreational fishing include the presence of offshore structures, oil spills, and service-vessel traffic. Potential effects from accidental events including oil spills on recreational fishing are also described below.

Recreational fishing could be indirectly impacted by adverse effects of the proposed action on fish stocks or EFH. The analyses of the potential impacts of the proposed action on fish resources and EFH and potential impacts on commercial fisheries (**Chapter 4.3.10**) also apply to the proposed action's indirect impacts on recreational fishing. The analysis of fish populations is particularly relevant to recreational fishing impacts.

The most significant impact of routine operations on recreational fisheries is likely to result from space-use conflicts. The placement of MODU's disturbs the seafloor, causes turbidity, and may temporarily drive fishes away from the general area. These activities would primarily affect soft-bottom species. Fishes would, however, eventually return to the disturbed area.

The introduction of high-profile structures, specifically drilling rigs and platforms, into a lease sale area frequented by offshore fishermen is the development activity most likely to affect fish and recreational fishing. As noted in **Table 3-9**, only a small portion of the marine recreational fishing trips in the Gulf of Mexico extend into offshore water under Federal jurisdiction. Most marine anglers would not be expected to travel to the proposed Lease Sale 224 area since this location is at least 125 mi (201 km) offshore and approximately 133 mi (214 km) south of Pensacola, Florida. In addition, most marine anglers are not equipped to fish in water depths of 800-3,200 m (2,625-10,500 ft), which is the water depth associated with the proposed action. Recreational fishing and diving are also popular near artificial reefs (e.g., platforms) that attract fish; however, there are no existing artificial structures in the proposed lease sale area.

There are innumerable locations in Gulf coastal areas for recreational fishermen to fish, including areas along navigation channels. These navigation channels are used by OCS-related vessel traffic **(Chapter 4.1.1.8.2**). The proposed action is expected to result in 15,000-20,000 service-vessel round trips over the life of the leases or about 375-500 trips annually. Service vessels are assumed to use established nearshore traffic lanes at least 90 percent of the time. These vessels can generate wakes that are a nuisance to recreational fishermen; if the wakes are large enough, they may even pose a safety issue for those in small boats. It is standard etiquette for vessels to slow to idle speed when passing recreational fishing vessels. If this is done, impacts to recreational fishermen are negligible. On average, vessel use associated with the proposed action would represent less than 1 percent of total vessel use. These navigation channels are also used by vessels associated with State oil and gas activities; commercial fishing including shrimp boats, oyster boats, and menhaden vessels; and recreational fishing boats, including large charter vessels.

Summary and Conclusion

Although each structure placed in the GOM to produce oil or gas can function as a *de facto* artificial reef, this is unlikely because the proposed sale area is at least 125 mi (201 km) offshore and this would most likely prohibit much recreational fishing due to the long distance needed to travel. Impacts on recreational fishing because of OCS-related vessel wakes would be minor because, on average, vessel use associated with the proposed action would represent less than 1 percent of total vessel use.

During the course of the preparation of this SEIS, MMS has concluded that there have been hurricane-induced changes to the baseline conditions, particularity in the nearshore areas where recreational fishery resources may have been severely affected. However, it is impossible to determine the effects of hurricanes on baseline conditions due to the unreliable estimate of pre-storm population levels and uncertain recovery times. In addition, determination of tropical storm effects are further complicated by the broad scope of the habitat changes in some areas combined with the short-term effect of the storms. Any alterations in the baseline condition of recreational fishery resources due to the recent hurricanes would not exacerbate or increase the potential effects of the proposed action. Although these effects upon habitat may be considered moderate to severe in some localized areas, the effect of the proposed action upon fishery resources would be negligible. The loss of suitable habitat through natural causes does not expand or cause the minor effects of the proposed action to become more harmful to recreational fishery resources.

Accidental Impacts

The discussion of the impacts of accidents associated with the proposed action on fish resources and commercial fishing also applies to recreational fishing (**Chapter 4.3.10**).

Oil spills and pollution events resulting from possible accidents and events associated with the proposed action could have temporary and minor adverse impacts on recreational fishing. Recreational fishing boats inadvertently contacting spills or pollution caused by accidents associated with activities resulting from the proposed action could be soiled, which may require the fishermen to temporarily modify their fishing plans. Recreational fishermen can be expected to actively avoid the area of a blowout or spill.

Recreational fisheries could be affected by oil spills resulting from the proposed action. Accidental oil spills can affect recreational fisheries directly by contaminating target species through ingestion of spilled oil and indirectly by degrading habitats that are critical for the survival of target species. Impacts affecting recreational species or the ability to fish for these species can have broad effects on local economies. Motels, restaurants, bait and tackle shops, charter boats, guides, and other supporting industries can experience economic losses caused by declining fishing activity. A large oil spill that degrades the aesthetic value of a particular shoreline could deter fishers from using an area even if the impact to fish stocks were negligible. Nearshore spills are projected to be small spills that would rapidly weather and disperse in the high-energy environment **(Chapter 4.2.1.7)**. Based on the number of spills estimated for the proposed action, persistent degradation of shorelines and waters are not likely to occur.

Summary and Conclusion

The estimated number and size of potential spills associated with the proposed action's activities (**Chapter 4.2.1.2**) are unlikely to decrease recreational fishing activity but may divert the location or timing of a few planned fishing trips. Potential impacts on recreational fisheries due to accidental events as a result of the proposed action would be minor. Based on the sizes of oil spills assumed for the proposed action, only localized and short-term disruption of recreational fishing activity might result (minor impact).

During the course of the preparation of this SEIS, MMS has concluded that there have been hurricane-induced changes to the baseline conditions, particularity in the nearshore areas where recreational fishery resources may have been severely affected. However, it is impossible to determine the effects of hurricanes on baseline conditions due to the unreliable estimate of pre-storm population levels and uncertain recovery times. In addition, determination of tropical storm effects are further complicated by the broad scope of the habitat changes in some areas combined with the short-term effect of the storms. Any alterations in the baseline condition of recreational fishery resources due to the recent hurricanes would not exacerbate or increase the potential effects of the proposed action. Although these effects upon habitat may be considered moderate to severe in some localized areas, the effect of the proposed action upon fishery resources would be negligible. The loss of suitable habitat through natural causes does not expand or cause the minor effects of the proposed action to become more harmful to recreational fishery resources.

Cumulative Impacts

This cumulative analysis considers existing recreational and commercial fishing activity, artificial reef developments, fishery management regimes, and past and future oil and gas developments. As indicated previously in this section, sport fishing is a very popular recreational activity throughout the GOM and is one of the major attractions that generate significant tourism economies along the Louisiana, Mississippi, Alabama, and Florida coastal areas. The latest information indicates participation in marine recreational fishing in the GOM has shown annual increases since 1997 (USDOC, NMFS, 1999c).

In many instances throughout the GOM, competition between commercial and recreational fishermen targeting the same species has led to depleted fish stocks and habitat alterations. Over 30 years ago, national concern for the health and sustainability of marine fisheries led to Federal legislation that has resulted in the development of fishery management plans affecting recreational fish species in the GOM. Fisheries management plans focused on targeted species, such as red snapper, have led to size and creel limits as well as seasonal closures and gear restrictions or modifications in both commercial and recreational fishing. Recent amendments to the Magnuson Fishery Conservation and Management Act require that fishery management plans also identify essential fish habitat to allow it to be protected from fishing, other coastal and marine activities, and developments.

Many Gulf States have aggressively supported artificial reef development programs to help encourage and increase interest and enjoyment in offshore recreational fishing. Alabama, for example, has permitted over 1,000 mi^2 (640,000 ac) of offshore area for artificial reef development and has cooperated with the military and other Federal agencies in acquiring materials such as tanks, ships, and oil and gas structures for reef development and enhancement. Although the structures associated with the proposed action would act as artificial reefs, recreational fishermen, due to the water depths of the proposed lease sale area, would target pelagic, highly migratory species such as tuna. Operators may request from the USCG that safety zones be implemented around these deepwater structures. Current USCG policy applies only to vessels greater than 100 ft (30 m) in length; therefore, it does not apply to most recreational fishing vessels.

Almost all offshore recreational fishing is currently confined within 100 mi (161 km) of shore. Very few fishing trips go beyond the 200-m (656-ft) contour line. Approximately 3,866 oil and gas platforms are in Federal waters in 0-200 m (0-656 ft), and they have had a dramatic and long-term positive effect on offshore fish and fishing. The number of offshore platforms is estimated to decrease in the future (removals would outpace installations). Although it is known that fish abundance and species composition can change dramatically with platform size, location, and season of the year, Stanley (1996) has suggested that the average major platform can harbor over 20,000 fish. The fish range out in proximity to the structure and are concentrated throughout the water column, mainly in the top 200 ft (61 m) of water. The fish become scarce at depths below 200 ft (61 m). Based on the NMFS Statistics Survey, Witzig (1986) estimated that over 70 percent of all recreational fishing trips that originated in Louisiana and extended more than 3 mi (5 km) from shore targeted oil and gas structures for recreational fishing.

Impact-producing factors associated with cumulative effects to recreational fisheries from routine OCS operations also include space-use conflicts. Conflicts are usually minimal as compared with some types of commercial fisheries. However, due to the distance from shore and the depth of the water, the projected single OCS structure that may result from the proposed lease sale is not likely to interfere with commercial or recreational fishers.

Noise from rig and platform installation may scatter some groundfish away from their homing area, but most fish will return once the noise quits. Platform removal using explosives may temporarily drive fish away. Non-OCS activities could also have the potential to adversely affect nearshore recreational fisheries. Recreational fisheries may be affected by coastal development, commercial fishing, dredge and fill activities, and marine mining.

Oil spills can affect recreational fishers in ways similar to those stated for commercial fishers—fouling gear with oil, tainting the catch, and degrading water quality and fishing grounds—all of which could occur as a result of either OCS or non-OCS cumulative activities. Recreational fishing boats inadvertently contacting spills or pollution caused by accidents associated with OCS or non-OCS could be soiled, which may require the fishermen to temporarily modify their fishing plans. Spills are unlikely to decrease recreational fishing activity but may divert the location or timing of a few planned fishing trips.

The OCS oil spills most likely to affect recreational anglers would be the shallow water spills since the recreational anglers are less likely to venture far offshore. Most recreational fishing is conducted close to shore. It is unlikely that all of these assumed spills will occur inshore. Therefore, the overall impact of these spills on recreational fisheries will be less than would be expected for the commercial fisheries.

In addition, public perception of the effects of a spill on marine life and its extent may ultimately result in a loss of revenue for the fishing-related recreation industry. Party and charter boat recreational fisheries often have loss of income because of reduced interest in fishing when a spill has occurred. Local hotel, restaurant, bait and tackle shops, and boat rental companies associated with recreational fisheries may experience reduced sales because of the public perception of the effects of an oil spill.

Summary and Conclusion

Recreational fishing continues to be a popular nearshore and offshore recreational activity in the northeastern and Central GOM. Concern for the sustainability of fish resources and marine recreational fishing has led to Federal legislation that established a fisheries management process that will include the identification and protection of essential fish habitat. Because only one platform is projected to be constructed, the incremental contribution of the proposed action (as analyzed in **Chapter 4.3.12**) to the cumulative impact on recreational fishing is negligible. The cumulative impact of OCS and State oil and gas activities would be minor.

During the course of the preparation of this SEIS, MMS has concluded that there have been hurricane-induced changes to the baseline conditions, particularity in the nearshore areas where recreational fishery resources may have been severely affected. However, it is impossible to determine the effects of hurricanes on baseline conditions due to the unreliable estimate of pre-storm population levels and uncertain recovery times. In addition, determination of tropical storm effects are further complicated by the broad scope of the habitat changes in some areas combined with the short-term effect of the storms. Any alterations in the baseline condition of recreational fishery resources due to the recent hurricanes would not exacerbate or increase the potential effects of the proposed action. Although these effects upon habitat may be considered moderate to severe in some localized areas, the effect of the proposed action upon fishery resources would be negligible. The loss of suitable habitat through natural causes does not expand or cause the minor effects of the proposed action to become more harmful to recreational fishery resources.

4.3.12. Impacts on Recreational Resources

Routine Impacts

This section discusses the possible effects of routine activities associated with proposed Lease Sale 224 on recreational beaches. Millions of annual visitors attracted to these resources are responsible for thousands of local jobs and billions of dollars in regional economic activity. Major recreational beaches are defined as those frequently visited sandy areas along the shoreline that are exposed to the GOM and that support a wide variety of recreational activities, most of which are focused at the land and water interface. Included are Gulf Islands National Seashore, State parks and recreational areas, county and local parks, urban beaches, private resort areas, and State and private environmental preservation and conservation areas.

The primary impact-producing factors to the enjoyment and use of recreational beaches are trash and debris, and oil spills (discussed below). Additional factors such as the noise from OCS-related aircraft can adversely affect a beach-related recreation experience. All these factors, either individually or collectively, may adversely affect the number and value of recreational beach visits. The potential impacts from oil spills and other accidental events are discussed in **Chapter 4.2.1**.

The value of recreation and tourism in the GOM coastal zone from Texas through Florida has been estimated in the tens of billions of dollars annually (USDOI, MMS, 2001a; pages III-101 and III-102). A significant portion of these expenditures is made in coastal counties, where major shoreline beaches are primary recreational attractions. Over one million people visit the mainland unit and barrier island beaches of the Gulf Island National Seashore in Mississippi and Florida annually, demonstrating the popularity of destination beach parks throughout the Gulf Coast region east of the Mississippi River.

Trash and debris from OCS operations can wash ashore on GOM recreational beaches. Litter on recreational beaches from OCS operations could adversely affect the ambience of the beach environment, detract from the enjoyment of beach activities, and increase administrative costs on maintained beaches. Some trash items, such as glass, pieces of steel, and drums with chemical residues, can also be a health threat to users of recreational beaches. 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 Lease Sale 224 is projected to result in the drilling of 5-15 exploration and delineation wells and the installation of 1 platform. Approximately 15-20 development wells consisting of 11-14 oil wells and 4-6 gas wells are also projected. Minor amounts of marine debris will be lost from time to time from OCS operations associated with drilling activities and production facilities projected to result from the proposed action. Waste management practices and training programs are expected to minimize the level of accidental loss of solid wastes from activities resulting from the proposed action. Beached litter and debris from the proposed action is unlikely to be perceptible to beach users or administrators because the proposed action would constitute only a small percentage of the total OCS Program activity.

Only one offshore platform is predicted for proposed Lease Sale 224. Since the lease sale area is located, at a minimum, 133 mi (214 km) south of Pensacola, Florida, any resulting structure will not be visible from recreational beaches. Federal and State oil and gas operations are already occurring on nearshore tracts off Louisiana, Mississippi, and Alabama. Although these factors may affect the quality of recreational experiences, they are unlikely to reduce the number of recreational visits to coastal beaches.

The noise associated with vessels and aircraft traveling between coastal shore bases and offshore operation sites can adversely affect the natural ambience of primitive coastal beaches. The proposed action is expected to result in about 375-500 service-vessel round trips and approximately 75-125 helicopter operations (take off and landing) 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. This additional helicopter and vessel traffic will add very little noise pollution likely to affect beach users, due to the absence of recreational beaches in the vicinity of the likely routes to be followed by the service vessels and helicopters.

Summary and Conclusion

Marine debris will be lost from time to time from operations resulting from the proposed action. The impact on Gulf Coast recreational beaches is expected to be minimal. The incremental increase in helicopter and vessel traffic is expected to not add noise that may affect beach users. The proposed action is expected to result in nearshore operations that may adversely affect the enjoyment of some Gulf Coast beach uses; however, these will have little effect on the number of beach users. Patterns of recreational beach use will not be affected.

Accidental Impacts

Oil spills can be associated with the exploration, production, or transportation phases of the proposed action. Large oil spills contacting recreational beaches can cause short-term displacement of recreational activity from the areas directly affected, including the closure of beaches for periods of 2-6 weeks or until the cleanup operations are complete. A large oil spill resulting from the proposed action would acutely threaten recreational beaches for up to 30 days. The risk of a spill occurring and contacting recreational beaches is described in **Chapter 4.2.1.5**. Natural processes such as weathering and dispersion and human efforts to contain and remove the spill would significantly change the nature and form of the oil. Factors such as season, extent of pollution, beach type and location, condition and type of oil washing ashore, tidal action, cleanup methods (if any), and publicity can have a bearing on the severity of effects on a recreational beach and its use.

All of the respondents from a total of 39 semi-structured discussions conducted from March through May 1997 for the MMS study, "Socioeconomic and Environmental Issues Analysis of Oil and Gas Activity on the Outer Continental Shelf of the Western Gulf of Mexico," recognized environmental threats posed by the nature and specific operations of the industry (Kelley, 2002). Most respondents to the study believed that a large oil spill would have devastating effects on the tourist industry. While "small" spills were deemed to occur with some frequency, it is "the big one" that people fear most. Offshore trash and tar is often noted as the second biggest threat to the conditions of the beaches in the Gulf of Mexico coastal region. Additional factors such as the physical presence of platforms and drilling rigs can affect the aesthetics of beach appreciation. Soil contamination and air and water pollution created by the refining of oil and the production of petrochemical products are other areas of concern.

Figure 4-4 displays the probabilities of an oil spill of at least 1,000 bbl occurring and contacting the shoreline within 10 days. In the proposed action, only a single location (Plaquemines Parish, Louisiana (1%)) shows a probability greater than 0.5 percent of a spill occurring and contacting the region within 10 days. It is the only parish or county where the probability of an oil spill ≥1,000 bbl reaches 1 percent. All other counties and parishes in the GOM region have probabilities of less than 0.5 percent.

Figure 4-5 displays the probabilities of oil spills of at least 1,000 bbl occurring and contacting State offshore waters or recreational beaches within 10 days of a spill. The higher probabilities of oil contacting State offshore waters are in Central (1-2%) and Eastern (<0.5-1%) Louisiana waters (**Figure 4-5**). The probability of an oil spill ≥1,000 bbl occurring and contacting all other State offshore waters and recreational beaches is less than 0.5 percent.

Tarballs (the floating residue remaining after an oil slick dissipates) are likely results from a large spill. Tarballs are known to persist as long as 1-2 years in the marine environment. An MMS-funded study investigated the abundance and sources of tarballs on the recreational beaches of the CPA (Henry et al., 1993). The study concluded that the presence of tarballs along the Louisiana coastline is primarily related to marine transportation activities and that their effect on recreational use is below the level of social and economic concern.

Chapter 4.2.1 discusses the risk of spill occurrence, the number of spills estimated for the proposed action, and the likelihood of an OCS spill contacting the Gulf Coast. With the exception of Plaquemines Parish, no coastal beach shows a >0.5 percent chance of a spill occurring and contacting the beach. However, should such a spill contact a recreational beach, short-term displacement of recreational activity from the areas directly affected would occur. Beaches directly impacted would be expected to close for periods of 2-6 weeks, or until the cleanup operations were complete. Should a spill occur, factors such as season, extent of pollution, beach type and location, condition and type of oil washing ashore, tidal action, and cleanup methods would have a bearing on the severity of effects the spill would have on a recreational beach and its use. Sorenson (1990) reviewed the economic effects of several historic large oil spills on beaches and concluded that a spill near a coastal recreation area would reduce visitation in the area by 5-15 percent over one season but would have no long-term effect on tourism.

Chapter 4.2.1.8 summarizes MMS's information on the risk to recreational resources from oil spills and oil slicks that could occur as a result of the proposed action. **Figure 4-5** provides the results of the analysis of the risk of a spill ≥1,000 bbl occurring offshore as a result of the proposed action and reaching major recreational beach areas. Large oil and petroleum product spills could occur over the next 40 years and cause temporary closure (up to 6 weeks) of park and recreation areas along the Gulf Coast and could affect tourism at the local level. The most likely source of OCS-related offshore oil spills is pipelines, which are concentrated in the Gulf. No new pipelines will be installed and no barging or tankering of oil or gas to shore will take place as a result of the proposed action. Although the probability is low, the most likely location for contact is in Central and Eastern Louisiana offshore waters. Spills from OCS operations occurring in proximity to recreational beaches and coastal parks could result in shoreline oiling, leading to closure of these parks and beaches during cleanup operations which can last from 2 to 6 weeks.

Summary and Conclusion

It is unlikely that a spill would be a major threat to recreational beaches because any impacts would be short term and localized. Should a spill contact a recreational beach, short-term displacement of recreational activity from the areas directly affected would occur. Beaches directly impacted would be expected to close for periods of 2-6 weeks or until the cleanup operations were complete. Should a spill result in a large volume of oil contacting a beach or a large recreational area being contacted by an oil slick, visitation to the area could be reduced by as much as 5-15 percent for as long as one season, but such an event should have no long-term effect on tourism.

Tarballs can lessen the enjoyment of the recreational beaches but should have no long-term effect on the overall use of beaches.

Cumulative Impacts

This cumulative analysis considers the effects of impact-producing factors related to the proposed action, plus those related to prior and future OCS sales, State offshore and coastal oil and gas activities throughout the GOM, tankering of crude oil imports, merchant shipping, commercial and recreational fishing, military operations, recreational use of beaches, and other offshore and coastal activities that result in debris, litter, trash, and pollution, which may adversely affect major recreational beaches. Specific OCS-related impact-producing factors analyzed include trash and debris, the physical presence of platforms and drilling rigs, support vessels and helicopters, oil spills, and spill clean-up activities.

Non-OCS-related factors such as land development, civil works projects, and natural phenomena have affected, and will continue to affect, the quality of the beach environment and public use and appreciation of major recreational beaches. Ultimately, all these factors plus the health of the U.S. economy and the price of gasoline can affect the travel and tourism industry and the level of beach use along the U.S. Gulf Coast.

Trash and debris are a recognized problem affecting enjoyment and maintenance of recreational beaches along the Gulf Coast. Coastal and offshore oil and gas operations, as well as a large variety of other sources, contribute to trash and debris washing up on Texas and Louisiana beaches (Miller and Echols, 1996; Lindstedt and Holmes, 1988). **Chapter 4.1.2.2.4** discusses recent beach cleanups conducted in Texas, Louisiana, Mississippi, Alabama, and Florida; and indicates volunteers removed approximately 700,000 of pounds of trash and debris from coastal recreational beaches. Regulatory, administrative, educational, and volunteer programs involving government, industry, environmental, school, and civic groups; specific marine user groups; and private citizens are committed to monitoring and reducing the beach litter problem Gulfwide.

Trash and debris detract from the aesthetic quality of beaches, can be hazardous to beach users, and can increase the cost of maintenance programs. Other offshore activities (such as merchant shipping; Naval operations, offshore and coastal commercial and recreational fishing, State offshore oil and gas activities), coastal activities (such as recreation, State onshore oil and gas activities, condominiums, and hotels), and natural phenomena (such as storms, hurricanes, and river outflows) contribute to debris and pollution existing on the major GOM recreational beaches.

Land use along the coastal reaches of the Gulf Coast has undergone a dramatic change in the last 30 years. The demands for coastal recreation and access to seaside accommodations have driven the explosive growth of seaside communities and the huge increase in tourism along the Gulf. This growth has lead to rapid increases in land values and has forced small communities to deal with rapid expansion and increased demand on infrastructure. The increased number of people using small reaches of land, more growth on unstable barrier islands, and the rising cost of a day at the beach have all changed the user experience.

Military use of the eastern Gulf of Mexico is discussed in **Chapter 4.1.3.1.2.** Typically, military activity areas include airspace designated by the Air Force in which military aircraft conduct various weapons test and training missions. From time-to-time, these operations include activities that result in debris that may burn up in the atmosphere or fall to the Gulf surface. The Navy uses the Gulf waters for shakedown cruises for newly-built ships, for ships completing overhaul or extensive repair work in Gulf shipyards such as Pascagoula, Mississippi, and for various types of training operations. Future uses of the Eastern Gulf by the military are expected to increase. The new F-22 fighter aircraft is based at Tyndall Air Force Base and the new F-35 Joint Strike Fighter is programmed to be based at Eglin Air Force Base in 2009. Both bases are located in northwest Florida. In addition, a new generation of theater missile defense weapons systems may require the large air and water spaces of the Eastern Gulf for development and testing. All of these activities have the potential to affect recreational resources.

Aesthetic impacts are the negative perceptions attributed to the visible presence of offshore drilling rigs and platforms and are of some concern in some regions of the Gulf of Mexico. At present, there are approximately 4,000 OCS platforms on the GOM OCS, with nearly 1,000 platforms within 10 mi (16 km) of the coast in the CPA. In the CPA east of the Mississippi River, 14 percent of OCS platforms are within 10 mi (16 km) of the Louisiana, Mississippi, or Alabama coast. Oil and gas operations in State waters off Louisiana, and Alabama are also visible from shore. Aesthetic impacts are unlikely to affect the level of beach recreation, but they may affect the experience of some beach users, especially at beach areas such as the Gulf Islands National Seashore on Mississippi's outer barrier islands.

Marine transportation in the Gulf of Mexico is very active, from nearshore small craft to ocean-going vessels of all types. Helicopter and service-vessel traffic servicing OCS operations will be infrequently seen or heard by beach users, due to the routes that are used from their base to the offshore platforms. Very few of these service bases are in the vicinity of recreational resources. Commercial and recreational maritime traffic will add to the visual and noise impacts, as well as existing and future oil and gas developments in the State waters.

The estimated annual, oil-spill occurrences expected in the future, based on historical data maintained by MMS and USCG, are presented in **Table 4-13**. The great majority of coastal spills that do occur from OCS-related activities are likely to originate near terminal locations in the coastal zone around marinas, refineries, commercial ports, pipeline routes, and marine terminal areas, usually during the transfer of fuel. The average fuel-oil spill is 18 bbl. It is expected that these frequent, but small, spills will not affect coastal beach use.

Although hundreds of small spills are documented annually from all sources within the marine and coastal environment of the Gulf Coast, it is primarily large spills (≥1,000 bbl) that are a major threat to coastal beaches. Should a large spill impact major recreational beaches, no matter the source, it will result in unit and park closures until cleanup is complete. Oil-pollution events impacting recreational beaches will generate immediate cleanup response from responsible oil and gas industry sources. Recreational use will be displaced from impacted beaches and closed parks (generally 2-4 weeks). Recreational use and tourism impacts will be more significant if spills affect beaches during peak-use seasons and if publicity is intensive and far-reaching.

Summary and Conclusion

A large number of uses of the eastern GOM have the potential to cumulatively affect the recreational resources of the area. Debris and litter derived from both offshore and onshore sources are likely to diminish the tourist potential of beaches and to degrade the ambience of shoreline recreational activities, thereby affecting the enjoyment of recreational beaches throughout the area. The sound, sight, and wakes of OCS-related and non-OCS-related vessels are occasional distractions that are noticed by some beach users. Widespread land-use changes have moved large areas of the coast from quiet and serene to tourist destinations. The very active use of the region by the military for weapons systems testing and training is expected to continue and increase. The potential for oil spills that would remain on the sea surface long enough to impact a beach is <0.5 percent. If a spill were to happen and contact the beach, it may preclude short-term recreational use of the affected area for a period of time. The duration of the impact depends on many variables and cannot be precisely modeled. Due to the great distance from shore to the sale area, the comparatively small number of support trips, the low number of wells drilled, and the low level of development expected as a result of the proposed sale, it is anticipated that the cumulative impact of this sale would be negligible.

4.3.13. Impacts on Archaeological Resources

Routine, Accidental, and Cumulative Impacts

The impact-producing factors associated with development and production of the Lease Sale 224 area that could affect archaeological resources include direct physical contact from drilling rig and platform emplacement; pipeline installation and trenching; anchoring; dredging activity; oil spills; and ferromagnetic debris. The specific locations of archaeological sites cannot be known without first conducting a remote-sensing survey of the seabed and near-surface sediments. The MMS, by virtue of operational regulations under 30 CFR 250.194, requires that an archaeological survey be conducted prior to development of leases within the high-probability zones for historic and prehistoric archaeological resources.

An Archaeological Resources Stipulation was included in all GOM lease sales from 1973 through 1994. The stipulation has been incorporated into operational regulations, which can be found at 30 CFR 250.194. All protective measures offered in the Stipulation have been adopted in this regulation. The current NTL for archaeological resource surveys and reports—NTL 2005-G07, effective July 01, 2005—supersedes all other archaeological NTL's and LTL's, and updates requirements to reflect current technology. The list of lease blocks requiring an archaeological survey and assessment are identified in NTL 2006-G07.

The proposed action includes the potential drilling of 5-15 exploration wells and 15-20 development wells over the 40-year life of the proposed action. Approximately 15,000-20,000 service-vessel trips (**Table 4-2**) are estimated under the proposed action; this is a rate of 375-500 service-vessel trips annually.

Lease blocks with a high probability for prehistoric archaeological resources may only be found landward of a line that roughly follows the 60-m (200-ft) water depth as the seaward extent of prehistoric archaeological potential on the OCS. The water depth in the proposed Lease Sale 224 area ranges from

800 to 3,200 m (2,625 to 10,500 ft). Based on the extreme water depth, there is no potential for prehistoric archaeological resources; therefore, no impacts can occur.

There are areas of the northern Gulf of Mexico that are considered by MMS to have a high probability for historic period shipwrecks (Garrison et al., 1989; Pearson et al., 2003). Statistical analysis of shipwreck location data identified two specific types of high-probability areas: (1) within 10 km (6 mi) of the shoreline and (2) proximal to historic ports, barrier islands, and other loss traps. Additionally, MMS has created high-probability search polygons associated with individual shipwrecks to afford protection to wrecks located outside the two high-probability areas. Of the 134 unleased blocks in proposed Lease Sale 224, no blocks fall within the GOM Region's high-probability area for historic resources and no historic shipwrecks are reported within this area. However, three historic shipwrecks have been reported within 15 mi (24 km) of the proposed Lease Sale 224 area.

Several OCS-related, impact-producing factors may cause adverse impacts to unknown historic archaeological resources. Offshore development activities that could result in the most severe impacts to an unknown historic shipwreck would be contact with an installation barge or TLP anchors and mooring chains, and the installation of subsea production infrastructure, such as manifolds, flow lines, production risers, and pipeline tie-backs. Direct physical contact with a shipwreck site could destroy fragile remains, such as the hull and wooden or ceramic artifacts, and could disturb the site context. The result would be the loss of archaeological data on ship construction, cargo, and the social organization of the vessel's crew, as well as the loss of information on maritime culture for the time period from which the ship dates. The likelihood of impacts on a historic archaeological resource from any permitted actions within the proposed Lease Sale 224 area is considered to be extremely small.

Offshore operations can introduce tons of ferromagnetic structures, components, and debris onto water that, if dropped or accidentally lost without recovery, have the potential to mask the magnetic signatures of historic shipwrecks. However, the water depths that occur within the proposed Lease Sale 224 area exceed the requirement for magnetometer surveys and would therefore not be a factor in identifying historic shipwrecks.

No onshore development in support of the proposed action is expected; therefore, no impact to onshore historic sites, such as forts, lighthouses, cemeteries, or buildings, from any onshore development in support of operations in the proposed Lease Sale 224 area would be expected. Cumulative impacts may occur, however. Should spilled oil contact a coastal historic site, such as a fort or a lighthouse, oil would be in a weathered and degraded state. The major impact would be visual petroleum contamination of the site and surroundings. Impacts to coastal historic sites are not expected to occur, and if a spill does occur impacts would be temporary and reversible.

A reevaluation of the baseline conditions for archaeological sites was recently conducted as a result of recent hurricane activity in the GOM. While it is expected that hurricane activity can have severe impacts on shipwrecks in shallow water, there is no indication of any disturbances to shipwrecks in water depths similar to those of the proposed Lease Sale 224 area.

Summary and Conclusion

There is no possibility that activities in the proposed Lease Sale 224 area will impact prehistoric archaeological resources because of the extreme water depths. Additionally, there is expected to be no direct or indirect impact on the inventory of known or unknown historical shipwrecks located in the proposed Lease Sale 224 area. Impacts are possible on an historic shipwreck because of incomplete knowledge about the location of shipwrecks in the Gulf of Mexico, but they are not likely. Direct contact between anchors and mooring lines for OCS surface structures, or the emplacement of sea-bottom production structures could destroy or disturb important historic archaeological artifacts or information. Other impact-producing factors would not be expected to adversely affect historic archaeological resources. Should any archaeological resource be discovered during MMS-permitted, seafloor-disturbing activities, permittees are required to cease operations within 1,000 ft (310 m) of the location of discovery and notify the Regional Director within 48 hours (30 CFR 250.194(c)).

4.3.14. Impacts on Human Resources and Land Use

4.3.14.1. Land Use and Coastal Infrastructure

Routine, Accidental, and Cumulative Impacts

Chapters 3.3.5.1.2 and 3.3.5.8 discuss land use and OCS-related onshore oil and gas infrastructure associated with the analysis area. The existing onshore oil and gas infrastructure is expected to be sufficient to handle development associated with the proposed action. Proposed Lease Sale 224 will require no new oil and gas coastal infrastructure and thus would not alter the current land use of the area.

Accidental events associated with the proposed action such as oil or chemical spills, blowouts, and vessel collisions would have no effects on land use. Coastal or nearshore spills could have short-term adverse effects on coastal infrastructure requiring cleanup of any oil or chemicals spilled.

The cumulative analysis considers the effects of impact-producing factors from OCS and State oil and gas activities. The OCS-related factors consist of prior, current, and future OCS lease sales. Unexpected events that may influence oil and gas activity within the analysis area, but cannot be predicted, are not considered in this analysis. Examples of unexpected events include major future natural disasters (including but not limited to hurricanes), oil embargos, and acts of war or terrorism.

The hurricanes of 2005 impacted every facet of the GOM oil and gas industry—from platform fabrication yards and service bases to production platforms and drilling rigs to processing facilities and deliveries to end-users, and everything in between. However, despite the amazing degree of destruction, these sectors, in large part, were able to recover relatively quickly and all are operating at or near pre-hurricane levels even though a few facilities, however, are currently not operational.

Chapters 3.3.5.1.2 and 3.3.5.8 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 and onshore. However, State oil and gas production is expected to continue to decline over the analysis period.

Land use in the analysis area will evolve over time. While the majority of this change is estimated as general regional growth rather than activities associated with the OCS Program and State production. The new coastal infrastructure forecast to support the OCS Program is discussed in Chapter 4.1.2.1 of the Multisale EIS (USDOI, MMS, 2007a) and is incorporated by reference. Except for the projected new gas processing plants (up to 14 with a capacity of 1.75 Bcfd, assuming average retirement and no expansions and/or the addition of new capacity to replace what is physically depreciating at all existing facilities) and the 4-6 pipeline shore facilities, the OCS Program will require no new oil and gas coastal infrastructure. There may be some expansion at current facilities, but the land in the analysis area is sufficient to handle development. While it is possible that up to 14 new, greenfield gas processing facilities could be developed, it is much more likely that a large share of the natural gas processing capacity that is needed in the industry will be located at existing facilities, using future investments for expansions and/or to replace depreciated capital equipment. It is likely that few (if any) new, greenfield gas processing facilities would be developed along the Central or Western GOM. The MMS expects that there is sufficient land to construct the few new, greenfield gas processing plants and pipeline shore facilities in the analysis area. New facilities and expansions would also support State oil and gas production. Thus, the results of OCS and State oil and gas activities are expected to minimally alter the current land use of the area.

Shore-based OCS and State servicing should also 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 area ports to minimize disruption to current residential and business use patterns. Port Fourchon, though, has limited land available; operators have had to create land on adjacent wetland areas. Construction of an elevated stretch of Louisiana Highway 1 (LA Hwy 1) from Port Fourchon to Leeville has begun. Without this and other planned expansions and upgrades of LA Hwy 1, any changes in the infrastructure at Port Fourchon that lead to increases in LA Hwy 1 usage would further strain the highway system. In addition, any increase in OCS and State demand of water will further strain Lafourche Parish's water system. Other ports in the analysis area that have sufficient available land plan to make infrastructure changes. Additional OCS activity will further strain Lafourche Parish's social infrastructure as well, such as local hospitals and schools. For example, the parish is classified as having a shortage of mental health professionals, especially in its southern areas (Louisiana Dept. of Health and Hospitals, 2002). Some community residents also state that oil and gas activity in Port Fourchon has impacted the school system by introducing more Spanish-speaking residents that work in these industries, creating a need for additional services and a new funding category that may detract from other programs (Petterson et al., in preparation).

Since the State of Florida and many of its residents reject any mineral extraction activities off their coastline, oil and gas businesses are not expected to be located there.

Summary and Conclusion

Activities relating to the OCS Program and State production are expected to minimally affect the analysis area's land use. Most subareas in the analysis area have strong industrial bases and designated industrial parks to accommodate future growth in oil and gas businesses. Any changes (mostly expansions, except for the 4-6 new pipeline shore facilities and any new, greenfield gas processing plants as discussed above) are expected to be contained on available land. Port Fourchon is expected to experience significant impacts to its land use from OCS-related expansion. Increased OCS-related usage from port clients is expected to significantly impact LA Hwy 1 in Lafourche Parish. Also, the increased demand of water by the OCS will further strain Lafourche Parish's water system.

The incremental contribution of the proposed action to the cumulative impacts on land use and coastal infrastructure are expected to be minor.

4.3.14.2. Demographics

In this section, MMS projects how and where future demographic changes will occur and whether they correlate with proposed Lease Sale 224. The addition of any new human activity, such as oil and gas development resulting from the 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 and land use.

Routine Impacts

Population

Although proposed Lease Sale 224 is approximately 125 mi (201 km) from Florida's Panhandle region, the majority of employment and population impacts will not occur in this area. Considering Florida's current opposition to oil and gas development in offshore waters and the scarcity, if not absence, of onshore supporting service bases, MMS anticipates that very few OCS-related activities will be staged from Florida. No new pipeline landfalls or other forms of coastal OCS-related infrastructure will be constructed as a result of proposed Lease Sale 224. Port Fourchon, Louisiana, will serve as the primary service base and will therefore be more likely to experience population impacts than areas near Florida or Alabama. Because OCS-related employment is widespread across the GOM region (i.e., offshore workers do not necessarily live near their place of work) and most OCS-related jobs are in the fabrication sectors, MMS does not expect that population effects due to the proposed lease sale will be concentrated in the Florida Panhandle region. Therefore, the population projections include an analysis of all 13 economic impact areas (EIA's) (**Chapter 3.3.5.4**) across the GOM region. Population projections related to activities resulting from the proposed action are expressed as the total population numbers and as a percentage of the population levels that would be expected if the proposed lease sale was not held. **Chapter 3.3.5.4.1** discusses baseline population projections for the analysis area through 2030. Because the baseline projections assume the continuation of existing social, economic, and technological trends at the time of the forecast, they also include population changes associated with the continuation of current patterns in OCS Program activities. Population impacts from the proposed action mirror the assumptions for employment impacts described in **Chapter 4.3.14.3** below. Projected population changes reflect the number of people dependent on income from OCS-related employment for their livelihood (e.g., family members of oil and gas workers), which is based on the ratio of population to employment in the analysis area over the life of the proposed lease sale. The population projections due to proposed Lease Sale 224 are calculated by multiplying the employment projections (**Chapter 4.3.14.3** and **Table 4-23**) by a ratio of the baseline population (**Table 3-28**) to the baseline employment (**Table 3-29**). Note that EIA's LA-1, LA-2, LA-3, LA-4, MA-1, and AL-1 correspond to the offshore CPA; TX-1, TX-2, and TX-3 correspond to the WPA; and FL-1, FL-2, FL-3 and FL-4 correspond to the EPA. Using the same assumptions as the employment impact analysis, the population projections (**Tables 4-23**) represent the maximum potential impact that would occur in a single EIA (**Chapter 4.3.14.3**). **Table 4-24** analyzes the population impacts under this assumption for each of the 13 EIA's.

Population associated with the proposed lease sale is estimated at about 43-1,653 persons during the peak year of impact (year 19) for the low- and the high-case scenarios, respectively. While population associated with the proposed lease sale is projected to peak in year 19, years 5 and 18 also display higher levels of population.

Population impacts from the proposed action are expected to be minimal, i.e., less than 1 percent of the total population for any EIA (**Table 4-24**). The mix of males to females is expected to remain unchanged. 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 (some of whom may be foreign) projected to move into focal areas, such as Port Fourchon, Louisiana, which will serve as the primary service base. The population projections (**Table 4-24**) also indicate that there would be minimal impact in the Florida Panhandle region as a result of proposed Lease Sale 224. The absence of any new OCS-related coastal infrastructure in the GOMR and the lack of onshore service bases in the Florida Panhandle region correspond with the population projection results shown in **Tables 4-23 and 4-24**.

Age

If the proposed lease sale is held, the age distribution of the analysis area is expected 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 in **Chapter 3.3.5.4.2** is expected to continue through the year 2048. Activities relating to the proposed action are not expected to affect the analysis area's median age.

Race and Ethnic Composition

The racial distribution of the analysis area is expected to remain virtually unchanged if the proposed lease sale is held. Given the low levels of employment and population growth and the industrial expansion projected for the proposed action, the racial distribution pattern described in **Chapter 3.3.5.4.3** is expected to continue through the year 2048. (See **Chapters 3.3.5.4.1 and 3.3.5.4.3** for a discussion of race and ethnic composition changes as a result of Hurricanes Katrina and Rita.)

Summary and Conclusion

Activities relating to proposed Lease Sale 224 are expected to minimally affect the analysis area's land use, infrastructure, and demography. These impacts are projected to mirror employment effects that are estimated to be negligible to any one EIA. Baseline patterns and distributions of these factors, as described in **Chapter 3.3.5.4**, are expected to approximately maintain the same level. Changes in land use throughout the analysis area are expected to be contained and minimal. The OCS-related infrastructure is in place and no new coastal infrastructure will be developed as a result of the proposed action. Current baseline estimates of population growth for the analysis area show a continuation of growth, but at a slower rate.

Accidental Impacts

Accidental events associated with the proposed action, such as oil or chemical spills, blowouts, and vessel collisions, would have no effects on the demographic characteristics of the Gulf coastal communities.

Cumulative Impacts

The following cumulative analysis considers the effects of OCS-related, impact-producing factors as well as non-OCS-related factors. The OCS-related factors consist of population and employment from prior, current, and future OCS lease sales; non-OCS-related factors include fluctuations in workforce, net migration, relative income, oil and gas activity in State waters, and offshore LNG activity. Unexpected events that may influence oil and gas activity within the analysis area, but cannot be predicted, are not considered in this analysis. Examples of unexpected events include major future natural disasters (including but not limited to hurricanes), oil embargos, and acts of war or terrorism.

Most approaches to analyzing cumulative effects begin by assembling a list of "other likely projects and actions" that will 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 (from Texas to Florida) over a 40-year period. Instead of an arbitrary assemblage of future possible projects and actions, this analysis employs the economic and demographic projections from Woods and Poole Economics, Inc. (2006) 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 population 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 and Poole projections represent a more comprehensive and accurate appraisal of cumulative conditions than could be generated using the traditional list of possible projects actions. These projections also include Woods and Poole's assumptions regarding Hurricanes Katrina and Rita's impact on the Southeast (**Chapter 3.3.5.5**). Hence, the regional economic impact assessment methodology used to estimate changes to population for the proposed lease sale was used for the cumulative analysis.

This section projects how and where future demographic changes will occur and whether they correlate with the OCS Program. The addition of any new human activity, such as oil and gas development resulting from the proposed action, can affect local communities in a variety of ways. Typically, these effects are in the form of people and money that can translate into changes in the local social and economic institutions and land use.

Population

C**hapter 3.3.5.4.1** discusses the analysis area's baseline population and projections through 2030. The population of the eight parishes and counties that were most negatively impacted by Hurricanes Katrina and Rita (St. Bernard, Orleans, Plaquemines, Jefferson, Cameron, Louisiana; and Hancock, Jackson, and Harrison, Mississippi) are not expected to return to their pre-hurricane levels for several years. Population impacts from the OCS Program (**Tables 4-25 and 4-26)** mirror those assumptions associated with employment described below in **Chapter 4.3.14.3**. Projected population changes reflect the number of people dependent on income from oil- and gas-related employment for their livelihood (e.g., family members of oil and gas workers). This figure is based on the ratio of population to employment in the analysis area over the 40-year analysis period. The population projections due to the OCS Program are calculated by multiplying the employment projections (**Chapter 4.3.14.3** and **Tables 4-27 and 4-28** by a ratio of the baseline population (**Table 3-28**) to the baseline employment (**Table 3-29**). Activities associated with the OCS Program are projected to have minimal effects on population in most of the coastal subareas. Regions in Louisiana coastal subareas, Lafourche (EIA LA-3) and Lafayette (EIA LA-2) Parishes in particular, are expected to experience noteworthy increases in population resulting from increases in the demand for OCS labor. The population projections (**Tables 4-25 and 4-26** indicate that there would be minimal impact in the Florida Panhandle region as a result of proposed Lease Sale 224. The absence of any new OCS-related coastal infrastructure in the GOM region and the lack of onshore service bases in the Florida Panhandle region correspond with the population projection results shown in **Tables 4-23 and 4-24** In addition, the cumulative effects of the OCS Program (**Tables 4-25 and -26**) are also expected to have a minimal impact on population. From a cumulative standpoint, OCS activities in the EPA should have a very small effect on coastal Mississippi and Alabama demographics and an insignificant effect in the Florida Panhandle. There is sufficient land designated in commercial and industrial parks and adjacent to existing ports to minimize disruption to current residential and business use patterns.

Following Hurricanes Katrina and Rita, some parishes and counties experienced population and employment gains because of residential displacement. In the updated Woods and Poole (2006) projections, St. Tammany Parish, Louisiana, was assumed to gain 27 percent; St. John the Baptist Parish, Louisiana, 21 percent; St. James Parish, Louisiana, 14 percent; Ascension Parish, Louisiana, 10 percent; East Baton Rouge Parish, Louisiana, 10 percent; Stone County, Mississippi, 15 percent; St. Charles

Parish, Louisiana, 18 percent; and Tangipahoa Parish, Louisiana, 18 percent from 2005 to 2006. Additional OCS-related employment and population could strain existing infrastructure and services in these communities. The population and employment increases are projected to stabilize in 2007.

The cumulative effects of human and natural activities in the coastal area have severely degraded the deltaic processes and shifted the coastal area from a condition of net land building to one of net landloss (USACOE, 2004c). As inland marshes and barrier islands erode or subside, without effective restoration efforts, the population in coastal communities in southern Louisiana is expected to shift to the more northern portions of the parishes and cause increasing populations in urban and suburban areas and declining populations in rural coastal areas (USACOE, 2004c).

Age

The age distribution of the analysis area is expected to remain virtually unchanged with respect to OCS Program activities. Given both the low levels of population growth and industrial expansion associated with the OCS Program, the age distribution pattern discussed in **Chapter 3.3.5.4.2** is expected to continue throughout the 40-year analysis period. Activities relating to OCS operations in the Eastern Gulf are not anticipated to affect the region's median age.

Race and Ethnic Composition

The racial distribution of the analysis area is expected to remain virtually unchanged with respect to the OCS Program. Given the low levels of employment and population growth and the industrial expansion projected for the proposed action, the racial distribution pattern described in **Chapter 3.3.5.4.3** is expected to continue throughout the 40-year analysis period. (See **Chapters 3.3.5.4.1 and 3.3.5.4.3** for a discussion of race and ethnic composition changes in the New Orleans metropolitan area as a result of Hurricane Katrina.)

Summary and Conclusion

Activities relating to the OCS Program are expected to minimally affect the analysis area's demographic patterns. Baseline patterns and distributions of these factors, as described in **Chapter 3.3.5.4.1**, are not expected to change for the analysis area as a whole. The baseline population patterns are expected to change for the eight counties and parishes that were most negatively affected by the 2005 hurricane season (see **Chapter 3.3.5.4** for a discussion of these changes). Some regions within Louisiana coastal subareas, Port Fourchon in particular, are expected to experience some impacts to population and their education system as of a result of increase demand of OCS labor. As discussed in **Chapter 4.3.14.2**, the proposed action in the proposed lease sale area is expected have an incremental contribution of less than a 1 percent to the population level in any of the EIA's. From a cumulative standpoint, OCS activities in the EPA should have a very small effect on coastal Mississippi and Alabama demographics and an insignificant effect in the Florida Panhandle. There is sufficient land designated in commercial and industrial parks and adjacent to existing ports to minimize disruption to current residential and business use patterns. The incremental contribution of the proposed action to population changes would be minimal. Given both the low levels of population growth and industrial expansion associated with the proposed action, the baseline age, sex, and racial distributions are expected to continue through the year 2048.

4.3.14.3. Economic Factors

Routine Impacts

Employment

The oil and gas industry is significant to the coastal communities of the Gulf of Mexico, particularly in south Louisiana and eastern Texas. The economic impact analysis for proposed Lease Sale 224 focuses on the potential total employment impacts (i.e., direct, indirect, and induced) 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**. The employment numbers are based on the analysis done for Lease Sale 181, which is summarized below and is incorporated by reference (Section IV.D.a.(15)(b) of the Lease Sale 181 FEIS (USDOI, MMS, 2001a)).

The methodology developed to quantify impacts on population and employment takes into account changes in OCS-related employment, along with population impacts resulting from these employment changes within each individual coastal subarea, also referred to as an EIA in this SEIS. The model applied for Lease Sale 181 had two steps. The first step estimated the expenditures on proposed Lease Sale 181's exploration and development scenario activities (i.e., exploratory drilling; development drilling; production operations and maintenance; platform fabrication and installation; pipeline construction; pipeline operations and maintenance; gas processing and storage construction; gas processing and storage operations and maintenance; workovers; and platform removal and abandonment) and assigned these expenditures to industrial sectors in eight MMS coastal subareas defined in Section III.D.4.b in the Lease Sale 181 FEIS (USDOI, MMS, 2001a). The second step in the model used multipliers from the commercial input-output model IMPLAN to translate these expenditures into projected direct, indirect, and induced (as well as their sum, or total) employment and other economic factors. Direct employment results from the first round of industry spending. It is the employment that results from the initial dollars spent by the oil and gas industry on the 10 scenario activities (listed above). Indirect employment results as the initial spending reverberates through the economy. First, the suppliers of the goods and services for the 10 activities spend the initial direct dollars from the industry. Then, these dollars are re-spent by other suppliers until the initial dollars have trickled throughout the economy. Labor income produces induced spending by the households receiving that income.

Both the level (the amount spent) and the sectoral (the industry in which it is spent) allocation of expenditures can vary considerably by the phase of OCS activity and by the water depth of the activities. For example, an exploratory well in 0-60 m (0-197 ft) of water is expected to be drilled using a jack-up rig and cost substantially less than an exploratory well in 900 m (2,953 ft) or greater water depth and that is expected to be drilled using a drillship. In addition, spending on materials such as steel will be much higher for platform fabrication and installation than for operations and maintenance once production begins. Therefore, the model estimated and allocated expenditures by 10 types of activities in four water-depth categories: 0-60 m (0-197 ft), 61-200 m (200-656 ft), 201-900 m (659-2,953 ft), and >900 m (>2,953 ft). Because local economies vary, a separate set of IMPLAN multipliers was used for each MMS coastal subarea to which expenditures were assigned. Each set of multipliers was based on the actual historical patterns of economic transactions in the area. Model results for employment were presented in number of jobs per year, where one job was defined as a year of employment. Total employment projections for activity resulting from the proposed action were expressed as absolute numbers and as a percentage of the employment levels expected if no development occurs in Tables IV-46 and IV-47 in the Lease Sale 181 FEIS (USDOI, MMS, 2001a).

The MMS estimates that the undiscovered technically recoverable resources associated with proposed Lease Sale 224 area are approximately 8 percent of those associated with the Lease Sale 181 area. For impact analysis purposes, MMS rounds the proportion up to 10 percent to account for the logic that a more narrowly focused geographic area will likely draw proportionately more leasing and activity. The estimated total annual employment for all Gulf coastal subareas (EIA's) from activities associated with proposed Lease Sale 224 using this methodology is shown in **Table 4-29** (need to add employment table ref). Based on this approach, total employment is not expected to exceed 395-945 jobs in any given year over the proposed action's 40-year lifetime. However, a portion of these employment estimates do not represent "new" jobs. Many of these jobs would represent new contracts or orders at existing firms. The contracts would essentially keep the firm operating at its existing level as earlier contracts and orders are completed or filled. In other words, a portion of these jobs would be staffed with existing company labor force and would simply maintain the status quo.

To better understand the impacts of OCS development on the Gulf States, MMS has expanded its geographic area of analysis and revised the EIA's from 8 to 13 since the Lease Sale 181 FEIS was completed. In order to conduct an impact analysis that accounts for changes that have taken place to the Sale 181 model variables (such as expanded geographic area, increases in the price of oil and gas, more recent IMPLAN multipliers, etc.) that represents a "maximum impact analysis," MMS analyzes the total employment number for each year from **Table 4-29** for each individual EIA. In other words, MMS examines a scenario where the total forecast employment from proposed Lease Sale 224 would take place in a single EIA (an unrealistic assumption but one that examines the maximum potential impacts) and analyzes the impacts under this assumption for each of the 13 EIA's. The baseline EIA employment forecast used in this analysis are described in **Chapter 3.3.5.5** and **Tables 3-18 through 3-30**. Because these baseline forecasts assume the continuation of existing social, economic, and technological trends, they also include employment resulting from the continuation of current patterns in OCS Program activities. As discussed in **Chapter 3.3.5.5**, these baseline forecasts include Woods and Poole's assumptions regarding the employment impacts of Hurricanes Katrina and Rita (Woods and Poole Economics, Inc., 2006).

Total employment forecasts for activities resulting from the proposed Lease Sale 224 as a percentage of these baseline employment projections is presented in **Table 4-30**. Even under the assumption that all employment would occur in a single EIA, projected employment does not exceed one percent of the total employment in any given EIA of Texas, Louisiana, Mississippi, Alabama, or Florida. The MMS expects that the distribution of employment will follow a similar pattern to that in the Lease Sale 181 FEIS and for a CPA proposed sale as described in the recent Final Multisale EIS (USDOI, MMS, 2007a). Hence, most of the employment related to proposed Lease Sale 224 will likely take place in EIA's LA-2, LA-3, and TX-3. Considering Florida's current opposition to oil and gas development in offshore waters and the scarcity, if not absence, of onshore supporting service bases, MMS anticipates very few OCS-related activities will be staged from Florida.

Summary and Conclusion

Should proposed Lease Sale 224 occur, there would be only minor economic changes in the Texas, Louisiana, Mississippi, Alabama, or Florida EIA's. The proposed action is expected to generate less than a 1 percent increase in employment in any of these subareas. This demand will be met primarily with the existing available labor force for reasons discussed above.

Accidental Impacts

The resource costs of cleaning up an oil spill, either onshore or offshore, were not included in the economic analyses for the proposed action (**Chapter 4.3.14.3**) for two reasons. First, the potential impact of oil-spill cleanup activities is a reflection of the spill's opportunity cost. The cleanup and remediation of an oil spill involves the expenditure of millions of dollars and the creation of hundreds of jobs. While such expenditures are revenues to business and employment/revenues to individuals, the cost of responding to a spill is not a benefit to society and is a deduction from any comprehensive measure of economic output. An oil spill's opportunity cost has two generic components: cost and lost opportunity. Cost is the value of goods and services that could have been produced with the resources used to cleanup and remediate the spill if the resources had been able to be used for production or consumption. The second is the value of the opportunities lost or precluded to produce (e.g., harvest oysters) or consume (e.g., recreational/tourism activities) (Pulsipher et al., 1999). The second reason for excluding the costs of cleaning up an oil spill from the proposed action economic analyses is that the occurrence of a spill is not a certainty. Spills are unpredictable, accidental events. Even if the proposed lease sale was held, leases let, and oil and gas produced, the timing, numbers, sizes, offshore locations of occurrence, and onshore locations of contact of potential spills occurring over the life of the proposed action are all unknown variables. Additionally, the cost involved in any given cleanup effort is influenced by a variety of factors: whether or not the oil comes ashore; the type of coastal environment contacted by the spill; weather conditions at the time of the incident; the type and quantity of oil spilled; and the extent and duration of the oiling. **Chapter 4.2.1.5.1** depicts 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 4-4** shows the GOM coastal counties and parishes having a risk >0.5 percent of being contacted within 10 days by an offshore spill ≥1,000 bbl as a result of the proposed action. All counties in Texas, Mississippi, Alabama, and Florida and all but one parish in Louisiana have a <0.5 percent probability of a spill ≥1,000 bbl occurring and contacting (combined probability) their shorelines within 10 days. In Louisiana, Plaquemines Parish has the greatest risk (1%) of an OCS offshore spill ≥1,000 bbl occurring and contacting its shoreline within 10 days as a result of the proposed action.

The immediate social and economic consequences for the region in which a spill occurs are a mix that include not only additional opportunity cost of employment and expenditures but also non-market 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 an oil 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 (Pulsipher et al., 1999). **Chapters 4.3.10, 4.3.11, and 4.3.12** analyze the potential consequences of an oil spill on commercial fishing, recreational fishing, and recreational resources, respectively. Net employment impacts from an oil 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 proposed action.

Tarballs (the floating residue remaining after an oil slick dissipates) are likely results from a large spill. Tarballs are known to persist as long as 1-2 years in the marine environment. Findings from an MMS study investigating the abundance and sources of tarballs on the recreational beaches of the CPA concluded that the presence of tarballs along the Louisiana coastline is primarily related to marine transportation activities and that their effect on recreational use is below the level of social and economic concern (Henry et al., 1993).

Summary and Conclusion

The short-term social and economic consequences for the Gulf coastal region should a spill ≥1,000 bbl occur includes opportunity cost of employment and expenditures that could have gone to production or consumption rather than spill-cleanup efforts. Non-market 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 an oil 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.

Cumulative Impacts

This cumulative economic analysis focuses on the potential total (direct, indirect, and induced) employment impacts of the OCS Program's oil and gas activities in the GOM, 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 will 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 (from Texas to Florida) over a 40-year period. Instead of an arbitrary assemblage of future possible projects and actions, this analysis employs the economic and demographic projections from Woods and Poole Economics, Inc. (2006) 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 and Poole projections represent a more comprehensive and accurate appraisal of cumulative conditions than could be generated using the traditional list of possible projects' actions. These projections also include Woods and Poole's assumptions regarding Hurricanes Katrina and Rita's impact on the Southeast. Hence, the regional economic impact assessment methodology used in **Chapter 4.3.14.3** to estimate changes to employment for the proposed lease sale was used for the cumulative analysis.

To improve regional economic impact assessments and to make them more consistent across planning areas, MMS has developed a model called the MMS Alaska-GOM Model Using IMPLAN (MAG-PLAN) for forecasting changes to employment and other economic factors (Saha et al., 2005). The MAG-PLAN model is discussed in Chapter 4.2.2.1.15.3 of the Final Multisale EIS and is incorporated by reference. The MAG-PLAN model retains the two-stage process of the older MMS models. Stage I forecasts the expenditures required to support the activity levels in a specific exploration and development scenario, and allocates these expenditures to the various industrial sectors in the onshore geographic units of interest. Stage II forecasts how the initial dollars spent in a geographic area reverberate through the economy, using multipliers taken from the widely used IMPLAN model to forecast the employment, income, and other economic effects. For each of these economic effects, MAG-PLAN forecasts direct, indirect, induced, and total effects. In standard usage, the direct effects refer to the spending of the oil and gas industry as a result of the projects being analyzed, as well as the employment, income, and other such effects caused by that spending. Indirect effects are those that arise from subsequent rounds of spending by contractors, vendors, and other businesses. Induced effects arise from the spending of worker households. While total effects remain the same, most "direct" MAG-PLAN forecasts include the first round of indirect and induced effects. The MAG-PLAN direct effects include local payroll and non-payroll expenditures of oil and gas companies, as well as of their immediate suppliers.

The addition of the proposed Sale 224 area to the GOM 5-year program area covered in the Final Multisale EIS will result in anticipated production and activity that remains within range of the low- and high-case exploration and development scenarios for the OCS Program used in the cumulative case of the Final Multisale EIS. Tables 4-45 through 4-47 of the Final Multisale EIS present projected employment for the OCS Program based on these scenarios and the percentage to total baseline in each economic impact area and are updated in this document as **Tables 4-27, 4-28, and 4-31**. The projections are not statements of what will happen but of what might happen, given the assumptions and methodologies used. The projections are business-as-usual trend forecasts, given known technology, technological and demographic trends, and current laws and regulations. Because energy markets are complex, models are simplified representations of energy production and consumption, regulations, and producer and consumer behavior. Projections are highly dependent on the data, methodologies, model structures, and assumptions used in their development. Energy projections are subject to much uncertainty. Many of the events that shape energy markets cannot be anticipated, such as severe weather, political disruptions, strikes, and technological breakthroughs. In addition, future developments in technologies, demographics, and resources cannot be foreseen with any degree of certainty. Given this, MMS has endeavored to make these projections as objective, reliable, and useful as possible.

Tables 4-27, 4-28, and 4-31 present projected employment associated with the OCS Program including proposed Lease Sale 224 and the percentage to total baseline employment in each EIA. As noted above, these baseline projections include employment resulting from the continuation of current patterns in OCS Program activities. Hence, forecasting total employment from the OCS Program and then dividing by a number that already includes all of the employment from previous OCS Program actions significantly overestimates the impacts of the OCS Program on a percentage basis. Based on model results, direct employment in the MMS-defined EIA associated with OCS Program including proposed Lease Sale 224 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 peak period. Therefore, total employment resulting from OCS Program activities including proposed Lease Sale 224 in the MMS-defined EIA is not expected to exceed 257,000-328,000 jobs in any given year over the 40-year impact period.

Tables 4-27 and 4-28 also present projected employment for "Other-GOM" and "Other-US." Other-GOM consists of the remaining counties and parishes that are outside the MMS-defined EIA for the five Gulf States. Direct employment for this area associated with OCS Program activities including proposed Lease Sale 224 is estimated to range between 32,000 and 40,000 jobs during peak activity years for the low- and high-resource estimate scenarios, respectively. Indirect employment is projected between 16,000 and 20,000 jobs, while induced employment is projected between 26,000 and 339,000 jobs, resulting in a total of 74,000-93,000 jobs. Other-US consists of the remaining 45 states. Total employment in the remaining states is projected to be between 172,000 and 223,000 jobs during peak activity, with 37,000-48,000 being direct employment.

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 3.1 percent of the total employment in that EIA. The OCS-related employment for

Louisiana 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 greater in LA-2, reaching a maximum of nearly 21 percent versus about 8 percent in LA-3. While these numbers are high, it is important to remember that they are overestimates for the reason discussed in the previous paragraph. Also, the percentage analysis is highly dependent on the baseline employment projections, which are somewhat 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 (Dismukes, personal communication, 2006). The next greatest impacts in percentage terms are in TX-2, LA-4, and LA-1, respectively, with none exceeding 5.3 percent in any given year. The OCS-related employment for TX-1 and all of Alabama, Mississippi, and Florida's EIA's is not expected to exceed 1.8 percent of the total employment in any EIA. Population impacts, as conveyed in **Tables 4-25 and 4-26**, mirror those assumptions associated with employment.

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 MMS does expect some employment will be met through in-migration; however, this level is projected to be small and localized and, thus, MMS expects the sociocultural impacts from in-migration to be minimal in most EIA's. On a regional level, the cumulative impact on the population, labor, and employment of the counties and parishes of the impact area is considerable for some focal points. Peak annual changes in the population, labor, and employment of all EIA's resulting from the OCS Program are minimal, except in Louisiana.

On a local level, Port Fourchon is experiencing full employment, housing shortages, and stresses on local infrastructure—roads (LA Hwy 1), water supply, schools, hospitals, etc. Port Fourchon is a focal point for OCS development, especially deepwater OCS operations. As discussed in **Chapter 3.3.5.8** the Port (and the surrounding community and infrastructure) is experiencing increased activity as a result of the 2005 hurricane season because of both the extent of repairs being made to offshore infrastructure and the damages and lost capacity at other service bases such as Venice and Cameron. Although some of this increase is expected to be temporary while repairs are being made, some of the increase is likely to be permanent. Any additional employment, particularly new residential employment, and the resultant strain on infrastructure, due to the OCS Program, are expected to have a significant impact on the area. In addition, ports throughout the Gulf are experiencing labor shortages for higher skilled positions as electricians, fitters, crane operators, and boat captains, an issue that existed prior to the 2005 hurricane season. This may lead to additional in-migration to these areas to fill these positions.

The resource costs of cleaning up an oil spill, either onshore or offshore, were not included in the above cumulative analysis. The cleanup and remediation of an oil spill involves the expenditure of millions of dollars and the creation of up to hundreds of temporary jobs. While such expenditures are revenues to business and employment/revenues to individuals, spills represent a net cost to society and are a deduction from any comprehensive measure of economic output. In economic terms, spills represent opportunity costs. An oil spill's opportunity cost has two generic components. The first cost is the direct cost to clean up the spill and to remediate the oiled area. This is the value of goods and services that could have been produced with these resources had they gone to production or consumption rather than the cleanup. The second is the value of the opportunities lost or precluded to produce (e.g., harvest oysters) or consume (e.g., recreational/tourism activities) (Pulsipher et al., 1999).

Chapter 4.2.1 discusses the risk of spill occurrence, the number of spills estimated for the OCS Program, and the likelihood of an OCS spill contacting the Gulf Coast. The magnitude of the impacts discussed below depend on many factors including the season of spill occurrence and contact, the volume and condition of the oil that reaches shore, the usual use of the shoreline impacted, the diversity of the economic base of the shoreline impacted, and the time required for cleanup and remediation activities. In addition, the extent and type of media coverage of a spill may affect the magnitude and length of time that tourism is reduced to an impacted area.

The immediate social and economic consequences for a region contacted by an oil spill also included non-market 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 an oil 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 (Pulsipher et al., 1999). **Chapters 4.3.10, 4.3.11, and 4.3.12** contain more discussions of the consequences of a spill on commercial fishing, recreational fishing, and recreational resources, respectively.

Summary and Conclusion

The OCS Program, including proposed Lease Sale 224, will produce only minor economic changes in the Texas, Mississippi, Alabama, and Florida EIA's. With the exceptions of EIA's TX-2 and TX-3, it is expected to represent less than 1.8 percent of employment projected in any of the EIA's in these states. Employment associated with the OCS Program reaches 3.1 percent of total projected employment for EIA TX-3 and 2.1 percent of total projected employment for EIA TX-2. However, the OCS Program is projected to substantially impact the Louisiana EIA's LA-2 and LA-3, with OCS-related employment expected to peak at 20.8 percent and 8.0 percent of total employment, respectively. On a regional level, activities relating to the OCS Program are expected to significantly impact employment in Lafourche Parish, Louisiana, in EIA LA-3. Therefore, the population, housing, roads (LA Hwy 1), water supply, schools, and hospitals in the parish will be affected and strained.

The short-term social and economic consequences for the Gulf coastal region should a spill ≥1,000 bbl occur includes opportunity cost of employment and expenditures that could have gone to production or consumption rather than spill-cleanup efforts. Non-market 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 an oil 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. Overall employment projected for all oil and gas activities related to the OCS Program and proposed Lease Sale 224, including employment impacts from oil spills, is projected to be substantial (particularly in EIA's TX-3, LA-2, and LA-3).

As discussed in **Chapter 4.3.14.3**, the proposed action is expected have an incremental contribution of less than a 1 percent to the employment level in any of EIA's.

4.3.14.4. Environmental Justice

The analysis of environmental justice concerns is divided into those related to routine operations associated with proposed Lease Sale 224 and accidental events. Concerns related to oil spills are discussed below. Concerns related to routine operations, discussed in this section, center on increases in onshore activity (such as employment, migration, commuter traffic, and truck traffic). **Chapter 3.3.5.8** describes the widespread presence of an extensive OCS support system and associated labor force, as well as economic factors related to OCS activities. The MMS estimates that production from proposed Lease Sale 224 will be 0.10-0.14 BBO and 0.16-0.34 Tcf of gas.

Routine Impacts

Although the proposed lease sale is approximately 125 mi (201 km) from Florida's Panhandle region, the majority of socioeconomic impacts will not occur in Florida. Considering Florida's current opposition to oil and gas development in offshore waters and the scarcity, if not absence, of onshore supporting service bases, MMS anticipates that very few OCS-related activities will be staged from Florida. No new pipeline landfalls or other forms of coastal OCS-related infrastructure are projected to be constructed as a result of proposed Lease Sale 224. Port Fourchon, Louisiana, will serve as the primary service base and will therefore be more likely to experience population impacts than areas near Florida, Mississippi, or Alabama. Because OCS-related employment is widespread across the GOM region (i.e., offshore workers do not necessarily live near their place of work) and most OCS-related jobs are in the fabrication sectors, MMS does not expect that population and environmental justice effects due to the proposed lease sale will be concentrated in the Florida Panhandle region.

Environmental justice issues involve questions of disproportionate and negative effects on minority and low-income populations. Proposed Lease Sale 224 is expected to slightly increase employment opportunities in a wide range of businesses along the Gulf Coast. These conditions preclude a prediction of where much of this employment will occur or who will be hired. **Figures 3-14 through 3-19** display the geographic distribution of low-income and minority residents across Gulf counties and parishes. As stated in **Chapter 3.3.5.9** and displayed in **Figures 3-14 through 3-19**, there are communities that could exhibit disproportionate effects on low-income or minority groups in the region. Ten counties (or parishes in Louisiana) are considered to have a high concentration of oil-related infrastructure (**Table 3-35**). Of these 10 counties or parishes, 5 have higher minority percentages than their respective State average: Mobile County, Alabama; St. Mary Parish, Louisiana; and Galveston, Harris, and Jefferson Counties, Texas. Only 2 of the 10 high infrastructure concentration counties or parishes also have higher poverty rates than their respective State mean poverty rate: St. Mary Parish, Louisiana, and Jefferson County, Texas. Many of these low income and minority populations are in large urban areas where the complexity and dynamism of the economy and labor force preclude a measurable effect. Because the distribution of low-income and minority populations does not parallel the distribution of industry activity, effects of the proposed action are not expected to be disproportionate.

Ongoing MMS research includes gathering information on race and employment. Offshore workers in the production sector are almost entirely male and white (Rosenberg, personal communication, 2001). Other 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 b; Donato et al., 1998). A study of oil industry trends between 1980 and 1990 found that downsizing was concentrated in the production sector; therefore, it affected white male employment more than that of women or minorities (Singelmann, personal communication, 2006). Evidence also suggests that a healthy offshore petroleum industry also indirectly benefits low-income and minority populations. One MMS study in Louisiana found income inequality decreased during the oil boom and increased with the decline (Tolbert, 1995). Another MMS-funded study found that reemployment rates for poorly educated black and white women laid off in the closing of an OCS-related plant in one rural town were much higher than reemployment rates related to similar closings elsewhere because Louisiana's oil industry had created a complex local economy (Tobin, 2001). While the proposed action will provide little additional employment, it will have the effect of maintaining current activity levels, which is expected to be beneficial to low-income and minority populations.

Environmental justice concerns often arise from the possible siting of infrastructure in places that will have disproportionate and negative effects on minority and low-income populations. Since proposed Lease Sale 224 will help to maintain ongoing levels of activity rather than expand them, it will not generate new coastal infrastructure that would raise siting issues. For this reason, this SEIS considers infrastructure projections only for the cumulative analysis. The cumulative analysis concludes that, as with the analysis of employment effects of the proposed action, infrastructure effects are expected to be widely and thinly distributed. Since the siting of new infrastructure will reflect the distribution of the petroleum industry and not that of minority and low-income populations, the OCS activity in the proposed lease sale area is not expected to disproportionately affect these populations. Again, Lafourche Parish is identified as a location of more concentrated effects. Each OCS-related facility constructed onshore must first receive approval by the relevant Federal, State, county or parish, and community involved, and MMS assumes that new construction will be approved only if consistent with appropriate land-use plans, zoning regulations, and other State/regional/local regulatory mechanisms.

Because of Louisiana's extensive oil-related support system (**Chapter 3.3.5.8**), that State is likely to experience more employment effects related to the proposed action than are the other coastal states. Lafourche Parish, Louisiana, is likely to experience the greatest concentration and is the only parish where the additional OCS-related activities and employment are sufficiently concentrated to increase stress to its infrastructure. Even so, the effects of the proposed action are not expected to be significant in the long term. The concentrated socioeconomic impacts in Lafourche Parish are not expected to have disproportionate effects on minority and low-income populations for several reasons. The parish is not predominately minority or low income (**Figures 3-15 and 3-18**). The Houma, a Native American tribe recognized by the State of Louisiana, has been identified by MMS as a possible environmental justice concern.

Recent MMS research indicates that minority populations throughout Lafourche Parish, Louisiana, could sustain disproportionate effects should a major accident involving onshore activities occur (Hemmerling and Colten, 2003). Five different classes of relevant OCS activities exist in the region, including transportation corridors, oil and natural gas pipelines, petroleum bulk storage facilities, shipyards, and a natural gas processing plant. The majority of OCS-related infrastructure is located in south Lafourche Parish where the Houma Indian population is concentrated. The proposed lease sale would not significantly alter this preexisting situation where onshore cumulative effects already exist. Therefore, since the preexisting situation would not be significantly altered, minority and low-income populations would not sustain disproportionate adverse effects from the proposed action.

Two local infrastructure issues described in **Chapter 4.1.2.1** could possibly have related environmental justice concerns—traffic on LA Hwy 1 and the expansion of Port Fourchon. The most serious concern raised during scoping for this SEIS is the high-level of traffic on LA Hwy. 1. Increased traffic may have health risks (e.g., increased accident rates). As described in **Chapter 3.3.5**, human settlement patterns in the area (on high ground along LA Hwy 1 and Bayou Lafourche) mean that rich and low-income alike would be affected by any increased traffic. Port Fourchon is relatively new and is surrounded by mostly uninhabited land. Existing residential areas close to the port are also new and not considered low-income areas. Any expansion of infrastructure at Port Fourchon is not expected to disproportionately affect minority or low-income populations. Lafourche Parish is an area of relatively low unemployment because of the concentration of petroleum-related industry in the area (Hughes et al., 2001). While the minority and low-income populations of Lafourche Parish will share with the rest of the parish population any negative impacts related to the proposed action, there is no evidence that these groups would experience any disproportionate effects.

Summary and Conclusion

Because of the existing extensive and widespread support system for OCS-related industry and associated labor force, the effects of the proposed action are expected to be widely distributed and little felt. In general, who will be hired and where new infrastructure might be located is impossible to predict. Impacts related to the 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 proposed action is not expected to have a disproportionate effect on these populations.

Lafourche Parish will experience the most concentrated effects of the proposed action; however, because the Parish is not heavily low-income or minority, because the Houma are not residentially segregated, and because the effects of road traffic and port expansion will not occur in areas of low-income or minority concentration, these groups will not be differentially affected.

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

Accidental Impacts

Potential oil spills associated with the proposed action that would enter coastal waters can have negative economic or health impacts on the many people who use those waters for fishing, diving, boating, and swimming. The MMS estimates that coastal spills ≥1,000 bbl occurring from the proposed action have a low probability of occurrence (**Chapter 4.2.1.5** and **Figures 4-3, 4-4, and 4-5**).

Should an oil spill occur and contact coastal areas, any adverse effects would not be expected to disproportionately impact minority or low-income populations. The populations immediately adjacent to the coast are not physically, culturally, or economically homogenous. The homes and summer homes of the relatively affluent line much of the Gulf Coast, and this process of gentrification is ongoing. As shown by **Figures 3-14 through 3-19** and discussed in **Chapter 3.3.5.9**, coastal concentrations of minority and low-income populations are few and mostly urban. The higher probabilities of oil contacting land are in Plaquemines Parish, Louisiana (**Figure 4-4**). It is the only parish or county where the probability of an oil spill ≥1,000 bbl reaches 1 percent. All other counties and parishes in the GOM region have probabilities of <0.5 percent. In Louisiana, Grand Isle is the only inhabited barrier island, and this community is not predominantly minority or low income. Most of the Louisiana coast, including South Pass, Southwest Pass, and the shorelines surrounding Morgan City and the lower Mississippi Delta are virtually uninhabited and uninhabitable.

The users of the coast and coastal waters are not physically, culturally, or economically homogenous. Recreational users of coastal waters tend to be relatively affluent. For example, a recent survey of recreational and party-boat fishing around offshore oil rigs found significant per capita costs (Hiett and Milon, 2002). Offshore commercial fishing involves significant capital outlays that limit participation. One MMS-funded study of the Houma in Lafourche Parish found that they focus their commercial and subsistence activities on inland and nearshore wild resources, less capital demanding pursuits (Fischer, 1970). The higher probabilities of oil contacting State offshore waters are in Central (1-2%) and Eastern (<0.5-1%) Louisiana waters (**Figure 4-5**). The probability of an oil spill ≥1,000 bbl occurring and contacting all other State offshore waters and recreational beaches is <0.5 percent.

The direct impacts of an oil spill are unlikely to disproportionately affect minority or low-income people. Oil spills can have indirect effects, such as through serious, short-term impacts on tourism; however, these too are unlikely to disproportionately affect minority or low-income people.

While it is expected that hurricane activity can have severe impacts on all coastal communities, impacts on minority and low-income populations may be disproportionate to the remainder of the local population. Since the hurricanes have not forced a major shifting of the onshore infrastructure and the proposed action would predominately use existing infrastructure, no difference from the existing conditions will be evident.

Summary and Conclusion

Considering the low likelihood of an oil spill and the heterogeneous population distribution along the GOM region, accidental spill events associated with the proposed action are not expected to have disproportionate, adverse environmental or health effects on minority or low-income people.

Cumulative Impacts

This analysis addresses environmental justice concerns related to cumulative impacts. These concerns center on increases in onshore activity (such as employment, migration, commuter traffic, and truck traffic) and on additions to the infrastructure supporting this activity (such as fabrication yards, supply ports, and onshore disposal sites for offshore waste). After addressing the effects to environmental justice of the OCS Program, this section analyzes the cumulative effects of non-OCS factors that affect environmental justice in the study area. This section also considers the contribution of the proposed action to the cumulative impacts.

Chapter 3.3.5 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 the proposed action may have on any particular community. Generally, effects will be widely yet thinly distributed across the Gulf Coast and will consist of slightly increased employment and even more slightly increased population. For most of the Gulf Coast, the proposed action will result in only minor economic changes. Some places could experience elevated employment, population, infrastructure, and/or traffic effects because of local concentrations of fabrication and supply operations. Lafourche Parish, Louisiana, is one community where concentrations of industry activity and related employment are likely to strain the local infrastructure.

Environmental justice issues involve questions of disproportionate and negative effects on minority and low-income populations. In the cumulative case, employment opportunities will increase slightly in a wide range of businesses over the entire Gulf Coast. These conditions preclude a prediction of where much of this employment will occur or who will be hired. **Figures 3-14 through 3-19** provide distributions of counties and parishes of high concentrations of minority groups and low-income households. As stated in **Chapter 3.3.5.9**, pockets of concentrations of these populations are scattered throughout the GOM coastal counties and parishes, most in large urban areas where the complexity and dynamism of the economy and labor force preclude a measurable effect. Because the distribution of low-income and minority populations does not parallel the distribution of OCS-related industry activity, the cumulative effects of the proposed action are not expected to be disproportionate with regard to minority and low-income populations.

The proposed action's widespread economic effects on minority and low-income populations are not expected to be negative. Ongoing MMS research includes gathering information on race and employment. Offshore workers in the production sector are almost entirely male and white (Rosenberg, personal communication, 2001). Other sectors, such as the fabrication industry and support industries (e.g., trucking), do employ minority workers and provide jobs across a wide range of pay levels and educational/skill requirements (Austin et al., 2002a and b; Donato et al., 1998). A study of oil industry trends between 1980 and 1990 found that downsizing was concentrated in the production sector, hence it affected white male employment more than that of women or minorities (Singelmann, personal communication, 2006). Evidence also suggests that a healthy offshore petroleum industry also indirectly benefits low-income and minority populations. One MMS study in Louisiana found income inequality decreased during the oil boom and increased with the decline (Tolbert, 1995). Another MMS-funded study found that reemployment rates for poorly educated black and white women laid off in the closing of a plant in one rural Louisiana town were much higher than reemployment rates after similar closings elsewhere because Louisiana's oil industry had created a complex local economy (Tobin, 2001). While, except in Louisiana, the OCS Program is expected to provide little additional employment, it will have the effect of maintaining current activity levels, which is expected to be beneficial to low-income and minority populations.

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 will generate significant new infrastructure demand.

At present, there are 126 OCS-related pipeline landfalls and 50 OCS-related pipeline shore facilities in the GOM region (**Table 3-33**). As discussed in the environmental justice analysis for oil spills above, existing coastal populations are not generally minority or low-income. While several Louisiana parishes in the lower Mississippi River Delta area have a higher percentage of minorities than the State average (e.g., Iberville, St. James, St. John the Baptist, and Orleans Parishes; **Figure 3-15**), the majority of Louisiana's coastline, in general, is virtually uninhabited. Furthermore, none of the coastal Louisiana parishes with a high level of OCS-related infrastructure have a higher percentage of poverty than the State average (**Figure 3-18**). It is not expected that pipeline landfalls and their associated facilities will disproportionately affect minority or low-income populations.

Generally, MMS does not address downstream activities, stopping the analysis at the point offshore product is mixed with onshore and/or imported products. As described in **Chapter 3.3.5.8**, the Gulf's extensive OCS-related infrastructure is widely distributed. This distribution is based on economic and logistical considerations unrelated to the distribution of concentrations of minority or low-income populations. The MMS cannot predict and does not regulate the siting of future gas-processing plants. The MMS assumes that sitings of any future facilities will be based on the same economic, logistical, zoning, and permitting considerations that determined past sitings, and that they will not disproportionately affect minority and low-income populations.

Chapter 3.3.5.8 describes Louisiana's extensive oil-related support system. As a result of the concentration of OCS-support infrastructure, Louisiana has experienced more employment effects than the other Gulf Coast States. In Louisiana, Lafourche Parish is likely to experience the greatest concentration and is the community where the additional OCS-related activities and employment will be sufficiently concentrated to be significant and to affect and strain its local infrastructure. While the addition of a C-Port in Galveston, Texas, is expected to increase Texas's share of future effects, Louisiana is likely to continue to experience more effects than the other Gulf Coast States.

The concentrated socioeconomic impacts in Lafourche Parish are not expected to have disproportionate effects on minority and low-income populations for several reasons. The parish is not predominately low-income or minority (**Figures 3-15 and 3-18**). The Houma, a Native American tribe recognized by the State of Louisiana, has been identified by MMS as a possible environmental justice concern. Recent MMS research indicates that minority populations throughout Lafourche Parish, Louisiana, could sustain disproportionate effects should a major accident involving onshore activities occur (Hemmerling and Colten, 2003). Five different classes of relevant OCS activities exist in the region, including transportation corridors, oil and natural gas pipelines, petroleum bulk storage facilities, shipyards, and a natural gas processing plant. The majority of OCS-related infrastructure is located in south Lafourche Parish where the Houma Indian population is concentrated. The proposed lease sale would not significantly alter this preexisting situation where onshore cumulative effects already exist. Therefore, since the preexisting situation would not be significantly altered, minority and low-income populations would not sustain disproportionate adverse effects from the proposed action.

While it is expected that hurricane activity can have severe impacts on all coastal communities, impacts on minority and low-income populations may be disproportionate to the remainder of the local population. Since the hurricanes have not forced a major shifting of the onshore infrastructure and the proposed action would predominately use existing infrastructure, no difference from the existing conditions will be evident.

Chapter 4.3.14.2 discusses the potential strains on community infrastructure and services in the following parishes and counties: St. Tammany, St. John the Baptist, St. James, Ascension, St. Charles, East Baton Rouge, and Tangipahoa Parishes, Louisiana; and Stone County, Mississippi. Any concentrations of poor and/or minority communities are expected to incur the same infrastructure and service strains as the overall resident population, therefore not causing disproportionate and negative effects on minority and low-income groups. The distribution of low-income and minority populations also does not parallel the distribution of OCS-related industry activity.

Two local infrastructure issues described in **Chapter 3.3.5.2** could possibly have related environmental justice concerns: traffic on LA Hwy 1 and the expansion of Port Fourchon. The most serious concern raised during scoping for this SEIS is high level of traffic on LA Hwy 1. Increased truck traffic destined for Port Fourchon physically stresses the highway, inconveniences and sometimes disrupts local communities, and may pose health risks in the form of increased accident rates and possible interference to hurricane evacuations (Keithly, 2001; Hughes et al., 2001). As described in **Chapter 3.3.5.2**, the area's "string settlement pattern" means that rich and low-income alike live on a narrow band of high ground along LA Hwy 1 and will be equally affected by any increased traffic.

Port Fourchon is relatively new and mostly surrounded by uninhabited land. Existing residential areas close to the port are new and not low-income. While the minority and low-income populations of Lafourche Parish will share with the rest of the population the negative impacts of the OCS Program, most effects are expected to be economic and positive. While the link between a healthy oil industry and indirect economic benefits to all sectors of society may be weak in some communities, in Lafourche Parish it is strong. The Parish is part of an area of relatively low unemployment due to the concentration of petroleum industry activity (Hughes et al., 2001).

Many studies of social change in the GOM coastal region suggest that the offshore petroleum industry, and even the onshore petroleum industry, has not been a critical factor except in limited small areas for limited periods of time. This was a key conclusion of an MMS-funded study of the historical role of the industry in the Gulf, a study that addressed social issues related to environmental justice (Wallace et al., 2001). The MMS has noted previously (USDOI, MMS, 2007a) that the characterization of the GOM's sociocultural systems suggests that the historical impacts of offshore oil and gas activities on the sociocultural environment have not been sweeping regional effects. Impacts, including how communities respond to fluctuations in industry activity, vary from one coastal community to the next. While regional impacts may be unnoticed or very limited, individual communities may or may not realize adverse sociocultural impacts. 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. Further, non-OCS activities also have the potential for sociocultural impacts. These activities can lead to changes in social organization 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).

Summary and Conclusion

Because of the presence of an extensive and widespread support system for 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 proposed action are expected to be economic and 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 will be hired and where new infrastructure might be located is impossible to predict, although a new C-Port in Galveston is likely to increase Texas's share of effects. Given the existing distribution of the OCS-related industry and the limited concentrations of minority and low-income peoples, the cumulative effect of the proposed action will not have a disproportionate effect on these populations. Lafourche Parish will 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 will not occur in areas of low-income or minority concentration, these groups are not expected to be differentially affected.

The proposed action is not expected to have disproportionate high/adverse environmental or health effects on minority or low-income people. In the GOM coastal area, the contribution of the proposed action 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 will be concentrated in coastal areas, and particularly Louisiana. Most program effects are expected to be in the areas of job creation and the stimulation of the economy and are expected to make a positive contribution to economic justice. No significant effects on environmental justice issues should result over the long term from OCS-related activities in Mississippi, Alabama, or Florida. Any possible environmental justice effects in Louisiana would be marginal or nonexistent.

4.4. 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.

Sensitive Coastal Habitats: If an oil spill were to contact a barrier beach, the removal of beach sand during cleanup activities, if necessary, could result in adverse impacts if the sand is not replaced. If an oil spill contacts coastal wetlands, adverse impacts could be high in localized areas and short term in duration. The severity of the impacts would be dependent upon the amount of spillage, the response time of oil-spill, cleanup activities and the remedial methodology. In some areas, wetland vegetation would experience suppressed productivity for several years. Impacted wetland vegetation would recover over time, but some wetland areas may be converted to open water during the recovery period. Unavoidable impacts resulting from wake erosion, and other secondary impacts related to the utilization of existing unprotected channels by support marine vessels would occur as a result of the proposed action.

Sensitive Offshore Habitats: If an oil spill occurred and contacted sensitive offshore habitats, there could be some adverse impacts on organisms contacted by oil.

Water Quality: Normal offshore operations would have unavoidable effects to varying degrees on the quality of the surrounding water if the proposal is implemented. Drilling, construction, and pipelaying activities would cause an increase in the turbidity of the affected waters for the duration of the activity periods. A turbidity plume would also be created by the discharge of drill cuttings and drilling fluids. This, however, would only affect water quality in the immediate vicinity of the rigs and platforms. The discharge of treated sewage from the rigs and platforms would increase the levels of suspended solids, nutrients, chlorine, and BOD 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.

Unavoidable, although very minor, 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 impacted bodies of water through inputs of chronic 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. Louisiana, Alabama and Florida have programs in place in accordance with Section 319 of the CWA, which required states to develop a Non-Point Source Management Plan to reduce and control nonpoint sources of pollution from the various types of land uses that contribute to water quality problems across the United States.

Endangered and Threatened Species: Unavoidable adverse impacts to endangered and threatened marine mammals, birds, sea turtles, mice, and the Gulf sturgeon due to activities associated with the proposed action (e.g., seismic surveys, water quality and habitat degradation, helicopter and vessel traffic, oil spills and spill response, and discarded trash and debris) would be primarily sublethal. Lethal impacts to endangered species are not expected to occur.

Nonendangered and Nonthreatened Marine Mammals: Unavoidable adverse impacts to nonendangered and nonthreatened marine mammals due to activities associated with the proposed action (e.g., seismic surveys, water quality degradation, helicopter and vessel traffic, oil spills and spill response, and discarded trash and debris) would be primarily sublethal. Lethal impacts to nonendangered and nonthreatened marine mammals are expected to be rare.

Coastal and Marine Birds: Some localized injury or mortality to coastal birds could result from OCS-related oil spills, helicopter and OCS service-vessel traffic, and discarded trash and debris. Marine birds could be affected by noise, disturbances, and trash and debris associated with offshore activities. If an oil spill occurs and contacts marine or coastal bird habitats, some birds could experience sublethal impacts, and birds feeding or resting in the water could be coated with oil and die. Oil spills and oil-spill cleanup activities could also affect local bird prey species.

Fish Resources and Commercial Fisheries: Losses to fishing resources and fishing gear could occur from nearshore oil spills. Localized populations of fish species are expected to experience sublethal effects if a nearshore spill were to occur. This could result in a temporary decrease in a population on a local scale. It is unlikely that fishermen would harvest fish in the area of an oil spill because spilled oil could coat or contaminate commercial fish species rendering them unmarketable. The depth of the proposed operations and the distance from shore make impacts on offshore fisheries unlikely.

Recreational Beaches: Existing regulations prohibit littering of the marine environment with trash. However, offshore oil and gas operations may result in the accidental loss of some floatable debris in the ocean environment. This debris may eventually come ashore on major recreational beaches. Accidental events can lead to oil spills, which are difficult to contain in the ocean; therefore, it may be unavoidable that some recreational beaches become temporarily soiled by weathered crude oil.

Archaeological Resources: As a result of the proposed action, unique or significant archaeological information may be lost. 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. In some cases (e.g., in areas of high sedimentation rates), survey techniques may not be effective at identifying a potential resource.

4.5. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Irreversible or irretrievable commitments of resources refer to impacts or losses to resources that cannot be reversed or recovered. An irreversible loss is when a species becomes extinct. No efforts can reverse this event. Irretrievable commitments are those that are lost for a period of time. For example, fishermen would not be able to trawl in the same space as an offshore platform for as long as the platform is there (maybe 20-30 years). Once the platform is removed and the site cleared of any debris, fishermen could again trawl the location where the platform used to be.

Wetlands: An irretrievable loss of wetlands and associated biological resources could occur if wetlands are lost due to impacts from construction activities or oil spills. Oil spills can damage or destroy wetland vegetation, which can lead to increased erosion and conversion of wetlands to open water. No dredging or construction activities in the coastal regions are anticipated as a result of the proposal. However, the beneficial placement of dredged material at marsh elevation can restore lost wetlands and reduce the degree of conversion to open water. In addition, remediation may also have a mitigation component that replaces wetlands destroyed during cleanup activities.

Sensitive Offshore Resources: 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.

Fish Resources and Commercial Fisheries: Structure removal by explosives causes mortality to fish resources, including commercial and recreational species. Fish kills, including such valuable species as red snapper, are known to occur when explosives are used to remove structures in the GOM. However, in view of the positive impact of offshore platforms serving as artificial reefs to fish resources and commercial fishing, continued structure removal, regardless of the technique used, would reduce the net benefits to commercial fishing due to the presence of these structures. A single platform more than 125 mi (200 km) from shore is projected as a result of the proposal.

Recreational Beaches: Beached litter, debris, oil slicks, and tarballs may result in decreased enjoyment or lost opportunities for enjoyment of coastal recreational resources. However, the very limited nature of the proposal and the distance from shore will result in minimal opportunity for these impacts.

Archaeological Resources: Although the impact to archaeological resources as a result of the proposed action is expected to be low, any interaction between an impact-producing factor (drilling of wells, emplacement of platforms, subsea completions, and pipeline installation) and a significant historic shipwreck or prehistoric site could destroy information contained in the site components and in their spatial distribution. This would be an irreversible commitment of potentially unique archaeological data.

Local Employment, Income, and Population: The proposed action could result in the production of certain OCS-related goods and services. The extent that resources would be drawn away from other uses such as the production of goods and services of other types would be undetermined. Steel products, specialized manpower, and capital constitute required resources that may be scarce. Use of these resources for OCS needs means a potential reduced availability of these resources for other non-OCS-related activities. While these resources may be reclaimed over time, their use as a result of the proposed action would constitute an irretrievable commitment of resources at a given point in time. The extent that unemployed labor resources are used to fill new job opportunities would not constitute a cost to society in the form of foregone labor opportunities.

Oil and Gas Development: Leasing of the proposed blocks and the subsequent development and extraction could represent an irreversible and irretrievable commitment of nonrenewable oil and gas resources. The estimated amount of resources to be recovered as a result of the proposed Eastern Gulf sale is 0.10-0.14 BBO and 0.16-0.34 Tcf.

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 safety and environmental protection. Nonetheless, some loss of human and animal life is inevitable from unpredictable and unexpected acts of man and nature (e.g., unavoidable accidents, human error and noncompliance, and adverse weather conditions).

Some normal and required operations, such as structure removal, can result in the destruction of marine life. Although the possibility exists that individual marine mammals, marine turtles, birds, and fish can be injured or killed, there is no expected lasting effect that would lead to a decrease in baseline populations.

4.6. Relationship between the Short-term Use of Man's Environment and the Maintenance and Enhancement of Long-term Productivity

In this section, the short-term effects and uses of various components of the environment in the vicinity of proposed Lease Sale 224 area are related to long-term effects and the maintenance and enhancement of long-term productivity.

Short-term refers to the total duration of oil and gas exploration and production activities, whereas long-term refers to an indefinite period beyond the termination of oil and gas production. The specific impacts of the proposed action vary in kind, intensity, and duration according to the activities occurring at any given time. 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 (25-35 years), potentially punctuated by more severe impacts as a result of accidental events. Platform removal is also a short-term activity with localized impacts. The impacts of site clearance may, however, be longer lasting. Over the long term of several decades, natural environmental balances are expected to be restored.

Many of the effects discussed in **Chapter 4** are considered to be short term (being greatest during the construction, exploration, and early production phases). In practice, these impacts are further reduced by the mitigative measures discussed in **Chapter 2**.

The principal short-term use of the leased areas in the Gulf under the proposed action would be for the production of up to 0.1-0.14 BBO and 0.16-0.34 Tcf of natural gas. The short-term recovery of hydrocarbons may have long-term impacts on biologically sensitive offshore areas (**Chapter 4.3.4**) or archaeological resources (**Chapter 4.3.13**).

The OCS activities could temporarily interfere with recreation and tourism in the region in the event of an oil spill contacting popular tourist beaches. The proposed leasing is not projected to result in onshore development and population increases that could cause short-term adverse impacts to local community infrastructure (**Chapter 4.3.14.1**).

The marine environment is generally expected to remain at or return to its normal long-term productivity levels after the completion of oil and gas production. To date, there has been no discernible decrease attributed to OCS-related activities in long-term marine productivity in OCS areas where oil and gas have been produced for many years. In other areas that have experienced apparent increases in oil pollution, such as the North Sea, some long-term effects do appear to have taken place. Populations of pelagic birds have decreased markedly in the North Sea in recent years, as compared with the populations prior to the beginning of North Sea oil production.

The OCS development off Louisiana has enhanced recreational and commercial fishing activities, which in turn has stimulated the manufacture and sale of larger private fishing vessels and special fishing and recreational equipment. Commercial enterprises such as charter boats have become heavily dependent on offshore structures for satisfying recreational customers. The proposed sale, due to the distance from shore, would not increase these incidental benefits of offshore development. Offshore fishing and diving has gradually increased in the past three decades and platforms have been 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 maintenance of the long-term productivity of these artificial reefs (active rigs), which are attractive to fishermen and divers, is accomplished through the relocation of some platforms by artificial reef development programs (**Figure 4-17**). The ongoing rigs-to-reefs program has relocated removed rigs to designated artificial reef building sites (**Figure 4-18**). Although the site-specific losses of artificial reef structure will still occur, the development of these reef sites will, Gulfwide, maintain the long-term productivity associated with standing structures.

Short-term environmental and socioeconomic impacts could result from the proposed action, including possible short-term losses in productivity as a result of oil spills. Long-term, adverse environmental impacts would not be expected because archaeological regulations and the proposed biological stipulations could be adopted as part of the proposed action. However, some risk of long-term adverse environmental impacts remains due to the potential for accidents. No long-term productivity or environmental gains are expected as a result of the proposed action; the benefits of the proposed action are expected to be principally those associated with a medium-term increase in supplies of domestic oil and gas. While no reliable data exist to indicate long-term productivity losses as a result of OCS development, such losses may be possible.

Extraction and consumption of offshore oil and natural gas would be a long-term depletion of nonrenewable resources. Economic, political, and social benefits would accrue from the availability of these natural resources. Most benefits would be short term and would delay the increase in the Nation's dependency on oil imports. The production of offshore oil and natural gas from the proposed action would provide short-term energy and perhaps additional time for the development of long-term alternative energy sources or substitutes for these nonrenewable resources.

CHAPTER 5

CONSULTATION AND COORDINATION

5. CONSULTATION AND COORDINATION

5.1. Development of the Proposed Action

This SEIS addresses a single proposed Eastern Gulf of Mexico OCS lease sale. Lease Sale 224 is required by the Gulf of Mexico Energy Security Act of 2006 (**Figure 1-1**) and is tentatively scheduled to be offered in March 2008. On February 14, 2007, MMS announced in the *Federal Register* its intent to prepare an SEIS for Lease Sale 224.

The MMS 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 SEIS. Key agencies and organizations included NOAA, NMFS, FWS, USCG, DOD, USEPA, State Governors' offices, and industry groups.

5.2. Notice of Intent to Prepare an EIS and Call for Information and Nominations

On February 14, 2007, a combined Call for Information and Nominations (Call) and Notice of Intent to Prepare an SEIS for the proposed Eastern GOM lease sale was published in the *Federal Register*. A correction with a map identifying the boundaries of the proposed sale was published February 27, 2007. Additional public notices were distributed via local newspapers, the U.S. Postal Service, and the Internet. A 30-day comment period was provided; it closed on March 16, 2007. Federal, State, and local governments, along with other interested parties, were invited to send written comments to the GOM Region on the scope of the EIS. The MMS received 14 comment letters in response to the Call/NOI. These comments are summarized below in **Chapter 5.3.1**.

5.3. Development of the Draft SEIS

Scoping for the Draft SEIS was conducted in accordance with CEQ regulations implementing NEPA. Scoping provides those with an interest in the OCS Program an opportunity to provide comments on the proposed actions. In addition, scoping provides MMS an opportunity to update the GOM Region's environmental and socioeconomic information base. The scoping process officially commenced on February 14, 2007, with the publication of the NOI in the *Federal Register*. Formal scoping meetings were held in Louisiana and Florida. The dates, times, locations, and public attendance of the scoping meetings for the proposed Eastern Gulf lease sale were as follows:

Thursday, March 1, 2006 3:00 and 7:00 p.m. The New World Landing 600 Palafox St. Pensacola, Florida 35 attendees	Wednesday, March 7, 2007 7:00 p.m. Larose Civic Center Larose Regional Park Larose, Louisiana 32 attendees

5.3.1. Summary of Scoping Comments

Comments (both verbal and written) were received from the NOI and three scoping meetings from Federal, State, and local governmental agencies; interest groups; industry; businesses; and the general public on the scope of the SEIS, significant issues that should be addressed, alternatives that should be considered, and mitigation measures. All scoping comments received, which were appropriate for a lease sale NEPA document, were considered in the preparation of the Draft SEIS.

On March 1 and March 7, 2007, scoping meetings were held in Pensacola, Florida, and Larose, Louisiana, respectively. Written and verbal comments were received from State and local government agencies, interest groups, industry, business, and the general public. In summary, MMS used the scoping meetings as an opportunity to solicit comments on the scope of the SEIS for proposed Lease Sale 224. Verbal comments were made by 8 of the 32 people in attendance at the scoping meeting on March 7, 2007, in Larose, Louisiana. Written comments were also received. Comments were made by business and industry representatives in favor of the proposed lease sale. Speakers from various segments of Lafourche Parish Government expressed support for lease sales and concern for increased expenses, adverse impacts to wetlands, and the parish infrastructure, with an emphasis on the use and deterioration of LA Hwy 1. Spokespersons from a variety of organized community groups were in general support of oil and gas development but expressed frustration of what they referred to as "unmitigated" adverse impacts to wetlands, socioeconomics, and infrastructure. Verbal comments received from one speaker during the March 1, 2007, scoping meeting in Pensacola, Florida, reflected a concern over the use of alternate energies to replace the use of fossil fuels, spill response times in the event of a spill, air emission levels, seafood contamination, the continued use of fossil fuel that will delay the switch over to alternate energies, and the presumed introduction of toxins from oil and gas operations. Supporters of the proposed action referred to it as a good first step to increasing Florida's business employment and pointed out that 81 percent of the Federal OCS is off limits to oil and gas development.

5.3.2. Summary of Comments Received in Response to the Call

Comment letters on the Call were received by MMS from the State of Alabama, Governor's Office; Louisiana Department of Natural Resources (LADNR); and The Center for Regulatory Effectiveness (CRE). Governor Bob Riley referred to the revised information in the corrected notice and stated he forwarded it to the appropriate departments for review. The LADNR requested that MMS reexamine the environmental and socioeconomic baseline in light of impacts from the 2005 tropical storm season; compare previous assumptions, estimates, and projections with actual experience; include information from two specific MMS/CMI (Coastal Marine Institute) studies; describe mitigation for wetland loss due to OCS support activity; address cumulative impacts and infrastructure safety considerations; and stated that the proposal is consistent with the Louisiana Coastal Resources Program. The CRE stated that NTL 2007-G02 is adequate, and no imposition of different requirements is recommended. There were no other comments specifically referencing the Call for Information and Nominations.

5.3.3. Additional Scoping Opportunities

Although the scoping process is formally initiated by the publication of the NOI, scoping efforts and other coordination meetings have proceeded and will continue to proceed throughout this NEPA process. The GOM Region's Information Transfer Meetings provide an opportunity for MMS analysts to attend technical presentations related to OCS Program activities and to meet with representatives from Federal, State, and local agencies; industry; MMS contractors; and academia. Scoping and coordination opportunities are also available during MMS's requests for information, comments, input, and review of other MMS NEPA documents.

Summary of Meeting with the State of Florida

On March 1, 2007, representatives of MMS's GOM Region met with representatives of the Florida Governor's Office to discuss any concerns the State may have regarding the proposed action. The MMS presented an overview of the purpose of the meeting, scoping for the Draft Proposed SEIS, and its related processes. Specifically, MMS staff presented a plan of action for this EIS (**Chapter 2.1**, NEPA Analysis), as well as facts on the proposed lease sale areas (**Chapter 1.1**, Description of the Proposed Actions). The State mentioned concerns regarding the change to offshore administrative lines.

5.3.4. Cooperating Agency

According to Part 516 of the DOI Departmental Manual, MMS must invite eligible governmental entities to participate as cooperating agencies when developing an EIS in accordance with the requirements of NEPA and CEQ regulations. The MMS must also consider any requests by eligible governmental entities to participate as a cooperating agency with respect to a particular EIS, and then to either accept or deny such requests.

The NOI, published on February 14, 2007, included an invitation to other Federal agencies and State, tribal, and local governments to consider becoming cooperating agencies in the preparation of this SEIS. No request has been received from any entity to establish themselves as a cooperating agency.

5.4. DISTRIBUTION OF THE DRAFT SEIS FOR REVIEW AND COMMENT

The MMS sent copies of the Draft SEIS to the following public and private agencies and groups. Local libraries along the Gulf Coast were also provided copies of this document. The list of libraries and their locations is available on the MMS Internet website at http://www.gomr.mms.gov. To initiate the public review and comment period on the Draft SEIS, MMS published the NOI in the *Federal Register* on February 14, 2007. Additionally, public notices were mailed and placed on the MMS Internet website. All comments received on the Draft SEIS were considered in the preparation of this Final SEIS.

Federal Agencies

Congress
- Congressional Budget Office
- House Resources Subcommittee on Energy and Mineral Resources
- Senate Committee on Energy and Natural Resources

Department of Commerce
- National Marine Fisheries Service
- National Oceanic and Atmospheric Administration

Department of Defense
- Department of the Air Force
- Department of the Army
  - Corps of Engineers
- Department of the Navy

Department of Energy
- Strategic Petroleum Reserve PMD

Department of the Interior
- Fish and Wildlife Service
- Geological Survey
- Minerals Management Service
- National Park Service
- Office of Environmental Policy and Compliance
- Office of the Solicitor

Department of State
- Office of Environmental Protection

Department of Transportation
- Coast Guard
  - Office of Pipeline Safety

Environmental Protection Agency
- Region 4
- Region 6

Marine Mammal Commission

State and Local Agencies

Alabama
- Governor's Office
- Alabama Highway Department
- Alabama Historical Commission and State Historic Preservation Officer
- Alabama Public Service Commission
- Department of Environmental Management
- Department of Conservation and Natural Resources
- South Alabama Regional Planning Commission
- State Docks Department
- State Legislature Natural Resources Committee
- State Legislature Oil and Gas Committee

Florida
- Governor's Office
- Bureau of Archaeological Research
- Department of Community Affairs
- Department of Environmental Protection
- Department of State Archives, History and Records Management
- Escambia County
- Florida Coastal Zone Management Office
- State Legislature Natural Resources and Conservation Committee
- State Legislature Natural Resources Committee
- West Florida Regional Planning Council

Louisiana
- Governor's Office
- Calcasieu Regulatory Planning Commission
- Department of Culture, Recreation, and Tourism
- Department of Environmental Quality
- Department of Natural Resources
- Department of Transportation and Development

- Department of Wildlife and Fisheries
- Louisiana Geological Survey
- State Legislature Natural Resources Committee
- State House of Representatives Natural Resources Committee

Mississippi

- Governor's Office
- Department of Archives and History
- Department of Natural Resources
- Department of Wildlife Conservation
- State Legislature Oil, Gas, and Other Minerals Committee

Texas

- Governor's Office
- Attorney General of Texas
- General Land Office
- Southeast Texas Regional Planning Commission
- State Legislature Natural Resources Committee
- State Senate Natural Resources Committee
- Texas Historical Commission
- Texas Legislation Council
- Texas Parks and Wildlife Department
- Texas Water Development Board

Libraries

Alabama

- Auburn University Library, Montgomery
- Dauphin Island Sea Lab, Marine Environmental Science Consortium Library, Dauphin Island
- Gulf Shores Public Library, Gulf Shores
- Mobile Public Library, Mobile
- Montgomery Public Library, Montgomery
- University of South Alabama, Mobile

Colorado

- Colorado State Library, Fort Collins

Florida

- Collier County Public Library, Naples
- Florida A&M, Coleman Memorial Library, Tallahassee
- Florida State University, Strozier Library, Tallahassee
- Fort Walton Beach Public Library, Fort Walton Beach
- Leon County Public Library, Tallahassee
- Marathon Public Library, Marathon
- Monroe County Public Library, Key West
- Northwest Regional Library System, Panama City
- Selby Public Library, Sarasota
- St. Petersburg Public Library, St. Petersburg
- Tampa-Hillsborough Public Library, Tampa
- University of Florida, Holland Law Library, Gainesville
- University of Miami Library, Miami
- University of West Florida, Pensacola

Louisiana

- Calcasieu Parish Library, Lake Charles
- Cameron Parish Library, Cameron
- Grand Isle Branch Library, Grand Isle
- Iberville Parish Library, Plaquemines
- Jefferson Parish Regional Branch Library, Metairie
- Jefferson Parish West Bank Outreach Branch Library, Harvey
- Lafitte Branch Library, Lafitte
- Lafourche Parish Library, Thibodaux
- Louisiana State University Library, Baton Rouge
- Louisiana Tech University Library, Ruston
- Loyola University, Government Documents Library, New Orleans
- LUMCON Library, Chauvin
- McNeese State University, Luther E. Frazar Memorial Library, Lake Charles
- New Orleans Public Library, New Orleans
- Nicholls State University, Nicholls State Library, Thibodaux
- Plaquemines Parish Library, Buras
- St. Bernard Parish Library, Chalmette
- St. Charles Parish Regional Library, Luling
- St. John the Baptist Parish Library, LaPlace
- St. Mary Parish Library, Franklin
- St. Tammany Parish Library, Covington
- St. Tammany Parish Library, Slidell
- Terrebonne Parish Library, Houma
- Tulane University, Howard Tilton Memorial Library, New Orleans
- University of New Orleans Library, New Orleans
- University of Southwestern Louisiana, Dupre Library, Lafayette
- Vermilion Parish Library, Abbeville

Mississippi

- Gulf Coast Research Laboratory, Gunter Library, Ocean Springs
- Hancock County Library System, Bay St. Louis
- Harrison County Library, Gulfport

Jackson State University, Eudora Welty Library, Jackson

Oklahoma

University of Tulsa, McFarlin Library, Tulsa

Texas

Abilene Christian University, Abilene
Alma M. Carpenter Public Library, Sourlake
Aransas Pass Public Library, Aransas Pass
Bay City Public Library, Bay City
Brazoria County Library, Freeport
Calhoun County Library, Port Lavaca
Chambers County Library System, Anahuac
Corpus Christi Central Library, Corpus Christi
Dallas Public Library, Dallas
East Texas State University Library, Commerce
Houston Public Library, Houston
Jackson County Library, Edna
Liberty Municipal Library, Liberty
Orange Public Library, Orange
Port Arthur Public Library, Port Arthur
Port Isabel Public Library, Port Isabel
R. J. Kleberg Public Library, Kingsville
Reber Memorial Library, Raymondville
Refugio County Public Library, Refugio
Rice University, Fondren Library, Houston
Rockwall County Library, Rockwall
Rosenberg Library, Galveston
Sam Houston Regional Library & Research Center, Liberty
Stephen F. Austin State University, Steen Library, Nacogdoches
Texas A&M University Library, Corpus Christi
Texas A&M University, Evans Library, College Station
Texas Southmost College Library, Brownsville
Texas State Library, Austin
Texas Tech University Library, Lubbock
University of Houston Library, Houston
University of Texas Library, Arlington
University of Texas Library, Austin
University of Texas Library, Brownsville
University of Texas Library, El Paso
University of Texas Library, San Antonio
University of Texas at Dallas, McDermott Library, Richardson
University of Texas, LBJ School of Public Affairs Library, Austin
University of Texas, Tarlton Law Library, Austin
Victoria Public Library, Victoria

Industry

American Petroleum Institute
Alabama Petroleum Council
Amerada Hess Corporation
Area Energy LLC
Baker Atlas
Bellwether Group
B-J Services Co
BP Amoco
C.H. Fenstermaker & Associates
Chevron U.S.A. Inc.
Clayton Williams Energy, Inc
Coastal Conservation Association
Coastal Environments, Inc.
Continental Shelf Associates, Inc.
Coscol Marine Corporation
Devon Energy Corp.
Dominion Exploration & Production, Inc.
Ecological Associates, Inc.
Ecology and Environment
Energy Partners, Ltd.
EOG Resources, Inc.
Escambia County Marine Resources
Exxon Mobil Production Company
Florida Petroleum Council
FNGA, FPGA and AGDF
Forest Oil Corporation
Freeport-McMoRan, Inc.
Fugro Geo Services, Inc.
General DynamicsAIS
Geo Marine Inc.
Global Industries, Ltd.
Gulf Environmental Associates
Gulf of Mexico Newsletter
Halliburton
Horizon Marine, Inc.
Industrial Vehicles International, Inc.
International Association of Geophysical Contractors
International Paper Company
J. Connor Consultants
JK Enterprises
John Chance Land Surveys, Inc.
Kelly Energy Consultants
Kerr-McGee Corporation
Midstream Fuel Service
Mote Marine Laboratory
Newfield Exploration Company
NWF Daily News
Offshore Energy Center
Offshore Operators Committee
Petrobras America, Inc.

PPG Industries, Inc.
Propane Market Strategy Newsletter
Roffers Ocean Fishing Forecast Service
Science Applications International Corporation
Seneca Resources Corporation
Shell Exploration & Production Company
Stone Energy Corporation
Strategic Management Services-USA
T. Baker Smith, Inc.
Texas Geophysical Company, Inc.
The Houston Exploration Company
Triton Engineering Services Co.
W & T Offshore, Inc.
Walker Landscaping
Washington Post
WEAR-TV

Special Interest Groups

1000 Friends of Florida
American Cetacean Society
American Littoral Society
Apalachicola Riverkeeper
Audubon Louisiana Nature Center
Audubon of Florida
Audubon Society
Bay County Audubon Society
Citizens Assoc. of Bonita Beach
Clean Gulf Associates
Coalition to Restore Coastal Louisiana
Coastal Conservation Association
Conservancy of SW Florida
Defenders of Wildlife
Earthjustice
Florida Public Interest Research Group
Florida Sea Grant College
Gulf Coast Environmental Defense
Gulf Restoration Network
Hubbs-Sea World Research Institute
Izaak Walton League of America, Inc
Louisiana State University
Mobile Bay National Estuary Program
Natural Resources Defense Council
Nature Conservancy
Pacific Marine Technology
Perdido Key Association
Population Connection
Sierra Club
South Mobile Communities Association
Southeastern Fisheries Association
The Conservancy
The Conservation Fund
The Nature Conservancy
Walton County Growth Management

Ports/Docks

Alabama

Alabama State Port Authority
Port of Mobile

Florida

Port Manatee
Panama City Port Authority
Port of Pensacola
Tampa Port Authority

Louisiana

Greater Baton Rouge Port Commission
Greater Lafourche Port Commission
Lake Charles Harbor and Terminal District
Louisiana Offshore Oil Port, LLC
Plaquemines Port, Harbor and Terminal District
Port of Iberia District
Port of New Orleans
Port of Baton Rouge
Port of Krotz Springs
Port of Shreveport-Bossier
Port of South Louisiana
St. Bernard Port, Harbor and Terminal District

Mississippi

Port Bienville
Port of Biloxi
Port of Gulfport
Port of Natchez
Port of Pascagoula
Port of Vicksburg

Texas

Brownsville Navigation District—Port of Brownsville
Port Freeport—Brazos River Harbor Navigation District
Port Aransas
Port Arthur Navigation District
Port Lavaca/Point Comfort
Port Mansfield/Willacy County Navigation District
Port of Beaumont
Port of Corpus Christi Authority
Port of Galveston
Port of Houston Authority
Port of Isabel—San Benito Navigation District
Port of Orange
Port of Sabine Pass
Port of Texas City

5.5. PUBLIC HEARINGS

In accordance with 30 CFR 256.26, MMS held public hearings to solicit comments on the Draft SEIS for proposed Eastern GOM Lease Sale 224. The hearings also provide the Secretary of the Interior with information from interested parties to help in the evaluation of potential effects of the proposed lease sales. Announcement of the dates, times, and locations of the public hearings were included in the NOA for the Draft EIS. Notices of the public hearings were also included with copies of the Draft EIS mailed to the parties indicated above, posted on the MMS Internet website (http://www.gomr.mms.gov), and published in local newspapers (i.e., *The News Herald: Panama City*, *The Pensacola News Journal, The Tallahassee Democrat*, *The Mobile Press Register*, *The Houma Courier, The Times Picayune*, and *The Sun Herald*). The hearings were held on the following dates and at the times and locations indicated below:

Tuesday, July 24, 2007
7:00 p.m.
Larose Civic Center
307 East 5th Street
Larose Regional Park
Larose, Louisiana
46 registered attendees
25 speakers

Thursday, July 26, 2007
3:00 p.m. and 7:00 p.m.
New World Landing
600 South Palafox Street
Pensacola, Florida
6 registered attendees
5 speakers

Attendees at the hearings included representatives from State and local governments, interest groups, industry, businesses, and the general public. All hearing comments received on the Draft EIS were considered in the preparation of this Final EIS. The comments presented at each of the public hearings are summarized below.

Larose, Louisiana, July 24, 2007, 7:00 p.m.

Twenty-five speakers, including local government, organizations, industry, private citizens, and representatives of U.S. Senators and State Representatives provided testimony at the public hearing held in Larose, Louisiana, on July 24, 2007. Several speakers provided testimony for another organization, in addition to their own testimony.

Government representatives included:

- Wes Kungel representing U.S. Senator Mary Landrieu
- Rachel Perez representing U.S. Senator David Vitter
- Barney Arceneaux representing U.S. Representative Charlie Melancon
- Jane Arnette representing Louisiana State Senator Reggie Dupre
- Simon Maloz representing Louisiana State Representative Loulan Pitre
- Chett Chiasson, Economic Development and Grants Administrator, Greater Lafourche Port Commission
- Larry Weidel, Public Informations Officer for the Lafourche Parish Sheriff's Office
- Windell Curole, General Manager of the South Lafourche Levee District
- Dick Barrios, General Manager of the Lafourche Parish Water District
- Henri Boulet, representing Charlotte Randolph, Lafourche Parish President

Representatives of organizations included:

- Henri Boulet, Director of the Louisiana Highway 1 Coalition
- Jennifer Armand, Executive Director of the Bayou Industrial Group
- Simone Maloz, Executive Directory of Restore or Retreat

- James Hines, Harvey Canal Industrial Association
- Deanna McKneely, Executive Director of Les Reflections du Bayou
- Jane Arnette, Executive Director, South Central Industrial Association

Representatives of local business and industry included:

- James Calahan, Vision Communications
- Fred Palmer, U.S. Communications manager for Shell Exploration and Production Corporation
- Lin Kiger, President of the Chamber of Commerce of Lafourche Parish

Private citizens that provided testimony included Dianne Badeaux, Susan Terrebonne, Harold Chiasson, Chad Bourgeois, Dwayne Jennings, Melanie Boulet, Gunter Bischof, and Sherry Robichaux. All speakers described the impact OCS activity has had on their community. The majority of the speakers asked for mitigation measures to address impacts to coastal infrastructure, namely Louisiana Highway 1, and coastal restoration. The majority of those speakers asked specifically for additional funding as a mitigation measure to address the OCS-related impacts on Louisiana Highway 1 and to specifically include the impacts of OCS-related activities on Louisiana Highway 1 in the SEIS. Other impacts discussed included the burden of providing schools, police protection, and interpretive services resulting from an increase in population, including immigrants, caused by OCS activity; and the importance of the hurricane protection system. Responses to these hearing comments have been incorporated into the responses to the letters of comment in **Chapter 5.7**.

Pensacola, Florida, July 26, 2007, 3:00 p.m. and 7:00 p.m.

Two attendees spoke at the 3:00 p.m. hearing and three attendees spoke at the 7:00 p.m. hearing. The speakers included organizations, industry and private citizens.

Representatives of organizations and industry included

- Dr. Enid Sisskin, Gulf Coast Environmental Defense
- Mary Gutierrez, West Florida Regional Planning Council and Bay Area Resource Council
- Kent Satterlee, Senior Regional Policy Advisor, Shell Exploration and Production Corporation

Speakers also included Dan Ferguson and Ann Bennett. Concerns raised by the speakers included revenue sharing, global warming, trash and debris, and avoidance of impacts. Responses to these hearing comments have been incorporated into the responses to the letters of comment in **Chapter 5.7**.

5.6. MAJOR DIFFERENCES BETWEEN THE DRAFT AND FINAL EIS'S

Comments on the proposed Eastern GOM Lease Sale 224 and the Draft SEIS were received during the public hearings and were received via written and electronic correspondence. As a result of these comments, changes have been made between the Draft and Final EIS's. The text has been revised or expanded to provide clarification on specific issues. The text revisions were related to Development and Production Plans, amount of Coastal Impact Assistance Program funds used for construction of Louisiana Highway 1, updated Notices to Lessees, scenario projections, toxicity tests involving Synthetic Based Fluids (SBF), air quality standards, and updated citations.

5.7. Letters of Comment on the Draft EIS and MMS's Responses

The NOA and announcement of public hearings were published in the *Federal Register* on June 29, 2007, posted on the MMS Internet website, and mailed to interested parties. Distribution of the Draft EIS began on June 29, 2007. The comment period ended on August 13, 2007. Fifteen comment letters were received from the following:

Federal Agencies

U.S. Environmental Protection Agency

State Agencies and Representatives

State of Louisiana, Office of the Governor
State of Alabama, Office of the Governor
The Honorable Mary Landrieu, U.S. Senate
The Honorable Michael S. Bennett, Florida State Senate
Alabama Historical Commission
Greater Lafourche Port Commission

Organizations and Associations

Florida Minerals and Chemistry Council
ManaSota-88
Populus-Leflore Preservation Park

General Public

Dianne Badeaux
Jessie Guidry
Dwayne Jennings
Deanna McKneely
B. Sachau

Copies of these letters are presented on the subsequent pages. Each letter's comments have been marked for identification purposes. The MMS's responses immediately follow each relevant letter.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

August 20, 2007

Mr. Joseph Christopher
Regional Supervisor, Leasing and Environment (MMS 5410)
Minerals Management Service, Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Subject: Gulf of Mexico Oil and Gas Lease Sale 224, Eastern planning Area
Draft Supplemental Environmental Impact Statement. CEQ: 20070273;
ERP: MMS-E02011-00

Dear Mr. Christopher:

Pursuant to Section 309 of the Clean Air Act (CAA) and Section 102(2)(C) of the National Environmental Policy Act (NEPA), the U.S. Environmental Protection Agency (EPA) Region 4 has reviewed the Minerals Management Service's (MMS) Draft Supplemental Environmental Impact Statement (SEIS) for the proposed Lease Sale 224 in the Eastern Planning Area of the Gulf of Mexico. Under Section 309 of the CAA, EPA is responsible for reviewing and commenting on major federal actions significantly affecting the quality of the human environment.

MMS proposes to offer for lease about 134 unleased blocks covering approximately 584,000 acres located 125 miles at its closest point seaward off the coast of Alabama and Florida. Water depths in the lease sale area are greater than 2,600 feet deep. The MMS estimates from 0.1-0.14 billion barrels of oil and 0.16-0.34 trillion cubic feet of gas could be produced from this sale. One other alternative identified in the SEIS is "No Action" whereby MMS would not undertake this lease sale at this time.

The currently proposed sale is within the area addressed by the EIS for Lease Sale 181 EIS completed in 2001. Two reasons are given by MMS for supplementing the earlier EIS. The Gulf of Mexico Energy Security Act of 2006 made additional area available for leasing, and new scientific information relevant to the proposed action is under consideration. MMS reports on damage to oil and gas infrastructure caused by recent hurricanes, and on environmental studies including surveyed deep Gulf biological communities and evaluations of the degradation of drilling fluids following discharge of drill cuttings.

EPA has concern with potential impacts of oil and gas spills including those from pipelines, which have experienced damage from anchor contacts and from storms. Our concern is amplified by the travel distances and potentially long response times to spills that could occur in the lease area. Additionally, EPA is requesting further study of the potential impacts of drilling discharges. We also did not find discussion about the management of greenhouse gas emissions associated with the proposed oil and gas extraction activities. EPA has rated this document EC-2 (Environmental Concerns-Insufficient Information), meaning that additional mitigation for identified adverse impacts may be appropriate, and additional information should be provided to clarify the proposed action and its environmental affects. EPA's technical comments are further discussed in the enclosure.

Thank you for the opportunity to review and comment on this draft SEIS. We would be pleased to discuss the comments at your convenience by either contacting me at 404/562-9611 (mueller.heinz@epa.gov) or Ted Bisterfeld who is the primary reviewer on my staff at 404/562-9621 (bisterfeld.ted@epa.gov).

Sincerely,

Heinz J. Mueller
Chief, NEPA Program Office

Enclosure

cc: National Marine Fisheries Service, St. Petersburg

ENCLOSURE

Technical Comments on the Gulf of Mexico Lease Sale 224 Draft SEIS

Air Quality

USEPA-1

Page 3-3, Section 3.1.1. Discussion of air quality should include the small particulate matter $PM_{2.5}$ National Ambient Air Quality Standard in addition to the listed PM_{10} standard. Further, the $PM_{2.5}$ 24-hour standard was made more stringent and is 35μgm/m3, effective December 18, 2006. Table 3-1 should also indicate the new 24 hour particulate standard.

USEPA - 2

Page 4-89. A cumulative impacts analysis for air quality impacts to the (Chandeleur Islands) Cape Breton National Wildlife Refuge, a PSD Class I area, is being conducted by MMS. This is a modeling study that is assessing the potential impacts of increased emissions of criteria pollutants along with defining baseline concentrations at Cape Breton and emissions sources and inventories of these pollutants within the OCS leasing region. The MMS has stated previously that this study was due for completion in 2006. The "initial results" are mentioned but EPA Region 4 wishes to be provided the final report when it is available.

Water Quality

USEPA - 3

Page 4-94 Section 3.2.2.2. Newly published study results of the impact of synthetic-based fluids (SBF) adhered to drill cutting are referenced. While the sediment concentrations of barium and other metals increased from pre-drilling background, sampling did not occur until 5 months to 2 years after drilling ceased. The results do not indicate what concentrations occurred initially and whether there was recovery of sediment quality during this period. Also, there is no mention of whether there will be re-sampling to document pollutant biodegradation and redistribution over time. It is also important to relate the concentrations of SBF constituents to data being analyzed in other MMS studies on their toxicity to the marine organisms living within indigenous sediments.

Spills

USEPA -4

Page 4-100, Section 4.3.3.1, Coastal Barrier Beaches. The proposed lease sale is not envisioned to require additional landfalls for pipelines. Recent storms, however, caused massive shoreline erosion along the Gulf Coast. While there may not have been ruptures, pipelines could be left with insufficient cover for protection from additional storms or accidental strikes. MMS or other responsible agencies should evaluate the present guidelines for placement of pipelines, burial depth requirements, and consider appropriate mitigation. Future coastal erosion is certain due to storm activity.

USEPA-5

Table 4-12, Offshore Spills from Accidents Associated with Oil Pipeline. Data in this table show most previous accidental spills (greater than 1000 barrels) of oil associated with offshore pipelines were caused by some type of anchor contact with pipelines. MMS should assess the adequacy of the policies and specifications for sub-sea pipelines and consider ways to minimize this source of spills. Pipelines would be in use for 40 years, according to the MMS development scenario. If pipelines are installed with inadequate protection from physical damage, corrective actions after installation would be difficult at best. This tally of pipeline accidents and spill estimates in Table 4-13 do not indicate inclusion of pipelines carrying produced natural gas, and no data for natural gas pipeline could be found. Therefore, it is probable that more anchor contact has occurred than tabulated in these tables. A sub-sea release of gas also has an adverse impact on water quality and marine biota, and therefore damage to gas pipelines should be addressed in the final SEIS.

USEPA-6

Despite the long distance to shore, we note MMS has projected 100% of the production from this lease sale to be piped to shore. With an estimated range of 118-273 additional miles of pipeline to be installed as a result of this lease sale, there is greater likelihood of accidental spills. Proposed safeguards for pipelines should be identified and considered in detail in the final SEIS.

Greenhouse Gas Emissions

USEPA-7

Methane is a greenhouse gas that remains in the atmosphere for approximately 9-15 years, and is over 20 times more effective in trapping heat in the atmosphere than carbon dioxide (CO_2) over a 100 year period. Flaring of gases is addressed in the document and EPA understands the need to flare methane and other gases from OCS facilities due to safety concerns, etc. There should be some evaluation of the capabilities and feasibility of capturing methane on the oil and gas extraction facilities, rather than continued periodic releases into the atmosphere. Also, ways should be explored for capturing and sequestering CO_2, the bi-product of combustion emissions, on the facilities. From a cumulative perspective, the OCS activities result in large quantities of greenhouse gas released to the atmosphere.

These comments are in accordance with our NEPA review responsibilities. EPA has not yet determined future actions with respect to addressing emissions of greenhouse gases under the relevant regulatory portions of the Clean Air Act. Therefore, these comments on emissions do not reflect, and should not be construed as suggesting future actions in accordance with regulatory provisions of the Clean Air Act.

USEPA-1 Emission figures for $PM_{2.5}$ were not included in the analysis because they were not available for all of the source categories. Impacts from $PM_{2.5}$ would be the same or slightly lower than the ones for PM_{10} since most of the particulate matter emitted is less than 2.5 microns in diameter. **Table 3-1** has been modified to incorporate the revised 24-hour particulate standard.

USEPA-2 The final report for the air quality modeling analysis for the Breton National Wilderness Area was undergoing final editing as of September 2007 (USDOI, MMS, in preparation (b)). The MMS will provide USEPA Region 4 with a copy of the report once it is released.

USEPA-3 Due to ship scheduling and timing of rig departure, no samples were able to be collected immediately following cessation of discharges, as part of the referenced study. Therefore, no data were collected to determine initial concentrations of barium and other metals. This information has been added to **Chapter 4.3.2.2.** It has also been noted in that chapter that there are currently no plans to collect more samples from the CSA 2006 study locations to document pollutant biodegradation and redistribution over time. Information on the potential toxic effects of synthetic-based fluids (SBF) constituents and cuttings on various benthic organisms is limited and essentially nonexistent for deepwater taxa. However, CSA (2004) conducted sediment toxicity tests with sediments collected near discharge points. Most of the sediment samples within 250 m (820 ft) of the discharge locations had amphipod survival exceeding 75 percent and were considered nontoxic. At sites where multiple samples had amphipod survival rates less than 50 percent, sediment toxicity and SBF concentrations were correlated. Although the full areal extent and depth of these sediments are not known, the potential impacts are expected to be localized and short term. Since these areas would occupy a minuscule portion of the available seafloor in the deepwater Gulf of Mexico, these impacts are not considered significant provided that sensitive communities (e.g., chemosynthetic communities) are avoided. This additional information has been added to **Chapter 4.3.2.2**.

USEPA-4 In the GOM, all pipelines installed in OCS waters at depths <60 m (196 ft) must be buried to 0.9 m (3 ft) below the mudline. For lines 8⁵/₈ 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 will allow the weight of the pipeline to cause it to sink into the sediments (self-burial). For water depths ≤60 m (196 ft), any length of pipeline that crosses a fairway or anchorage in Federal waters must be buried to a minimum depth of 3.0 m (10 ft) below mudline across a fairway and a minimum depth of 4.9 m (16 ft) below the mudline across anchorage areas, or a depth specified by the Corps of Engineers (COE), the agency that issues specific permits for pipelines crossing these areas. Some operators voluntarily bury these pipelines deeper than the minimum. During the past few years, the Gulf Coast States and GOM oil and gas activities have been impacted by several major hurricanes. These storms have caused significant erosion in some areas. These eroded areas are primarily within State waters over which MMS has no jurisdiction regarding pipeline burial or protection of pipelines. The U.S. Department of Transportation (DOT) has jurisdiction over some pipelines in inshore areas, with the rest being under State jurisdiction. The DOT has a regulation in the GOM and its inlets that requires pipeline owners to inspect the pipelines under DOT jurisdiction to ensure the pipelines are not a hazard (exposed). This applies to pipelines in water depths of ≤4.6 m (15 ft).

USEPA-5 Most of the previous accidental spills ≥1,000 bbl resulting from pipeline accidents were caused by mudslides, anchor or mooring drags, or damages from dislodged jack-up rigs. Reviews of these incidents have resulted in changes in construction or installation requirements. Pipelines in depths <60 m (200 ft) are required to be buried (see the response to Comment USEPA-4 above) and may also be routed around areas that are likely to have underwater mudslides. In an effort to reduce accident risks during hurricanes, MMS set forth guidance (NTL's) to improve performance in the area of jack-up and moored rig station-keeping during the environmental loading that may be experienced during hurricanes. The guidance is described in **Chapter 3.3.5.7.3**. During MMS's review of pipeline applications, protective safety devices are thoroughly evaluated, as well as plans for installation, maintenance, and inspections of the pipelines.

The data contained in **Table 4-12** provides information on OCS oil and chemical spills ≥1,000 bbl that have occurred offshore in the GOM for the entire period that records have been kept (1964-present). This data on past spills is used with production data, along with estimates of future production, to evaluate the risk and potential impacts of future oil spills. Although breaks of gas pipelines would certainly cause impacts, these impacts would be primarily to air quality and safety in the location of the gas plume at the surface. Negative impacts to marine biological communities of any kind would be very minor, especially benthic communities. First, any escaping gas from a pipeline break or failure would immediately rise. Since pipelines are either buried or lay on the surface of soft sediments, the impacts to soft-bottom benthic communities would be limited to a very short distance related to the turbulence and energetic water movements near the escaping gas. It could be expected that some hydrocarbon gas (primarily methane) would dissolve into the water column and would be detectable at the nanomolar levels at some distance. Hydrothermal venting in some areas is studied using the detection of increased dissolved methane (HuaiYang et al., 2007). Very small increases in dissolved methane in the 10 to 100 nanomolar range (the maximum seen in this study) would not cause negative biological impacts. In general, impacts resulting from damage to gas pipelines are not significant. Therefore, impacts to the environment due to damaged gas lines were not thoroughly discussed in the document.

USEPA-6 The pipeline spill rate is correlated to the amount of production rather than the length of pipeline. These projected pipelines would be located in very deep water, while virtually all large oil spills have taken place in shallower water. **Chapter 4.1.1.8.1** provides information regarding pipeline maintenance, inspection, and safety devices. During MMS's review of pipeline applications, protective safety devices are thoroughly evaluated, as well as plans for installation, maintenance, and inspections of the pipelines.

USEPA-7 Current Federal regulations (30 CFR 250.1105) specify the conditions under which OCS operators may release natural gas into the atmosphere. These regulations are designed to minimize the flaring and venting of natural gas and promote the conservation of resources. Operators in the U.S. Federal OCS flare or vent <0.5 percent of all natural gas that is produced. This efficiency is one of the best in the world. In order to maintain this leadership, MMS continues to improve our regulatory oversight. For example, completely revised flaring and venting regulations were proposed in the *Federal Register* on March 6, 2007.

Flaring (igniting) the natural gas as it is released yields primarily carbon dioxide into the atmosphere, whereas venting (releasing unburned) the natural gas yields primarily methane. As the commenter noted, methane is significantly more effective in trapping atmospheric heat than carbon dioxide. At this time, there is no regulatory requirement to flare gas as opposed to venting it, when such emissions are allowable. However, as indicated in the *Federal Register* notice on March 6, 2007, MMS intends to conduct a workshop on this issue. This workshop is tentatively scheduled to occur in 2008 and would be followed by rulemaking if determined appropriate.

There are currently no Federal regulations requiring the capture or sequestration of carbon dioxide released from OCS facilities. The MMS is not aware of any U.S. law upon which such a requirement would be based, and such a mandate could pose a significant burden on the oil and gas industry. Carbon monoxide emissions, however, are monitored to ensure proper air quality standards and compliance with existing laws. The MMS and DOI are currently involved in a number of efforts to understand the effects of climate change and to determine appropriate future actions to address causes and effects.

KATHLEEN BABINEAUX BLANCO
GOVERNOR

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August 13, 2007

Joseph A. Christopher
Regional Supervisor
Leasing and the Environment
Minerals Management Service
Gulf of Mexico OCS Region (MS 5410
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

RE: Comments on the draft Supplemental Environmental Impact Statement (SEIS) for Outer Continental Shelf (OCS) Lease Sale 224, **Eastern Gulf of Mexico Planning Area, scheduled for March 2008**

Mr. Christopher:

On June 25, 2007, we received your letter notifying us of Public Hearings on the draft SEIS on Lease Sale 224, an enclosed copy of the draft SEIS, and a request for comments on the document. Your letter provides until August 13, 2007 for interested parties to submit comments on the draft SEIS. Following are the State of Louisiana's comments on the draft SEIS.

Size of Lease Sale 224

LA-1

While we recognize that Lease Sale 224 encompasses a relatively small area compared to regular annual lease sales in the Western and Central Gulf of Mexico Planning Areas, many of the impacts to Louisiana coastal communities and coastal wetlands and resources are generic and will be incrementally affected as a result of the Lease Sale. Further, we cannot allow this draft SEIS to pass without comment, MMS's discounting of numerous environmental effects of significance to this State. Though these effects may be insignificant in the context of this particular Lease Sale, they still must be fully treated by MMS in the final SEIS document as discussed more fully below.

Issues Considered by MMS but Not Analyzed

On page 2-6 of the draft SEIS, MMS states that increased revenue sharing would act as mitigation of OCS-related impacts to coastal communities including impacts to Louisiana Highway 1 and Lafourche Parish from OCS-related activity at Port Fourchon. As you are well aware, in the context of the National Environmental Policy Act (NEPA), mitigation requires the avoidance, reduction, minimization and compensation for impacts resulting from the activity. As MMS has repeatedly stated to Louisiana, revenue sharing is a function of Congress rather than the MMS, and has no direct bearing on the NEPA obligations for mitigation.

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LA-2

Accordingly, we do not feel that MMS has adequately addressed the NEPA requirements for avoidance, reduction, minimization, and compensation and we would like to see serious considerations of actual projects to accomplish these NEPA requirements in the final SEIS.

LA-3

Global warming is another issue that MMS has not analyzed with respect to this Lease Sale that we believe should be addressed in the final SEIS. Many in the scientific community think the potential adverse impacts of global warming are becoming more and more obvious as additional data is obtained. Thus, we cannot wait until the next 5-year Program (not expected until after 2012) to assess the impacts on areas that are especially vulnerable, such as coastal Louisiana. New leasing is likely to result in increased carbon dioxide releases which are known to force global warming, with a consequent sea level rise, ocean warming, and a possible increase in the frequency and severity of hurricanes, to which all of low-lying coastal Louisiana is especially vulnerable.

Updating the EIS and the Environmental Baseline Since Hurricanes Katrina and Rita

LA-4

Hurricanes Katrina and Rita resulted in the recognition of significant new and changing issues that must be thoroughly considered by the MMS in the final SEIS for Lease Sale 224. MMS must ensure that it thoroughly examines the environmental impacts of the proposed sale in light of the current environmental and socioeconomic baseline. This is particularly important when, as here, there have been extenuating intervening circumstances bearing on the earlier environmental review.

LA-5

Indeed, the current environmental and socioeconomic baseline materially differs from the baseline that existed before the 2005 hurricanes. For instance, new predictions with respect to the frequency and intensity of catastrophic hurricane events, and new models of hurricane impacts, affect the risk of oil spills, the potential for damage to OCS infrastructure, and the potential for coastal wetlands and other land loss exacerbated by onshore support infrastructure. Each of these considerations is highly relevant to an analysis of the impacts of new oil and gas leasing activity, and must be thoroughly reevaluated. In addition, the impacts of the storms resulted in significant infrastructure damage and caused significant socioeconomic changes that bear on the availability and stability of necessary infrastructure and workforce. We do not believe that the draft SEIS adequately accounts for these changed circumstances. These considerations also must be thoroughly reevaluated in the final SEIS.

Evaluation of Past Assumptions, Estimates, and Projections

LA-6

Over the past three decades, MMS has produced various EISs, Environmental Assessments (EAs), and other NEPA documents examining the potential effects of OCS activities to coastal Louisiana. Included in those documents are assumptions, estimates, and projections of anticipated wetland loss and other adverse impacts to coastal Louisiana as a result of each of the proposed OCS lease sales. In order to ensure that its assessment of the impacts of Lease Sale 224 is as accurate as possible, it is essential that MMS compare such assumptions, estimates, and projections with actual experience, to determine their validity and make appropriate refinements, and document this comparison for public review in the SEIS.

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LA-7 Further, the SEIS should include a discussion of the methodologies used by MMS to predict environmental and social impacts, and any actions taken or planned to verify these methodologies through examination of the accuracy of earlier predictions.

Incorporation of Study Results

LA-8 Appropriately, MMS has recognized the existence of additional informational needs regarding OCS leasing activity and its onshore impacts in the wake of Hurricanes Katrina and Rita. The State understands that MMS is working with Louisiana State University's Coastal Marine Institute (CMI) to design and fund two studies to gather information on these hurricane-related issues: (1) "Spatial Restructuring and Fiscal Impacts in the Wake of Disaster: The Case of the Oil and Gas Industry Following Hurricanes Katrina and Rita"; and (2) "Post Hurricane Assessment of OCS-Related Infrastructure and Communities in the Gulf of Mexico Region." In its EA for Lease Sale 200, MMS stated that "[i]nformation from these studies will be incorporated into future MMS NEPA documents." Lease Sale 200 EA at 12. We further understand that MMS is working with CMI on a study titled "Gulf Coast Subsidence and Wetland Loss: A Synthesis of Recent Research" to "highlight and quantify important potential socioeconomic impacts of coastal land loss that can be included in future EIS analyses of upcoming lease sales" and develop an understanding that "will be important in determining the impact of future coastal land loss on upcoming lease sales and offshore activities." The information from these studies is critical to understanding the impact of the hurricanes on existing OCS-related onshore infrastructure and the development of future infrastructure, and to an accurate analysis of the impacts of Lease Sale 224. Therefore, the State believes that the information from these studies must be incorporated into the Lease Sale 224 final SEIS.

Mitigation of Wetland Impacts

LA-9 The catastrophic loss of Louisiana's wetlands during the late summer and fall of 2005 demonstrates the fragility of these unique areas and their extreme importance to the State and the nation. In a June 14, 2006 letter responding to the State's comments on the EA for Lease Sale 200, MMS stated: "In recent years there has been a very high level of concern regarding wetland loss in coastal States, in particular Louisiana, and this has led to a 'no net loss of wetlands' policy. Wetland loss due to oil and gas activities, as well as other activities, is kept to an absolute minimum and any losses must be mitigated." Louisiana absolutely agrees with these statements. In this regard, the SEIS must explain how MMS will ensure that any potential adverse impacts to wetlands and other important coastal features and resources will be mitigated.

Cumulative Impacts

LA-10 Pursuant to NEPA, the SEIS must consider not only the direct effects of the proposed Lease Sale, but also the "incremental impact of the action when added to other past, present, and reasonably foreseeable future actions." 40 C.F.R. § 1508.7; *see also* 40 C.F.R. § 1508.27(b)(7) (requiring an agency to consider "[w]hether the action is related to other actions with individually insignificant but cumulatively significant impacts").

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LA-11

MMS should ensure that the Lease Sale 224 final SEIS thoroughly considers the cumulative impacts of the proposed Lease Sale. This should include, among other impacts, cumulative impacts associated with past and ongoing OCS-related activity, particularly on the resources, communities, and infrastructure in coastal Louisiana; and future planned OCS lease sales. It also should include relevant non-OCS activities and impacts, including, but not limited to, liquefied natural gas facilities and their impacts, and the reasonably foreseeable impacts of heightened storm activity as is now being predicted for the coming decades. Given the effects on coastal wetlands and OCS infrastructure, and on the resources and communities of coastal Louisiana in general, intensified hurricane activity, such as the affected area experienced in 2005, is now reasonably foreseeable and should be addressed in the cumulative impacts analysis.

Infrastructure Safety

LA-12

We recommend that the Lease Sale 224 final SEIS include an analysis of safety considerations relating to OCS oil and gas infrastructure. In this regard, the SEIS should address the following issues, among others: (1) whether infrastructure is being constructed using materials and techniques that are sufficient to withstand predicted heightened storm activity; (2) identification of the nature and extent of impacts caused by debris from storm-damaged oil and gas infrastructure, including other uses, such as commercial and recreational fisheries; and (3) whether evacuation plans for the OCS are developed only to provide for getting personnel to the forward services bases immediately onshore, or provide as well for further evacuation from those bases.

If your staff has any questions concerning these comments, please have them contact Gregory J. DuCote at 225-342-5052 or 1-800-267-4019 or gregory.ducote@la.gov.

Sincerely,

Kathleen Babineaux Blanco
Governor

cc: Scott A. Angelle, Secretary Louisiana Department of Natural Resources
Chris Oynes, MMS Associate Director, Offshore Minerals Management
Lars Herbst, MMS Acting Regional Director, New Orleans
Dennis Chew, MMS
CMD File C20070311

LA-1 While this is a small area relative to the Western and Central Planning Areas, MMS still takes the analysis of potential environmental and socioeconomic impacts very seriously. All relevant environmental and socioeconomic resources have been analyzed.

LA-2 The NEPA does not explicitly define or require mitigation for activities resulting in environmental impacts. The regulations of the Council on Environmental Quality (CEQ) (40 CFR 1508.20) provides for the definition of mitigation. Federal agencies often use mitigation measures to reduce environmental impacts, even though this is not specifically required. The MMS routinely applies mitigation to reduce environmental and socioeconomic impacts.

Chapter 2.1.2.2 of the SEIS, Existing Mitigating Measures, provides information on existing mitigation categories, types, and potential mitigation enhancements applied by MMS. These mitigations include standard and site-specific mitigation to avoid or minimize impacts and are continually developing and improving these mitigations whenever conditions warrant. The MMS does not believe it would be appropriate to include a list of all potential site-specific mitigation that MMS applies to OCS operations in the Final SEIS. Listing all of the mitigation in the Final SEIS, without a detailed discussion of the context in which they may be applied, would not help the public or decisionmakers more fully understand the mitigating measures. Please note that the MMS Internet website at http://www.gomr.mms.gov/WebStore/pifront.asp provides the public the ability to query submitted plans, pipeline applications, structure-removal applications, geological and geophysical permit applications, as well as MMS approval letters and/or site-specific environmental assessments that list the actual mitigation MMS applied to the site-specific "plan" in question. The LADNR feels that MMS should be providing compensatory mitigation for impacts caused by OCS activities. The purpose of the SEIS is to examine the potential impacts of the proposed lease sale on environmental and socioeconomic resources. Cumulative analyses are also included in order to put the incremental contribution of the proposed action in context considering all of the other types of activities (past, present, and reasonably foreseeable) that have the potential to cause impacts similar to those analyzed for the proposed action, including impacts from the overall OCS Program. The incremental contribution of the proposed lease sale to these impacts is very small. Many of the impacts to environmental and socioeconomic resources that are identified in the cumulative analysis of the SEIS have occurred over many years, much of it prior to the enactment of important laws to protect the environment and prior to the bulk of OCS activities. Of particular importance are the National Environmental Policy Act (1969), the Clean Water Act (CWA) (1972), the Coastal Zone Management Act (1972), the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) (1990), and the State of Louisiana's Coastal Use Program (1980). In recent years there has been a very high level of concern regarding wetland loss in coastal States, in particular Louisiana, and this has led to a "no net loss of wetlands" policy at the State and Federal levels. In today's regulatory climate, wetland loss related to oil and gas exploration, as well as other activities, is kept to an absolute minimum, and any losses are mitigated through their respective permit programs. It is important to point out that MMS only permits that portion of pipelines emplaced on the OCS, and mitigation measures (primarily avoidance) are in place to protect any sensitive biological or archaeological resources along the pipeline route. That portion of pipelines in State waters and onshore coastal areas are permitted by Louisiana pursuant to their Coastal Use Program and COE pursuant to the CWA; under their control and jurisdiction, mitigation can be and frequently is required. The shorelines along the channel from Port Fourchon, which will be the primary service base for Lease Sale 224, have hard shoreline protection and will have few, if any, areas where wetlands erode. The construction and maintenance of navigation channels are also regulated by the State of Louisiana and COE, and they have the authority to mitigate adverse environmental and socioeconomic impacts.

The MMS is not a permitting agency for onshore pipelines, canals, dredging, dredged material placement, or infrastructure construction. The permitting agencies are the COE and the state in which the activity has or would occur. A discussion of onshore mitigation, most commonly applied by the permitting agencies, is contained in **Chapter 4.3.3.2** and **Table 4-22** of the Final SEIS. This table lists a variety of mitigation techniques, the associated decision processes, and the factors to consider. In terms of compensatory mitigation for past cumulative impacts to coastal habitats and onshore infrastructure, Louisiana already receives and will receive funds to mitigate these types of impacts. From FY 1986 to FY 2005, Louisiana has received over $1 billion from Federal offshore 8(g) revenues. Louisiana received $30.9 million for FY 2005 alone. With the enactment of the Gulf of Mexico Energy Security Act of 2006 (GOMESA), Louisiana will receive a much larger share of offshore revenues. According to a January 9, 2007, press release from Representative Bobby Jindal, it was estimated Louisiana would receive around $200 million over the first 10 years and from $650 million to $1 billion a year beginning in 2017 from GOMESA (U.S. House of Representatives, 2007). Senator Mary Landrieu stated in a December 2006 press release that, in addition to these funds, the State is expected to receive $9 billion for hurricane protection, wetlands restoration, and navigation projects in the next 10 years from the regular budget process and other previous legislation, such as CWPPRA, and CIAP (U.S. Senate, 2006). Louisiana has also received millions of dollars from the Land and Water Conservation Fund ($469,166 in FY 2006) and the National Historic Preservation Fund ($629,567 in FY 2006), which are funded 90 percent and 100 percent, respectively, by revenues generated from offshore oil and gas activities. From 1968 to FY 2002, $64.4 million was distributed to Louisiana through the Land and Water Conservation Fund from OCS revenues and $14.3 million through the Historic Preservation Fund. Section 384 of the Energy Policy Act of 2005 established CIAP, which authorizes funds to be distributed to OCS oil- and gas-producing states to mitigate the impacts of OCS oil and gas activities. Under CIAP, the Secretary of the Interior is authorized to distribute to producing States and coastal political subdivisions $250 million for each of the fiscal years 2007 through 2010. This money will be shared among Alabama, Alaska, California, Louisiana, Mississippi, and Texas and shall be used for one or more of the following purposes:

- projects and activities for the conservation, protection, or restoration of coastal areas, including wetlands;
- mitigation of damage to fish, wildlife, or natural resources;
- planning assistance and the administrative costs of complying with this section;
- implementation of a federally-approved marine, coastal, or comprehensive conservation management plan; and
- mitigation of the impact of OCS activities through funding or onshore infrastructure projects and public service needs.

LA-3 The potential impacts of global warming were discussed in the Final EIS for the OCS Oil and Gas Leasing Program: 2007-2012. Section IV.A.2 of that EIS presents a general discussion of climate change science, potential consequences of climate change on the environment, and an estimate of greenhouse gas emissions resulting from the OCS Program. Furthermore, Section IV.L presents discussions of climate change impacts as part of the cumulative impact on the environment.

LA-4 During the past few years, the Gulf Coast States and GOM oil and gas activities have been impacted by several major hurricanes. Hurricanes Lili (2002), Ivan (2004), Katrina (2005), and Rita (2005) are discussed in **Chapters 3 and 4**. The description of the affected environment (**Chapter 3**) includes impacts from these storms on the physical environment, biological environment, and socioeconomic activities and OCS-related infrastructure. Changes in baseline data are considered in the assessment of impacts from the proposed action to the resources and the environment (**Chapter 4**). The cumulative analysis considered non-OCS issues, including impacts from past and future hurricanes on environmental and socioeconomic resources and on coastal and offshore infrastructure.

LA-5 The MMS does not predict the increased frequency or intensity of hurricane events, or new models of hurricane impacts, upon the future oil and gas industry. The hurricanes of 2005 impacted every facet of the GOM oil and gas industry—from platform fabrication yards and service bases, to production platforms and drilling rigs, to processing facilities and deliveries to end-users, and everything in between. The impacts to the different sectors and facilities are detailed in the **Chapter 3.3.5.8**. However, one of the most important findings of this chapter is that, despite the amazing degree of destruction, these sectors, in large part, were able to recover relatively quickly and virtually all are operating at or near pre-hurricane levels. Hurricane Ivan in 2004 also affected OCS-related coastal infrastructure, although the impact was much less severe in terms of the number of facilities affected and the overall range.

LA-6 The scenarios presented in the SEIS are intended to describe the level of activity that could reasonably result from the proposed lease sale. In order to present the best reasonable projections possible, MMS continuously 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. Based on a recent analysis prepared by MMS, over half of the time the actual activity fell below the level of forecasted activity (USDOI, MMS, 2007f-h). When within the forecasted range, the majority of time the actual activity was at or near the low end of the forecasted range. The analyses of potential environmental and socioeconomic impacts presented in past EIS's and EA's were based on these exploration and development activity scenarios that, in most cases, were overestimated. If the level of activity was overestimated, the environmental and socioeconomic impacts of a lease sale may have been overstated. In addition, a single lease sale accounts for only a small percentage of the total OCS activities. In addition, MMS is proposing a study to investigate erosion rates along several coastal waterways in the GOM region; these waterways are used for approximately 90 percent of OCS activities. The majority of waterways used by OCS-related vessels are armored. The proposed study will provided erosion rates for unarmored waterways used for GOM OCS-related vessels.

LA-7 The Offshore Impact-Producing Factors and Scenario, as described in **Chapter 4.1.1** of this SEIS, is used by subject matter experts to estimate and evaluate the environmental and socioeconomic impacts of the proposed lease sale. Please see the response to Comment LA-6 regarding the verification of scenario estimates by MMS.

LA-8 The three ongoing studies that MMS has contracted with CMI will not be substantially complete until 2008, following completion of the SEIS. Therefore, the information collected from these three studies will not be included with this document, but it will be included in future NEPA documents.

LA-9 The MMS is not a permitting agency for onshore pipelines, canals, dredging, dredged material placement, or infrastructure construction. The permitting agencies would be COE and the State in which the activity has or would occur. That portion of pipelines in State waters and onshore coastal areas is permitted by Louisiana pursuant to their Coastal Use Program and by COE pursuant to the CWA; under their control and jurisdiction, mitigation can be, and frequently is, required. The construction and maintenance of navigation channels in Louisiana are also regulated by the State of Louisiana and COE, and they have the authority to mitigate adverse environmental and socioeconomic impacts. Please see the response to Comment LA-2 for additional information on mitigation.

LA-10 and 11 **Chapter 4.3** of the SEIS addresses the cumulative impacts of the proposed lease sale on environmental and socioeconomic resources, pursuant to NEPA. The cumulative analysis considers environmental and socioeconomic impacts that may result from the incremental impact of the proposed lease sale 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; recreational and commercial fishing; onshore development; and natural processes. The devastating effects of past and future hurricanes on coastal communities, infrastructure, and environmental resources have also been documented throughout the SEIS.

LA-12 (1) The MMS'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. The effects of Hurricanes Ivan, Katrina, and Rita were detrimental to oil and gas operations on the OCS. These effects included structural damage to fixed production facilities, semisubmersibles, jack-ups, and pipelines. In an effort to reduce these effects, MMS 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. The MMS issued NTL 2007-G19, "Moored Drilling Rig Fitness Requirements for the 2007 Hurricane Season," and NTL 2007-G13, "Jack-up Drilling Rig Fitness Requirements for the 2007 Hurricane Season." These NTL's, described in **Chapter 3.3.5.7.3,** provide guidance on the information operators must submit with Applications for Permits to Drill to demonstrate the fitness of any jack-up or moored drilling rig used to conduct drilling, workover, or completion operations in the GOM OCS during the 2007 hurricane season. It is likely that these NTL's or NTL's very similar to these will be revised every hurricane season.

(2) The MMS acknowledges that fishers may be impacted by OCS-related debris in the Gulf resulting from hurricanes. This debris could cause damage to commercial or recreational vessels or fishing gear (primarily commercial fishing gear). Such damages or losses due to OCS oil and gas activities can be mitigated by the Fishermen's Contingency Fund. Final regulations for the implementation of Title IV of the OCS Lands Act (OCSLA), as amended (43 U.S.C. 1841-1846), were published in the *Federal Register* on January 24, 1980 (50 CFR 296). The OCSLA, as amended, established the Fishermen's Contingency Fund to compensate commercial fishermen for actual and consequential damages, including loss of profit due to damage or loss of fishing gear by various materials and items associated with oil and gas exploration, development, or production on the OCS. This Fund, administered by the Financial Services Division of NOAA Fisheries, mitigates most losses suffered by commercial fishermen due to OCS oil and gas activities. Once an obstruction site has been identified, it is added to the Department of Commerce's National Oceanic and Atmospheric Administration, National Ocean Service (NOAA/NOS) nautical charts or weekly USCG Notice to Mariners. A detailed discussion of the Fishermen's Contingency Fund can be found in **Chapter 4.1.1.3.3.3** of the SEIS.

(3) Development of evacuation plans for OCS facilities is the responsibility of the operator. The OCS operators develop detailed evacuation plans that encompass evacuation procedures that go beyond just getting the personnel to shore; they also take measures to ensure that personnel associated with onshore infrastructure are out of harm's way prior to storm landfall.

OFFICE OF THE GOVERNOR

BOB RILEY
GOVERNOR

STATE CAPITOL
MONTGOMERY, ALABAMA 36130

(334) 242-7100
FAX: (334) 242-0937

STATE OF ALABAMA

August 13, 2007

Mr. Joseph A. Christopher
Regional Supervisor, Leasing and Environment (MS 5410)
Mineral Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, LA 70123-2394

RE: Draft Supplemental Environmental Impact Statement for Outer Continental Shelf Oil and Gas Lease Sale 224

Dear Mr. Christopher:

This is in regard to your letter of June 20, 2007, concerning the draft Supplemental Environmental Impact Statement (SEIS) for Outer Continental Shelf (OCS) Eastern Gulf of Mexico (EGOM) Oil and Gas Lease Sale 224 for 2008. We offer the following comments regarding this proposed Eastern Planning Area sale.

AL-1 As you are aware, Alabama has consistently requested protection for live bottom areas, pinnacle reefs, chemosynthetic communities, and other sensitive environments in the OCS off of Alabama's coast. We continue to request that MMS provide reasonable and adequate protections for these and other sensitive features and areas, such as archeological sites, that might be impacted by OCS related oil and gas exploration and production activities in the EGOM Planning Area.

AL-2 The State of Alabama continues to oppose the offering for lease blocks south and within 15 miles of the Baldwin County coast in order to minimize the visual impact of new natural gas structures within the area. We believe that the State's position on minimizing the visual impact of new natural gas structures is consistent with the proper development of offshore Alabama. We are pleased that MMS will not offer any blocks in this area in Oil and Gas Lease Sale 224.

AL-3 It is my position that the revenues associated with OCS lease sales and subsequent development and production, as well as revenues from existing production, should be shared in a fair and equitable way with the adjacent states that support leasing and development. I am pleased to note that revenues associated with Lease Sale 224 are subject to revenue sharing with Alabama, and the other Gulf coastal states that support offshore development, under provisions of the Gulf of

Mr. Joseph Christopher
August 13, 2007
Page 2

AL-3 Mexico Energy Security Act (GOMESA). I continue to respectfully request that the Administration join with me, and other like-minded Governors and U.S. Senators and Representatives, to work toward the enactment of new legislation to make additional revenue sharing with affected states, such as Alabama, a reality in the very near future.

AL-4 The State of Alabama supports a balanced and reasonable OCS leasing program that leads to exploration, development, and production with the stipulation that all OCS activities are carried out in full compliance with relevant Alabama laws, rules, and regulations in a manner consistent with our Coastal Zone Management Program.

AL-5 Please keep my office and Dr. Nick Tew, State Geologist, apprised of any recommendations or conclusions of the MMS Scientific Committee regarding the potential for mercury contamination associated with any oil and gas related activity on the OCS.

We appreciate the opportunity to comment on the draft SEIS for Oil and Gas Lease Sale 224. We look forward to working cooperatively with MMS in the successful, safe, and environmentally sound development of the resources occurring in offshore Alabama and in sharing in the benefits of OCS leasing and production activities.

Sincerely,

Bob Riley
Governor

CC: Dr. Berry H. (Nick) Tew, Jr., State Geologist
Geological Survey of Alabama/State Oil and Gas Board
P.O. Box 869999
Tuscaloosa, AL 35486-6999

Commissioner M. Barnett Lawley
Department of Conservation & Natural Resources
P.O. Box 301456
Montgomery, AL 36130-1456

Mr. Trey Glenn, Director
Alabama Department of Environmental Management
P.O. Box 301463
Montgomery, AL 36130-1463

Mr. Brian Taylor, Policy Director
Governor's Office

AL-1 **Chapter 2.1.2.2** of the Final SEIS discusses mitigation measures that would be applied by MMS. The following are examples of post-approval submittal mitigation that may be applied to plans for protection of archaeological and biological resources. Text located within open and closed double chevrons (<< >>) represent mitigation parameters that may contain standard or free-form text entered by the analyst on a case-by-case basis:

Archaeological Mitigation for Avoidance of Magnetic Anomalies and/or Side-Scan Sonar Targets

Our review of your plan indicates that your proposed activities are in the vicinity of the unidentified <<magnetic anomalies, side-scan sonar targets, magnetic anomalies and side-scan sonar targets>> listed in the Enclosure, features that may represent significant archaeological resources. In accordance with 30 CFR 250.194(b), you must either (1) conduct an underwater archaeological investigation prior to commencing construction activities to determine whether these features represent archaeological resources or (2) ensure that all seafloor disturbing actions resulting from the proposed activities (e.g., rig placement, anchors, cables, etc.) avoid the subject features by a distance greater than that listed in the Enclosure. If you choose to avoid the features, submit an as-built map at a scale of 1-in = 1,000-ft with DGPS accuracy, showing the location of any seafloor disturbance (rig, anchors, cables, etc.) relative to these features to the Regional Supervisor, Field Operations, Plans Section (MS 5231), at the same time you submit your End of Operations report (Form MMS-125) to the appropriate MMS GOMR District Office. If you conduct an underwater archaeological investigation, contact either Dr. Jack Irion at (504) 736-1742 or Mr. David Ball at (504) 736-2859 at least two weeks prior to performing operations to obtain the investigation methodology.

Biological Mitigation for Avoidance of High-Density Chemosynthetic Communities

<<Our review indicates, you have stated in your plan>> that your proposed activities are in the vicinity of areas that could support high-density chemosynthetic communities. Use a state-of-the-art positioning system (e.g., differential global positioning system) on your anchor handling vessel to ensure that any seafloor disturbance resulting from your use of anchors (including that caused by the anchors, anchor chains, and wire ropes) does not occur within 250 ft of such areas (see <<the enclosed map/Map xxx (specify map by name), submitted with your survey report>> which depicts the areas). Submit plats<<for Well(s) xxx>>, which depict the "as-placed" location of all anchors and any associated anchor chains and wire ropes on the seafloor, at a scale of 1-in = 1,000 ft with DGPS accuracy, to this office at the same time you submit your End of Operations report (Form MMS-125) to the appropriate MMS GOMR District Office, to demonstrate that the features were not physically impacted by these anchoring activities.

Biological Mitigation for Avoidance of Hard Bottoms/Pinnacles

Our analysis indicates that there are hard bottoms/pinnacles located in the vicinity of the activities proposed in your plan that likely provide habitat for biological assemblages. Any bottom-disturbing activities associated with the activities proposed in your plan must avoid these hard bottoms/pinnacles as depicted on the enclosed <<map or maps>> by a distance of at least 100 ft. Submit to Plans Section, Office of Field Operations, at the same time you submit your End of Operations report (Form MMS-125) to the appropriate MMS GOMR District Office, an as-built map at a scale of 1-in = 1,000 ft with DGPS accuracy, showing the location of any seafloor disturbance (jack-up rig, barge anchors, etc.) relative to these features.

Biological Mitigation for Avoidance of Topographic Features

Bottom-disturbing activities associated with the activities proposed in your plan must avoid the "No Activity Zone" of the biologically sensitive feature shown on the enclosed map by a distance of at least 500 ft. Submit to Plans Section, Office of Field Operations, at the same time you submit your End of Operations report (Form MMS-125) to the appropriate MMS GOMR District Office, an as-built map at a scale of 1-in = 1,000 ft with DGPS accuracy, showing the location of any seafloor disturbance (jack-up rig placement, rig anchors, construction barge anchors, etc.) to demonstrate that the "No Activity Zone(s)" was not physically impacted.

AL-2 Comment noted.

AL-3 Comment noted.

AL-4 Comment noted.

AL-5 The MMS will keep Alabama apprised of any new recommendations or conclusions of the MMS Scientific Committee on the potential for mercury contamination associated with OCS activity. The MMS is in the final stages of publishing the "Study of Barite Solubility and the Release of Trace Components to the Marine Environment." This four-part study was designed to gather data to describe trace metals concentrations in barite and the environmental conditions that would cause their release from the barite to the environment. Mercury was one of the trace metals analyzed in the study.

STATE OF ALABAMA
ALABAMA HISTORICAL COMMISSION
468 SOUTH PERRY STREET
MONTGOMERY, ALABAMA 36130-0900

COLONEL (RET.) JOHN A. NEUBAUER
EXECUTIVE DIRECTOR

TEL: 334-242-3184
FAX: 334-240-3477

July 24, 2007

Regional Supervisor
Leasing & Environment (MS 5410)
Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Re: AHC 07-0544
Eastern Planning Area
Lease Sale 224
Gulf of Mexico

Dear Sir:

ALHC-1

Upon review of the draft SEIS submitted by your office, we have determined the following. We agree with the authors that the lease area does not have a high or moderate probability for the location of submerged terrestrial archaeological sites or shipwrecks. We also agree with the caveat in the SEIS that should shipwreck material be discovered during project activities, work will stop within a 1000 foot radius and the appropriate parties, including our office, will be notified. With this stipulation, we can concur with the draft SEIS and the proposed lease.

We appreciate your efforts on this project. Should you have any questions, my point of contact for this matter is Greg Rhinehart at (334) 230-2662. Please have the AHC tracking number referenced above available and include it with any correspondence.

Sincerely,

Elizabeth Ann Brown for

Colonel (Ret.) John A. Neubauer
State Historic Preservation Officer
JAN/GCR/gcr

THE STATE HISTORIC PRESERVATION OFFICE
www.preserveala.org

ALHC-1 Comment noted.

Public Comments on MMS' EIS
Senator Mary Landrieu
7-24-2007

Through both the Coastal Impact Assistance Program and the Domenici-Landrieu Gulf of Mexico Energy Security Act, congress has shown its desire to include local affected communities in the decision-making process. As a result, both the Domenici-Landrieu Gulf of Mexico Energy Security Act and the Coastal Impact Assistance Program include consideration of the impacts offshore oil and gas activity have on local infrastructure.

In Section III.A under Land Use and Existing Infrastructure, the current EIS includes the following recognition of the importance of key infrastructure like LA-1:

"Demand for port facilities has risen since the occurrences of Hurricanes Katrina and Rita in 2005 as companies repair rigs, wells and pipelines. For example, the demand upon Port Fourchon to provide critical OCS-related services has increased dramatically, resulting in double digit traffic increases on LA-1 and an increase in daily truck traffic to about 1,300 (T. Falgout, pers. Commun., May 16, 2006). January and February 2006 traffic counts have averaged nearly 20 percent above last year for those months, further impacting an already stressed system (T. Falgout, pers. Commun., May 28, 2006)."

LANDRIEU-1

We appreciate the recognition of LA-1's importance to offshore oil and gas activities in the Environmental Impact Statement, but encourage the Minerals Management Service to work hard to better engage state and local partners in the NEPA process. For too many years, Louisiana's coastal communities have suffered for providing domestic oil and gas to the rest of the nation, and, on behalf of Senator Landrieu, I urge MMS to carefully consider all of the impacts offshore oil and gas activities have on Louisiana residents living along the coast.

LANDRIEU-1 The MMS sent written notices to Federal, State and local officials to solicit comments regarding new information or issues that should be addressed in the Draft SEIS. In addition to written notices, MMS also held scoping meetings in Pensacola, Florida and Larose, Louisiana on March 1 and 7, 2007, respectively. The MMS also sent copies of the Draft SEIS to Federal, State and local officials for comment. Public hearings were also held in Larose, Louisiana and Pensacola, Florida on July 24 and 26, 2007, respectively. **Chapter 4.3** of the SEIS addresses the cumulative impacts of the proposed lease sale on environmental and socioeconomic resources, including impacts affecting residents of coastal Louisiana.

THE FLORIDA SENATE
Tallahassee, Florida 32399-1100

SENATOR MICHAEL S. "MIKE" BENNETT
21st District

COMMITTEES:
Communications and Public Utilities, *Chair*
Banking and Insurance
Criminal Justice
General Government Appropriations
Higher Education
Oversight and Procedural Policy and Calendar
Responsible Regulation Policy and Calendar
Rules

JOINT COMMITTEE:
Administrative Procedures, *Chair*
Public Service Commission Oversight, *Chair*

August 22, 2007

Regional Supervisor Leasing and Environment
Minerals Management Service (MS 5410)
Gulf of Mexico Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394.

Dear Sirs and/or Madams:

Water makes Florida special. We are known for our beautiful, sandy warm Gulf beaches, our crystalline Atlantic waters, unique coral reefs and abundant aquatic wildlife.

BENN-1

I am against expanding drilling into the eastern Gulf of Mexico. I represent millions of Floridians who share this view. While my constituents live along Gulf shores, there are millions more Floridians who recognize that the Gulf of Mexico is both a Florida treasure and a national treasure that must not be placed at risk.

BENN-2

It does not take a catastrophic or even a small spill to put this resource at risk. Still, it's worth noting that one of the worst "blowouts" in a well occurred in the Gulf of Mexico in 1979. I know that petroleum producers will assure us that technology has improved since that time. I'm sure it has. Likewise, the industry will assure us that major hurricanes have passed through leaving rigs standing and intact. This, they will say, is a testament to improved engineering. I'm sure it is. Again, it does not take a blowout or a blowover to damage our national treasure. Ongoing pollution is just part of the process.

BENN-3

Daily operations of drilling rigs dump tons of toxic materials into emerald Gulf waters. This chronic and ongoing pollution is part of normal operations. The drilling muds mixed with lubrication contain materials like cadmium, lead, nickel and benzene and they are just dumped over the side of drilling rigs. The rigs also belch polluting toxins into the air. There are no air quality restrictions like there are on shore. Picture the industrial operations that dot our coastal areas. They are regulated. Picture the same industrial discharges without regulation—unlike the improved engineering and technology, this is much as it has always been. It's a factory on the water.

REPLY TO:
❒ Wildewood Professional Park, Suite 90, 3653 Cortez Road West, Bradenton, Florida 34210 (941) 727-6349
❒ 216 Senate Office Building, 404 South Monroe Street, Tallahassee, Florida 32399-1100 (850) 487-5078

Senate's Website: *www.flsenate.gov*

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BENN-4 And that factory, even if allowed to encroach further east, cannot produce sufficient quantities of fossil fuel to feed our need. By the time we locate and harvest that oil, we could have and should have alternatives in place. We will risk much and buy precious little time. Of greatest concern to me is that our fixation on past prevents us from moving forward.

BENN-5 The reserves of gas and oil in the Gulf pale in comparison to our present and future need for energy. We could risk the health of our Gulf waters, burn through the resources there and still be left with a gaping need. Worse, while we binge on fossil fuels, we're failing to develop the alternative sources of energy that will propel our lives and Florida's economy through this century and into the next.

BENN-6 That is, we're looking to old solutions to our challenges and as we do, we fail to identify and develop, to focus on the things that will drive our future. It doesn't make sense and it is not good policy.

BENN-7 The Gulf of Mexico is more than a national treasure. Its economic value to the U.S. is quantifiable and clear. Two critical industries that affect the economic well being of Florida are fisheries and tourism. Expanded drill affects them both.

BENN_8 Fisheries: The Gulf is facing challenges, especially along the coasts where estuaries provide habitat for shrimp, crab and fish through part of their lifecycle. And Florida's estuaries are the most productive along the Gulf Coast. Along Florida's coast we have the amazing recovery of Sarasota Bay where today, swimmers and boaters can see a sandy bottom from more than 10 feet above. Charlotte Harbor is the heart of economic vitality for Charlotte and Lee Counties. The proposed lease is a greater threat to our lovely panhandle communities, but a threat to them is one aimed at all Floridians. The Gulf Coast yields 69% of the shrimp and 70% of the oysters caught in the
U.S. Populations of fish and shellfish that depend on good water quality. That water quality must be protected. Expanding drilling puts it at risk.

BENN-9 The federal government recognizes our exceptional coastal resources and invests in their protection through the National Estuary Program and a number of others. On the one hand, the feds invest in protecting our coastlines while on the other hand they threaten those same resources with drilling for gas and oil.

BENN-10 Tourism: While all of the Gulf states depend on tourism, Florida is synonymous with "vacation" for many families. Our state and our individual communities depend on beaches, fishing, snorkeling, diving, boating and other outdoor activities that generate millions of dollars annually and provide jobs for millions of Floridians.

As the Gulf of Mexico Alliance clearly articulates:

> The Gulf of Mexico is an integral part of our nation's economic and ecological vitality.

August 22, 2007
Page 3

BENN-11

This region helps fuel and feed the nation by providing the largest domestic market for shrimp, oysters and many species of fishes for the nation.

The Gulf of Mexico provides a critical transportation link to move our trading products worldwide. It also provides essential habitat for migrating waterfowl, other birds, and many other species such as bullfrogs, alligators, dolphins and whales.

BENN-12

Drilling has had some awful consequences in some other Gulf States. Some Texas hotels are kind enough to provide guests with toweletts so that guests can wipe off the little tar balls found in their Gulf waters. We don't want that for Florida—any part of Florida. Yes, we recognize that technology has improved, but the risk to tourism, to our economic wellbeing and environmental resources is just too great.

BENN-13

We do not support exploration as the level and depth of the resource is ultimately immaterial. When the drilling camel gets his nose in the tent of the eastern Gulf, it will not be long before the herd presses in.

BENN-14

Floridians will resist this. We will call on our federal representatives to exercise every possible alternative to derail this bad plan for the country and for our state. And we will call on those seeking office to commit to our protection.

Sincerely,

Michael S. "Mike" Bennett
HR/cre

BENN-1 Comment noted.

BENN-2 Loss of well control and resultant blowouts seldom occur on the Gulf OCS. The potential causes and probabilities of blowouts are discussed in **Chapter 4.2.2.** The MMS requires the use of blowout preventers (BOP's), which are a special assembly of heavy-duty valves installed on top of a well and which can be closed to prevent high-pressure oil or gas from escaping from the wellhole during drilling operations.

BENN-3 The MMS strives to operate in an environmentally sound manner, with every regulatory effort to minimize any adverse impacts to the environment. Mitigating measures (**Chapter 2.1.2.2**) that are a standard part of the MMS program are implemented to reduce impacts to the maximum extent practicable. A thorough analysis of the cumulative impacts of the proposed lease sale was conducted to ensure that State and Federal laws will not be violated. Although there are no USEPA air emissions criteria for offshore, MMS does have its own air quality regulations that are imposed on oil and gas activities. The MMS performs air quality reviews on oil and gas activities according to MMS's Standard Operating Procedures for Air Quality Reviews and 30 CFR, Subpart C (Pollution Prevention and Control).

BENN-4 Comment noted.

BENN-5 Comment noted.

BENN-6 Comment noted.

BENN-7 Comment noted.

BENN-8 Mitigating measures that are a standard part of the MMS program ensure that the operations are always conducted in an environmentally sound manner, with a zero tolerance of pollution and with every regulatory effort to minimize any adverse impact to the environment. A thorough analysis of the cumulative impacts of the proposed lease sale was conducted to ensure that State and Federal laws will not be violated. The MMS and USEPA together ensure the protection of water quality that, in turn, supports healthy populations of fish and shellfish. Under the Clean Water Act (CWA), it is unlawful for any person to discharge any pollutant from a point source into a navigable water without an NPDES permit. Therefore, all waste streams generated from offshore oil and gas activities and discharged to water are regulated by USEPA. Under Section 403(c) of the CWA, USEPA must consider Ocean Discharge Criteria to "prevent unreasonable degradation of the marine environment and to authorize imposition of effluent limitations, including a prohibition of discharge to ensure this goal." The activities must also be consistent with local and State Coastal Zone Management Plans. Wastes such as drilling muds, produced waters, and other discharges must meet the effluent limitations specified in the permit. Wastes, the discharge of which is prohibited, include produced sand, oil-based drilling fluid, and drilling fluids that cannot meet toxicity limitations. Operators planning activities in <200 m (656 ft) water depth or near to an Area of Biological Concern must apply for an individual permits.

BENN-9 Comment noted.

BENN-10 Comment noted.

BENN-11 Comment noted.

BENN-12 Tarballs are the floating residue remaining after an oil slick dissipates and are likely to result from a large spill. Prior to washing up on beaches, tarballs may persist in the sea for years. They may remain neutrally buoyant and suspended in the water column or they may settle on the seafloor. The risk of exposure to tarballs or persistent hydrocarbons from an oil spill in the sea is less than the risk associated with exposure to an oil slick. According to the Florida Department of Environmental Protection (http://www.dep.state.fl.us/law/BER/TarBalls.htm), the risk of weathered oil washing ashore on the west coast of Florida is relatively low. Oil from natural oil seepage, land-based sources, or other sources that are not affected by the proposed action could still impact Florida beaches and is not included in the MMS Oil Spill Risk Analysis study. See the response to Comment MANAS-6.

BENN-13 Comment noted.

BENN-14 Comment noted.

FOURCHON

Greater Lafourche Port Commission

Port Fourchon ♦ South Lafourche Leonard Miller, Jr. Airport

"The Gulf's Energy Connection"

July 24, 2007

Mr. Joseph Christopher
Regional Supervisor
Leasing & Environment (MS 5410)
Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Blvd.
New Orleans, LA 70123-2394

RE: Comment on Draft Supplemental EIS for Gulf of Mexico Lease Sale #224

Dear Mr. Christopher:

Good Evening, my name is Chett Chiasson, and I am here tonight representing the Greater Lafourche Port Commission.

I would like to thank you for coming to Bayou Lafourche tonight to take comments on the Draft EIS for the upcoming lease sale. It is this community, along the LA 1 Corridor, particularly from Raceland south to Port Fourchon, which will likely experience the greatest impacts from the proposed activity.

As I am sure you know, Port Fourchon's role in supporting OCS oil and gas activities continues to increase to a measure well beyond the MMS description of a focal point of activity. Today Port Fourchon is providing some level of support to over 90% of the Deepwater Projects in the Federal OCS.

I agree with much of the text of your EIS, especially page 4-186 of the summary, which states that "Increased OCS-related usage from port clients is expected to significantly impact LA 1 in Lafourche Parish."

GLPC-1

However, I do not agree that it is fair to this community to say that impacts to LA 1 do not need to be analyzed because they have been covered by "prior environmental review", such as in revenue sharing legislation. While some of the impacts of this future lease sale will be mitigated by revenue sharing funds, failing to talk about the mitigation of existing impacts which our community is living with is again, inexcusable.

Administration Office
16829 East Main Street
P.O. Drawer 490
Galliano, LA 70354
(985) 632-6701 phone
(985) 632-6703 fax

Seaport Operations
108 A.O. Rappelet Road
Port Fourchon, LA 70357
(985) 396-3911 phone
(985) 396-2596 fax

Airport Operations
551 Airport Road
Galliano, LA 70354
(985) 475-6701 phone
(985) 475-5050 fax

www.portfourchon.com

GLPC-2

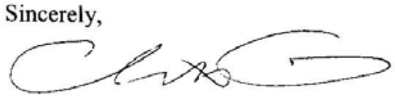
Our port has taken a very clear position, alongside our local government and local industry through our Chamber of Commerce and our Highway Coalition, which has repeatedly told MMS that it has not followed through with the NEPA Process on numerous EIS's. Yet again, MMS Leadership has failed to bring the mitigation of past, well documented impacts to the table for discussion. We believe MMS has a much greater responsibility than that of only identifying an impact. Once an impact is clearly identified in an EIS and further defined by supporting documents, MMS should play a leadership role in seeing that this impact is properly mitigated. We urge you, as a partner of the industry you regulate, to take action organizing a meeting on creating a mechanism to mitigate these very well documented, existing impacts.

GLPC-3

I would like to close my comments reminding you of specific MMS documents completed years ago which list these impacts, and to this date, MMS has yet to act on. In the 1997 multi-year EIS, impacts to Lafourche Parish and LA1 in particular were identified. A subsequent study commissioned by MMS entitled "Lafourche Parish and Port Fourchon Louisiana: Effects of the OCS Petroleum Industry on the Economy and Public Services", was completed in 2001. In this document, impacts to some of the public services were well documented and it concluded that the ability of LA1 to provide "adequate" level of services needed to support expanding offshore oil and gas activities will become increasingly strained and that the deterioration of LA1 will also be exacerbated with expanding oil and gas activity.

Again, thank for being here. Please convey to MMS leadership that we are most serious in seeking a resolution to the mitigation of existing, well documented impacts, and we are hoping this can be done in an amicable and equitable way.

Sincerely,



Chett C. Chiasson, MPA
Economic Development & Grants Administrator

Greater Lafourche Port Commission
Port Fourchon ♦ South Lafourche Leonard Miller, Jr. Airport
"The Gulf's Energy Connection"

GLPC-1 The MMS recognizes the importance of Port Fourchon and LA Hwy 1 to the Nation's energy infrastructure and the area's desire for impact assistance to ameliorate effects of the OCS Program. **Chapters 3.3.5.2 and 4.3.14.1** describe how OCS development has affected Port Fourchon and coastal infrastructure, including LA Hwy 1. See the response to Comment LA-2 for information regarding the mitigation of OCS activities.

GLPC-2 On September 25, 2007, Randall Luthi, Director of the Minerals Management Service, attended a meeting with LADNR, Greater Lafourche Parish Port Commission, South Lafourche Levee District, Louisiana Highway 1 Coalition, President of Lafourche Parish, and industry representatives from Shell Oil Corporation and Gulf Islands Fabrication. Discussions took place regarding the importance of Port Fourchon to offshore operations, the substandard conditions of LA Hwy 1, revenue sharing, and coastal restoration. The MMS appreciates the contributions of Port Fourchon and the Louisiana Highway 1 Coalition to the OCS Program and the offshore oil and gas industry. The MMS strives to maximize cooperation with the Port, to improve communication with the local and regional governments, and will work to continuously identify and evaluate impacts that cross jurisdictional boundaries. However, regarding compensatory mitigation of impacts of inshore infrastructure construction and operations associated with the OCS Program, the Anti-Lobbying Act (18 U.S.C. 1913) prohibits any Federal agency from lobbying Congress directly or indirectly. Therefore, MMS would not be able to contact Congress or draft legislation regarding mitigation without a request for technical assistance from a member of Congress. See the response to Comment LA-2 regarding mitigation features currently implemented by MMS and Congress.

GLPC-3 Comment noted.

FMCC
FLORIDA

1625 Summit Lake Drive
Suite 300
Tallahassee FL 32317
(850) 402-2930
email: nancy@fmcc.org

July 26, 2007

Regional Supervisor
Leasing and Environment (MS5410)
Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Blvd
New Orleans, La. 70123-2394

Re: Support of the Supplemental Environmental Impact Statement
2008 Oil & Gas Leasing Proposal in the Eastern Gulf of Mexico

Dear Sir:

FMCC-1

The Florida Minerals and Chemistry Council supports Lease Sale 224 and hope that the lease is carried out in a timely manner. Since manufacturers are extremely dependent on energy supplies, we are concerned that any delay could hinder future OCS exploration and the delivery of needed energy supplies.

We are optimistic and hopeful that the MMS will continue to ensure the safe and environmentally sensitive production of domestic energy to support the U.S. economy and guarantee that manufacturers and other consumers have access to reasonably-priced energy.

Thank you for the opportunity to comment.

Sincerely,

Nancy D. Stephens, CAE
Executive Director

FMCC-1 Comment noted.

MANASOTA–88

A Project for Environmental Quality 1968-2088

MANATEE
SARASOTA

July 29, 2007

Regional Supervisor
Leasing and Environment (MS 5410)
MMS
Gulf of Mexico OCS Region
1201 Elmwood Park Blvd.
New Orleans, Louisiana 70123-2394

Re: EIS of EGOM Oil and Gas Lease Sale 224

ManaSota-88, Inc. (ManaSota-88) is a public interest environmental and public health organization incorporated under the laws of the State of Florida as a not-for-profit corporation. The membership of ManaSota-88 consists of citizens and residents of Florida, including residents living or working in Manatee and Sarasota County. Members of ManaSota-88 use and enjoy the waters of the Gulf of Mexico, which is the subject of the Mineral Management Service's (MMS) lease program.

ManaSota-88 recommends the FDEP find the MMS Proposed Supplemental Environmental Impact Statement (EIS) for the Eastern Gulf of Mexico Oil and Gas (EGOM) Oil and Gas Lease Sale 224 for 2008 to be ***inconsistent*** with the Coastal Zone Management Act for the following reasons:

Cumulative Impact Analysis

MANAS-1 The MMS has not provided reasonable assurances that the cumulative impacts of the proposed lease, including applicable past, present and foreseeable cumulative impacts, will not cause violations of any state or federal standard.

MANAS-2 There will be significant unpermittable foreseeable adverse cumulative impacts on water quality, conservation and protection of fish and wildlife resulting from oil and gas drilling in the proposed lease area.

Live Bottom Habitat Impacts

MANAS-3 ManaSota-88 finds the potential impacts to the live hard-bottom communities within the lease area unacceptable. Hard-bottom habitats provide important cover and feeding areas for many fish and invertebrates, including threatened and endangered aquatic species.

Information
P.O. Box 1728
Nokomis, FL 34274
(941) 966-6256
FAX (941) 966-0659
www.manasota88.org

[redacted]

MANAS-4 The MMS has not provided reasonable assurances that live hard bottom areas located within the lease area will not be impacted. Live bottom habitat is one of the most difficult, if not impossible, wetland habitats to mitigate.

Oil Spill Risk Analysis

MANAS-5 It appears the Tampa Bay region may be within the area to be the most severely impacted by offshore oil drilling in the Gulf of Mexico.

MANAS-6 Because no oil-spill research has been conducted for our area, and the impact of an oil spill on such an environment is still not known, FDEP should find the EIS for the lease area inconsistent with the Coastal Zone Management Act.

MANAS-7 Spill studies showing spill probabilities, trajectories and points of impact for the Tampa Bay area have not been done.

MANAS-8 The value of our biologically sensitive areas, mangroves, seagrasses, beaches, barrier islands and endangered and threatened species cannot be overstated. The commercial and sport saltwater fishing industries and our tourist trade are overwhelming economic factors to be considered.

Essential Fish Habitat

A purpose of the Magnuson-Stevens Act is: "to promote the protection of essential fish habitat in the review of projects conducted under Federal permits, licenses or other authorities that affect, or have the potential to affect such habitat."

Sustainable Gulf of Mexico fisheries have declined, recovery of threatened or endangered species is not occurring, and the health of marine and anadromous fish habitats continues to degrade. Pollution of water resources, degradation of important marine habitats, and habitat loss continue at an unacceptable rate in gulf coastal states.

Florida's coastline is home to hundreds of fish species. In addition, these fish support commercial and recreational fishing industries that bring substantial revenues to the state and coastal communities.

MANAS-9 Oil and gas drilling in the proposed lease area will be in conflict with the Magnuson-Stevens Act.

Adverse Secondary Impacts

MANAS-10 There will be unpermittable foreseeable adverse secondary impacts from the proposed drilling of oil and gas in the lease area.

MANAS-11

The MMS has not provided reasonable assurances that oil and gas drilling would not adversely affect the conservation of fish and wildlife, including endangered or threatened species, or their habitats or the marine productivity in the vicinity of the proposed lease area.

Sincerely,

Glenn Compton

Chairman, ManaSota-88

MANAS-1 The MMS strives to operate in an environmentally sound manner, with every regulatory effort to minimize any adverse impacts to the environment. Mitigating measures (**Chapter 2.1.2.2**) that are a standard part of the MMS program are implemented to reduce impacts to the maximum extent practicable. A thorough analysis of the cumulative impacts of the proposed lease sale was conducted to ensure that State and Federal laws will not be violated (**Chapter 4.3**).

MANAS-2 **Chapter 4.6** of the SEIS discusses the relationship between the short-term use of man's environment and the maintenance and enhancement of long-term productivity. Any impacts to water quality or fish and wildlife are considered to be short-term and localized, and the marine environment is generally expected to remain at or return to its normal long-term productivity levels after completion of oil and gas production. See the response to Comment MANAS-1 above regarding cumulative impacts.

MANAS-3 The term "live hard-bottom" typically refers to hard substrate areas on the continental shelf with a variety of attached invertebrates and associated fishes. All of the lease area in question is on the continental slope and is deeper than 800 m (2,625 ft). The vast majority of the lease blocks in the sale area do not have any exposed hard bottom of any kind. There is the possibility that a few small areas at the bottom of the Florida Escarpment may have some exposed carbonate blocks that have fallen off upper portions of the escarpment and accumulated at its base at a depth of around 2,800 m (9,186 ft). There is a possibility that some of these carbonate blocks have exposed hard substrate that may be colonized by deepwater invertebrates. However, there is no potential for impacts to these areas from activities related to the lease sale due to the extreme topography that would prohibit drilling activities or anchoring. In addition, NTL 2000-G20 would also be applied in these water depths for any proposed activities. This NTL considers hard substrate as one indictor of chemosynthetic communities.

MANAS-4 See the response to Comment MANAS-3 above.

MANAS-5 The Tampa Bay region is well over 200 mi (322 km) from any proposed offshore drilling locations. Results of the MMS Oil Spill Risk Analysis Model (OSRA Model) show that there is a low probability of an oil spill occurring and contacting the Tampa Bay region as a result of offshore oil drilling in the Gulf of Mexico. No OCS service bases occur in the Tampa Bay region nor will any OCS-related pipelines make landfall in the region. See the response to Comment MANAS-6 below.

MANAS-6 The OSRA Model has been thoroughly validated over many years. A description of this trajectory model and its results are summarized in the SEIS and are published in a separate report (Ji et al., in preparation). This report will be available online at http://www.mms.gov/eppd/sciences/esp/programs/osra.htm along with past OSRA reports. The OSRA Model simulates thousands of spills launched throughout the GOM OCS and calculates the probability of these spills being transported and contacting specified environmental resources. The OSRA modeling results in a numerical expression of risk based on spill rates, projected oil production, and trajectory modeling. The OSRA Model results show <0.5 percent probability of oil spills occurring and contacting within 10 days various resources in Florida as shown on **Figures 4-5 through 4-11**. Although similar probabilities for some environmental resources covering several states including Florida (such as the Brown Pelican Habitat, **Figure 4-14**) were as high as 2 percent, probabilities for environmental resources that exist only in Florida were all <0.5 percent. The OSRA Model output shows <0.5 percent probability of oil spills occurring and contacting within 10 days each of the 23 Florida coastal counties (including Sarasota, Manatee, Hillsborough, Pinellas, Pasco, and Hernando Counties in the Tampa Bay area). This is the case when even the highest estimate of oil production given in the SEIS was assumed. A map showing these low probabilities was deemed unnecessary given the other very low Florida probabilities shown in **Figures 4-5 through 4-11** and given the fact that the Tampa Bay Region is well over 200 mi (322 km) from any proposed offshore drilling locations. The MMS is hesitant to claim a zero probability of an oil spill occurring and impacting any environmental resource or area, but it can confidently claim that the probabilities of an oil spill occurring and contacting within 10 days counties and resources in the Tampa Bay area as a result of the proposed action are extremely low.

MANAS-7 See the response to Comment MANAS-6.

MANAS-8 Comment noted.

MANAS-9 **Chapter 1.3** of the SEIS contains information describing the consultation and coordination process between the MMS and NMFS as well as the required components of the EFH consultation. This information provides documentation of the methods used by MMS to ensure compliance of Lease Sale 224 with the Magnuson-Stevens Fishery Conservation and Management Act.

MANAS-10 The SEIS utilizes a great deal of credible scientific information and years of experience in assessing the impacts of offshore oil and gas activities. The SEIS analyzes all impacts, short-term and long-term, localized and regional, direct and indirect, and cumulative, to offshore and coastal resources from all activities projected for the entire proposed Lease Sale 224 area. See the responses to Comments MANAS-1 and MANAS-2.

MANAS-11 The MMS strives to operate in an environmentally sound manner, with every regulatory effort to minimize any adverse impacts to the environment. Mitigating measures (**Chapter 2.1.2.2**) that are a standard part of the MMS program are implemented to reduce impacts to the maximum extent practicable. Under Section 7 of the Endangered Species Act, MMS consults with both NMFS and FWS to ensure that activities on the OCS and under MMS jurisdiction do not jeopardize the continued existence of threatened or endangered species and/or result in adverse modification or destruction of their critical habitat. See the responses to Comments MANAS-1, MANAS-2, and MANAS-10.

From: jean public [mailto:jeanpublic@yahoo.com]

Sent: Saturday, June 30, 2007 11:51 AM

To: Environment; AMERICANVOICES@MAIL.HOUSE.GOV; BLUEWATER@BLUEWATERNETWORK.ORG

Cc: COMMENTS@WHITEHOUSE.GOV; VICEPRESIDENT@WHITEHOUSE.GOV; FOE@FOE.ORG

Subject: PUBLIC COMMENT ON FEDERAL REGISTER OF 6/29/07 VOL 72 #125 PG 35719

FED REG DOC E7 12667 - DOI MMS OUTER CONTINENTAL SHELF EASTERN GULF OF MEXICO OIL AND GAS LEASES FOR AREA 181 AND 224

SACHAU-1

NOWHERE IN THIS DOCUMENT DO YOU TELL THE PUBLIC HOW MANY ACRES OR MILES ARE INVOLVED IN THIS SALE. HOW CAN THE PUBLIC BE EXPECTED TO COMMENT IF THEY ARE NOT GIVEN ANY FACTS ON THIS? I THINK THIS SHOULD BE REPOSTED AGAIN WITH INFORMATION ON THE SALE/LEASE.

SACHAU-2

I ALSO BELIEVE THAT THIS IS OK IF YOU ARE DRILLING THE DEAD ZONE OF THE GULF OF MEXICO. THE DEAD ZONE OF COURSE HAS BEEN GROWING IN SIZE FOR THE LAST FIFTY YEARS WITH THE US GOVERNMENT DOING NOTHING ABOUT THIS KILLING OF THIS GULF FROM FARM TOXIC CHEMICALS AND FERTILIZERS. YOU HAVE IN FACT KILLED A LARGE PART OF THE GULF OF MEXICO - WILL THE DRILLING BE IN THAT PART? IF SO ITS OK BECAUSE NOTHING LIVES THERE ANYWAY AND THIS IS IN FACT DEAD SEA.

HOWEVER IF THIS SALE OR LEASE WILL IMPACT MARINE LIFE IN OTHER SECTIONS, I OPPOSE THIS SALE/LEASE.

B SACHAU

15 ELM ST

FLORHAM PARK NJ 07932

SACHAU-1 **Chapter 1.2** of the SEIS states that the EPA sale area encompasses approximately 584,000 ac. **Figure 1-1** of the SEIS shows the location of the proposed Lease Sale 224 area.

SACHAU-2 **Chapter 3.1.2.2** contains information related to the zone of hypoxic conditions found seasonally on the continental shelf west of the Mississippi River. 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 contribution of produced water to hypoxic conditions is minimal. The amount of oxygen-demanding pollutants in produced water was determined for produced water discharged into the hypoxic zone (Veil et al., 2005) as a requirement for the reissued NPDES general permit. Existing hypoxia models were used to analyze the potential incremental impacts to the hypoxia from produced-water discharges (**Chapter 4.3.2.2**). The USEPA determined that the potential impact of the hypoxia from produced-water discharges was insignificant (USEPA, 2006e).

Populus-Leflore Preservation Park

Owned And Operated
By Heirs Of
Jean Vincent Populus
And
Dolly Leflore Populus

POPULUS-LEFLORE PRESERVATION PARK

Thelma P Gordon
34 New England Ct
Gretna, LA 70053-4932

(504) 367-5434
(504) 650-7499

JULY 9, 2007

TO: REGIONAL SUPERVISOR
LEASING AND ENVIRONMENT (MS 5410)
MINERALS MANAGEMENT SERVICE
GULF OF MEXICO OCS REGION
1201 ELMWOOD PARK BLVD.
NEW ORLEANS, LOUISIANA 70123-2394

GENTLEMAN:

Thank you for your NOTICE OF A MEETING RELATIVE TO THE SEIS ON A PROPOSED OIL AND GAS LEASE IN THE EASTERN PLANNING AREA TO BE HELD IN CONJUNCTION WITH A CENTRAL GULF OF MEXICO SALE #224 ON JULY 24, 2007 AT 7:00 P.M. AT THE LAROSE CIVIC CENTER, 307 EAST 5th. STREET, LAROSE, LOUISIANA.

Regrettably, I will be unable to attend the Larose Meeting on July 24, 2007, however, I am interested in "KNOWING" why the THEFT OF OUR OIL AND GAS IN SECTIONS 26, 27 and 43, TOWNSHIP 4, RANGE 10 EAST IN ST. TAMMANY PARISH HAS NOT BEEN ACCOUNTED FOR WITH PAYMENTS TO MY FAMILY AND OTHER RELATIVES.

PLPP-1

I have enclosed copies of documents filed in the St. Tammany Parish Court House that reveals OWNERSHIPS of these lands, since the early 1800's. I have also enclosed a OIL AND GAS MAP THAT DOCUMENTS THE PIPE LINES ON THESE LANDS TO STEAL THE NATURAL RESOURCES FROM THESE LANDS, BY OIL COMPANY ORGANIZED CRIME.

PLPP-2

It is my personal oppinion that the OFF SHORE DRILLING IS TO CONCEAL THE THIEVERY OF OIL AND GAS FROM LAND OWNERS HERE IN THE GULF COAST STATES AND IS THE REASON WE HAVE THE EXPENSE OF MAINTAINING OUR HIGHWAYS, STREETS AND HOMES, AS WELL AS TAXES FOR GOVERNMENT.

THE DAY OF RECKONING WILL ARRIVE AT SOMETIME IN THE FUTURE, WHEN THE EARTH'S FOUNDATION HAS LOST ITS STRENGTH BECAUSE OF THE MINERALS LOSS FROM THE EARTH AND THE PEOPLE INHERIT FLOODED CITIES FROM THE LAKES, RIVERS AND OCEANS. (After learning in 1990 that A.R. BLOSSMAN of BLOSSMAN OIL COMPANY HAD FILED A "SUCCESSION" ON MY DAD, LAWRENCE POPULUS/POPULIS AND THREE OF HIS SIBLINGS, ATTESTING TO BE THE "SUCCESSOR" TO EACH OF THEM, I LOST MY FAITH AND TRUST IN THE SYSTEM.)

Sincerely,

THELMA POPULUS/POPULIS GORDON
TPG/

PLPP-1 The MMS has no jurisdiction over onshore oil and gas development.

PLPP-2 Comment noted.

JENNINGS-1

COMMENT SHEET

Public Hearing Meeting on the Supplemental Environmental Impact Statement for Eastern Planning Area Oil and Gas Lease Sale 224

Comments:

PLEASE PRINT

QUICK UPGRADE OF HWY 1-308 FROM PORT FOURCHON TO HWY 90/49.

I have DRIVEN these ROADS FOR 30 YEARS. The TRAFFIC LOAD is EXCESSIVE TO ROADS THAT HANDLE FARM EQUIPMENT (SLOW MOVING) PERMITTED WIDE/LONG LOADS OF OIL FIELD EQUIPMENT AND NORMAL TRAFFIC. DURING School AND SUGAR CANE HARVESTING, YOU CAN AlWAYS FIND AREAS WHERE TRAFFIC Will BACK UP TO 1/4 MILE, this CAUSES PASSING + SPEEDING IN DOUBLE YELLOW LINE + CURVE AREAS NOT ONLY FROM STANDARD CARS - BUT 18 WHEELERS. LOOK AT OUR ACCIDENT STATISTICS. I HAVE BEEN INVOLVED IN 2 ACCIDENTS. NEAR MISSES ??? — IN SHORT, THE ADDED OIL FIELD EXPANSION IS NEEDED FOR OUR NATION - HELP THOSE WHO ARE DIRECTLY INVOLVED + IMPACTED BY this GIVE THE EXPANSION the HELP IT/WE NEED.

Thanks

[signature]

Name: DWAYNE JENNINGS

Organization: PRIVATE CITIZEN - RETIRED / PART-TIME DEPUTY SHERIFF

Title: PROFESSIONAL LOAFER

Address: 440 Belle

City, State & Zip: LOCKPORT, LA. 70374

Comments are not limited to the space on this sheet, please feel free to add additional sheets if necessary.

JENNINGS-1 Section 384 of the Energy Policy Act of 2005 established the Coastal Impact Assistance Program (CIAP), which authorizes funds to be distributed to OCS oil- and gas-producing states to mitigate the impacts of OCS oil and gas activities. Under CIAP, the Secretary of the Interior is authorized to distribute to producing States and coastal political subdivisions $250 million for each of the fiscal years 2007 through 2010. This money will be shared among Alabama, Alaska, California, Louisiana, Mississippi, and Texas and shall be used for a number of purposes. The State of Louisiana and coastal parishes will receive over $127 million for each of the four years. See the response to Comment LA-2 for additional information regarding mitigation.

[redacted]

July 24, 2007

Mr. Joseph Christopher
Regional Supervisor, Leasing and Environment
U.S. Minerals Management Service
GOM OCS Region
1201 Elmwood Park Blvd.
New Orleans, LA 70123-2394

Re: Comment on Draft Supplemental EIS for GOM Lease Sale #224

Dear Mr. Christopher:

GUIDRY-1 We support the responsible development of the Outer Continental Shelf. We encourage the Minerals Management Service to document impacts caused by this activity, and to take the lead role in developing federal legislation which will pay for the mitigation of impacts we are already experiencing.

GUIDRY-2 We realize impacts of OCS activity in our community are far and wide. There are impacts to our wetlands, and we hope last year's federal royalty sharing legislation by Senators Landrieu/Domenici are enough funds, in enough time to address the massive need.

GUIDRY-3 There are impacts of increased industrial traffic coming into our community. We hope the Minerals Management Service will be fair with our transportation representatives and make sure that existing traffic impacts from existing MMS leases are mitigated.

GUIDRY-4 We know that as tax payers, the Water District located in Lockport, which provides much water to Fourchon to be transported to the Outer Continental Shelf (OCS) Drilling Facilities, has had to bond money out to pay for OCS related supply needs. We hope the MMS will be fair in reimbursing our water district for these expenses.

GUIDRY-5 We know that the protection of these communities by our South Lafourche Levee District, where the blue-collar workers which man Port Fourchon and live, is critical. We feel it is in MMS's interest to take a role in protecting the

[redacted]

residents and their homes within the levee system by including our Levee District in plans to secure this needed critical infrastructure.

GUIDRY-6

We know that our <u>law enforcement agencies and public school system</u> budgets are impacted by having to hire bilingual translators to deal with an ever-growing influx of outside labor.

GUIDRY-7

Southern Lafourche Parish bears a huge burden for the nation, in providing access to/ and support services for <u>20 % of the nations incoming oil,</u> both domestic and imported. We hope the Minerals Management Service, as the regulator of this industry, will treat our community equitably in dealing with all these impacts, both existing and future.

Thank you for allowing me to comment tonight.

GUIDRY-1 See the response to Comment LA-2.

GUIDRY-2 See the response to Comment LA-2.

GUIDRY-3 See the response to Comment LA-2.

GUIDRY-4 See the response to Comment LA-2.

GUIDRY-5 The MMS has no jurisdiction over onshore development and flood control projects nor does it have the authority to require hurricane protection for coastal communities, infrastructure, and environmental resources.

GUIDRY-6 Comment noted.

GUIDRY-7 The MMS has no jurisdiction over imported oil. See the response to Comment LA-2.

[redacted]

July 24, 2007

Mr. Joseph Christopher
Regional Supervisor, Leasing and Environment
U.S. Minerals Management Service
GOM OCS Region
1201 Elmwood Park Blvd.
New Orleans, LA 70123-2394

Re: Comment on Draft Supplemental EIS for GOM Lease Sale #224

Dear Mr. Christopher:

My name is Deanna McNeely, Executive Director of Les Reflections du Bayou. Our organization works on projects to save our coast, keep our recreational beaches clean and safe for all, and beautification enhancements in public areas along Bayou Lafourche. I am happy to offer comments on the Draft Supplemental EIS for GOM Lease Sale #224, which is currently being considered by your department.

MCKN-1 We support the responsible development of the Outer Continental Shelf. We do, however, encourage the Minerals Management Service to document impacts caused by this activity, and to take the lead role in developing federal legislation which will pay for the mitigation of impacts we are already experiencing.

MCKN-2 We realize impacts of OCS activity in our community are far and wide. There are impacts to our wetlands, and we hope last year's federal royalty sharing legislation are enough funds, in enough time to address the massive need.

MCKN-3 There are impacts of increased industrial traffic coming into our community. We hope the Minerals Management Service will be fair with our transportation representatives and make sure that existing traffic concerns from existing impacts of lease sales are addressed.

MCKN-4 We know that as tax payers, the Water District located in Lockport, which provides much water to Fourchon to be transported to the Outer Continental Shelf (OCS) Drilling Facilities, has had to bond money out to pay for OCS

[redacted]

related supply needs. We hope the MMS will be fair in reimbursing our water district for these expenses.

MCKN-5 We know that the protection of these communities by our South Lafourche Levee District, where the blue-collar workers which man Port Fourchon and live, is critical. We feel it is in MMS's interest to take a role in protecting the residents and their homes within the levee system by including our Levee District in plans to secure this needed critical infrastructure.

MCKN-6 We know that our law enforcement agencies and public school system budgets are impacted by having to hire bilingual translators to deal with an ever-growing influx of outside labor.

MCKN-7 Southern Lafourche Parish bears a huge burden for the nation, in providing access to/ and support services for 20 % of the nations incoming oil, both domestic and imported. We hope the Minerals Management Service, as the regulator of this industry, will treat our community equitably in dealing with all these impacts, both existing and future.

Thank you for allowing our organization to comment on this Draft EIS.

Sincerely,

Deanna McKneely

Deanna McNeely
Executive Director

MCKN-1 See the responses to Comments LA-1 and LA-2.

MCKN-2 See the response to Comment LA-2.

MCKN-3 See the response to Comment LA-2.

MCKN-4 See the response to Comment LA-2.

MCKN-5 See the response to Comment GUIDRY-5.

MCKN-6 Comment noted.

MCKN-7 The MMS has no jurisdiction over imported oil. See the response to Comment LA-2.

Dianne Badeaux
11318 Highway 1
Lockport, LA 70374

July 25, 2007

Mr. Joseph Christopher
Regional Supervisor, Leasing and Environment
U.S. Minerals Management Service
GOM OCS Region
1201 Elmwood Park Blvd.
New Orleans, LA 70123-2394

Re: Comment on Draft Supplemental EIS for GOM Lease Sale #224

Dear Mr. Christopher:

My name is Diane Badeaux and I am a concerned citizen fortunate enough to be retired from the oil industry.

As a resident of Larose living right along Highway 1 and a member of the industry's New Orleans Chapter of the Desk and Derrick Club I am kept keenly aware of the increasing importance of Louisiana Highway 1 as an Energy Corridor.

Recently I was fortunate to witness the groundbreaking ceremony of the LA 1 Project's southern-most phase, from Leeville to Port Fourchon. I was shocked to see the vulnerability of this highway to a future washout, with water on a beautiful calm day coming within inches of the highway blacktop. While at the groundbreaking, I was surprised to learn that in all of the project funds amassed to date, the federal participation in financing this project has been only 22%.

BADEAUX-1

This fiscal arrangement seems backwards. I thought most major Highway Projects have a 80% federal cost share and 20% local cost share relationship.

[redacted]

BADEAUX-2

I am conscious that the local community, including myself, will pay 37% of expenses through toll revenues over 30 years. With the $5 billion dollars per year of oil the federal government is getting out of the Gulf, largely through this Corridor, the federal role in financing the LA 1 Project should rightfully be at 80%, not 20%!

BADEAUX-3

I will close my comments tonight by asking the Minerals Management Service to call a summit in Washington to creatively get legislation to fund the entire LA 1 Project – not just for our community's behalf, but on behalf of the entire nation!
Get the Department of Homeland Security involved, and the Department of Energy as well. Make them aware of exactly how vulnerable this road is. Tell them it is the "Poster Child of at-risk critical energy infrastructure."

Make the calls.--- Take action.-- Get it done for the nation.

Thank you.

Sincerely,

Dianne Badeaux

BADEAUX-1 The MMS has no direct jurisdiction over funding or construction of onshore infrastructure projects.

BADEAUX-2 See the response to Comment BADEAUX-1.

BADEUAX-3 The Anti-Lobbying Act (18 U.S.C. 1913) prohibits any Federal agency from lobbying Congress directly or indirectly.

CHAPTER 6

REFERENCES

6. REFERENCES

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CHAPTER 7

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CHAPTER 8

GLOSSARY

8. GLOSSARY

Acute—Sudden, short term, severe, critical, crucial, intense, but usually of short duration.

Anaerobic—Capable of growing in the absence of molecular oxygen.

Anthropogenic—Coming from human sources, relating to the effect of humankind on nature.

API gravity—A standard adopted by the American Petroleum Institute for expressing the specific weight of oil.

Aromatic—Class of organic compounds containing benzene rings or benzenoid structures.

Attainment area—An area that is shown by monitored data or by air-quality modeling calculations to be in compliance with primary and secondary ambient air quality standards established by the USEPA.

Barrel (bbl)—A volumetric unit used in the petroleum industry; equivalent to 42 U.S. gallons or 158.99 liters.

Benthic—On or in the bottom of the sea.

Biological Opinion—FWS or NMFS evaluation of the impact of a proposed action on endangered and threatened species, in response to formal consultation under Section 7 or the endangered Species Act.

Block—A geographical area portrayed on official MMS protraction diagrams or leasing maps that contains approximately 2,331 ha (9 mi^2).

Blowout—Uncontrolled flow of fluids from a wellhead or wellbore.

Cetacean—Aquatic mammal of the order Cetacea, such as whales, dolphins, and porpoises.

Chemosynthetic—Organisms that obtain their energy from the oxidation of various inorganic compounds rather than from light (photosynthetic).

Coastal waters—Waters within the geographical areas defined by each State's Coastal Zone Management Program.

Coastal wetlands—forested and nonforested habitats, mangroves, and marsh islands exposed to tidal activity. These areas directly contribute to the high biological productivity of coastal waters by input of detritus and nutrients, by providing nursery and feeding areas for shellfish and finfish, and by serving as habitat for birds and other animals.

Coastal zone—The coastal waters (including the lands therein and thereunder) and the adjacent shorelands (including the waters therein and thereunder) strongly influenced by each other and in proximity to the shorelines of the several coastal states; the zone includes islands, transitional and intertidal areas, salt marshes, wetlands, and beaches and extends seaward to the outer limit of the United States territorial sea. The zone extends inland from the shorelines only to the extent necessary to control shorelands, the uses of which have a direct and significant impact on the coastal waters. Excluded from the coastal zone are lands the use of which is by law subject to the discretion of or which is held in trust by the Federal Government, its officers, or agents. See also State coastal zone boundaries.

Completion—Conversion of a development well or an exploratory well into a production well.

Condensate—Liquid hydrocarbons produced with natural gas; they are separated from the gas by cooling and various other means. Condensates generally have an API gravity of 50º -120º.

Continental margin—The ocean floor that lies between the shoreline and the abyssal ocean floor, includes the continental shelf, continental slope, and continental rise.

Continental shelf—General term used by geologist to refer to the continental margin province that lies between the shoreline and the abrupt change in slope called the shelf edge, which generally occurs in the Gulf of Mexico at about 200 m water depth. The continental shelf is characterized by a gentle slope (about 0.1º). This is different from the juridicial term used in Article 76 of the

Convention on the Law of the Sea (see the definition of Outer Continental Shelf).

Continental slope—The continental margin province that lies between the continental shelf and continental rise, characterized by a steep slope (about 3 º-6º).

Critical habitat—Specific areas essential to the conservation of a protected species and that may require special management considerations or protection.

Crude oil—Petroleum in its natural state as it emerges from a well, or after it passes through a gas-oil separator but before refining or distillation. An oily, flammable, bituminous liquid that is essentially a complex mixture of hydrocarbons of different types with small amounts of other substances.

Deferral—Action taken by the Secretary of the Interior at the time of the Area Identification to remove certain areas/blocks from the proposed sale.

Delineation well—A well that is drilled for the purpose of determining the size and/or volume of an oil or gas reservoir.

Demersal—Living at or near the bottom of the sea.

Development—Activities that take place following discovery of economically recoverable mineral resources, including geophysical surveying, drilling, platform construction, operation of onshore support facilities, and other activities that are for the purpose of ultimately producing the resources.

Development and production plan (DPP)—A document that must be prepared by the operator and submitted to MMS for approval before any development or production activities are conducted on a lease in the Eastern Gulf.

Development well—A well drilled to a known producing formation to extract oil or gas; a production well; distinguished from a wildcat or exploratory well and from an offset well.

Direct employment—Consists of those workers involved the primary industries of oil and gas exploration, development, and production operations (Standard Industrial Classification Code 13—Oil and Gas Extraction).

Discharge—Something that is emitted; flow rate of a fluid at a given instant expressed as volume per unit of time.

Dispersion—A suspension of finely divided particles in a medium.

Drilling mud—A mixture of clay, water or refined oil, and chemical additives pumped continuously downhole through the drill pipe and drill bit, and back up the annulus between the pipe and the walls of the borehole to a surface pit or tank. The mud lubricates and cools the drill bit, lubricates the drill pipe as it turns in the wellbore, carries rock cuttings to the surface, serves to keep the hole from crumbling or collapsing, and provides the weight or hydrostatic head to prevent extraneous fluids from entering the well bore and to downhole pressures; also called drilling fluid.

Economically recoverable resources—An assessment of hydrocarbon potential that takes into account the physical and technological constraints on production and the influence of costs of exploration and development and market price on industry investment in OCS exploration and production.

Effluent—The liquid waste of sewage and industrial processing.

Effluent limitations—Any restriction established by a State or the USEPA on quantities, rates, and concentrations of chemical, physical, biological, and other constituents discharged from point sources into U.S. waters, including schedules of compliance.

Epifaunal—Animals living on the surface of hard substrate.

Essential habitat—Specific areas crucial to the conservation of a species and that may necessitate special considerations.

Estuary—Coastal semienclosed body of water that has a free connection with the open sea and where freshwater meets and mixes with seawater.

Eutrophication—Enrichment of nutrients in the water column by natural or artificial methods accompanied by an increase of respiration, which may create an oxygen deficiency.

Exclusive Economic Zone (EEZ)—The maritime region extending 200 nmi from the baseline of the territorial sea, in which the United States has exclusive rights and jurisdiction over living and nonliving natural resources.

Exploration Plan (EP)—A plan that must be prepared by the operator and submitted to MMS for approval before any exploration or delineation drilling is conducted on a lease in the Western Gulf.

Exploration well—A well drilled in unproven or semi-proven territory to determining whether economic quantities of oil or natural gas deposit are present; exploratory well.

False crawls—Refers to when a female sea turtle crawls up on the beach to nest (perhaps) but does not and returns to the sea without laying eggs.

Field—An accumulation, pool, or group of pools of hydrocarbons in the subsurface. A hydrocarbon field consists of a reservoir in a shape that will trap hydrocarbons and that is covered by an impermeable, sealing rock.

Floating production, storage, and offloading (FPSO) system—A tank vessel used as a production and storage base; produced oil is stored in the hull and periodically offloaded to a shuttle tanker for transport to shore..

Gathering lines—A pipeline system used to bring oil or gas production from a number of separate wells or production facilities to a central trunk pipeline, storage facility, or processing terminal.

Geochemical—Of or relating to the science dealing with the chemical composition of and the actual or possible chemical changes in the crust of the earth.

Geophysical survey—A method of exploration in which geophysical properties and relationships are measured remotely by one or more geophysical methods.

Habitat—A specific type of environment that is occupied by an organism, a population, or a community.

Hermatypic coral—Reef-building corals that produce hard, calcium carbonate skeletons and that possess symbiotic, unicellular algae within their tissues.

Harassment—An intentional or negligent act or omission that creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns that include, but are not limited to, feeding or sheltering.

Hydrocarbons—Any of a large class of organic compounds containing primarily carbon and hydrogen. Hydrocarbon compounds are divided into two broad classes: aromatic and aliphatics. They occur primarily in petroleum, natural gas, coal, and bitumens.

Hypoxia—Depressed levels of dissolved oxygen in water, usually resulting in decreased metabolism.

Incidental take—Takings that result from, but are not the purpose of, carrying out an otherwise lawful activity (e.g., fishing) conducted by a Federal agency or applicant (see Taking).

Indirect employment—Secondary or supporting oil- and gas-related industries, such as the processing of crude oil and gas in refineries, natural gas plants, and petrochemical plants.

Induced employment—Tertiary industries that are created or supported by the expenditures of employees in the primary or secondary industries (direct and indirect employment), including consumer goods and services such as food, clothing, housing, and entertainment.

Infrastructure—The facilities associated with oil and gas development, e.g., refineries, gas processing plants, etc.

Jack-up rig—A barge-like, floating platform with legs at each corner that can be lowered to the sea bottom to raise the platform above the water.

Landfall—The site where a marine pipeline comes to shore.

Lease—Authorization that is issued under Section 8 or maintained under Section 6 of the Outer Continental Shelf Lands Act and that authorizes exploration for, and development and production of, minerals.

Lease sale—The competitive auction of leases granting companies or individuals the right to explore for and develop certain minerals under specified conditions and periods of time.

Lease term—The initial period for oil and gas leases, usually a period of 5, 8, or 10 years depending on water depth or potentially adverse conditions.

Lessee—A party authorized by a lease, or an approved assignment thereof, to explore for and develop and produce the leased deposits in accordance with regulations at 30 CFR 250.

Marshes—Persistent, emergent, nonforested wetlands characterized by predominantly cordgrasses, rushes, and cattails.

Military warning area—An area established by the Department of Defense within which military activities take place.

Minerals—As used in this document, minerals include oil, gas, sulphur, and associated resources, and all other minerals authorized by an Act of Congress to be produced from public lands as defined in Section 103 of the Federal Land Policy and Management Act of 1976.

Nepheloid—A layer of water near the bottom that contains significant amounts of suspended sediment.

Nonattainment area—An area that is shown by monitoring data or by air-quality modeling calculations to exceed primary or secondary ambient air quality standards established by the USEPA.

Nonhazardous oil-field wastes (NOW)—Wastes generated by exploration, development, or production of crude oil or natural gas that are exempt from hazardous waste regulation under the Resource Conservation and Recovery Act (*Regulatory Determination for Oil and Gas and Geothermal Exploration, Development and Production Wastes,* dated June 29, 1988, 53 FR 25446; July 6, 1988). These wastes may contain hazardous substances.

Naturally occurring radioactive materials (NORM)—naturally occurring material that emits low levels of radioactivity, originating from processes not associated with the recovery of radioactive material. The radionuclides of concern in NORM are Radium-226, Radium-228, and other isotopes in the radioactive decay chains of uranium and thorium.

Offloading—Unloading liquid cargo, crude oil, or refined petroleum products.

Operational discharge—Any incidental pumping, pouring, emitting, emptying, or dumping of wastes generated during routine offshore drilling and production activities.

Operator—An individual, partnership, firm, or corporation having control or management of operations on a leased area or portion thereof. The operator may be a lessee, designated agent of the lessee, or holder of operating rights under an approved operating agreement.

Organic matter—Material derived from living plants or animals.

Outer Continental Shelf (OCS)—All submerged lands that comprise the continental margin adjacent to the United States and seaward of State offshore lands.

Pelagic—Of or pertaining to the open sea; associated with open water beyond the direct influence of coastal systems.

Penaeids—Chiefly warm water and tropical prawns belonging to the family Penaeidae.

Plankton—Passively floating or weakly motile aquatic plants (phytoplankton) and animals (zooplankton).

Platform—A steel or concrete structure from which offshore development wells are drilled.

Play—An area in which hydrocarbon accumulations or prospects of a given type occur.

Primary production—Organic material produced by photosynthetic or chemosynthetic organisms.

Produced water—Total water discharged from the oil and gas extraction process; production water or production brine.

Production—Activities that take place after the successful completion of any means for the extraction of resources, including bringing the resource to the surface, transferring the produced resource to shore, monitoring operations, and drilling additional wells or workovers.

Province—A spatial entity with common geologic attributes. A province may include a single dominant structural element such as a basin or a fold belt, or a number of contiguous related elements.

Recoverable reserves—The portion of the identified hydrocarbon or mineral resource that can be economically extracted under current technological constraints.

Recoverable resource estimate—An assessment of hydrocarbon or mineral resources that takes into account the fact that physical and technological constraints dictate that only a portion of resources can be brought to the surface.

Recreational beaches—Frequently visited, sandy areas along the Gulf of Mexico shorefront that support multiple recreational activities at the land-water interface. Included are National Seashores, State Park and Recreational Areas, county and local parks, urban beachfronts, and private resorts.

Refining—Fractional distillation of petroleum, usually followed by other processing (for example, cracking).

Relief—The difference in elevation between the high and low points of a surface.

Reserves—Proved oil or gas resources.

Rig—A structure used for drilling an oil or gas well.

Royalty—A share of the minerals produced from a lease paid in either money or "in-kind" to the landowner by the lessee.

Saltwater intrusion—Saltwater invading a body of freshwater.

Sciaenids—Fishes belonging to the croaker family (Sciaenidae).

Seagrass beds—More or less continuous mats of submerged, rooted, marine, flowering vascular plants occurring in shallow tropical and temperate waters. Seagrass beds provide habitat, including breeding and feeding grounds, for adults and/or juveniles of many of the economically important shellfish and finfish.

Sediment—Material that has been transported and deposited by water, wind, glacier, precipitation, or gravity; a mass of deposited material.

Seeps (hydrocarbon)—Gas or oil that reaches the surface along bedding planes, fractures, unconformities, or fault planes.

Sensitive area—An area containing species, populations, communities, or assemblages of living resources, that is susceptible to damage from normal OCS-related activities. Damage includes interference with established ecological relationships.

Shunting—A method used in offshore oil and gas drilling and production activities where expended cuttings and fluids are discharged through a downpipe, which terminates no more than 10 m from the ocean floor, rather than discharged at the ocean surface.

State coastal zone boundary—The State coastal zone boundaries for each CZMA-affected State are defined at http://coastalmanagement.noaa.gov/mystate/docs/StateCZBoundaries.pdf

Structure—Any OCS facility that extends from the seafloor to above the waterline; in petroleum geology, any arrangement of rocks that may hold an accumulation of oil or gas.

Subarea—A discrete analysis area.

Supply vessel—A boat that ferries food, water, fuel, and drilling supplies and equipment to an offshore rig or platform and returns to land with refuse that cannot be disposed of at sea.

Taking—To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any endangered or threatened species, or to attempt to engage in any such conduct (including actions that induce stress, adversely impact critical habitat, or result in adverse secondary or cumulative impacts). Harassments is the most common form of taking associated with OCS Program activities.

Tension-leg platform (TLP)—A production structure that consists of a buoyant platform tethered to concrete pilings on the seafloor with flexible cable.

Tonnes—A long ton or metric ton; 2,200 pounds.

Total dissolved solids—The total amount of solids that are dissolved in water.

Total suspended particulate matter—The total amount of suspended solids in water.

Total suspended solids—The total amount of suspended solids in water.

Trunkline—A large-diameter pipeline receiving oil or gas from many smaller tributary gathering lines that serve a large area; common-carrier line; main line.

Turbidity—Reduced water clarity due to the presence of suspended matter.

Volatile organic compound (VOC)—Any organic compound that is emitted to the atmosphere as a vapor.

Water test areas—Areas within the Eastern Gulf where Department of Defense research, development, and testing of military planes, ships, and weaponry take place.

Weathering (of oil)—The aging of oil due to its exposure to the atmosphere, causing marked alterations in its physical and chemical makeup.

APPENDICES

Appendix A

Recent Publications of the Environmental Studies Program, Gulf of Mexico Region, 2003 to Present

A. RECENT PUBLICATIONS OF THE ENVIRONMENTAL STUDIES PROGRAM, GULF OF MEXICO REGION, 2003 TO PRESENT

Published in 2007	
Study Number	Title
MMS 2007-015	*Archaeological and Biological Analysis of World War II Shipwrecks in the Gulf of Mexico: Artificial Reef Effect in Deepwater*
MMS 2007-019	*Mixtures of Metals and Polynuclear Aromatic Hydrocarbons May Elicit Complex, Nonadditive Toxicological Interactions*
MMS 2007-022	*Full-Water Column Current Observations in the Central Gulf of Mexico*
MMS 2007-031	*Idle Iron in the Gulf of Mexico*
MMS 2007-033	*Cooperative Research to Study Dive Patterns of Sperm Whales in the Atlantic Ocean*
MMS 2007-034	*Competition and Performance in Oil and Gas Lease Sales and Development in the U.S. Gulf of Mexico OCS Region, 1983-1999*
MMS 2007-035	*Seafloor Characteristics and Distribution Patterns of Lophelia pertusa and Other Sessile Megafauna at Two Upper-Slope Sites in the Northeastern Gulf of Mexico*
MMS-2007-044	*Characterization of Northern Gulf of MexicoDeepwater Hard-Bottom Communities with Emphasis on Lophelia Coral*

Published in 2006	
Study Number	Title
MMS 2006-005	*Fidelity of Red Snapper to Petroleum Platforms and Artificial Reefs in the Northern Gulf of Mexico*
MMS 2006-011	*Sustainable Community in Oil and Gas Country: Final Report*
MMS 2006-028	*Degradation of Synthetic-Based Drilling Mud Base Fluids by Gulf of Mexico Sediments, Final Report*
MMS 2006-030	*Accounting for Socioeconomic Change from Offshore Oil and Gas: Cumulative Effects on Louisiana's Coastal Parishes, 1969-2000*
MMS 2006-034	*Sperm Whale Seismic Study in the Gulf of Mexico, Summary Report: 2002-2004*
MMS 2006-035	*Long-Term Monitoring at the East and West Flower Garden Banks National Marine Sanctuary, 2002-2003*
MMS 2006-036	*Study to Conduct National Register of Historic Places Evaluations of Submerged Sites on the Gulf of Mexico Outer Continental Shelf*
MMS 2006-037	*Effect of Depth, Location, and Habitat Type, on Relative Abundance and Species Composition of Fishes Associated with Petroleum Platforms and Sonnier Bank in the Northern Gulf of Mexico*
  MMS 2006-044 MMS 2006-045 MMS 2006-046	*Effects of Oil and Gas Exploration and Development at Selected Continental Slope Sites in the Gulf of Mexico;* *Volume I: Executive Summary* *Volume II: Technical Report* *Volume III: Appendices*
MMS 2006-063	*Economic Effects of Petroleum Prices and Production in the Gulf of Mexico OCS on the U.S. Gulf Coast Economy*
MMS 2006-064	*Capital Investment Decisionmaking and Trends in Petroleum Resource Development in the U.S. Gulf of Mexico*
MMS 2006-067	*Sperm Whale Seismic Study in the Gulf of Mexico, Annual Report: Years 3 and 4*
MMS 2006-071	*Annotated Bibliography of the Potential Environmental Impacts of Chlorination and Disinfection Byproducts Relevant to Offshore Liquefied Natural Gas Port Facilities*
MMS 2006-072	*Mica Shipwreck Project Report: Deepwater Archaeological Investigation of a 19th Century Shipwreck in the Gulf of Mexico*
 MMS 2006-073	*Exploratory Study of Deepwater Currents in the Gulf of Mexico* *Volume I: Executive Summary*

MMS 2006-074	*Volume II: Technical Report*

Published in 2005	
Study Number	Title
MMS 2005-008	*Visibility and Atmospheric Dispersion Capability over the Northern Gulf of Mexico: Estimates and Observations of Boundary Layer Parameters*
MMS 2005-009	*Interactions Between Migrating Birds and Offshore Oil and Gas Platforms in the Northern Gulf of Mexico: Final Report*
MMS 2005-012	*Potential Spatial and Temporal Vulnerability of Pelagic Fish Assemblages in the Gulf of Mexico to Surface Oil Spills Associated with Deepwater Petroleum Development*
MMS 2005-016	*Workshop on Socioeconomic Research Issues for the Gulf of Mexico OCS Region, February 2004*
MMS 2005-019	*Effects of Oil and Gas Development: A Current Awareness Bibliography 2000-2004*
MMS 2005-029	*Modeling Structure Removal Processes in the Gulf of Mexico*
MMS 2005-031	*Climatology of Ocean Features in the Gulf of Mexico*
MMS 2005-032	*Understanding the Processes that Maintain the Oxygen Levels in the Deep Gulf of Mexico: Synthesis Report*
MMS 2005-038	*Characterization of Algal-Invertebrate Mats at Offshore Platforms and the Assessment of Methods for Artificial Substrate Studies*
MMS 2005-039	*Aspects of the Louisiana Coastal Current*
MMS 2005-044	*Relative Contribution of Produced Water Discharge Oxygen Demand in the Development of Hypoxia*
MMS 2005-047	*Feasibility of Using Remote-sensing Techniques for Shoreline Delineation and Coastal Habitat Classification for Environmental Sensitivity Index (ESI) Mapping*
MMS 2005-054	*Evaluating Sublethal Effects of Exposure to Petroleum Additives on Fishes Associated with Offshore Platforms*
MMS 2005-066	*Proceedings: Twenty-Third Gulf of Mexico Information Transfer Meeting, January 2005*
MMS 2005-067	*Mapping Areas of Hard Bottom and Other Important Bottom Types: Outer Continental Shelf and Upper Continental Slope*

Published in 2004	
Study Number	Title
Executive Summary	*Gulf of Mexico Comprehensive Synthetic Based Muds Monitoring Program* *Volume I* *Volume II* *Volume III—Appendices*
MMS 2004-009	*Long-Term Oil and Gas Structure Installation and Removal Forecasting in the Gulf of Mexico: A Decision- and Resource-Based Approach*
MMS 2004-013	*Intermediate Depth Circulation in the Gulf of Mexico: PALACE Float Results for the Gulf of Mexico Between April 1998 and March 2002*
MMS 2004-015	*Minerals Management Service Environmental Studies Program: A History of Biological Investigations in the Gulf of Mexico, 1973-2000*
MMS 2004-016	*Fiscal System Analysis: Concessionary and Contractual Systems Used in Offshore Petroleum Arrangements*
MMS 2004-017	*Cross-Shelf Exchange Processes and the Deepwater Circulation of the Gulf of Mexico: Dynamical Effects of Submarine Canyons and Interactions of Loop Current Eddies with Topography; Final Report*
MMS 2004-022	*Subsurface, High-Speed Current Jets in the Deepwater Region of the Gulf of Mexico: Final Report*
MMS 2004-027	*OCS-Related Infrastructure in the Gulf of Mexico Fact Book*
MMS 2004-036	*Observational and Predictive Study of Inner Shelf Currents over the Louisiana-Texas Shelf*
MMS 2004-040	*Strong Mid-Depth Currents and a Deep Cyclonic Gyre in the Gulf of Mexico*

MMS 2004-041	*Economic Impact in the U.S. of Deepwater Projects: A Survey of Five Projects*
MMS 2004-047	*Supply Network for Deepwater Oil and Gas Development in the Gulf of Mexico: An Empirical Analysis of Demand for Port Services*
MMS 2004-049 MMS 2004-050 MMS 2004-051	*History of the Offshore Oil and Gas Industry in Southern Louisiana: Interim Report* *Volume I: Papers on the Evolving Offshore Industry* *Volume II: Bayou Lafourche—An Oral History of the Development of the Oil and Gas Industry* *Volume III: Samples of Interviews and Ethnographic Prefaces*
MMS 2004-052	*Effects of Changes in Oil and Gas Prices and State Offshore Petroleum Production on the Louisiana Economy, 1969-1999*
MMS 2004-057	*Labor Migration and the Deepwater Oil Industry*
MMS 2004-060	*Boundary Layer Study in the Western and Central Gulf of Mexico*
MMS 2004-063	*High-Resolution Integrated Hydrology-Hydrodynamic Model: Development and Application to Barataria Basin, Louisiana*
MMS 2004-067	*Sperm Whale Seismic Study in the Gulf of Mexico; Annual Report: Year 2*
MMS 2004-070	*User's Guide for the 2005 Gulfwide Offshore Activities Data System (GOADS-2005): Final Report*
MMS 2004-071	*Data Quality Control and Emissions Inventories of OCS Oil and Gas Production Activities in the Breton Area of the Gulf of Mexico*
MMS 2004-072	*Gulfwide Emission Inventory for the Regional Haze and Ozone Modeling Effort*

Published in 2003	
Study Number	Title
MMS 2003-004	*Dynamics of the Oil and Gas Industry in the Gulf of Mexico: 1980-2000; Final Report*
MMS 2003-005	*Proceedings: Twenty-First Annual Gulf of Mexico Information Transfer Meeting, January 2002*
MMS 2003-009	*Rigs and Reefs: A Comparison of the Fish Communities at Two Artificial Reefs, a Production Platform, and a Natural Reef in the Northern Gulf of Mexico*
MMS 2003-018	*Modeling the Economic Impacts of Offshore Oil and Gas Activities in the Gulf of Mexico: Methods and Applications*
MMS 2003-022	*Labor Demand in the Offshore Oil and Gas Industry in the 1990s: The Louisiana Case*
MMS 2003-029	*Importance of Zooplankton in the Diets of Blue Runner (Caranx crysos) Near Offshore Petroleum Platforms in the Northern GOM*
MMS 2003-030	*Workshop on Deepwater Environmental Studies Strategy: A Five-Year Follow-Up and Planning for the Future*
MMS 2003-031	*Long-Term Monitoring of the East and West Flower Garden Banks National Marine Sanctuary, 2000-2001*
MMS 2003-038	*Environmental Justice Considerations in Lafourche Parish, Louisiana*
MMS 2003-040	*Marine and Coastal Fishes Subject to Impingement by Cooling-Water Intake Systems in the Northern Gulf of Mexico: An Annotated Bibliography*
MMS 2003-041	*Changing Patterns of Ownership and Control in the Petroleum Industry: Implications for the Market for Oil and Gas Leases in the Gulf of Mexico OCS Region, 1983-1999*
MMS 2003-048 MMS 2003-049	*Deepwater Observations in the Northern Gulf of Mexico from In-Situ Current Meters and PIES: Final Report* *Volume I: Executive Summary* *Volume II: Technical Report*
MMS 2003-060 MMS 2003-061 MMS 2003-062	*Refining and Revising the GOM OCS Region High-Probability Model for Historic Shipwrecks* *Volume I: Executive Summary* *Volume II: Technical Narrative* *Volume III: Appendices*
MMS 2003-063	*Historical Reconstruction of the Contaminant Loading and Biological Responses in the Central Gulf of Mexico Shelf Sediments*

MMS 2003-065	*Preparation of an Interactive Key for Northern Gulf of Mexico Polychaete Taxonomy Employing the DELTA/INTKEY System*
MMS 2003-069	*Sperm Whale Seismic Study in the Gulf of Mexico; Annual Report: Year 1*
MMS 2003-070	*Explosive Removal of Offshore Structures: Information Synthesis Report*
MMS 2003-072	*Selected Aspects of the Ecology of the Continental Slope Fauna of the Gulf of Mexico: A Synopsis of the Northern Gulf of Mexico Continental Slope Study, 1983-1988*
MMS 2003-073	*Proceedings: Twenty-Second Annual Gulf of Mexico Information Transfer Meeting*
MMS 2003-074	*Modeling and Data Analysis of Circulation Processes in the Gulf of Mexico: Final Report*

Appendix B

MMS-Funded Hurricane Research and Studies

B. MMS-FUNDED HURRICANE RESEARCH AND STUDIES

Subject	Description
Hurricanes Katrina and Rita	
Joint Industry Project to Study Risk-Based Restarts of Untreated Subsea Oil and Gas Flowlines in the GOMR (Project No. 579)	This project assesses potential solutions to the disruptions of production restart from hydrates affecting pipelines after a long shut-in period such as a hurricane. Preliminary work shows that it may be possible to reduce the risk of hydrate plugging by selecting an appropriate restart rate. The MMS and industry will use the results of this project to reduce the risk of having hydrates stop production restarts.
Hindcast Data on Winds, Waves and Currents in Northern Gulf of Mexico in Hurricanes Katrina and Rita (2005) (Project No. 580)	The study objective is to develop a database of wind, sea state, and currents resulting from Hurricanes Katrina and Rita meteorological data and application of advanced hindcast models. The study contractor has already responded to urgent industry needs for a preliminary assessment of the impact of Hurricanes Katrina and Rita by performing and distributing to several offshore operators an "emergency response (ER)" wind and wave hindcast. The study contractor will make that same data immediately available to the other MMS contracted researchers providing Hurricane Katrina/Rita research then, following completion of the study contractor's new work, they will deliver a second and more in-depth hindcast data analysis (referred to as "fast response (FR)" that results from this new study. The FR hindcast differs from the ER hindcast in the following ways: (1) it will use a larger base of measured wind, wave, surge, and current data, (2) it will include a more detailed reanalysis of the wind field; (3) particular attention will be paid to provision of much higher resolution in shallow water and to the inclusion of the storm-perturbed water level in the shallow-water wave hindcast; and (4) more robust 1D and 2D current models will be adopted.
Pipeline Damage Assessment from Hurricane Katrina/Rita (Project No. 581)	The objective of the study is to find out what happened to the GOM pipeline infrastructure during Hurricanes Katrina and Rita and how to be better prepared in the future to reduce hurricane damage in the GOM. The study contractor proposes development of a web-based pipeline damage reporting system with MMS's eWell system. The intent of the web-based program is to allow operators with options to report their operational status more quickly and efficiently following a major event, plus it allows MMS the means to automate data collection and reporting.
Assessment of Fixed Offshore Platform Performance in Hurricanes Katrina and Rita (Project No. 578)	The objective of this effort is to conduct a qualitative and quantitative assessment of fixed offshore platforms that were affected by Hurricane Katrina and/or Rita. Resulting data will be evaluated to determine if any common trends occur, and also to determine if current API standards are an accurate indicator of expected performance. Coordination and consultation with the API HEAT group will occur throughout the project.
Modeling Waves and Currents Produced by Hurricanes Katrina and Rita (GM-06-x10)	The objective of the study is to assess the response of waves and currents throughout the water column on the northern GOM slope and shelf to Hurricanes Katrina and Rita, using numerical modeling techniques in conjunction with available meteorological and physical oceanographic data. In particular, this study aims at 1. a realistic simulation of circulation throughout the entire water column in the northern GOM continental slope and shelf regions, including the response of currents and waves to Hurricanes Katrina and Rita; 2. determination of the length of time for which substantial ocean response to these hurricanes persisted; and 3. determination of the area or areas of greatest wave height and current speed.

Post-Hurricane Assessment of Sensitive Habitats of the Flower Garden Banks Vicinity (GM-06-x11)	The condition of the communities on the banks selected for the study is important to the health of the ecosystem as a whole. This study will conduct field surveys at the East Flower Garden Bank and at Sonnier, Geyer, and possibly West Flower Garden and McGrail Banks to determine their condition and to track the progress of recovery from Hurricane Rita effects. The study will enhance MMS's ability to distinguish natural from anthropogenic impacts. Results from the study of these banks can be considered representative of others in the area and will improve the MMS's ability to make management decisions.
Post-Hurricane Assessment of OCS-Related Infrastructure and Communities in the Gulf of Mexico Region (GM-92-42-124)	The primary objective of this project is to update the existing Infrastructure Fact Book in light of the recent changes in the industry and the region. The goal will be a better understanding of the impacts that the 2005 tropical activity may have on future onshore infrastructure development trends and outlooks. A second objective will be to reorganize and supplement some of the information to better support EIS development. In addition to updating the underlying data, the original data documentation will be updated to ensure that the metadata associated with the project meets newer MMS data collection standards that have been developed since the original project concluded. The project will also conduct a socioeconomic analysis of select communities with a high concentration of OCS-related infrastructure. This analysis will take the existing GIS infrastructure information, as well as additions and supplements developed during this project, and identify communities of interest. For a set of 6-10 communities selected, detailed community profiles will be developed using Census data.
Spatial Restructuring and Fiscal Impacts in the Wake of Disaster: The Case of the Oil and Gas Industry Following Hurricanes Katrina and Rita (GM-92-42-125)	The objective of the study is to examine the following research questions: 1. What role will the oil and gas industry play in providing employment stability in the region in the aftermath of the storms, and how will this change over time? 2. Will a spatial shift of employment occur in response to the storms? If so, which areas stand to benefit and which areas stand to suffer from these changes? 3. How will the response of the oil and gas industry compare with other major industrial sectors in terms of its impact on employment and thus the region's recovery? 4. What strategies will the oil and gas industry use to recruit new and retain current employees? 5. What fiscal effects will the industry have on impacted communities, Gulf States, and the Gulf region?
Hurricane Ivan	
Examination and Review of Mobile Offshore Drilling Unit (MODU) Loss of Station-keeping Ability during Hurricane Ivan and Assessment of Current Mooring Standards and Criteria to Prevent Similar Failures (Project No. 548)	The project examined the loss of MODU station-keeping in the Gulf of Mexico during Hurricane Ivan in September 2004, comparing those findings with that of recent Hurricanes Andrew (1992) and Lili (2002), and it assessed the current mooring standards and criteria to prevent similar failures.
Assessment of Fixed Offshore Platforms in Hurricane Ivan, Andrew (Project No. 549)	Based on the damage data collected from Hurricanes Ivan (2004), Andrew (1992), and Lili (2002), this project determined the effectiveness of current structural design standards and MMS regulations. It analyzed the effectiveness of API RP2A and Section 17 to see if both the API standards and MMS regulations performed as expected for the assessment of existing fixed platforms.

A Pilot Study for Regionally-Consistent Hazard Susceptibility Mapping of Submarine Mudslides, Offshore Gulf of Mexico (Project No. 550)	During Hurricane Ivan in 2004, a number of GOM pipelines and platforms were believed to have been impacted by mudslides in the region of Ivan's path. This project provides hazard information for the design and placement of new pipelines and structures by determining the applicability of developing regionally consistent hazard maps that delineate relative susceptibility of GOM offshore regions to future submarine mudslides, including identification of past and future probable locations of underwater slope failures. The project consists of a pilot test to map the seafloor bottom using high-resolution bathymetric and seismic data to delineate past mudslide failures, sediments susceptible to failure, and areas of relative stability. An important part of this mapping is to determine the relative ages of sediment and past failures in order to evaluate where future failures are most likely to occur, and equally important, likely to not occur.
Assessment of Drilling and Workover Rig Storm Sea Fastenings on Offshore Floating Platforms During Hurricane Ivan (Project No. 551)	Drilling and workover rigs on floating production systems (FPS's) are held to the decks by sea fastenings to prevent movement during hurricanes. During Hurricane Ivan, a number of drilling or workover rigs shifted. These movements are assessed, along with the current design philosophy and criteria for storm sea fastenings, rig and storm sea fastening installation practices, and onboard storm operational practices to ready FPS's for a hurricane. The study's results provide information that can be used to assess any needs to revise tie-down criteria or practices.
Mudslides during Hurricane Ivan and an Assessment of the Potential for Future Mudslides in the GOM (Project No. 552)	During 2004 and 2005, Hurricanes Ivan, Katrina, and Rita damaged and destroyed hundreds of GOM pipelines and platforms, many from mudslides both in line with and adjacent to the hurricanes' paths. This project examines and reviews the mudflow/mudslide areas in the GOM caused by hurricanes. Revised and/or new maps indicating areas of high risk were produced. This will be accomplished through a review of both historical data, as well as new data that resulted from Hurricanes Ivan, Katrina, and Rita.
Pipeline Damage Assessment from Hurricane Ivan (Project No. 553)	In September 2004, Hurricane Ivan, a Category 4 hurricane, moved through the GOM with winds and waves that exceeded the 100-year storm design criteria of offshore facilities. Approximately 10,000 mi of pipelines were in the direct path of Hurricane Ivan. The MMS received industry damage assessment reports identifying damage to the offshore pipeline infrastructure. This project determined the type, cause, and extent of pipeline damage incurred during Hurricane Ivan and provides guidance for improving pipeline integrity/design to reduce potential damage from future GOM hurricanes.
Offshore Hurricane Readiness & Recovery Conference (Project No. 559)	The Offshore Hurricane Readiness & Recovery Conference, co-sponsored by MMS, was held July 26-27, 2005, in Houston, Texas. The conference brought industry and government officials together to share and learn from the experiences of Hurricane Ivan to improve future performance and reliability of offshore operations in the GOM.
Ocean Currents under Hurricane Ivan on the Mississippi/Alabama Shelf (GM-05-x12)	The purpose of this interagency agreement is to analyze vertical profiles of ocean currents prior to, during, and after the passage of Hurricane Ivan to assess the response of the ocean to such an energetic atmospheric event. In particular, a 3-dimensional response of ocean currents will be sought by the Naval Research Laboratory research team.

Hurricane Lili	
Validation and Calibration of API RP2A Using Hurricane Lili to Update the Hurricane Andrew Joint Industry Project (JIP) Results that Provided the Basis for API Section 17 (Project No. 466)	This project updates the API RP2A section using Hurricane Lili data to validate and calibrate Hurricane Andrew's JIP results. The general project objectives were to 1. determine the validity of the API RP2A process using a combined set of Hurricane Andrew and Hurricane Lili data; 2. determine the anticipated conservatism of the API process, if any, by determining the bias factors for the jacket and foundation; 3. identify the areas of the API design process, wave load, foundation design, etc., that provide the most significant bias contributors; and 4. make recommendations on improvements to API RP2A.
Hindcast Study of Winds, Waves, and Currents in Northern GOM in Hurricane Lili (2002) (Project No. 467)	The purpose of this study was to develop a description of the evolution and distribution of the surface wind field, wave, salinity, sea-surface temperature, and current field in the northern GOM during the approach and passage of Hurricane Lili in 2002. The hindcast used all available public domain meteorological and oceanographic measured data, and Oceanweather's most accurate cyclone wind and wave hindcast methods. Hindcast results are validated against available measured data and an assessment of the accuracy of the hindcast provided with the results. The narrative report includes a description of the data sources, storm evolution (track and intensity), wind and wave hindcast method and a summary of results.
Post-Mortem Failure Assessment of Drilling Rigs during Hurricane Lili (Project No. 469)	The project studied the failures of offshore drilling rigs, MODU's, and jackup rigs associated with the passage of Hurricane Lili in the autumn of 2002. It developed recommendations for updates on criteria, reviewed data from the Hurricane Andrew timeframe, and the made recommendations to SNAME RP for possible future mitigation action.
Assessment of Performance of Deepwater Floating Production Facilities (Project No. 471)	This project collected and assessed information on the performance of deepwater production facilities that were impacted by Hurricane Lili (2002). This study formed the basis for developing recommendations for improvement in design and operation of installations such as 1. vortex-induced vibration of risers; 2. loss of air gap with wave loading on decks; 3. tension leg platform TLP performance; and 4. spar performance measurements.

Evaluate and Compare Hurricane-Induced Damage to Offshore Pipelines for Hurricane Lili—Rev. A (Project No. 503)	This project investigated the major classes of pipeline failure that resulted to GOM OCS facilities by Hurricane Lili in the fall of 2002. The project had four objectives: 1. investigate pipeline failures resulting from Hurricane Lili, including flowlines, major trunk lines, and platform risers from both fixed and floating production facilities; 2. compare and contrast these failures with those reported from Hurricane Andrew; 3. make specific recommendations for changes in design or operations guidelines that might prevent or mitigate such failures in the future; and 4. suggest cost-effective methods for making existing pipelines designed by older guidelines less likely to fail in the future.
Hurricane Andrew	
Study and Hindcast of Wind and Wave Fields for Hurricane Andrew (Project No. 193)	This study was a JIP to describe the evolution and distribution of the surface wind field and wave field in the northern GOM during Hurricane Andrew in August 1992. The hindcast used public domain meteorological and oceanographic measured data and the Oceanweather's most accurate cyclone wind and wave hindcast methods. The narrative report includes a description of the data sources, storm evolution (track and intensity), hindcast method and a summary of results.
Hurricane Andrew Calibration Study (Project No. 199)	This study was a JIP to collect information gained from platform failures and survivals during Hurricane Andrew and to develop a database for the future management of existing platforms. The MMS, through its Platform Verification Program, is responsible for a wide variety of functions related to the strength and integrity of offshore platforms. This project incorporates a "calibration" task that uses the outcome of Hurricane Andrew (survived, damaged, or failed platforms) to update and adjust, where necessary, current practices for assessing in-place offshore platforms. This calibrated approach could become part of a future API RP2A recommendation for assessing existing offshore platforms.
Performance of Safety and Pollution Control Devices in the Aftermath of Hurricane Andrew (Part of the Hurricane Andrew OCS Damage Assessment Program) (Project No. 203)	The objective of this project was to develop a reliability database that will increase the confidence in the methodology used to develop safety systems, thereby increasing the safety of offshore developments. The basis of achieving the objectives of this work was to secure the support of operators associated with MMS to ease the gathering of data related to the performance of safety and pollution control devices within the offshore environment. These data were collated into a computer database and used as input to the review of reliability assessment methodology and the performance of test case analysis.
Post Mortem Platform Failure Evaluation Study (Project No. 204)	This study was a JIP that used the results of Hurricane Andrew to evaluate engineering methods for predicting platform failure or survivability by comparing screening analysis and/or detailed failure analysis against actual field data (i.e., platforms that were exposed to Andrew and either survived, collapsed, or were damaged). In addition, the study also examined the concept of a formal Offshore Platform Evaluation System as a management information system.
Shallow Water Wave and Current Field Study (Project No. 206)	The study provides a comprehensive and reliable database of environmental data in shallow-water (as well as offshore) areas affected by Hurricane Andrew through the implementation and application of advanced numerical wave and current hindcast models. The models adopted were previously applied and validated against historical GOM hurricanes. These were carefully checked and recalibrated against available data acquired in Hurricane Andrew.
API/Hurricane Foundation Study (Project No. 207)	The study is a JIP to develop separate bias factors for evaluation of pile foundations of GOM offshore steel jackets based upon their performance during Hurricane Andrew. Some similarly limited studies were performed for caisson structures. The purpose of the study is to evaluate possible conservatism in the current API RP2A foundation design recipe.

Development of Acceptance Criteria for Caisson Structures Damaged during Hurricane Andrew (Project No. 209)	Approximately 100 caisson structures were tilted during Hurricane Andrew. The objective of this study was to develop an acceptance criteria for those tilted structures and to develop guidelines for straightening those structures that did not meet the criteria.
Hurricane Andrew Effects on Offshore Platforms (Project No. 210)	This study was a JIP to inspect and analyze three Chevron platforms in their South Timbalier field. Two structures survived Hurricane Andrew; the other toppled during the hurricane. The objective of the study was to compare analytical predictions with actual field performance, with particular emphasis on individual members and platform system failures. This assessment provided information in developing guidelines to be incorporated into API RP2A.
Dynamic Nonlinear Loading Effects on Offshore Platforms (Project No. 224)	The project's objective was to conduct parametric studies of the dynamic response of reduced degrees of freedom nonlinear systems and to determine how the results from simplified nonlinear capacity analysis relate to the results from complex time-domain analysis of the performance of platforms in extreme condition storms. Observed platform performances during recent hurricanes (e.g., Andrew, Camille, Betsy, and Hilda) were used to verify the analysis. Engineering guidelines were developed to define dynamic nonlinear loading-capacity effects on the overall performance characteristics of platforms.
Hurricane Andrew Effects on Offshore Platforms (Phase IIJIP) (Project No. 229)	The study was a JIP. Phase I was a calibration task to study the effects of Hurricane Andrew on platforms (i.e., survived, damaged, or failed). The outcomes were used to update current practices for assessing the ability of in-place platforms to withstand hurricanes. This calibration approach became part of API's RP2A standard for assessing existing offshore platforms.

Appendix C

Figures

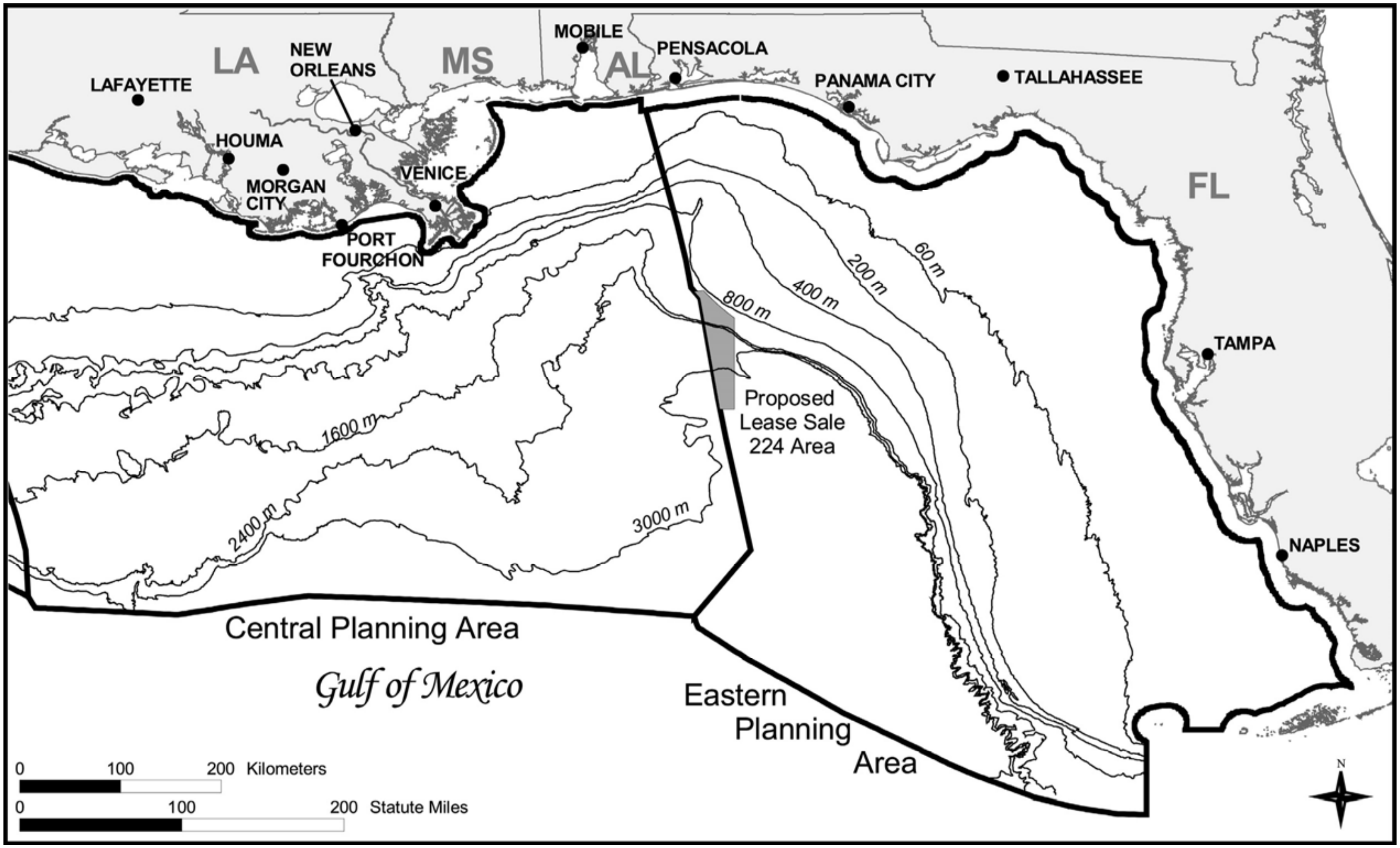


Figure 1-1. Gulf of Mexico Outer Continental Shelf Planning Areas, Proposed Lease Sale 224 Area, and Locations of Major Cities.

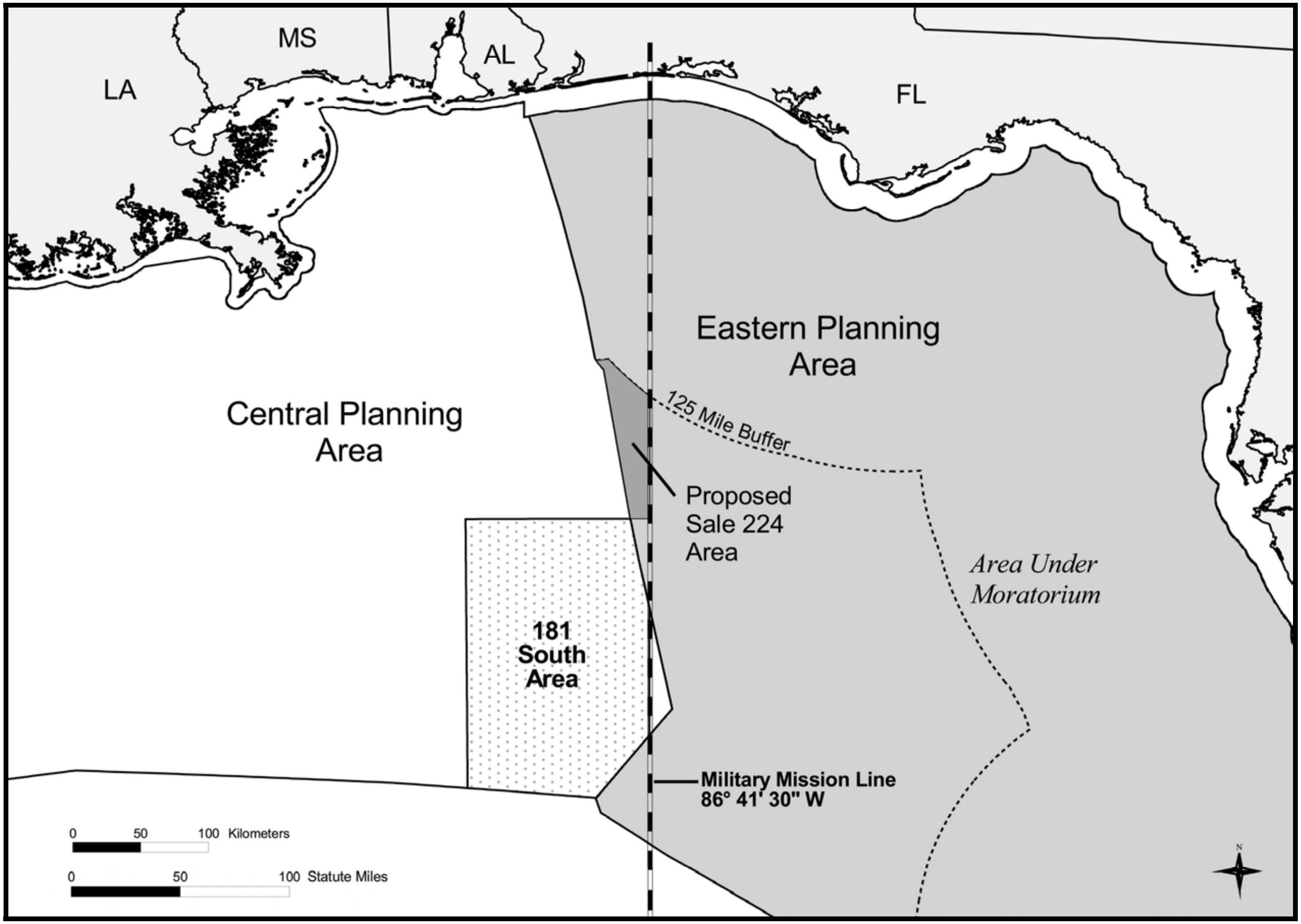


Figure 1-2. Two New Lease Sale Areas Available in the Gulf of Mexico as a Result of Gulf of Mexico Energy Security Act (Lease Sale 224 Area and 181 South Area).

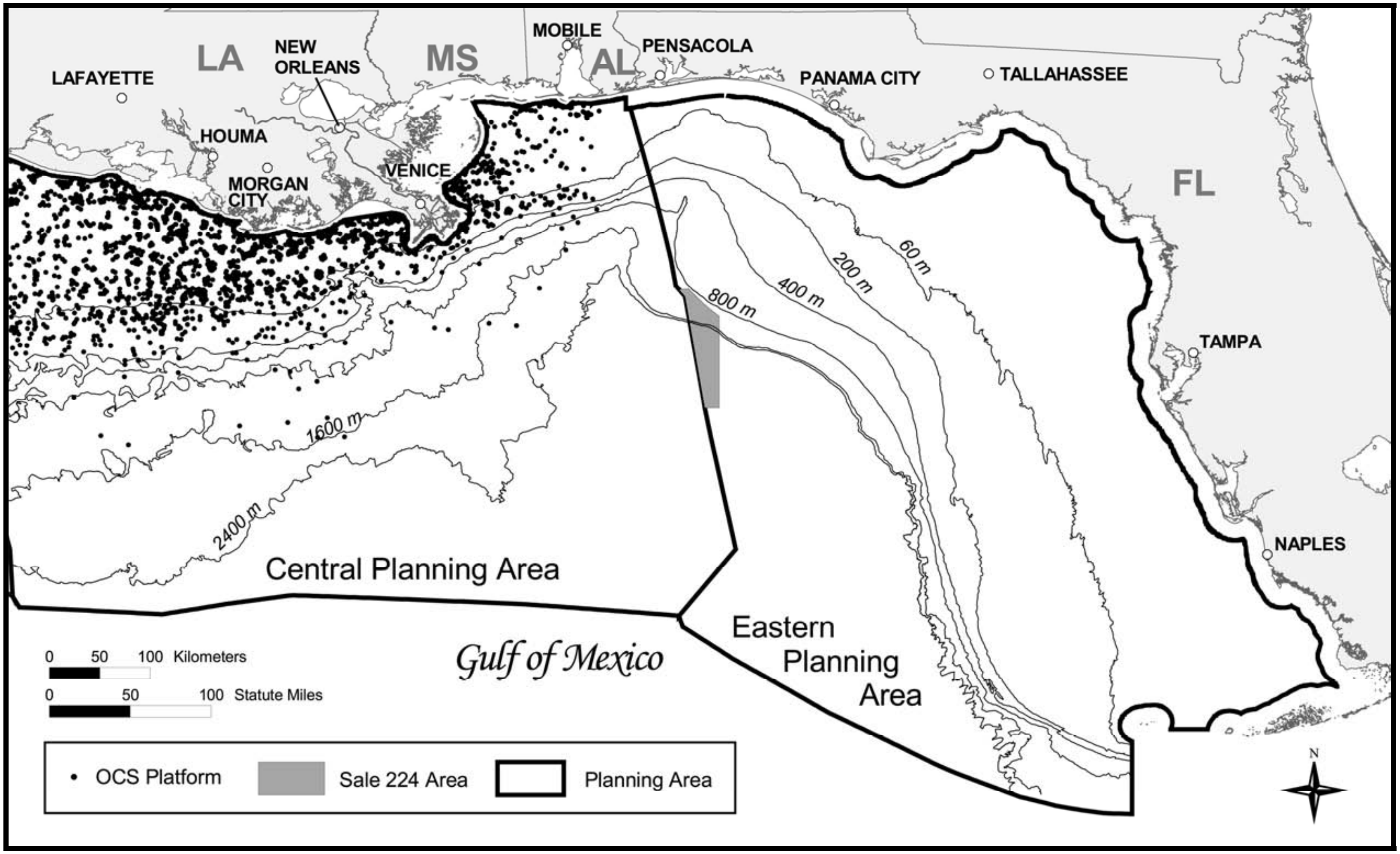


Figure 1-3. OCS Platform Distribution across the Gulf of Mexico.

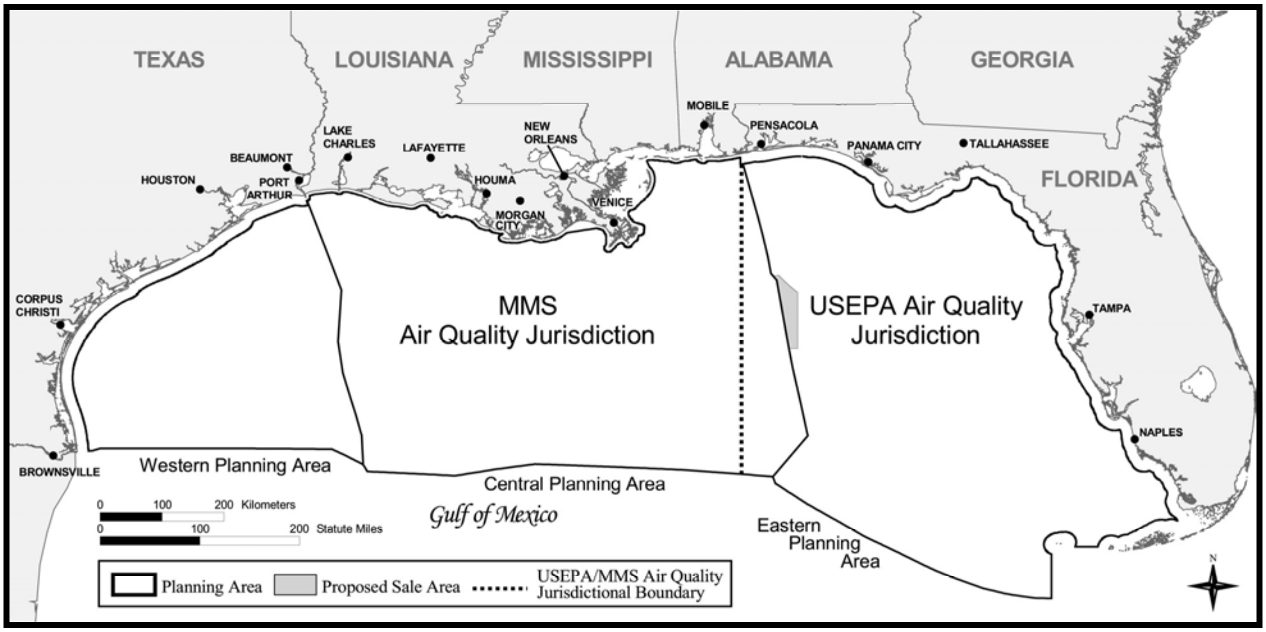


Figure 1-4. Air Quality Jurisdiction.

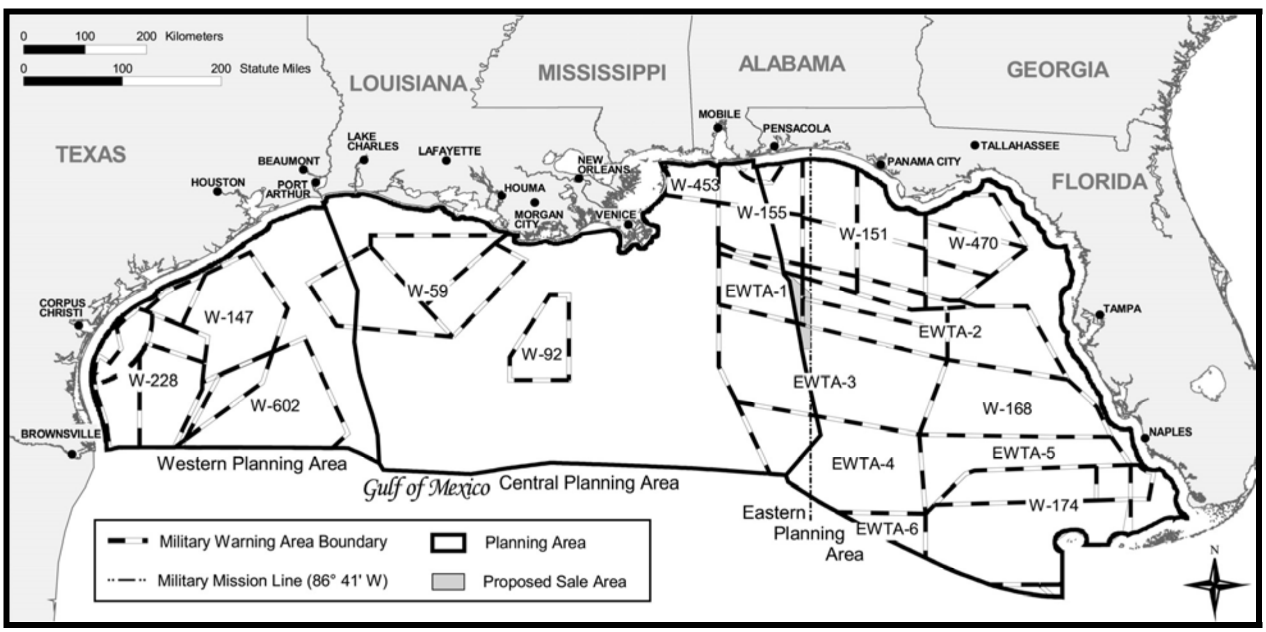


Figure 2-1. Military Warning Areas in the Gulf of Mexico.

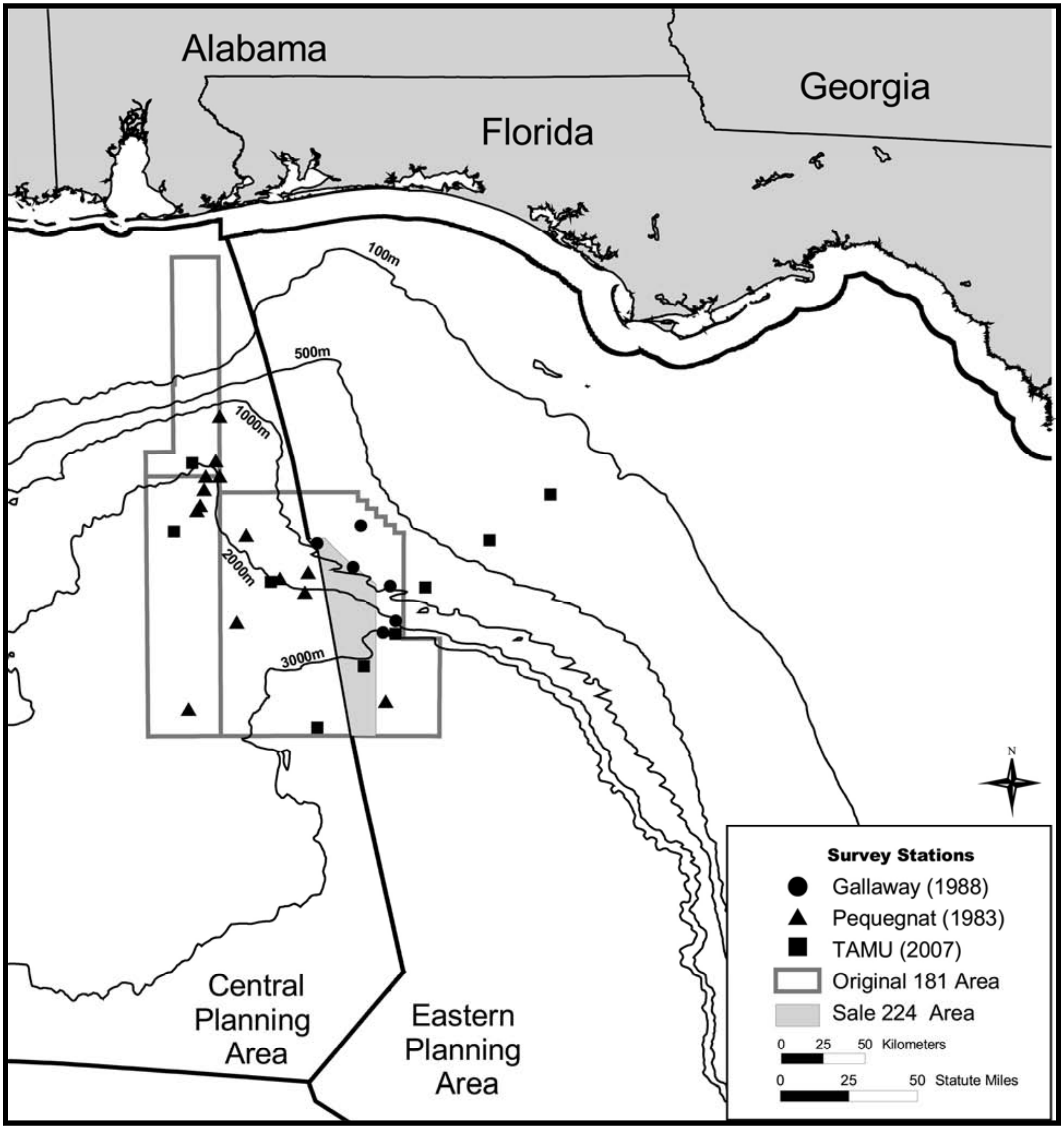


Figure 3-1. Biological Sample and Survey Locations in the Proposed Lease Sale 224 Area.

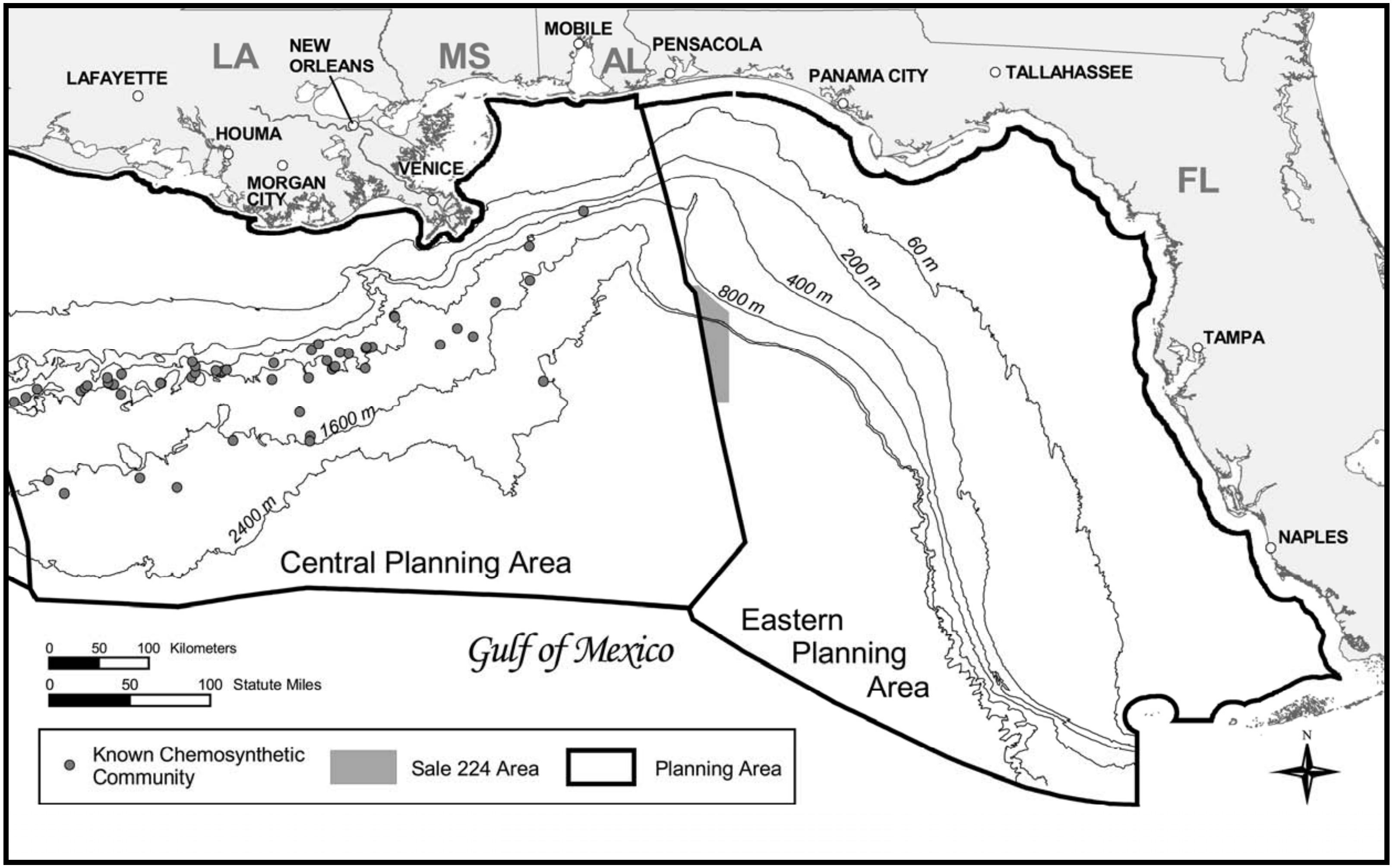


Figure 3-2. Location of Known Chemosynthetic Communities in the Gulf of Mexico.

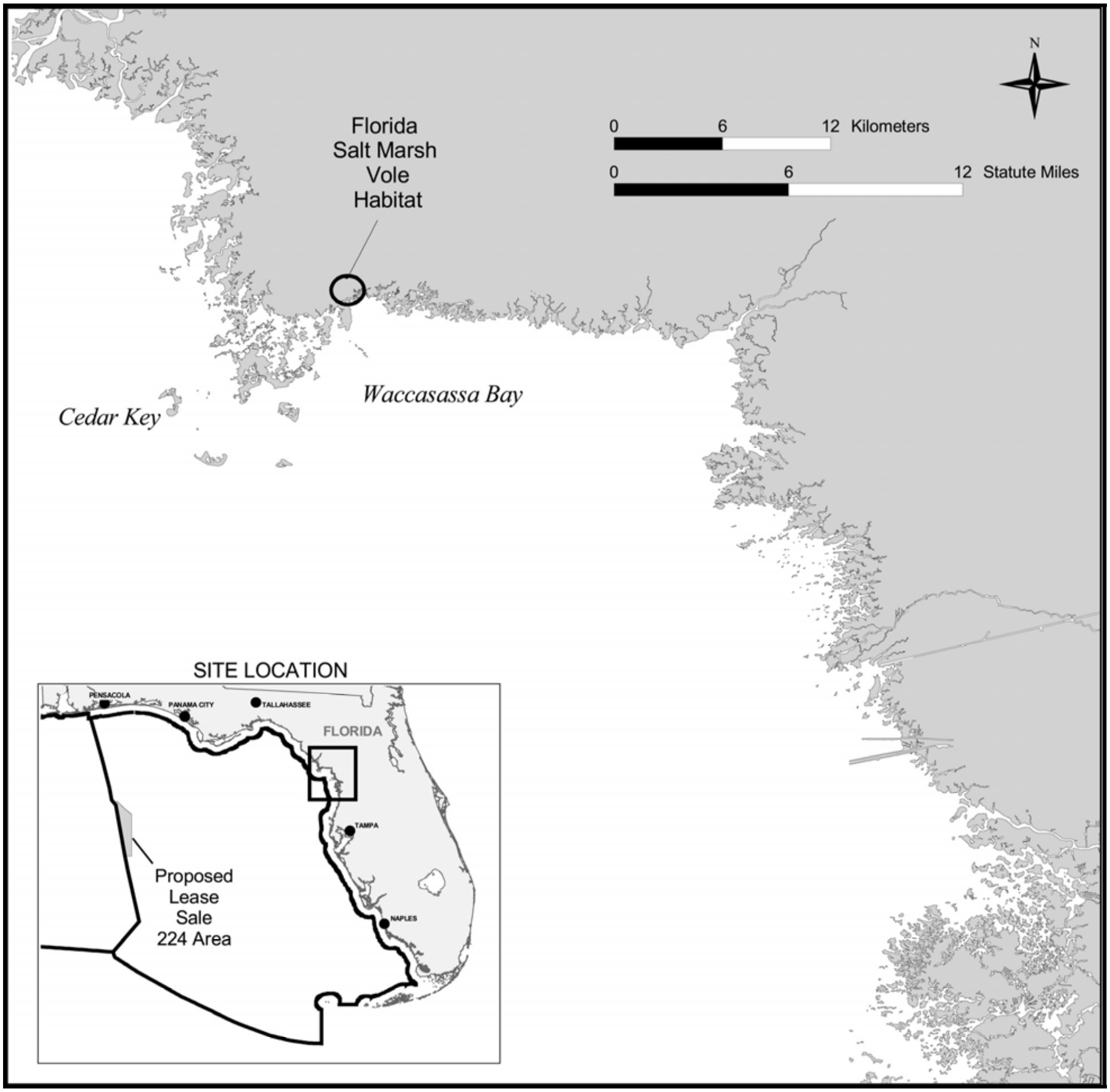


Figure 3-3. Location of the Only Known Site of the Florida Salt Marsh Vole Habitat.

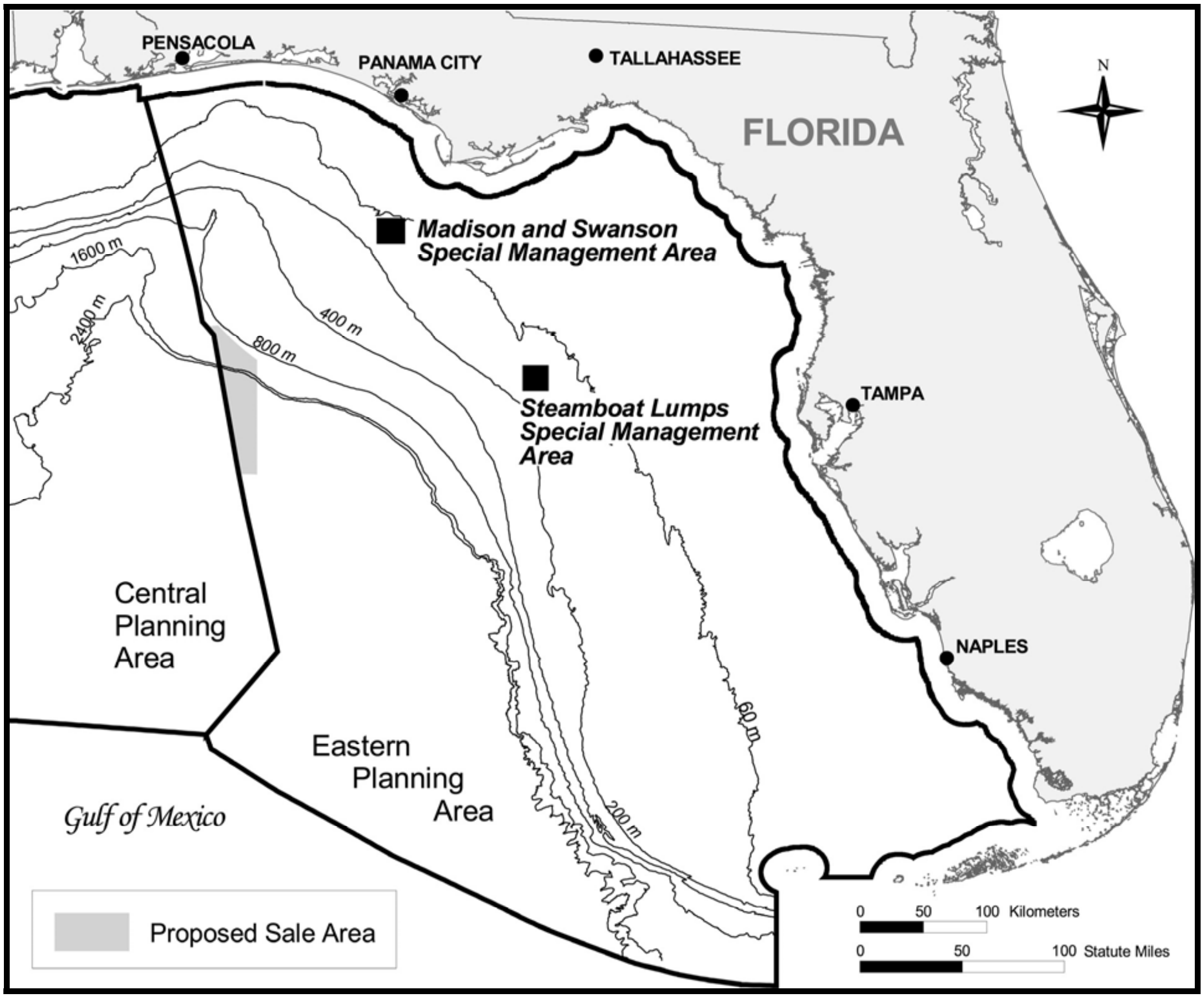


Figure 3-4. Marine Protected Areas in the Gulf of Mexico.

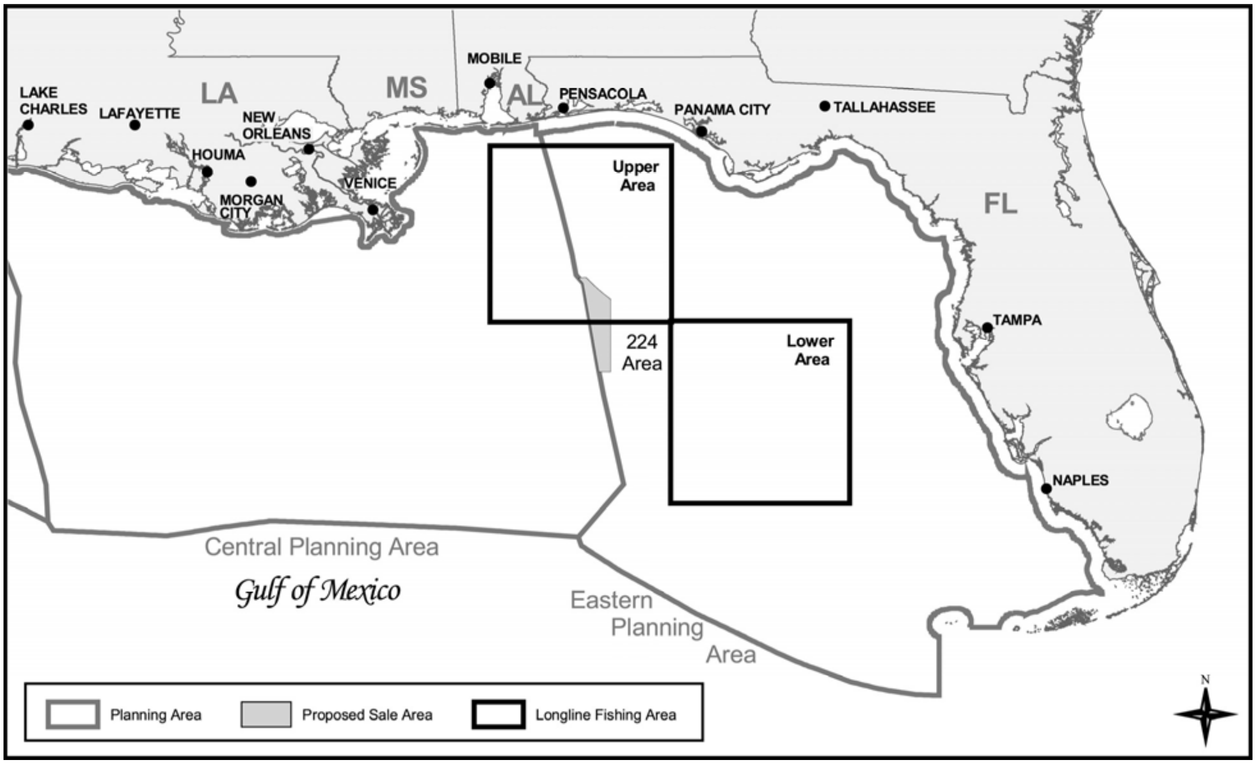


Figure 3-5. Areas Closed to Longline Fishing in the Gulf of Mexico.

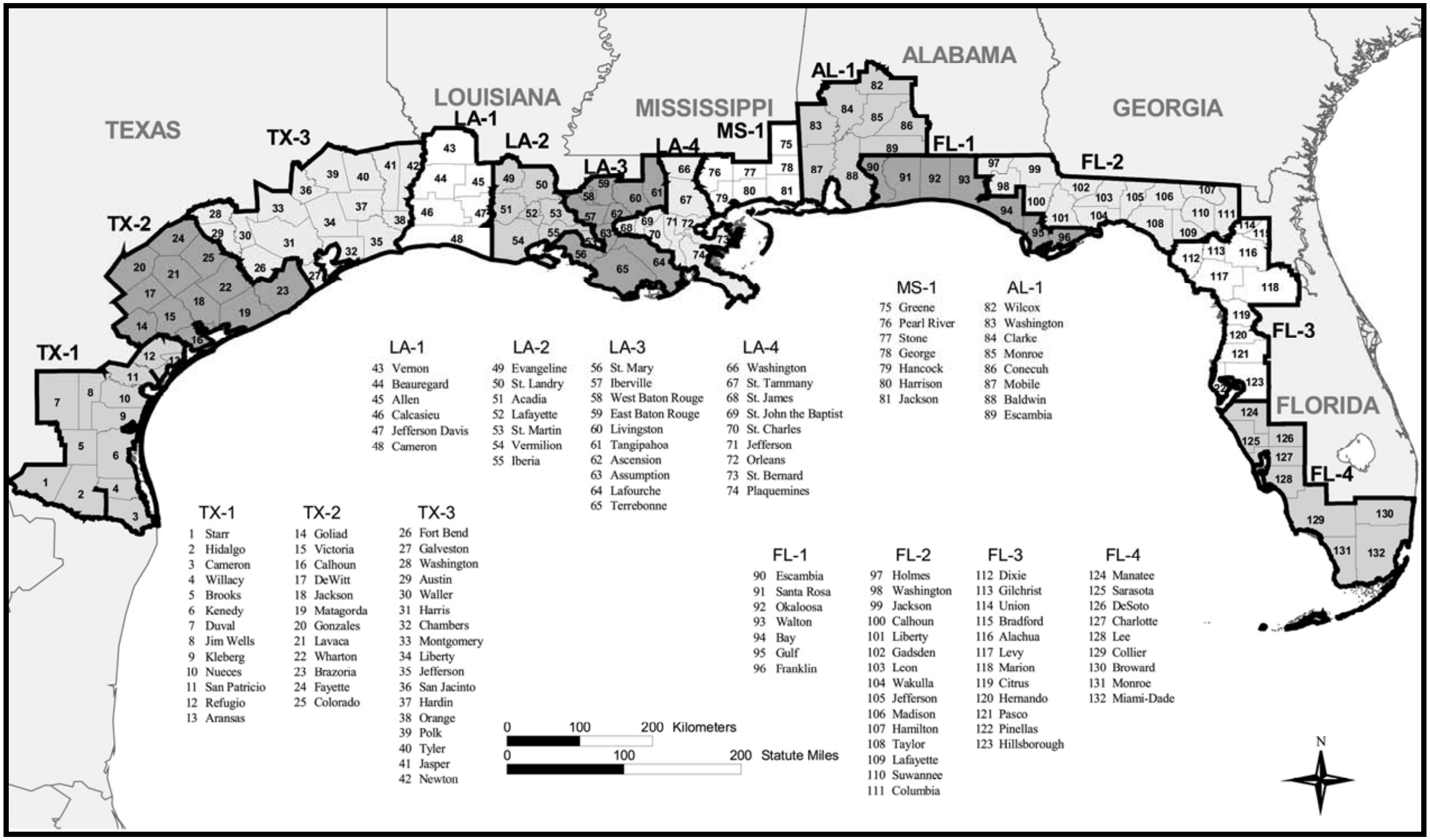


Figure 3-6. Economic Impact Areas in the Gulf of Mexico.

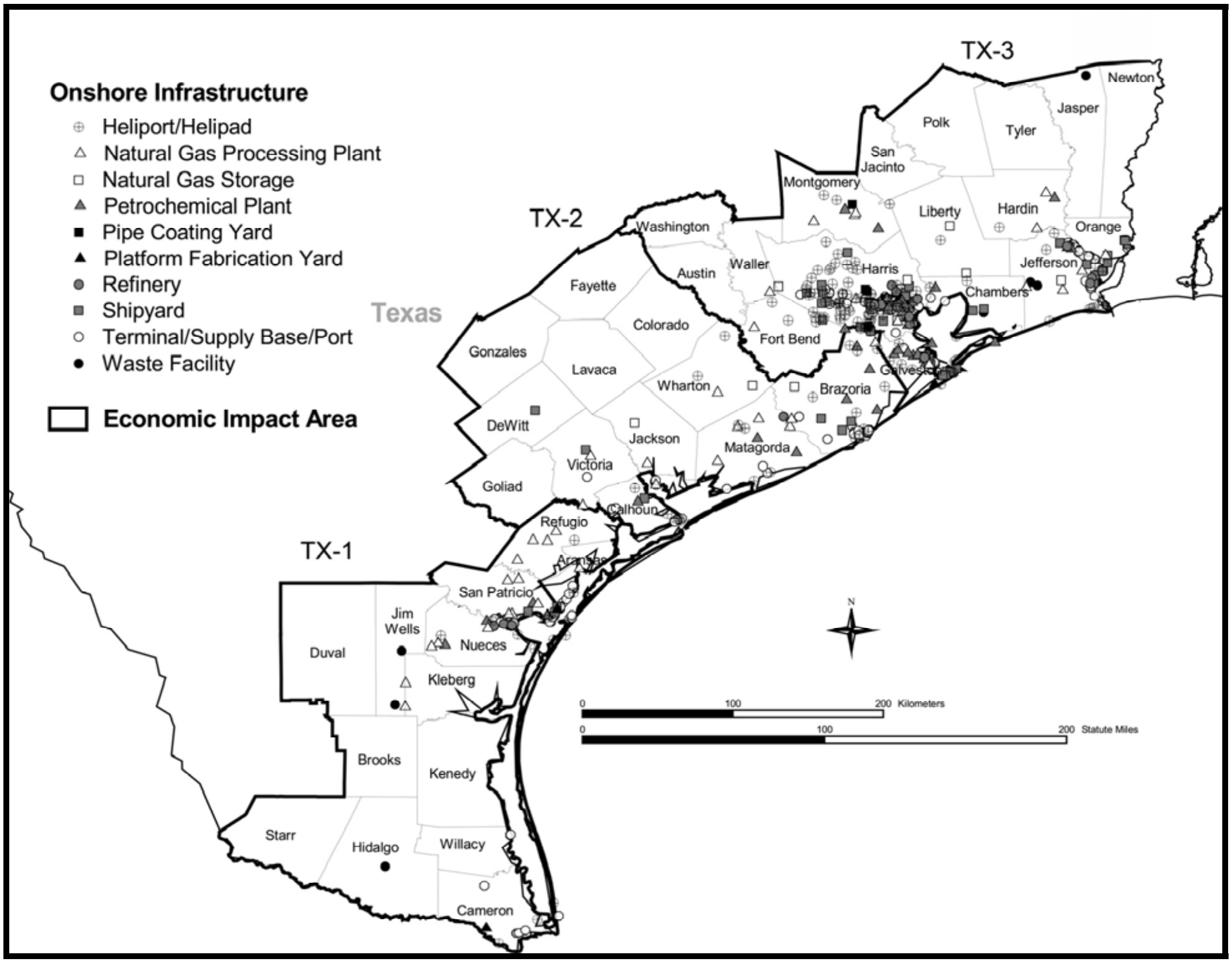


Figure 3-7. Onshore Infrastructure Located in Texas.

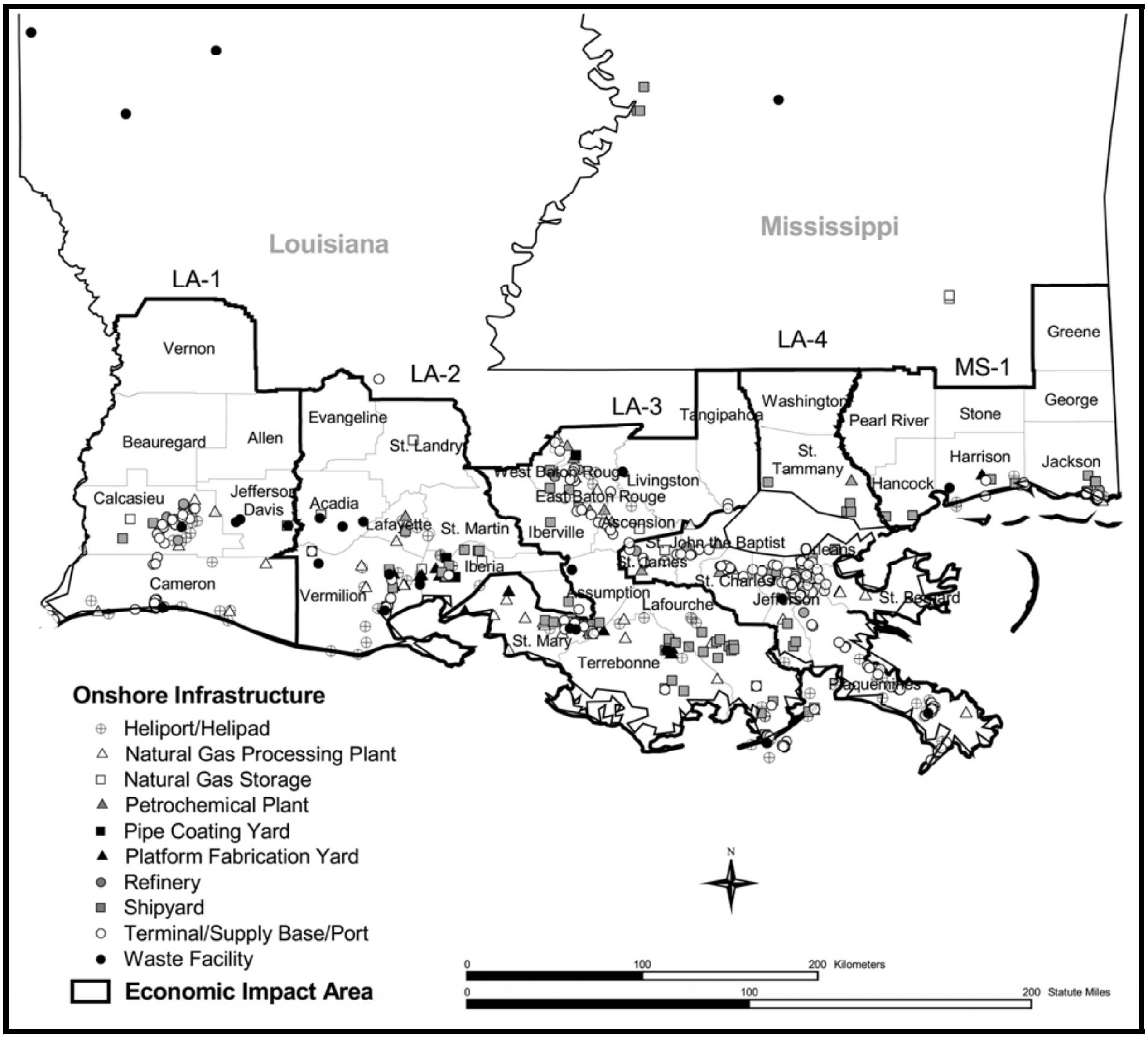


Figure 3-8. Onshore Infrastructure Located in Louisiana and Mississippi.

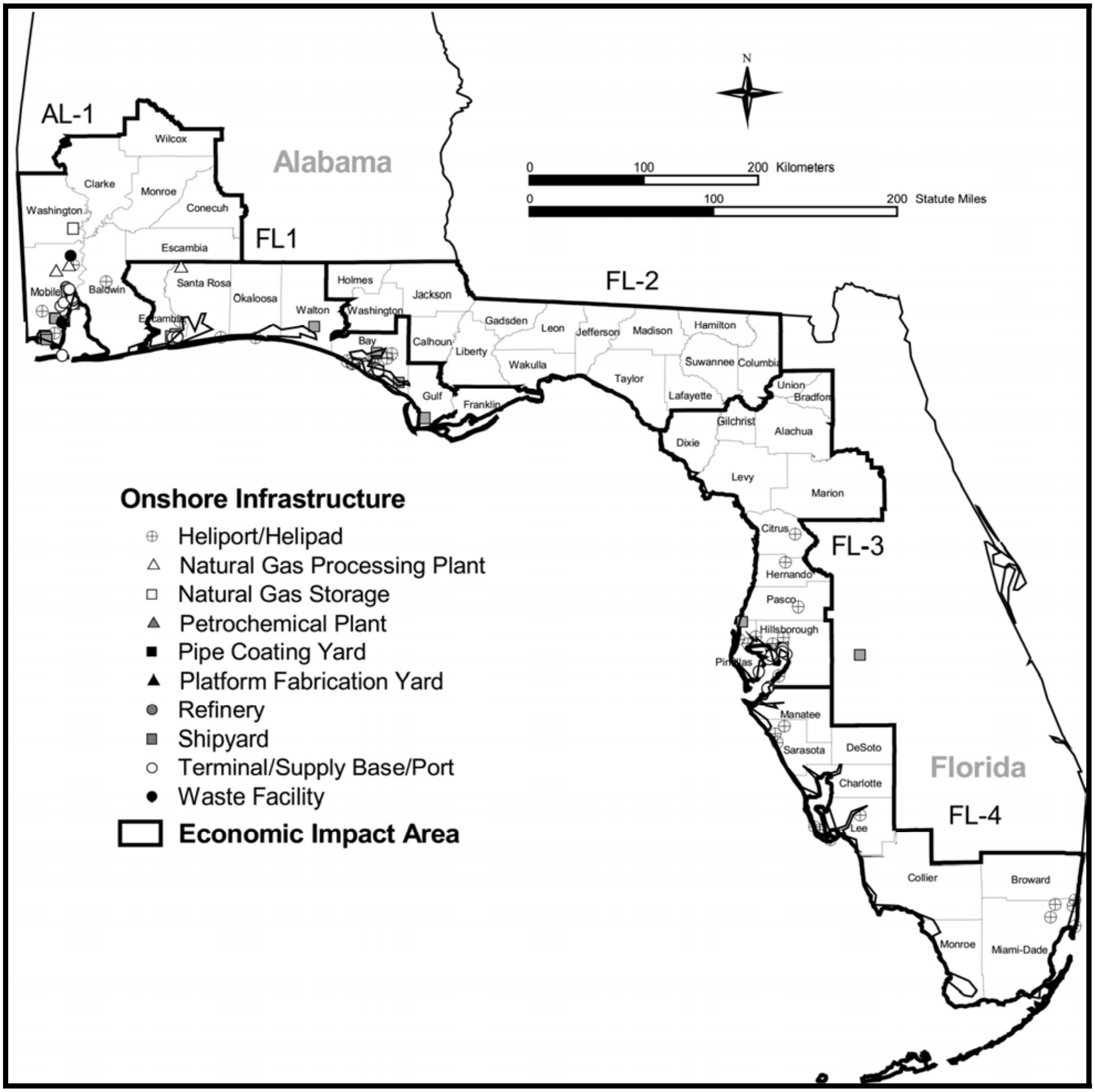


Figure 3-9. Onshore Infrastructure Located in Alabama and Florida.

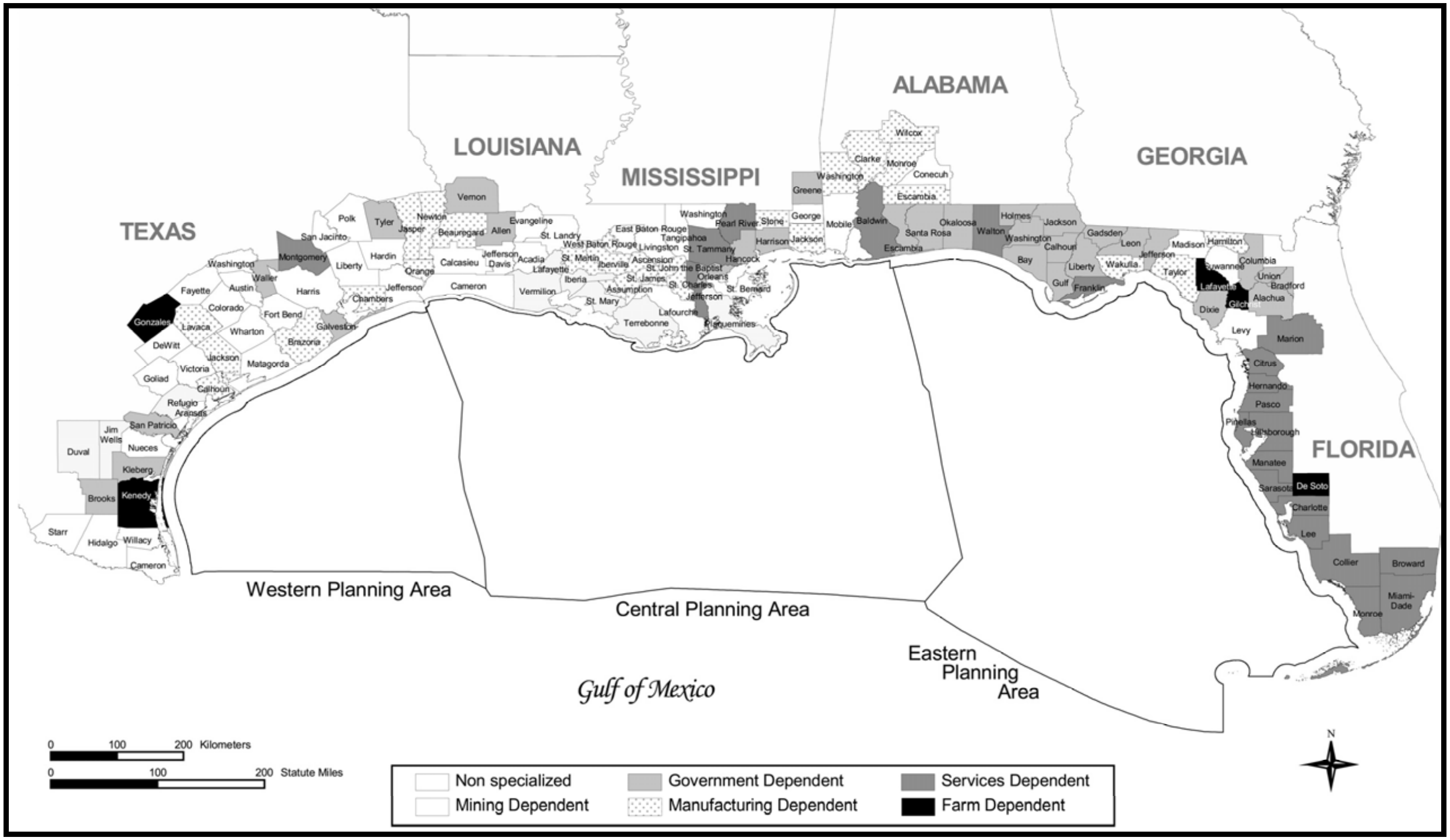


Figure 3-10. Economic Land Use Patterns.

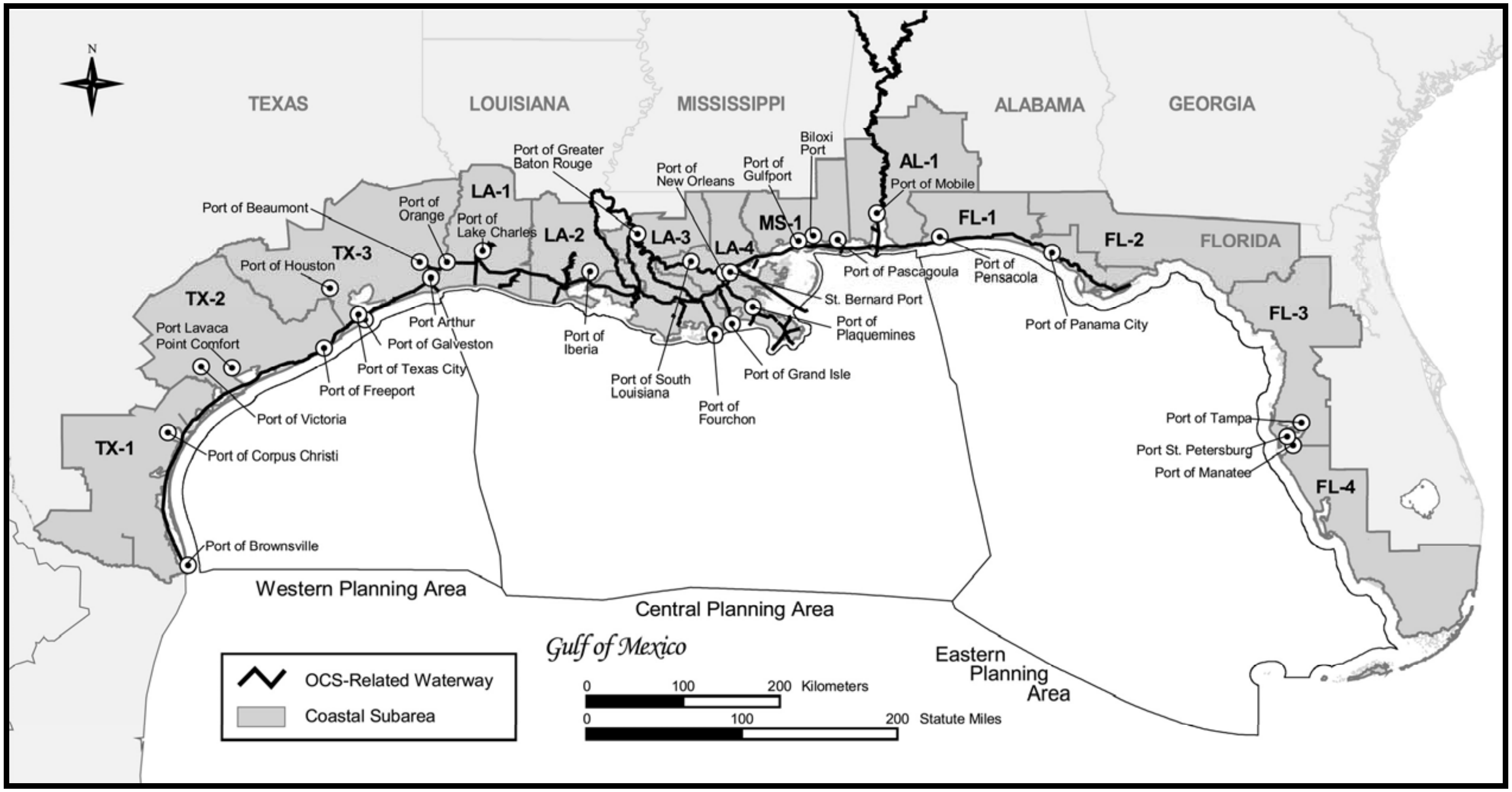


Figure 3-11. Major Ports and Domestic Waterways in the Gulf of Mexico.

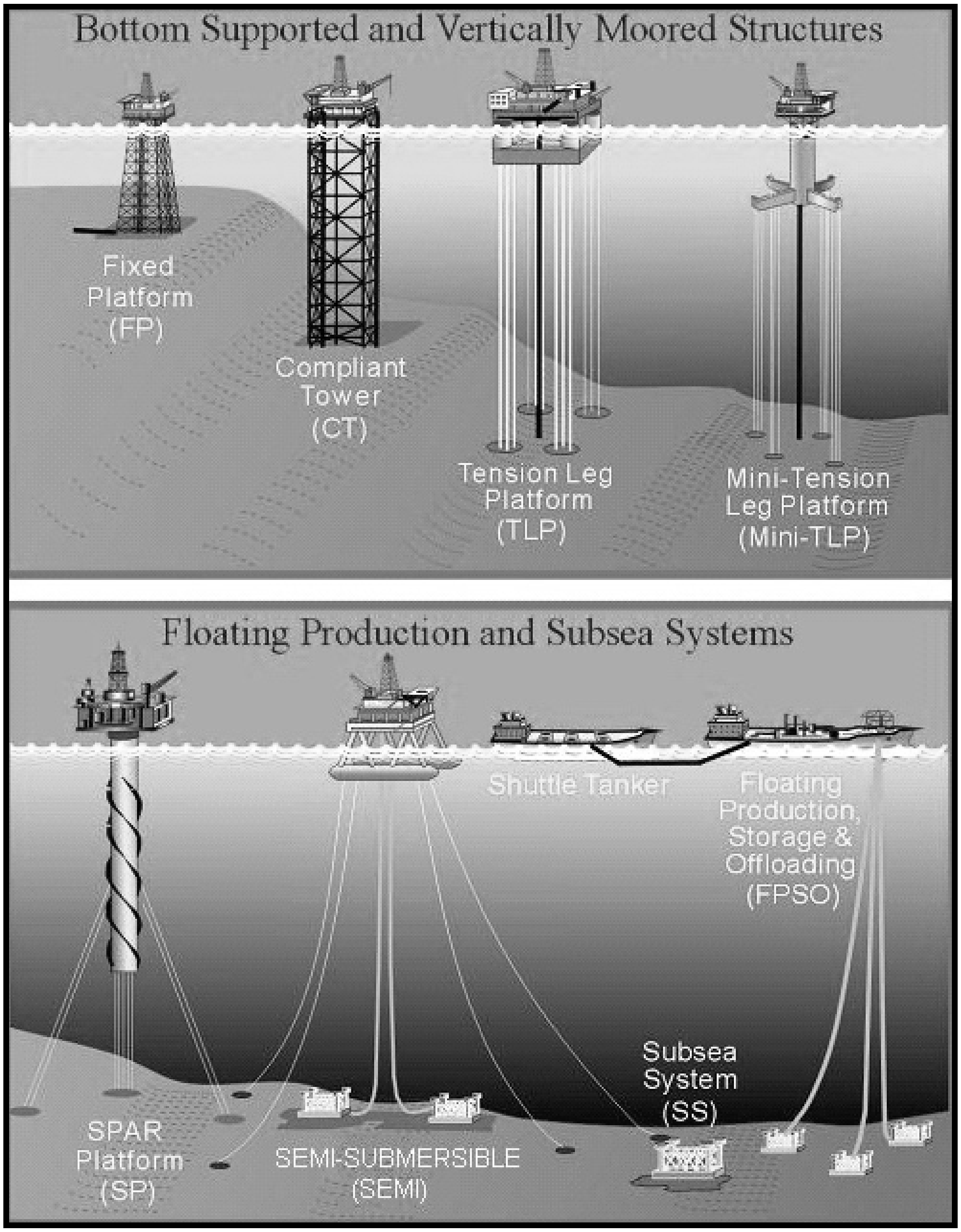


Figure 3-12. Types of Deepwater Production.

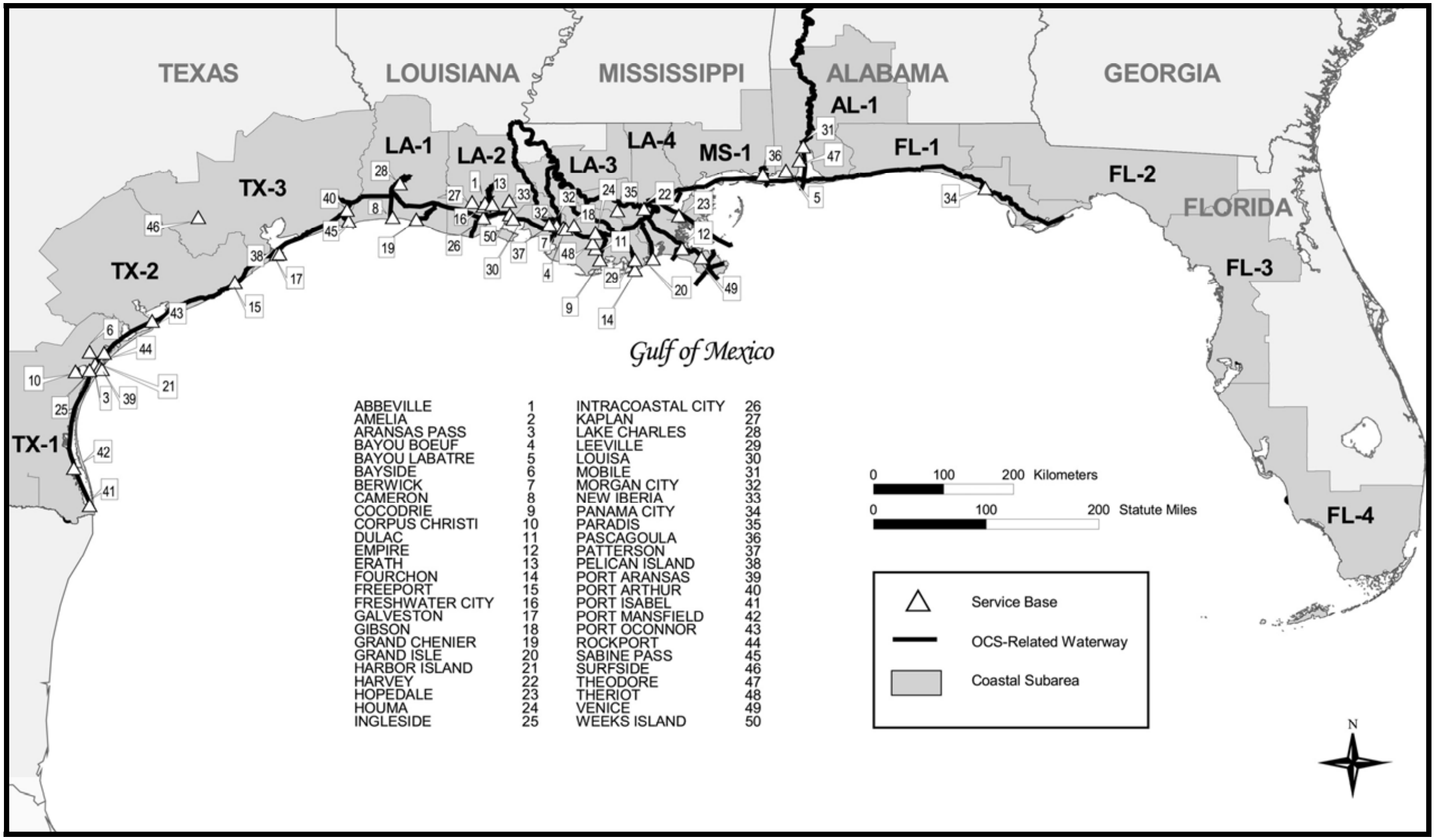


Figure 3-13. OCS-Related Service Bases in the Gulf of Mexico.

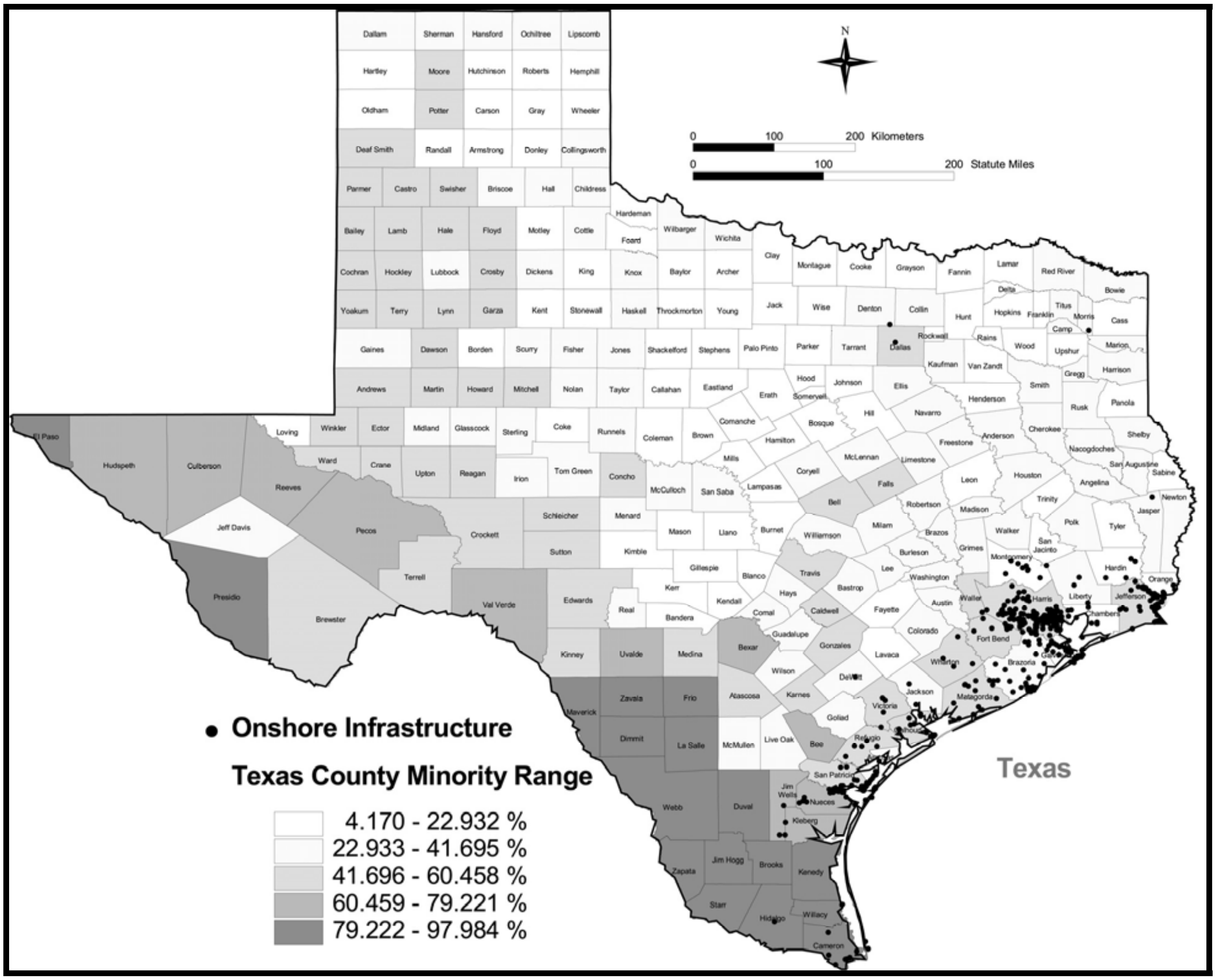


Figure 3-14. Percentage of Minority Population by County in Texas.

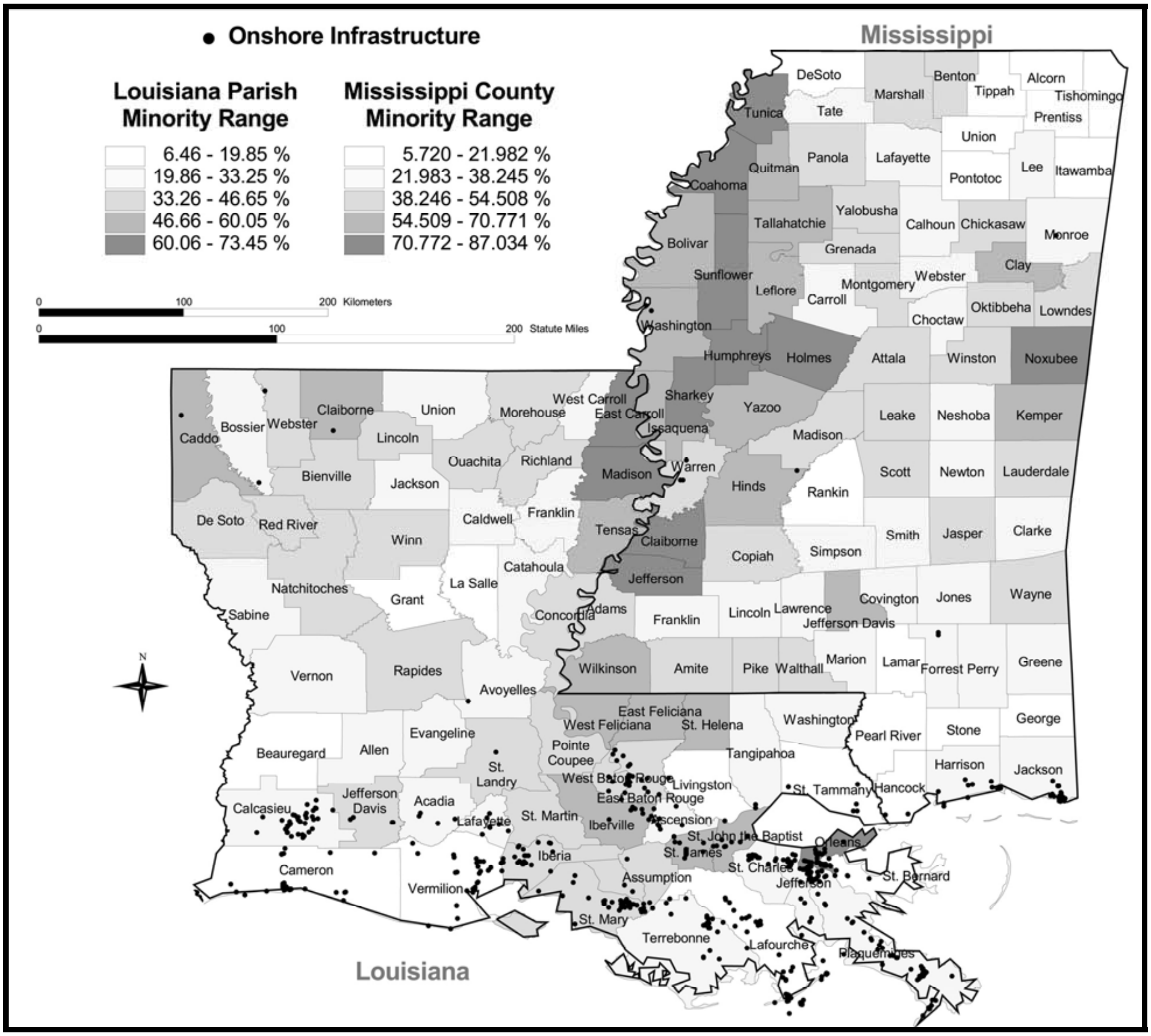


Figure 3-15. Percentage of Minority Population by Parish in Louisiana and by County in Mississippi.

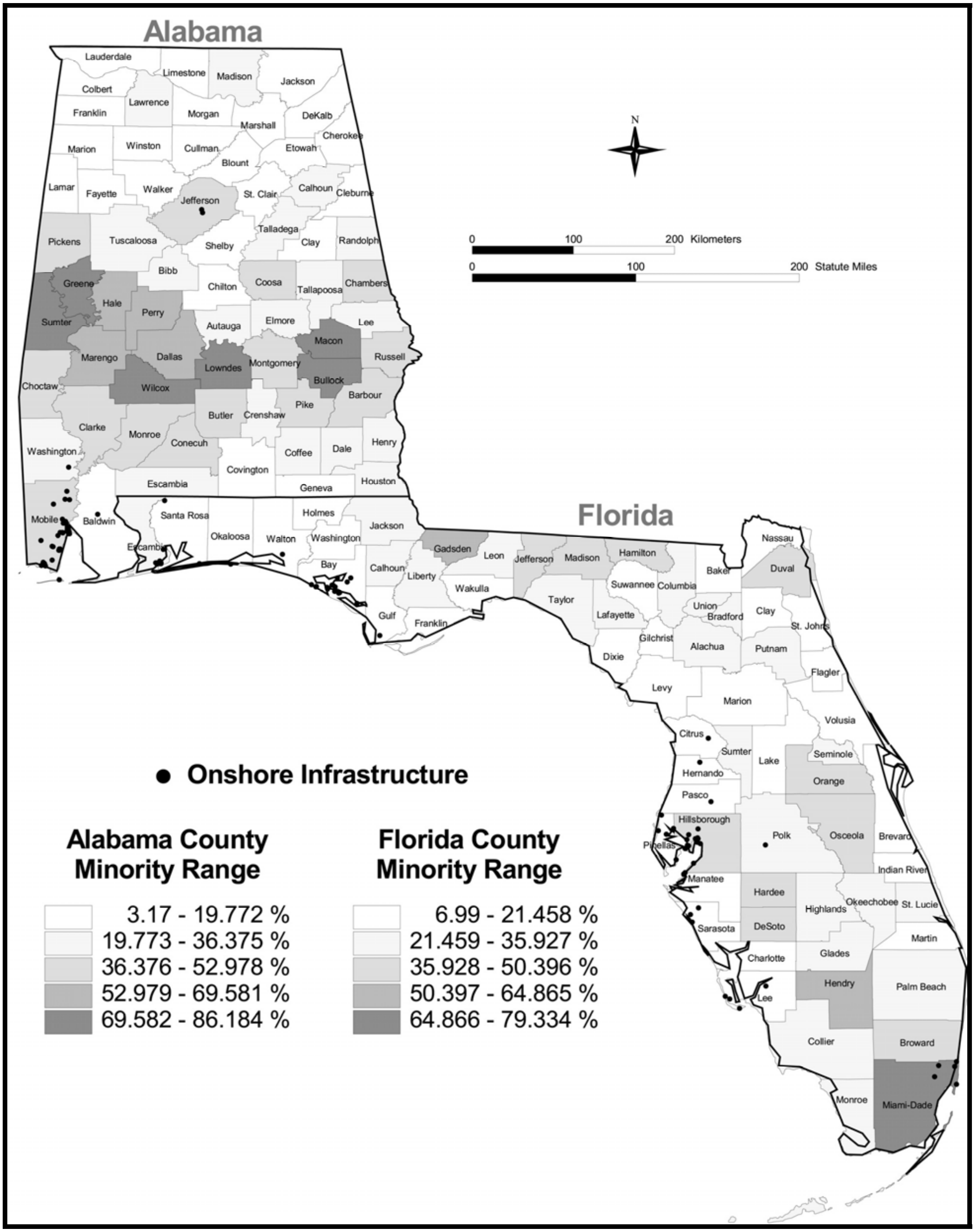


Figure 3-16. Percentage of Minority Population by County in Alabama and Florida.

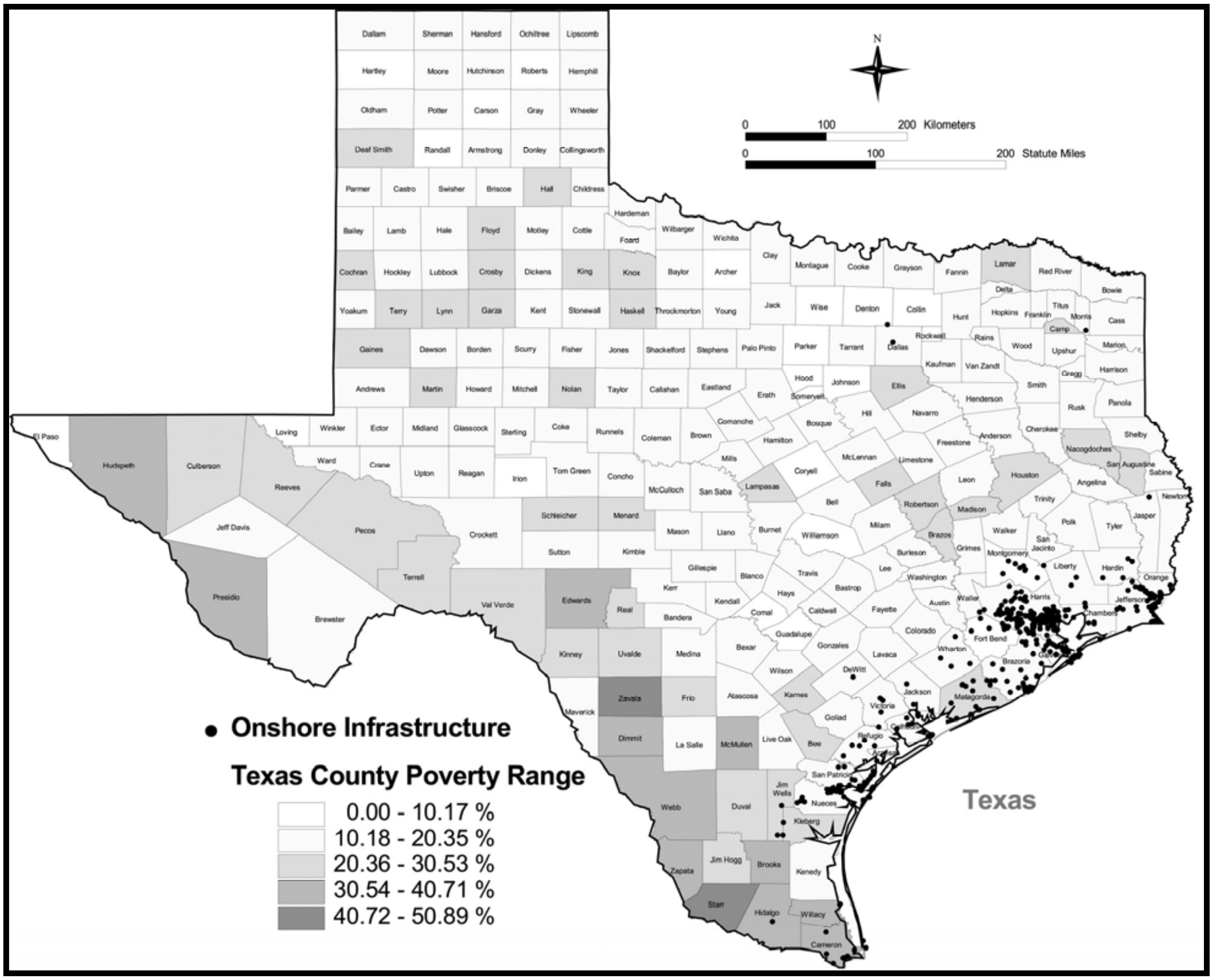


Figure 3-17. Percentage of Poverty by County in Texas.

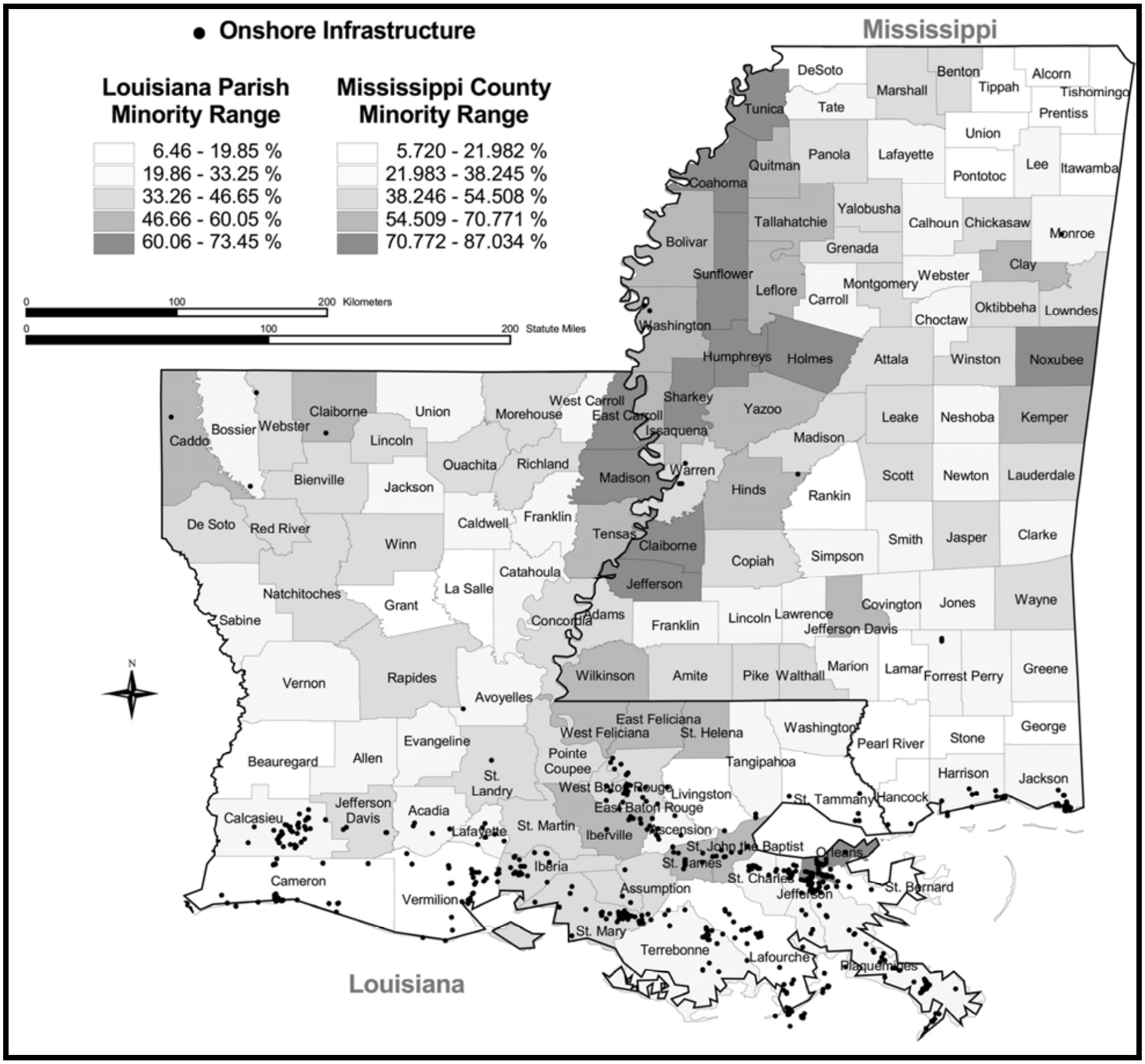


Figure 3-18. Percentage of Poverty by Parish in Louisiana and by County in Mississippi.

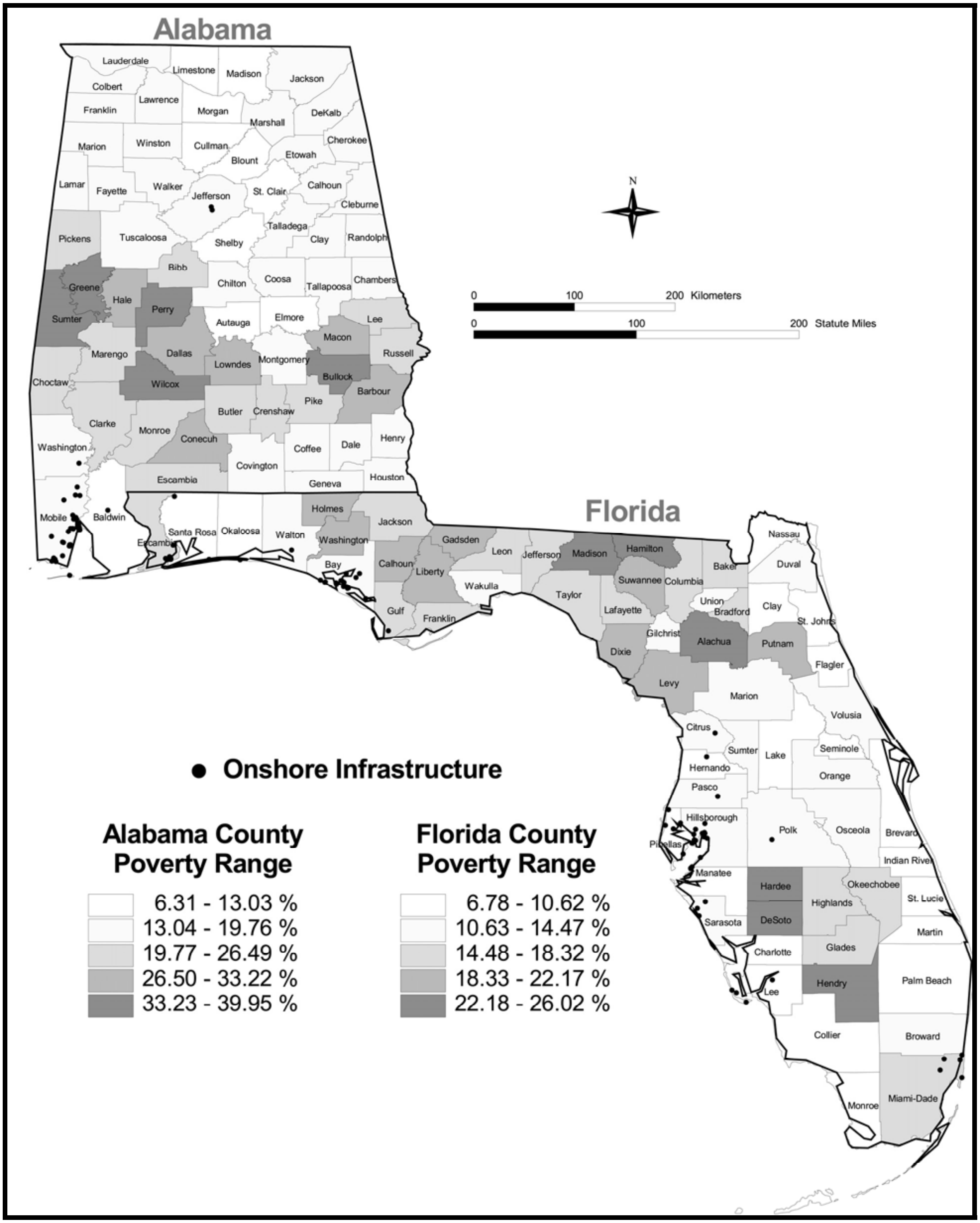


Figure 3-19. Percentage of Poverty by County in Alabama and Florida.

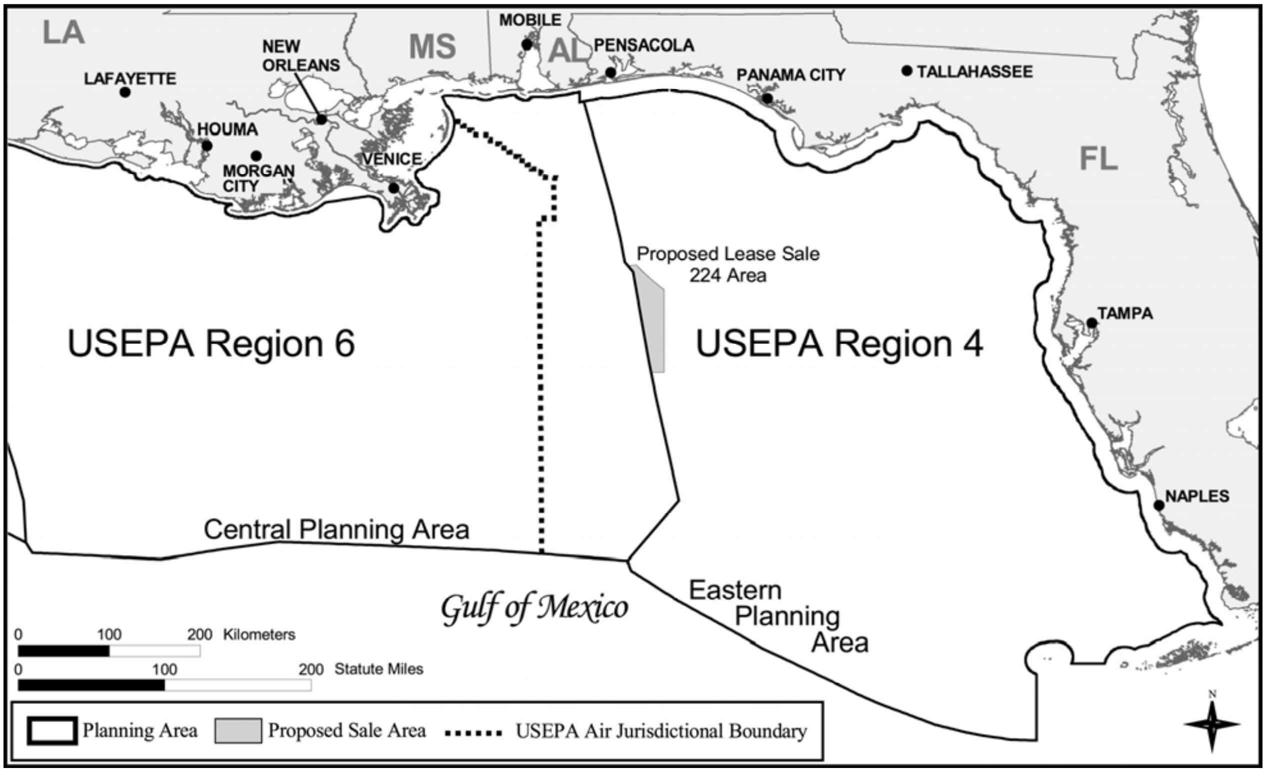


Figure 4-1. USEPA Regions 4 and 6 Regional Boundaries.

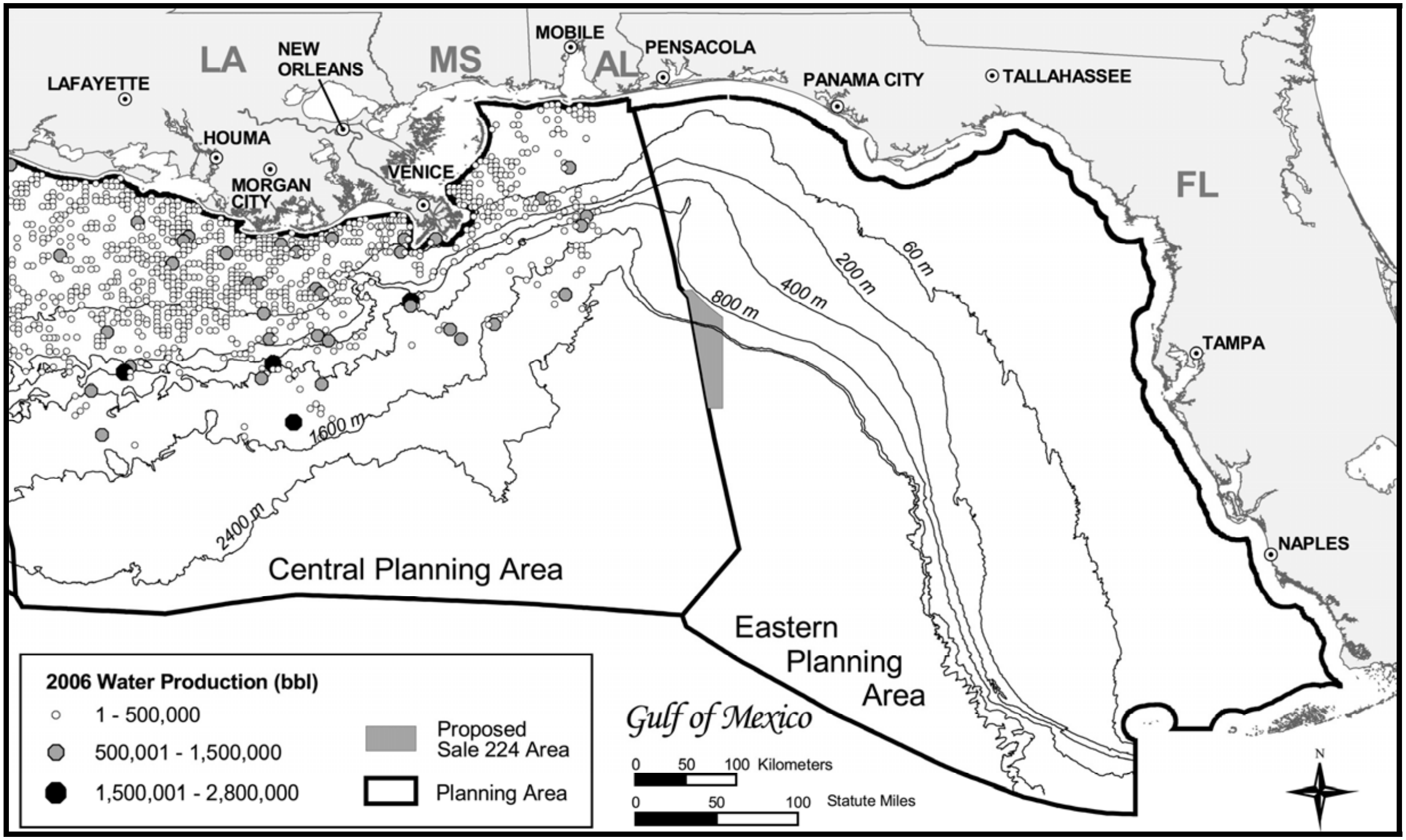


Figure 4-2. Produced Water Extracted in the Gulf of Mexico in 2006.

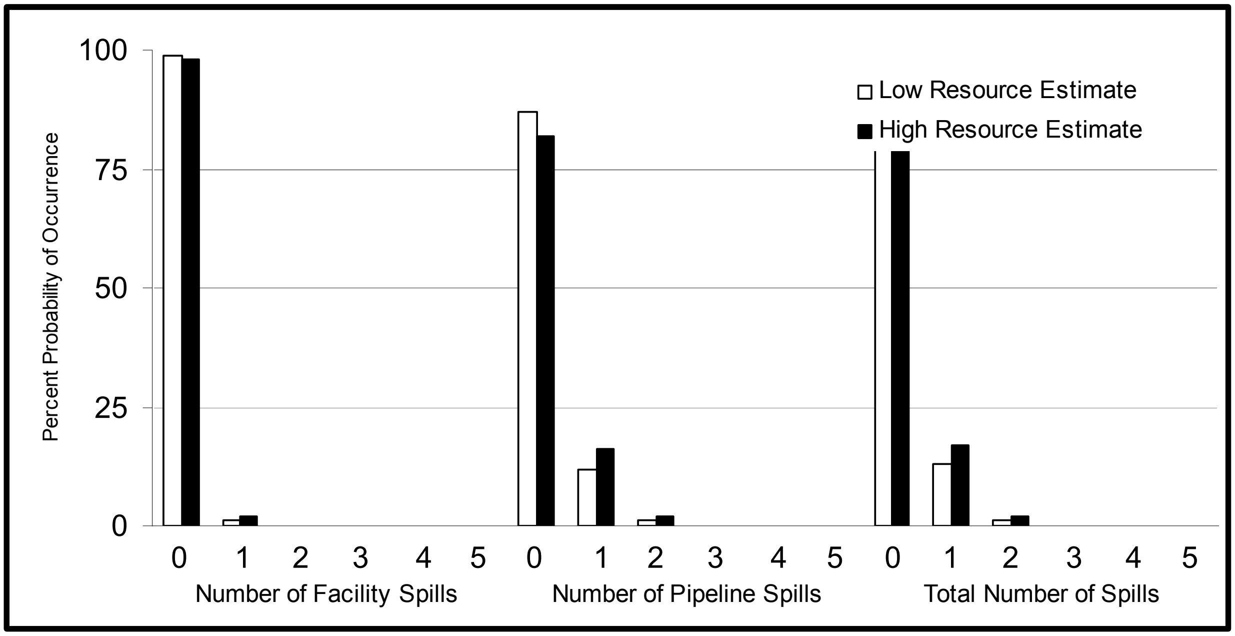


Figure 4-3. Probability (percent chance) of a Particular Number of Offshore Spills ≥1,000 bbl Occurring as a Result of Either Facility of Pipeline Operations Related to the Proposed Action.

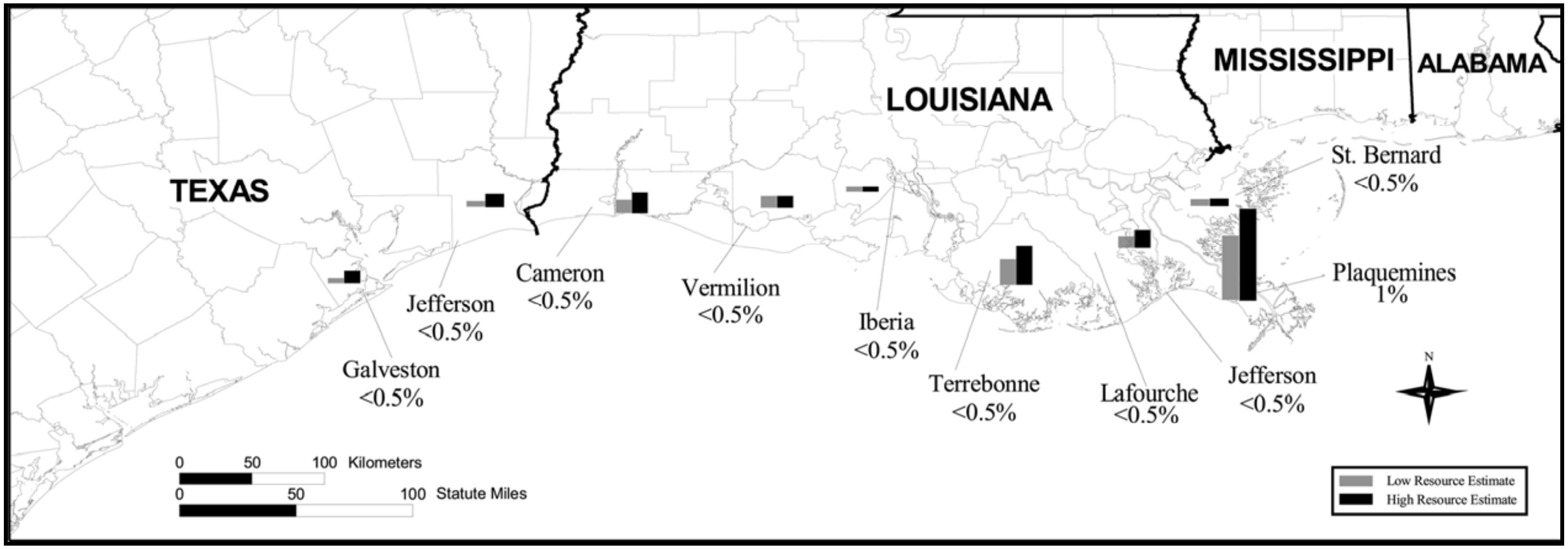


Figure 4-4. Probabilities of Oil Spills (≥1,000 bbl) Occurring and Contacting within 10 Days the Shoreline (counties and parishes) as a Result of the Proposed Action.

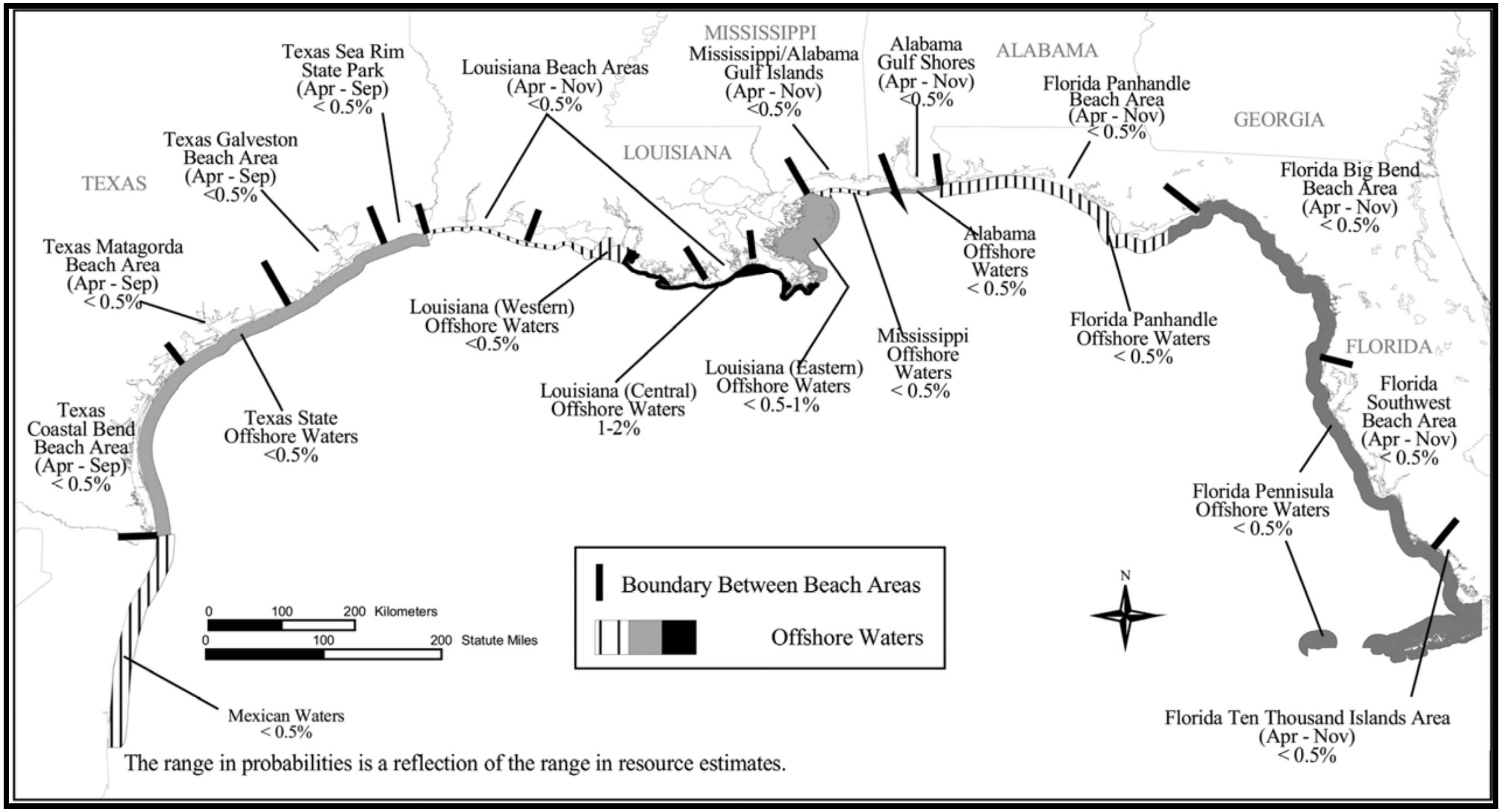


Figure 4-5. Probabilities of Oil Spills (≥1,000 bbl) Occurring and Contacting within 10 Days State Offshore Waters or Recreational Beaches as a Result of the Proposed Action.

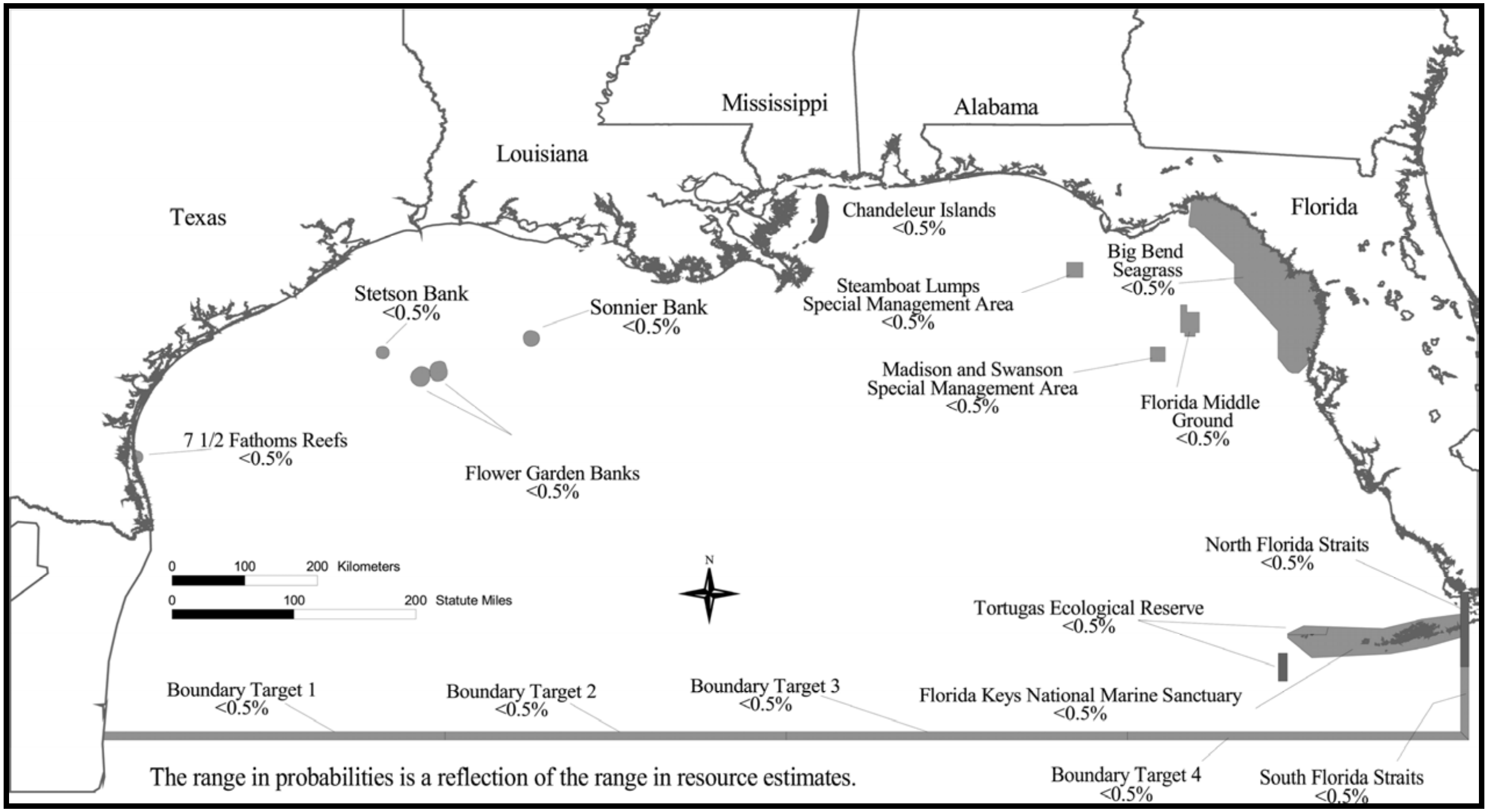


Figure 4-6. Probabilities of Oil Spills (≥1,000 bbl) Occurring and Contacting within 10 Days the Surface Waters Overlying and Surrounding Offshore Environmental Features or Boundary Targets as a Result of the Proposed Action.

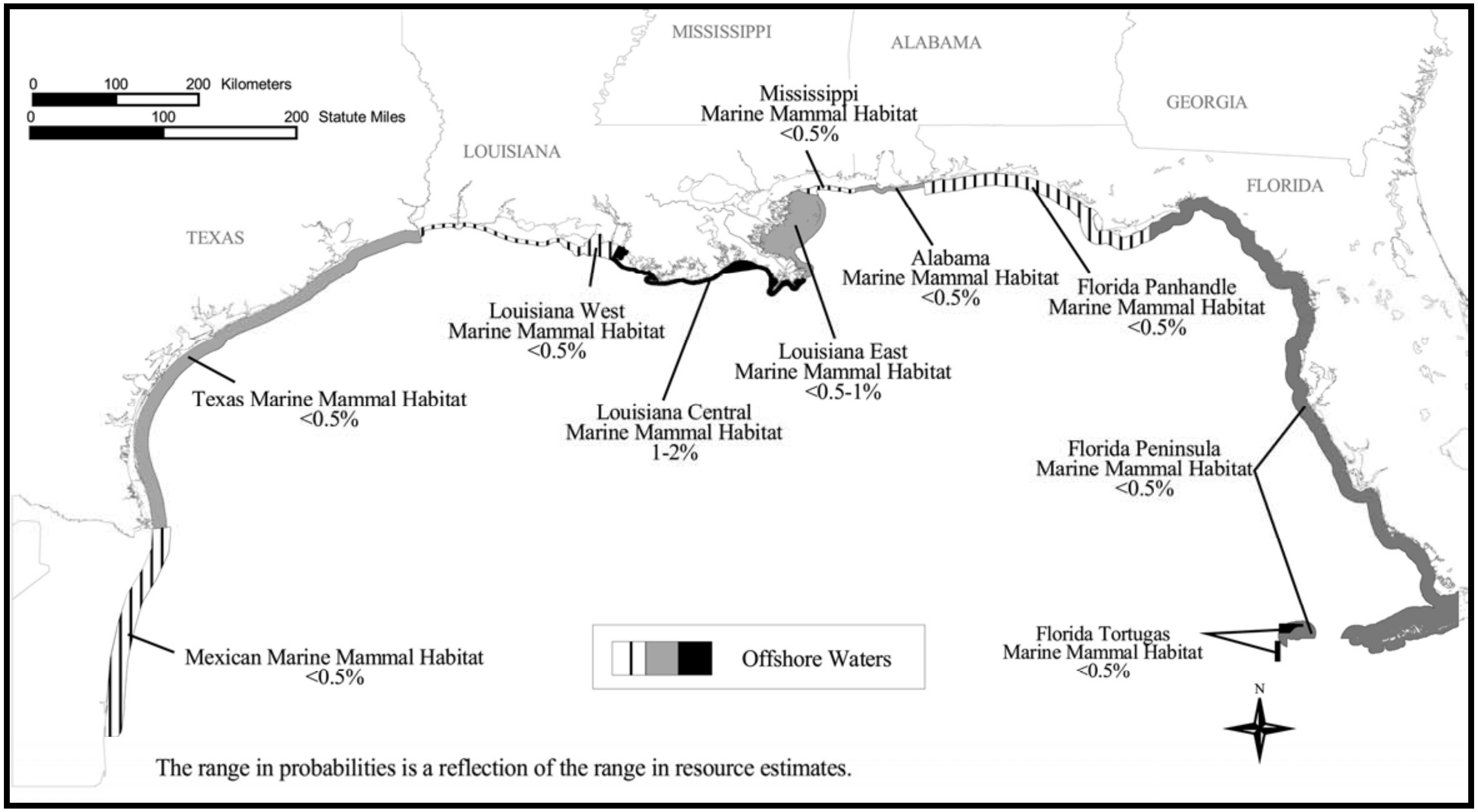


Figure 4-7. Probabilities of Oil Spills (≥1,000 bbl) Occurring and Contacting within 10 Days Marine Mammal Habitats as a Result of the Proposed Action.

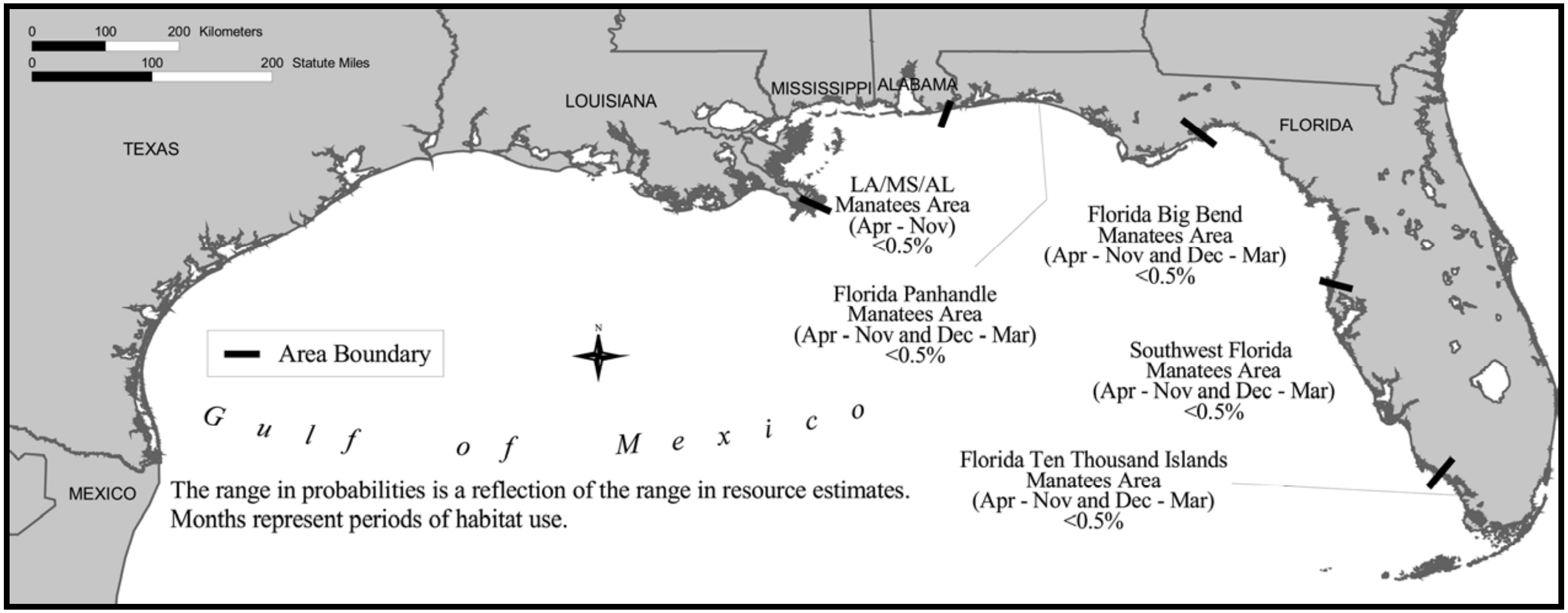


Figure 4-8. Probabilities of Oil Spills (≥1,000 bbl) Occurring and Contacting within 10 Days Manatee Habitat as a Result of the Proposed Action.

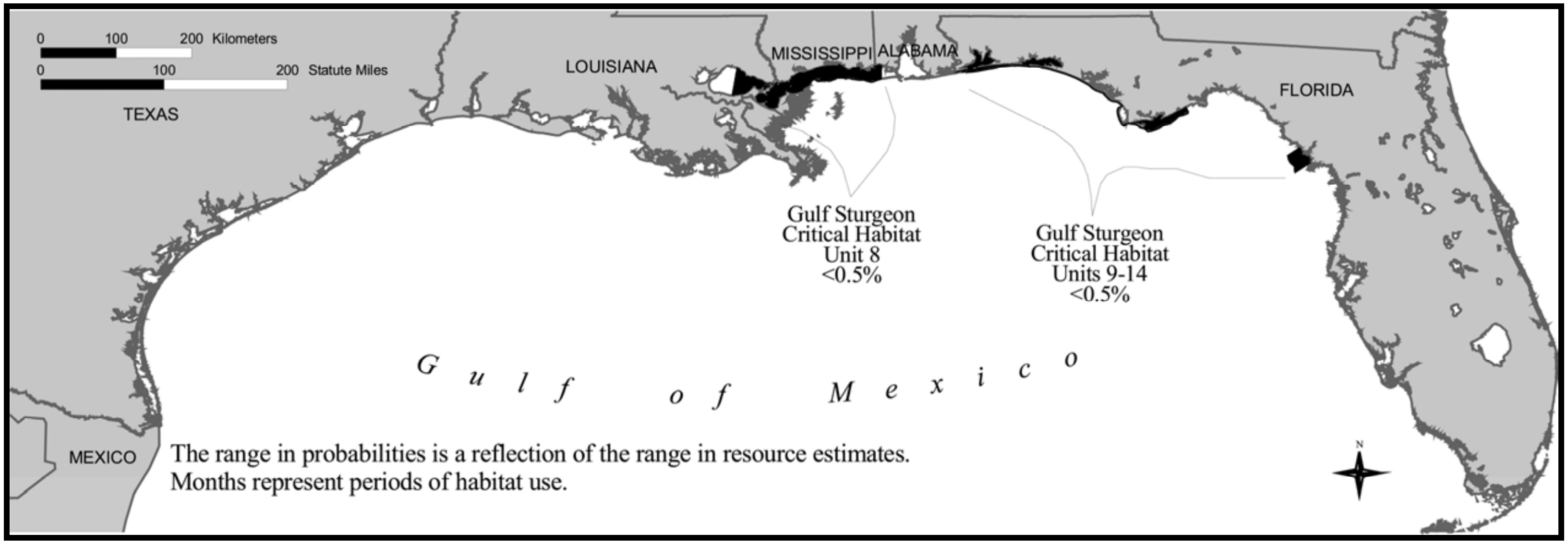


Figure 4-9. Probabilities of Oil Spills (≥1,000 bbl) Occurring and Contacting within 10 Days Known Locations of Gulf Sturgeon as a Result of the Proposed Action.

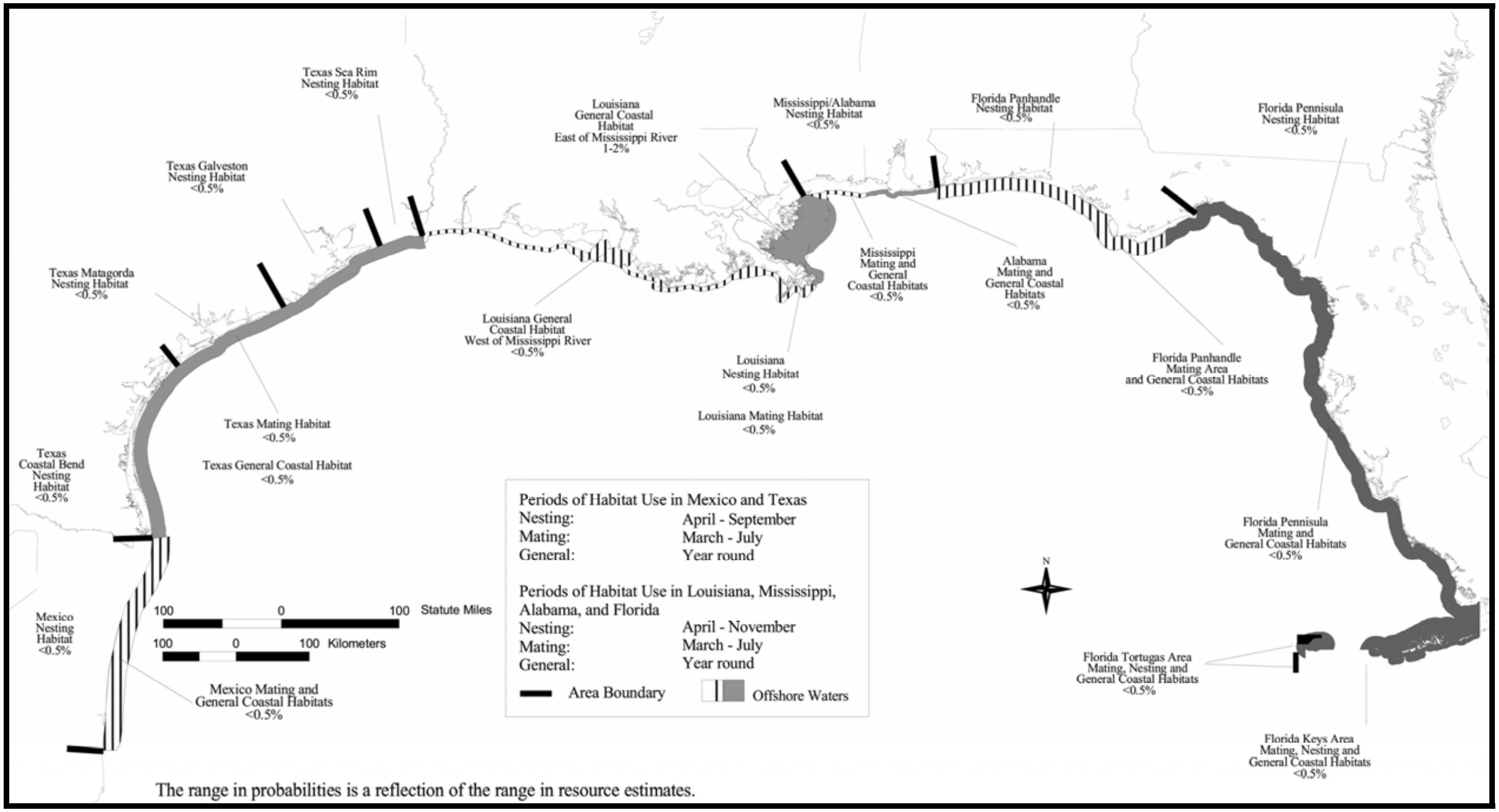


Figure 4-10. Probabilities of Oil Spills (≥1,000 bbl) Occurring and Contacting within 10 Days Sea Turtle Habitat as a Result of the Proposed Action.

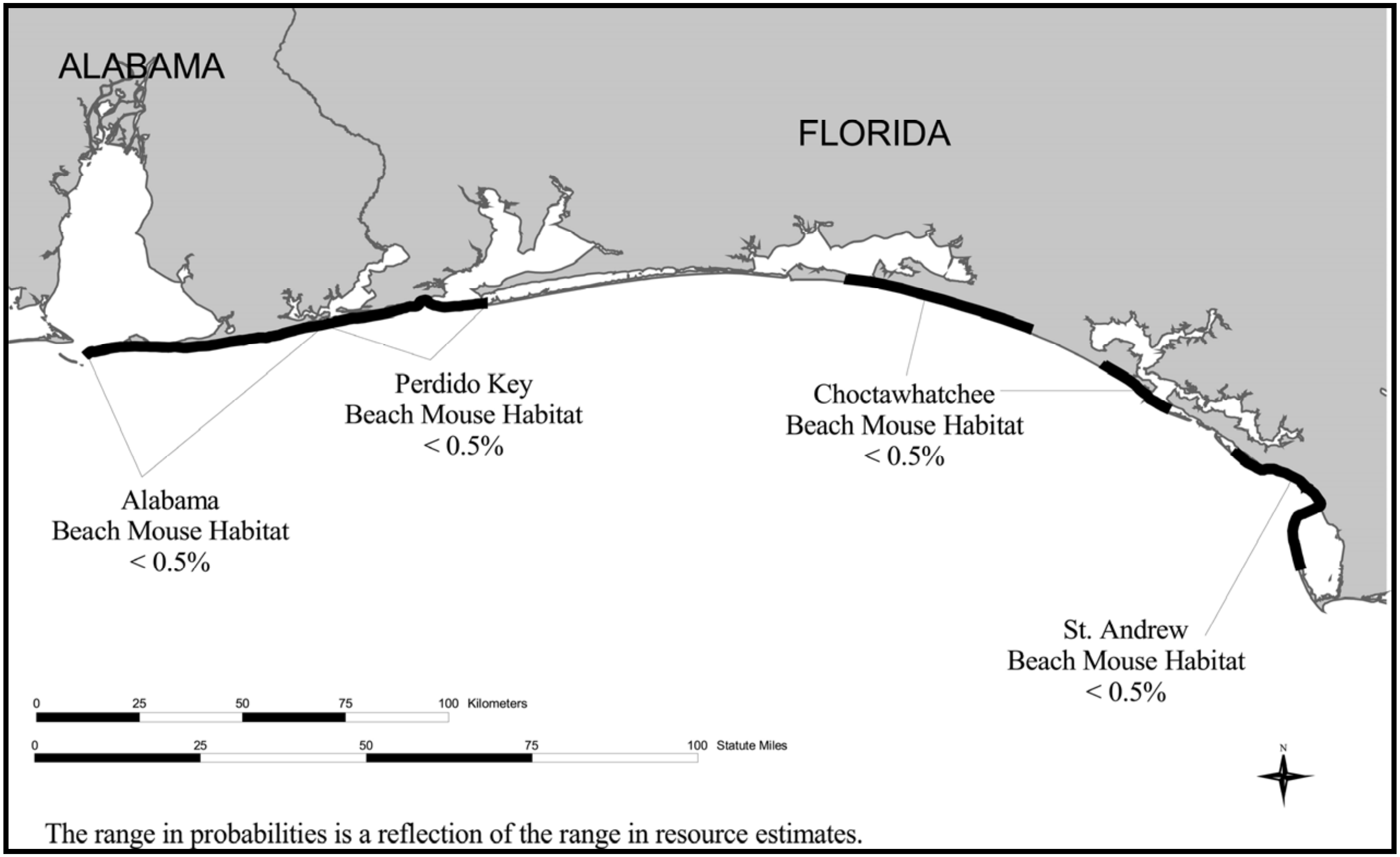


Figure 4-11. Probabilities of Oil Spills (≥1,000 bbl) Occurring and Contacting within 10 Days Endangered Beach Mouse Habitats as a Result of the Proposed Action.

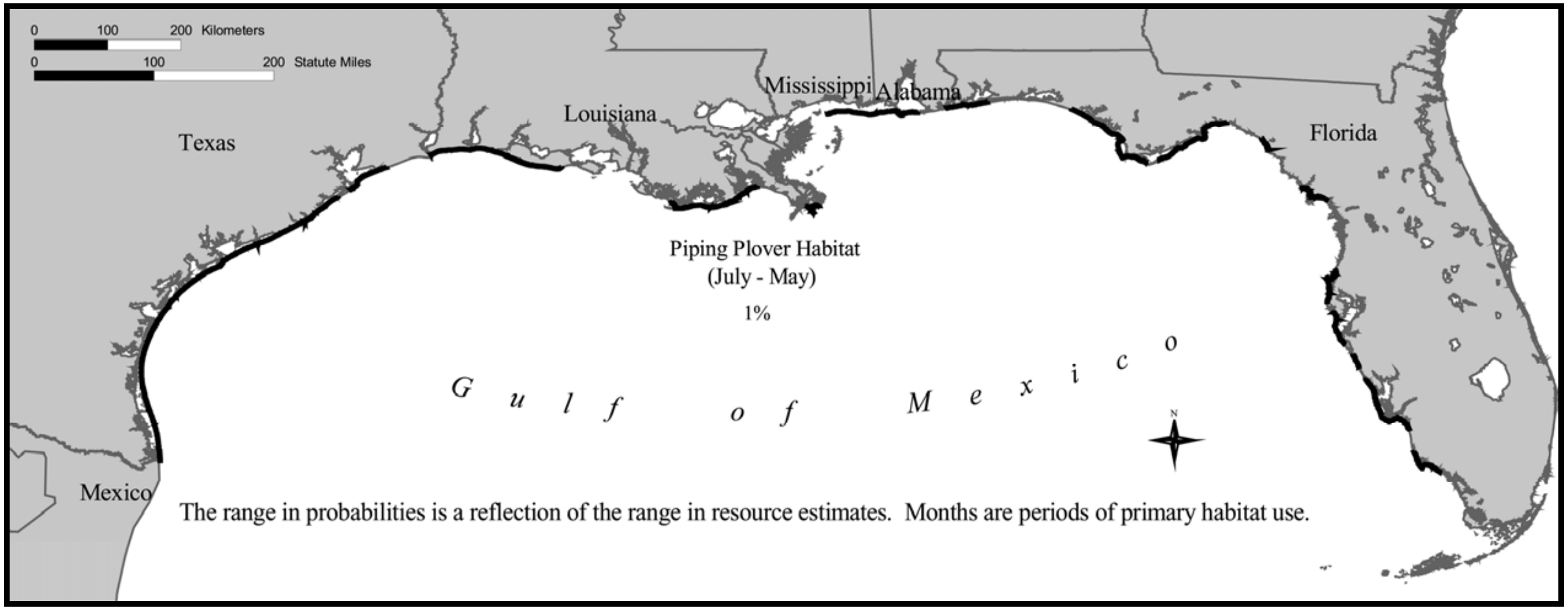


Figure 4-12. Probabilities of Oil Spills (≥1,000 bbl) Occurring and Contacting within 10 Days Piping Plover Habitat as a Result of the Proposed Action.

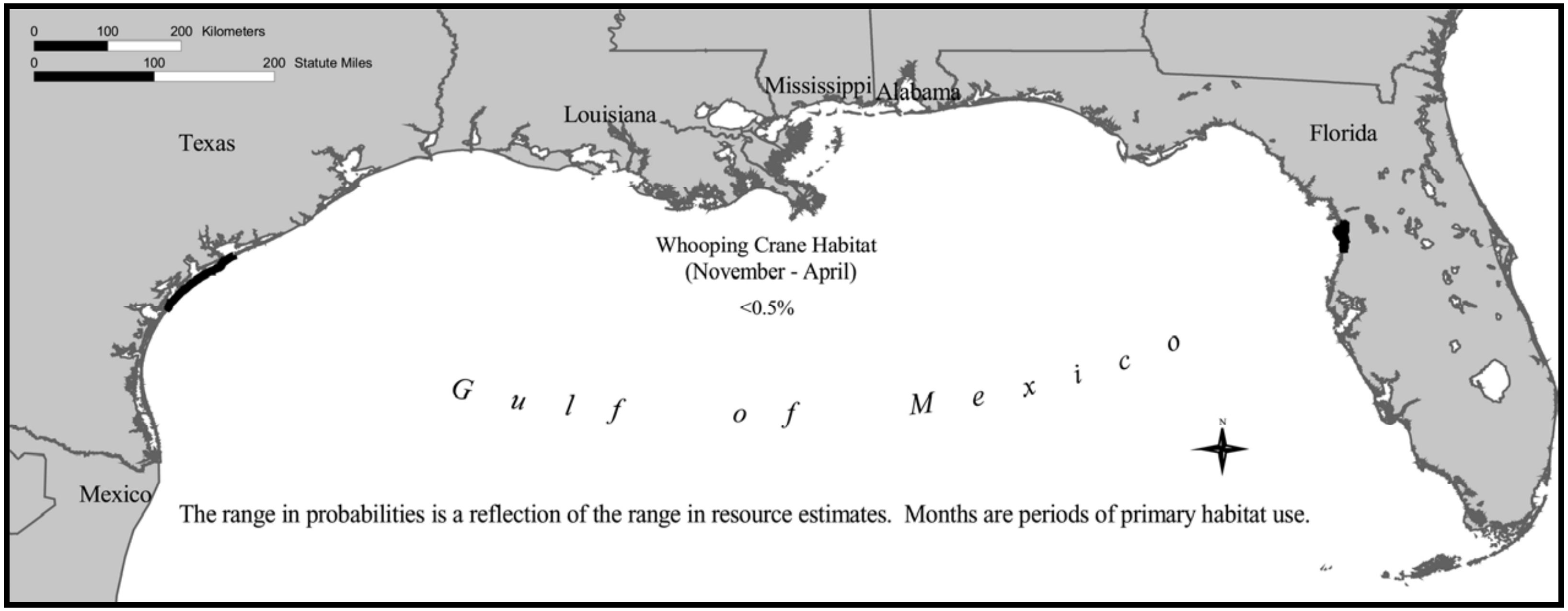


Figure 4-13. Probabilities of Oil Spills (≥1,000 bbl) Occurring and Contacting within 10 Days Whooping Crane Habitat as a Result of the Proposed Action.

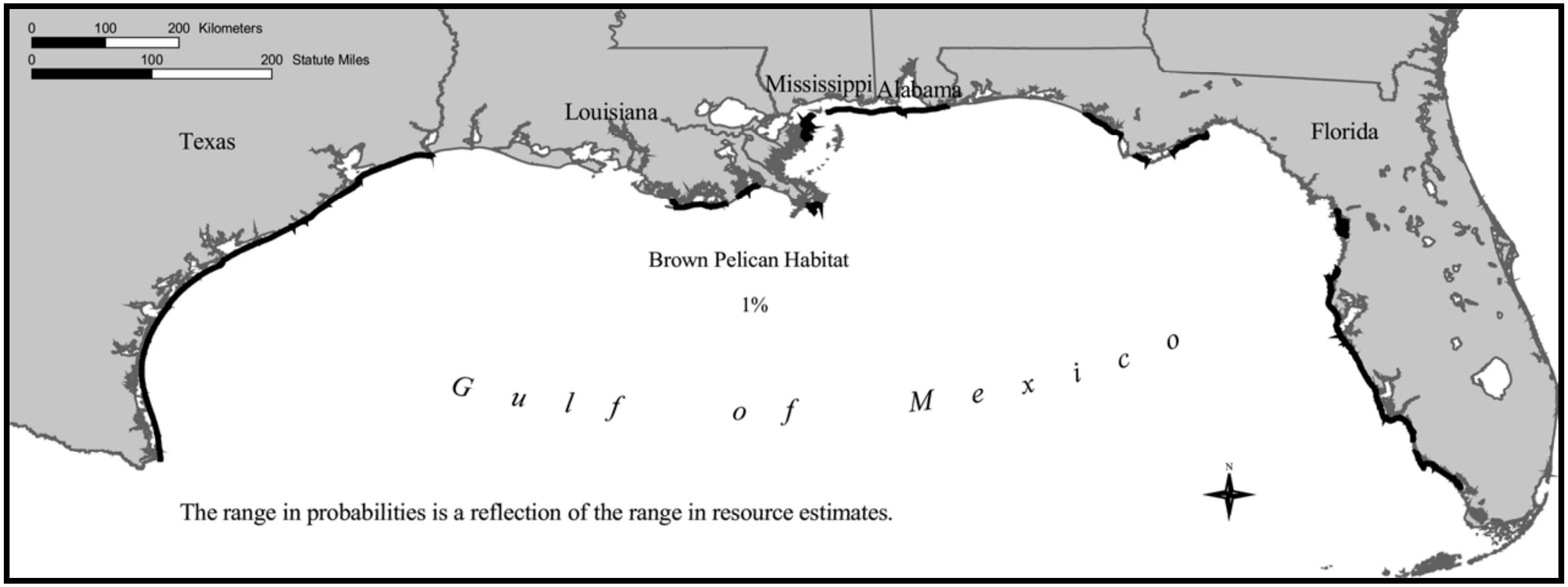


Figure 4-14. Probabilities of Oil Spills (≥1,000 bbl) Occurring and Contacting within 10 Days Brown Pelican Habitat as a Result of the Proposed Action.

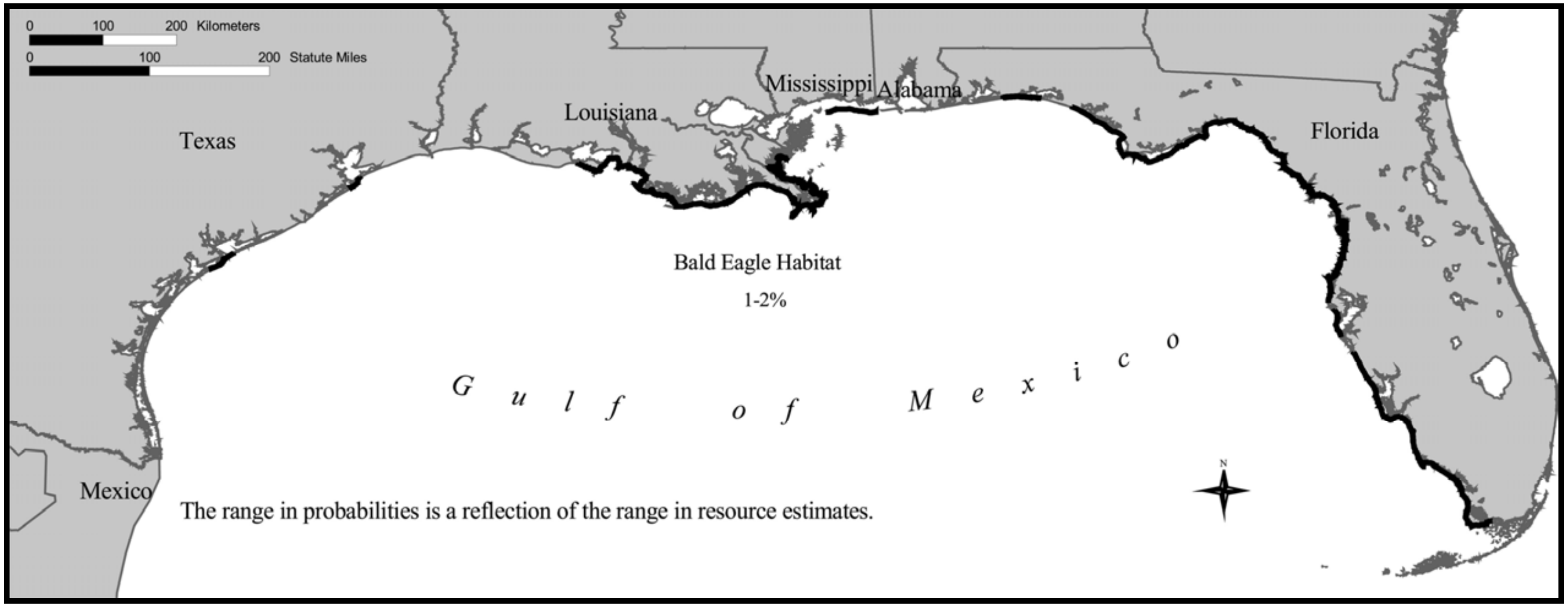
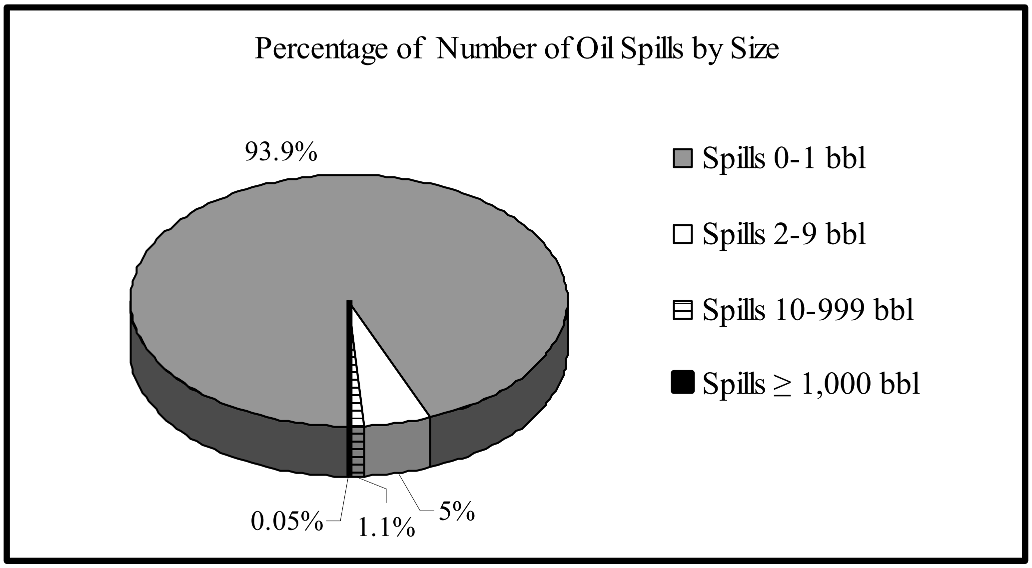


Figure 4-15. Probabilities of Oil Spills (≥1,000 bbl) Occurring and Contacting within 10 Days Bald Eagle Habitat as a Result of the Proposed Action.



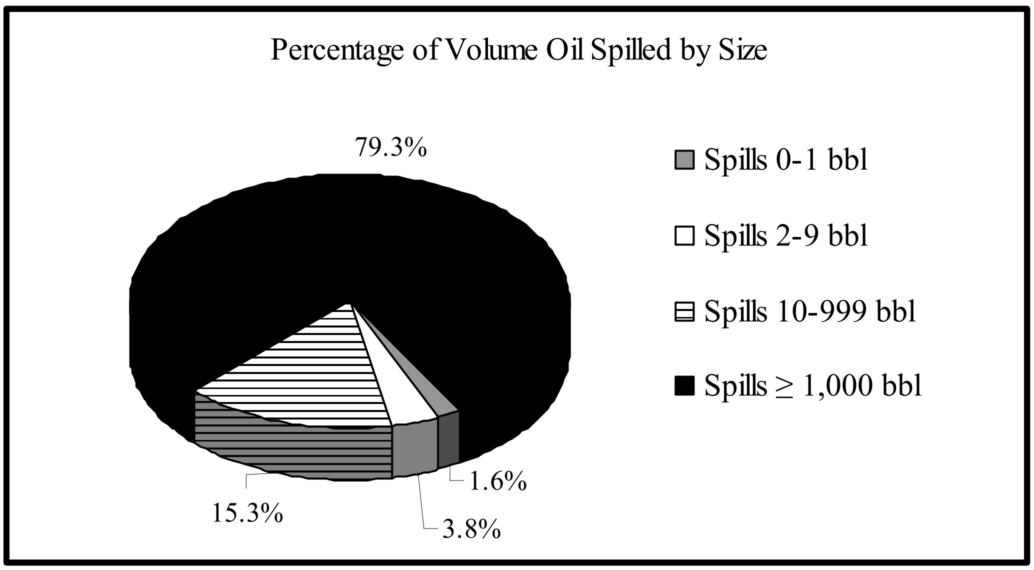


Figure 4-16. Comparison of Spill Frequency and Spill Volume for Past OCS Spills by Size Category (1971-1999 MMS OCS spill database; Anderson and Labelle, 2000).

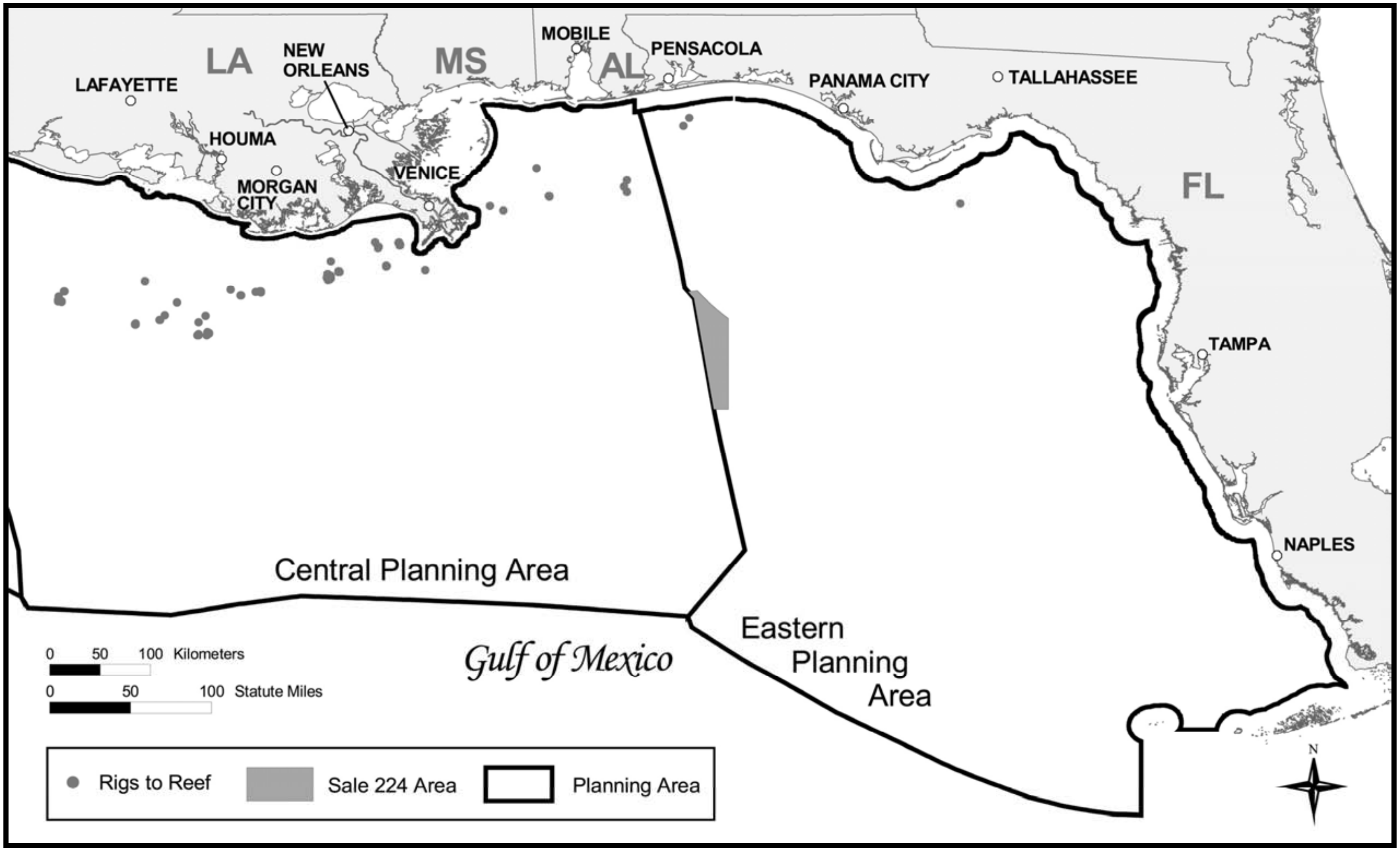


Figure 4-17. Locations of Rigs-to-Reefs in the Gulf of Mexico.

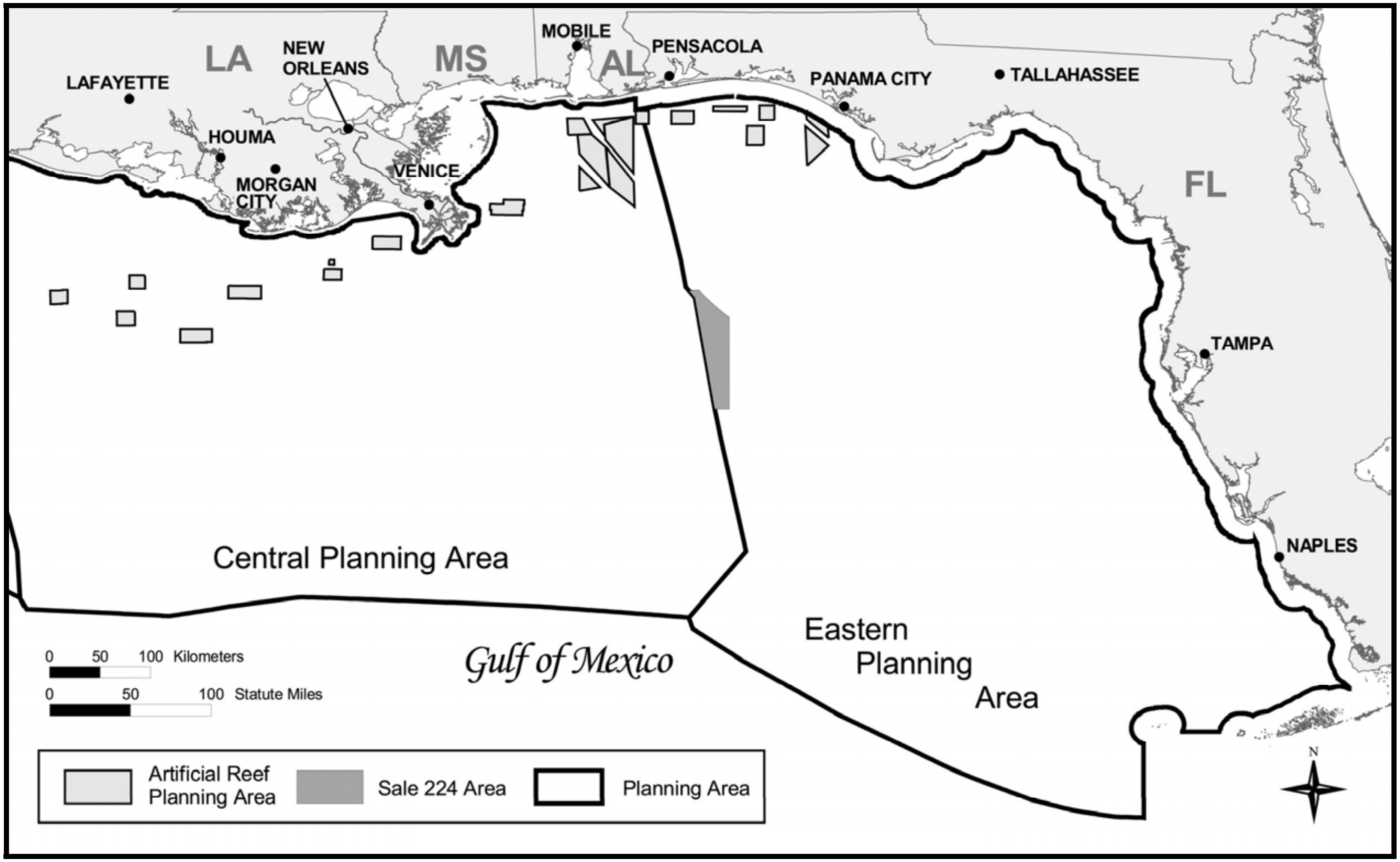


Figure 4-18. Location of Artificial Reef Planning Areas in the Gulf of Mexico.

Appendix D

Tables

Table 1-1

Proposed WPA and CPA Gulf of Mexico OCS
Lease Sales for 2007-2012

Sale	Area	Year
204	WPA	2007
205	CPA	2007
206	CPA	2008
207	WPA	2008
208	CPA	2009
210	WPA	2009
213	CPA	2010
215	WPA	2010
216	CPA	2011
218	WPA	2011
222	CPA	2012

Table 3-1

National Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Period	Primary Standards[a]	Secondary Standards[b]
Ozone	8-hour [d]	0.08 ppm (157 μg/m^3)	(same as primary)
Sulphur Dioxide	Annual	0.03 ppm (80 μg/m3)	NA
	24-hour	0.14 ppm (365 μg/m3)	NA
	3-hour [c]	NA	1,300 μg/m^3
Carbon Monoxide	8-hour [c]	9.0 ppm (10 mg/m^3)	NA
	1-hour [c]	35 ppm (40 mg/$m^{3)}$	NA
Nitrogen Dioxide	Annual	0.053 ppm (100 μg/$m^{3)}$	(same as primary)
Suspended Particulate			
Matter (PM_{10})	Annual	50 μg/m^3	(same as primary)
	24-hour	150 μg/m^3 [e]	(same as primary)
($PM_{2.5}$)	Annual	15 μg/m^3 [f]	(same as primary)
	24-hour	35 μg/m^3 [g]	(same as primary)
Lead	Calendar Quarter	1.5 μg/m^3	(same as primary)

[a] The levels of air quality necessary, with an adequate margin of safety, to protect the public health.
[b] The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.
[c] Not to be exceeded more than once a year.
[d] Three-year average of the annual fourth-highest daily maximum 8-hour average for each monitor.
[e] Based on the 99^{th} percentile of 24-hour PM_{10} concentration at each monitor.
[f] Based on 3-year average of annual arithmetic mean concentrations.
[g] Based on 3-year average of 98^{th} percentile of 24-hour concentrations.

Note: mg/m^3 = milligrams per cubic meter = 1,000 μg/m^{-3}.
μg/m^3 = micrograms per cubic meter.

Source: 40 CFR 50, 2005.

Table 3-2

Estimated Abundance of Cetaceans
in the Northern Gulf of Mexico Oceanic Waters

Species	Common Name	Estimated Number of Individuals
Balaenoptera edeni	Bryde's whale	40
Physeter macrocephalus	Sperm whale	1,349
Kogia spp.	Dwarf or pygmy sperm whale	742
Ziphius cavirostris	Cuvier's beaked whale	95
Unidentified ziphiid	Unidentified beaked whales	146
Feresa attenuata	Pygmy killer whale	408
Pseudorca crassidens	False killer whale	1,038
Orcinus orca	Killer whale	133
Globicephala sp.	Pilot whale	2,388
Peponocephala electra	Melonheaded whale	3,451
Grampus griseus	Risso's dolphin	2,169
Tursiops truncatus	Bottlenose dolphin	27,559
Steno bredanensis	Rough-toothed dolphin	2,223
Lagenodelphis hosei	Fraser's dolphin	726
Stenella frontalis	Atlantic spotted dolphin	30,947
Stenella longirostris	Spinner dolphin	11,971
Stenella attenuate	Pantropical spotted dolphin	91,321
Stenella clymene	Clymene dolphin	17,355
Stenella coeruleoalba	Striped dolphin	6,505

Source: Waring et al., 2004.

Table 3-3

Sea Turtle Taxa of the Northern Gulf of Mexico

Order Testudines (turtles)	Relative Occurrence	ESA Status
Family Cheloniidae (hardshell sea turtles)		
Loggerhead sea turtle (*Caretta caretta*)	C	T/E
Green sea turtle (*Chelonia mydas*)	C	E
Hawksbill sea turtle (*Eretmochelys imbricata*)	R	E
Kemp's Ridley sea turtle (*Lepidochelys kempi*)	C	E
Family Dermochelyidae (leatherback sea turtle)		
Leatherback sea turtle (*Dermochelys coriacia*)	U	E

Population status in the northern Gulf is summarized according to the following categories:
COMMON (C): A common species is one that is abundant wherever it occurs in the region (i.e., the northern Gulf). Most common species are widely distributed over the area.
UNCOMMON (U): An uncommon species may or may not be widely distributed but does not occur in large numbers. Uncommon species are not necessarily rare or endangered.
RARE (R): A rare species is one that is present in such small numbers throughout the region that it is seldom seen. Although not threatened with extinction, a rare species may become endangered if conditions in its environment change.

Endangered Species Act (ESA) status is summarized according to listing status under the following categories:
ENDANGERED (E): Species determined to be in imminent danger of extinction throughout all of a significant portion of their range.
THREATENED (T): Species determined likely to become endangered in the foreseeable future.

Table 3-4

Common Diving Birds in the Northern Gulf of Mexico

Common Name	Scientific Name	Occurrence*	Feeding Behavior and Diet
Common loon	*Gavia immer*	Wintering resident	Dives from surface for fish, arthropods, snails, leeches, frogs, and salamanders
Horned grebe	*Podiceps auritus*	Wintering resident	Fish and some arthropods
Eared grebe	*Podiceps nigricollis*	TX, LA, MS, AL	Arthropods
Pied-billed grebe	*Podilymbus podiceps*	Permanent resident	Arthropods, small fish
Anhinga	*Anhinga anhinga*	Permanent resident	Swims underwater for fish, frogs, snakes, and leeches
Olivaceous cormorant	*Phalacrocorax olivaceus*	*	NA
Double-crested cormorant	*Phylacrocorax auritus*	Permanent resident	NA

*All of these diving birds are distributed Gulfwide except where otherwise indicated.
NA = Not available.

Table 3-5

Common Marsh or Wading Birds in the Northern Gulf of Mexico

Common Name	Scientific Name	Occurrence*	Feeding Behavior and Diet
American bittern	*Botaurus lentiginosus*	*	Amphibians, small fish, small snakes, crawfish, small rodents, and water bugs
Least bittern	*Ixobrychus exilus*	Summer resident	NA
Great blue heron	*Ardea herodias*	*	Various aquatic animals
Great egret	*Casmerodias albus*	*	Fish, frogs, snakes, crawfish, and large insects
Snowy egret	*Egretta thula*	*	Arthropods, fish
Little blue heron	*Egretta caerulea*	*	Small vertebrates, crustaceans, and large insects
Tricolored heron	*Egretta tricolor*	*	NA
Reddish egret	*Egretta rufescens*	Gulfwide except for central and eastern FL Panhandle	NA
Cattle egret	*Bulbulcus ibis*	*	NA
Green-backed heron	*Butorides striatus*	Permanent resident in central LA and eastward; summer resident, TX and western LA	NA
Black-crowned night heron	*Nycticorax nicticorax*	*	NA
Yellow-crowned night heron	*Nyctanassa biolacea*	Permanent resident TX, eastern LA, MS, AL, and eastern FL Panhandle	Aquatic organisms, especially crustaceans
White ibis	*Eudocimus albus*	*	NA
Glossy ibis	*Plegadis falconellus*	*	Snakes, crawfish, and crabs
White-faced ibis	*Plegadis chini*	Permanent resident in TX and western and central LA; summer resident in eastern LA	NA
Roseate spoonbill	*Ajaia ajaja*	Permanent resident; summer resident in LA	NA

*All wading birds are permanent residents Gulfwide unless otherwise indicated.
NA = Not available.

Table 3-6

Common Waterfowl in the Northern Gulf of Mexico

Common Name	Scientific Name	Occurrence*	Feeding Behavior and Diet
Wood duck	*Aix sponsa*	Year-round	Dabbler; eats plants, invertebrates, tadpoles, and salamanders
Canvasback duck	*Aythya valisineria*	Year-round	Diver; feeds on molluscs and aquatic plants
Redhead duck	*Aythya americana*	*	Diver; mostly herbivorous
Ring-necked duck	*Aythya collaris*	*	Diver
Fulvous whistling duck	*Dendrocygna bicolor*	Nests in TX, LA	Feeds nocturnally on plant seeds on shore
Lesser scaup	*Aythya affinis*	High abundance	Diver; feeds on plants and animals
Greater scaup	*Aythya maarila*	*	Feeds on plants, insects, and invertebrates in nesting season; diet at sea in winter is mostly molluscs and plants
Black scoter	*Melanitta nigra*	Low abundance	Diver; feeds mostly on molluscs
White-winged scoter	*Melanitta fusca*	TX, LA, AL; low abundance	Diver; feeds mostly on shellfish
Surf scoter	*Melanitta perspicilla*	Low abundance	Diver; feeds mostly on molluscs and crustaceans
Common goldeneye	*Bucephala clangula*	*	Diver; needs on molluscs, crustaceans, insects, and aquatic plants
Bufflehead	*Bucephala albeola*	*	Diver; in fresh water, eats aquatic adult and larval insects, snails, small fish, and aquatic plant seeds; in salt water, eats crustaceans, shellfish, and snails
Common merganser	*Mergus merganser*	*	Diver; feeds on molluscs, crustaceans, aquatic insects, and some plants
Red-breasted merganser	*Mergus serrator*	*	Eats mostly fish
Hooded merganser	*Lophodytes cucullatus*	*	Diver; thin serrated bill is adapted to taking fish; also feeds on crustaceans, aquatic insects, other animals, and plants
Tundra swan	*Cygnus columbianus*	Winters on Atlantic Coast, minor presence in Gulf	NA
Greater white-fronted goose	*Answer albifrons*	TX, LA, AL	Feeds on plants and insects
Snow goose	*Chen caerulescens*	TX, LA, MS, AL	Dabbler; grazer; herbivore
Canada goose	*Branta canadensis*	*	Dabbler; herbivore
Brant goose	*Branta bernicla*	FL	Herbivore
Mallard duck	*Anas platyrhynchos*	*	Dabbler; usually a herbivore; female supplements diet with invertebrate protein source when producing eggs
Mottled duck	*Anas fulvigula*	TX, LA year-round	Dabbler; invertebrates and some plant material
American widgeon duck	*Anas americana*	*	Dabbler; may feed on widgeon grass (*Ruppia maritima*)
Northern pintail duck	*Anas acuta*	Abundant in TX	Dabbler mostly herbivorous
Northern shoveler duck	*Anas clypeata*	*	Dabbler; strains food through combs of teeth that are found inside the bill on each side
Blue-winged teal duck	*Anas discors*	*	Dabbler; mostly herbivorous
Cinnamon teal duck	*Anas cyanoptera*	TX, west LA	Dabbler; eats invertebrates, plant seeds, and algae; sometimes skims water surface with bill
Gadwall duck	*Anas strepera*	*	Dabbler; mostly herbivorous
Ruddy duck	*Oxyura jamaicensis*	*	Diver; mostly herbivorous

*All waterfowl are wintering residents Gulfwide unless otherwise indicated.
NA = Not available.

Table 3-7

Top Species Commonly Caught by Recreational Fishers in the
Marine Recreational Fisheries Statistics Gulf Coast States (2005)

Species	Number Fish	Inland (#)	Ocean (#)	Pounds	Inland (lb)	Ocean (lb)
Black drum	1,146,707	965,631	181,076	2,010,778	1,818,868	191,910
Dolphins	351,218	0	351,218	1,359,500	0	1,359,500
Gray snapper	5,929,017	3,749,438	2,179,579	1,998,595	313,055	1,685,540
Great amberjack	217,045	1,872	215,173	1,485,219	7,857	1,477,362
Herrings	30,374,315	24,990,502	5,383,813	773,356	731,757	41,599
King mackerel	405,226	25,083	380,143	1,791,314	23,408	1,767,906
Mycteroperca groupers	3,199,719	495,853	2,703,866	4,067,011	244,316	3,822,695
Pinfishes	10,593,868	5,873,515	4,720,353	1,239,773	627,284	612,489
Red drum	7,688,465	6,050,791	1,637,674	10,711,841	9,123,356	1,588,485
Red snapper	2,986,162	55,769	2,930,393	3,638,264	18,750	3,619,514
Saltwater catfishes	10,570,516	7,672,959	2,897,557	810,237	640,569	169,668
Sand seatrout	2,604,437	2,117,580	486,857	911,186	731,158	180,028
Sheepshead	4,060,699	3,065,549	995,150	5,434,088	3,557,581	1,876,507
Spotted seatrout	30,060,398	23,191,943	6,868,455	11,999,073	9,576,037	2,423,036

Source: USDOC, NOAA, NMFS, 2006.

Table 3-8

Recreational Fishing Participation in the
Marine Recreational Fisheries Statistics Gulf Coast States (2005)

State	Participation Estimates (number of people)			
	Coastal	Non-Coastal	Out-of-State	Total
West Florida	2,095,356	0	2,019,122	4,114,477
Alabama	227,471	98,320	162,136	487,927
Mississippi	107,436	29,731	38,400	175,567
Louisiana	702,922	67,241	135,866	906,029
Gulf Total	3,133,185	195,292	2,355,524	5,684,000

Source: USDOC, NOAA, NMFS, 2006.

Table 3-9

Mode of Fishing in the Marine Recreational Fisheries Statistics Gulf Coast States (not including Texas) (2005)

State	Area	Number of Trips	% State Total
Alabama	Shore Ocean (≤3 mi)	453,078	28.5%
	Shore Inland	257,177	16.2%
	Charter Ocean (≤3 mi)	4,781	0.3%
	Charter Ocean (>3 mi)	52,012	3.3%
	Charter Inland	9,723	0.6%
	Private/Rental Ocean (≤3 mi)	252,235	15.9%
	Private/Rental Ocean (>3 mi)	240,431	15.1%
	Private/Rental Inland	318,662	20.1%
	Total	1,588,099	
West Florida	Shore Ocean (≤10 mi)	2,935,056	18.7%
	Shore Inland	3,364,072	21.4%
	Charter Ocean (≤10mi)	175,042	1.1%
	Charter Ocean (> 10 mi)	375,948	2.4%
	Charter Inland	157,120	1.0%
	Private/Rental Ocean (≤10 mi)	3,008,528	19.1%
	Private/Rental Ocean (>10 mi)	1,025,078	6.5%
	Private/Rental Inland	4,691,298	29.8%
	Total	15,732,142	
Louisiana	Shore Ocean (≤3 mi)	160,463	4.1%
	Shore Inland	1,007,066	25.6%
	Charter Ocean (≤3 mi)	14,347	0.4%
	Charter Ocean (>3 mi)	39,068	1.0%
	Charter Inland	103,595	2.6%
	Private/Rental Ocean (≤3 mi)	90,538	2.3%
	Private/Rental Ocean (>3 mi)	99,375	2.5%
	Private/Rental Inland	2,421,441	61.5%
	Total	3,935,893	
Mississippi	Shore Ocean (≤3 mi)	6,174	0.7%
	Shore Inland	393,800	43.7%
	Charter Ocean (≤3 mi)	6,174	0.7%
	Charter Ocean (>3 mi)	2,157	0.2%
	Charter Inland	3,337	0.4%
	Private/Rental Ocean (≤3 mi)	8,406	0.9%
	Private/Rental Ocean (>3 mi)	28,795	3.2%
	Private/Rental Inland	451,845	50.2%
	Total	900,688	
Gulf Total	Shore Ocean (≤3 mi)	3,554,771	16.0%
	Shore Inland	5,022,115	22.7%
	Charter Ocean (≤3 mi)	200,344	0.9%
	Charter Ocean (>3 mi)	469,185	2.1%
	Charter Inland	273,775	1.2%
	Private/Rental Ocean (≤3 mi)	3,359,707	15.2%
	Private/Rental Ocean (>3 mi)	1,393,679	6.3%
	Private/Rental Inland	7,883,246	35.6%
	Total	22,156,822	28.5%

Source: USDOC, NOAA, NMFS, 2006.

Table 3-10

Employment in Tourism-Related Industries by Labor Market Area in 2004

Labor Market Area	Total Mid-March Employees	Total Establishments	Establishments by Employment Size Class			
			1 to 9	10 to 49	50 to 249	250 or more
Mobile	45,084	2,416	47,500	823	179	1,002
Alabama State Total	271,747	14,673	8,537	4,930	1,115	91
Biloxi – Gulfport	45,944	1,673	47,617	574	106	680
Mississippi State Total	203,337	9,725	5,737	3,267	642	79
Lake Charles	22,866	997	564	349	72	12
Lafayette	34,723	1,853	1,075	647	120	11
Baton Rouge	53,333	2,499	1,382	867	236	14
Houma	18,400	1,007	614	328	58	7
New Orleans	126,556	5,358	3,109	1,721	469	59
Louisiana State Total	323,895	15,488	8,963	5,156	1,241	128
Brownsville	50,655	2,592	1,529	861	180	22
Corpus Christi	29,826	1,747	1,055	572	113	7
Brazoria	17,077	979	622	290	60	7
Victoria	12,299	885	549	294	41	1
Beaumont - Port Arthur	26,693	1,478	917	437	114	10
Houston - Galveston	328,675	15,029	8,816	4,681	1,404	128
Texas State Total	1,448,422	70,387	40,930	23,137	5,811	509
Panama City	58,779	2,744	1,578	864	285	17
Pensacola	47,710	2,298	1,335	740	206	17
Lake City	29,344	1,419	790	492	129	8
Tallahassee	7,559	550	369	154	24	3
Gainesville	22,096	1,195	765	318	105	7
Ocala	22,125	1,162	699	361	94	8
Tampa - St. Petersburg	184,635	8,494	5,319	2,183	929	63
Ft. Myers	29,074	1,140	653	330	145	12
Miami	149,518	7,592	4,955	1,923	661	53
Sarasota	55,498	2,735	1,661	765	298	11
Florida State Total	1,340,117	61,177	38,055	16,716	5,913	493

Source: USDOC, Bureau of the Census, 2006.

Table 3-11

Employment in Tourism-Related Industries by Economic Impact Area in 2004

Economic Impact Area (EIA)	Total Mid-March Employees	Total Establishments	Establishments by Employment Size Class			
			1 to 9	10 to 49	50 to 249	250 or more
AL-1	45,084	2,416	47,500	823	179	1,002
MS-1	45,944	1,673	47,617	574	106	680
LA-1	22,866	997	564	349	72	12
LA-2	34,723	1,853	1,075	647	120	11
LA-3	71,733	3,506	1,996	1,195	294	21
LA-4	126,556	5,358	3,109	1,721	469	59
Louisiana EIA Total	255,878	11,714	6,744	3,912	955	103
TX-1	80,481	4,339	2,584	1,433	293	29
TX-2	29,376	1,864	1,171	584	101	8
TX-3	355,368	16,507	9,733	5,118	1,518	138
Texas EIA Total	465,225	22,710	13,488	7,135	1,912	175
FL-1	64,062	3,203	1,866	1,046	269	22
FL-2	36,903	1,969	1,159	646	153	11
FL-3	228,856	10,851	6,783	2,862	1,128	78
FL-4	276,517	13,306	8,316	3,576	1,326	88
Florida EIA Total	606,338	29,329	18,124	8,130	2,876	199

Source: USDOC, Bureau of the Census, 2006.

Table 3-12

Classification of the Gulf Economic Impact Areas

State	Economic Impact Area	Labor Market	County
Alabama	AL-1	Mobile	Baldwin
			Clarke
			Conecuh
			Escambia
			Mobile
			Monroe
			Washington
			Wilcox
Mississippi	MS-1	Biloxi-Gulfport	George
			Greene
			Hancock
			Harrison
			Jackson
			Pearl River
			Stone
Louisiana	LA-1	Lake Charles	Allen
			Beauregard
			Calcasieu
			Cameron
			Jefferson Davis
			Vernon
	LA-2	Lafayette	Acadia
			Evangeline
			Iberia
			Lafayette
			St. Landry
			St. Martin
			Vermilion
	LA-3	Baton Rouge	Ascension
			East Baton Rouge
			Iberville
			Livingston
			Tangipahoa
			West Baton Rouge
		Houma	Assumption
			Lafourche
			St. Mary
			Terrebonne
			Jefferson
			Orleans
	LA-4	New Orleans	Plaquemines
			St. Bernard
			St. Charles
			St. James
			St. John the Baptist
			St. Tammany
			Washington

State	Economic Impact Area	Labor Market	County
Texas	TX-1	Brownsville	Cameron
			Hidalgo
			Starr
			Willacy
		Corpus Christi	Aransas
			Brooks
			Duval
			Jim Wells
			Kenedy
			Kleberg
			Nueces
			Refugio
			San Patricio
	TX-2	Brazoria	Brazoria
			Matagorda
			Wharton
		Victoria	Calhoun
			Colorado
			Dewitt
			Fayette
			Goliad
			Gonzales
			Jackson
			Lavaca
			Victoria
	TX-3	Beaumont - Port Arthur	Hardin
			Jasper
			Jefferson
			Newton
			Orange
			Polk
			Tyler
		Houston - Galveston	Austin
			Chambers
			Fort Bend
			Galveston
			Harris
			Liberty
			Montgomery
			San Jacinto
			Waller
			Washington

State	Economic Impact Area	Labor Market	County
Florida	FL-1	Panama City	Bay
			Franklin
			Gulf
		Pensacola	Escambia
			Okaloosa
			Santa Rosa
			Walton
	FL-2	Tallahassee	Calhoun
			Gadsden
			Holmes
			Jackson
			Jefferson
			Leon
			Liberty
			Wakulla
			Washington
		Lake City	Columbia
			Hamilton
			Lafayette
			Madison
			Suwannee
			Taylor
	FL-3	Ocala	Citrus
			Marion
		Gainesville	Alachua
			Bradford
			Dixie
			Gilchrist
			Levy
			Union
		Tampa-St. Petersburg	Hernando
			Hillsborough
			Pasco
			Pinellas
	FL-4	Ft. Myers	Collier
			Lee
		Miami	Broward
			Miami-Dade
			Monroe
		Sarasota	Charlotte
			DeSoto
			Manatee
			Sarasota

Table 3-13

2001 Hunting and Wildlife Watching in Gulf States by U.S. Residents

	Alabama	Mississippi	Louisiana	Texas	Florida	Total
Hunting						
Hunters	423,000	357,000	333,000	1,201,000	226,000	2,540,000
Resident	307,000	245,000	295,000	1,100,000	191,000	2,138,000
Nonresident	116,000	111,000	38,000	100,000	35,000	400,000
Total Expenditures ($million)	$663.6	$360.3	$446.2	$1,513.8	$394.2	$3,378.1
Trip-related	$195.9	$132.1	$120.7	$555.8	$120.0	$1,124.5
Equipment & Other	$467.7	$228.2	$325.5	$958.0	$274.3	$2,253.7
Wildlife Watching						
Total Participants	1,016,000	631,000	935,000	3,240,000	3,240,000	9,062,000
Residential	925,000	576,000	806,000	1,002,000	2,635,000	5,944,000
Nonresidential	276,000	131,000	314,000	2,930,000	1,503,000	5,154,000
Total Expenditures ($million)	$626.4	$303.5	$168.4	$1,283.0	$1,575.5	$3,956.8
Trip-related	$79.5	$36.1	$55.4	$228.8	$675.4	$1,075.2
Equipment & Other	$546.9	$267.4	$113.0	$1,054.2	$900.1	$2,881.6

Source: USDOI, FWS and USDOC, Bureau of the Census, 2001.

Table 3-14

Demographic and Employment Baseline Projections for Economic Impact Area TX-1

	1990	2000	2003	2004	2005	2006	2007	2008	2009	2010	2015	2020	2025	2030
TOTAL POPULATION (THOUSANDS)	1,172.83	1,488.18	1,581.51	1,617.80	1,651.49	1,686.51	1,717.47	1,748.38	1,779.06	1,809.74	1,967.42	2,128.28	2,293.97	2,467.95
AGE UNDER 19 YEARS	37.80%	36.11%	35.96%	35.75%	35.42%	35.13%	34.84%	34.60%	34.31%	33.99%	32.47%	31.07%	28.89%	27.61%
AGE 20 TO 34 YEARS	22.60%	21.36%	21.71%	21.90%	21.82%	21.66%	21.53%	21.37%	21.29%	21.27%	20.77%	20.01%	20.61%	20.20%
AGE 35 TO 49 YEARS	17.93%	19.50%	18.97%	18.85%	18.90%	18.98%	19.03%	19.11%	19.17%	19.16%	19.52%	20.16%	19.86%	19.71%
AGE 50 TO 64 YEARS	11.33%	12.33%	12.78%	13.01%	13.39%	13.78%	14.14%	14.46%	14.72%	14.97%	15.71%	15.95%	16.39%	16.92%
AGE 65 YEARS AND OVER	10.34%	10.70%	10.58%	10.50%	10.47%	10.46%	10.46%	10.47%	10.51%	10.61%	11.53%	12.81%	14.24%	15.56%
MEDIAN AGE OF POPULATION (YEARS)	29.89	32.65	33.01	33.12	33.50	33.88	34.26	34.61	34.94	35.28	36.59	37.90	39.52	41.06
WHITE POPULATION	25.27%	20.45%	19.16%	18.78%	18.45%	18.16%	17.89%	17.63%	17.38%	17.15%	16.14%	15.29%	14.61%	14.09%
BLACK POPULATION	1.38%	1.38%	1.29%	1.26%	1.25%	1.24%	1.23%	1.22%	1.21%	1.20%	1.16%	1.13%	1.11%	1.09%
NATIVE AMERICAN POPULATION	0.14%	0.17%	0.18%	0.18%	0.17%	0.17%	0.17%	0.17%	0.17%	0.16%	0.15%	0.14%	0.13%	0.12%
ASIAN AND PACIFIC ISLANDER POP	0.40%	0.73%	0.78%	0.80%	0.81%	0.83%	0.84%	0.85%	0.87%	0.88%	0.92%	0.96%	0.98%	1.01%
HISPANIC POPULATION	72.81%	77.27%	78.59%	78.98%	79.32%	79.61%	79.87%	80.13%	80.38%	80.61%	81.62%	82.48%	83.17%	83.69%
MALE POPULATION	48.53%	48.68%	48.69%	48.71%	48.68%	48.68%	48.67%	48.66%	48.65%	48.64%	48.59%	48.53%	48.44%	48.35%
TOTAL EMPLOYMENT (THOUSANDS)	471.14	640.56	688.24	702.46	716.70	730.94	745.17	759.41	773.64	787.88	859.04	930.22	1,001.40	1,072.57
FARM EMPLOYMENT	3.25%	2.00%	1.89%	1.84%	1.80%	1.76%	1.72%	1.68%	1.65%	1.61%	1.46%	1.33%	1.21%	1.12%
AGRICULTURAL SERVICES, OTHER	2.26%	2.41%	2.55%	2.53%	2.52%	2.50%	2.49%	2.48%	2.46%	2.45%	2.39%	2.35%	2.30%	2.27%
MINING	2.81%	1.58%	1.54%	1.51%	1.49%	1.47%	1.45%	1.42%	1.41%	1.39%	1.30%	1.23%	1.17%	1.11%
CONSTRUCTION	5.68%	6.87%	6.66%	6.66%	6.65%	6.65%	6.65%	6.64%	6.64%	6.64%	6.62%	6.61%	6.60%	6.60%
MANUFACTURING	8.57%	6.37%	4.90%	4.84%	4.79%	4.74%	4.69%	4.65%	4.60%	4.56%	4.36%	4.20%	4.05%	3.93%
TRANSPORT, COMM. & PUBLIC UTIL	3.81%	4.44%	4.29%	4.27%	4.26%	4.25%	4.23%	4.22%	4.21%	4.20%	4.15%	4.11%	4.07%	4.04%
WHOLESALE TRADE	3.93%	3.34%	3.05%	3.02%	2.99%	2.96%	2.93%	2.91%	2.88%	2.86%	2.75%	2.66%	2.58%	2.51%
RETAIL TRADE	19.05%	17.89%	17.78%	17.67%	17.58%	17.48%	17.39%	17.31%	17.22%	17.14%	16.78%	16.47%	16.21%	15.98%
FINANCE, INS. & REAL ESTATE	5.80%	5.67%	6.01%	5.97%	5.93%	5.89%	5.85%	5.81%	5.78%	5.75%	5.59%	5.47%	5.36%	5.26%
SERVICES	24.72%	30.13%	32.73%	32.96%	33.19%	33.40%	33.61%	33.80%	33.99%	34.18%	35.01%	35.71%	36.31%	36.83%
FEDERAL CIVILIAN GOVT	2.53%	1.92%	1.78%	1.76%	1.73%	1.71%	1.68%	1.66%	1.64%	1.62%	1.53%	1.45%	1.38%	1.32%
FEDERAL MILITARY GOVT	1.65%	1.65%	1.44%	1.41%	1.38%	1.36%	1.34%	1.31%	1.29%	1.27%	1.17%	1.09%	1.02%	0.96%
STATE AND LOCAL GOVT	15.95%	15.74%	15.40%	15.55%	15.70%	15.84%	15.97%	16.10%	16.22%	16.34%	16.88%	17.33%	17.72%	18.06%
TOTAL EARNINGS (MILLIONS 1996 $)	10,800.99	16,122.59	18,078.88	18,608.83	19,122.16	19,641.84	20,171.93	20,703.28	21,246.07	21,800.60	24,759.66	28,058.99	31,743.04	35,862.37
FARM EARNINGS	1.32%	1.27%	1.19%	0.98%	0.97%	0.96%	0.95%	0.94%	0.93%	0.92%	0.88%	0.83%	0.79%	0.75%
AGRICULTURAL SERVICES, OTHER	1.24%	1.08%	1.02%	1.01%	1.01%	1.00%	0.99%	0.99%	0.98%	0.97%	0.94%	0.92%	0.90%	0.88%
MINING	4.35%	3.04%	2.96%	3.09%	3.02%	2.95%	2.89%	2.82%	2.76%	2.71%	2.44%	2.21%	2.00%	1.82%
CONSTRUCTION	5.83%	6.52%	6.50%	6.67%	6.65%	6.62%	6.59%	6.56%	6.53%	6.50%	6.36%	6.22%	6.09%	5.96%
MANUFACTURING	11.24%	9.44%	8.24%	8.14%	8.03%	7.93%	7.85%	7.78%	7.71%	7.63%	7.23%	6.79%	6.32%	5.82%
TRANSPORT, COMM. & PUBLIC UTIL	5.58%	6.37%	5.64%	5.61%	5.58%	5.56%	5.53%	5.51%	5.48%	5.46%	5.35%	5.26%	5.17%	5.10%
WHOLESALE TRADE	4.71%	4.45%	4.60%	4.55%	4.49%	4.43%	4.38%	4.33%	4.28%	4.23%	4.00%	3.80%	3.61%	3.44%
RETAIL TRADE	12.55%	11.88%	11.96%	11.87%	11.78%	11.70%	11.63%	11.56%	11.50%	11.44%	11.13%	10.84%	10.56%	10.29%
FINANCE, INS. & REAL ESTATE	3.83%	4.90%	5.41%	5.39%	5.40%	5.41%	5.41%	5.42%	5.42%	5.42%	5.44%	5.46%	5.47%	5.48%
SERVICES	22.78%	24.95%	26.51%	26.76%	27.04%	27.31%	27.58%	27.84%	28.11%	28.38%	29.74%	31.15%	32.60%	34.09%
FEDERAL CIVILIAN GOVT	5.72%	4.83%	4.73%	4.68%	4.63%	4.58%	4.52%	4.46%	4.41%	4.35%	4.09%	3.84%	3.62%	3.41%
FEDERAL MILITARY GOVT	2.24%	2.74%	2.56%	2.37%	2.34%	2.31%	2.28%	2.25%	2.23%	2.20%	2.07%	1.94%	1.82%	1.70%
STATE AND LOCAL GOVT	18.60%	18.52%	18.68%	18.88%	19.06%	19.24%	19.39%	19.53%	19.66%	19.79%	20.33%	20.74%	21.04%	21.25%
PERSONAL INCOME (MILLIONS 1996 $)	15,354.71	23,186.51	25,745.65	26,534.84	27,325.92	28,110.62	28,913.42	29,728.96	30,564.67	31,421.16	36,037.74	41,275.27	47,232.58	54,025.27
INCOME PER CAPITA (1996 $)	13,092.03	15,580.45	16,279.13	16,401.79	16,546.21	16,667.96	16,834.90	17,003.70	17,180.24	17,362.23	18,317.26	19,393.71	20,589.88	21,890.76
W&P WEALTH INDEX (U.S. = 100)	65.16	65.20	68.06	69.54	69.36	69.31	69.25	69.20	69.15	69.10	68.93	68.81	68.75	68.75
PERSONS PER HOUSEHOLD (PEOPLE)	3.34	3.29	3.28	3.26	3.25	3.24	3.23	3.22	3.21	3.20	3.17	3.15	3.15	3.17
MEAN HOUSEHOLD INCOME (1996 $)	41,608.62	50,577.77	53,915.69	56,277.77	56,582.31	56,790.23	57,132.85	57,427.38	57,811.54	58,213.31	60,461.77	63,408.15	66,916.85	71,012.23
NUMBER OF HOUSEHOLDS (THOUSANDS)	351.28	451.74	482.89	495.61	507.65	520.28	531.62	542.91	554.10	565.29	621.48	675.50	727.93	779.01
LESS THAN $10,000 (2000 $)	22.00%	17.46%	16.66%	16.41%	16.16%	15.92%	15.67%	15.44%	15.21%	14.98%	13.88%	12.72%	11.33%	9.77%
$10,000 TO $19,999	20.87%	19.58%	18.71%	18.44%	18.18%	17.91%	17.63%	17.37%	17.11%	16.85%	15.62%	14.32%	12.76%	11.01%
$20,000 TO $29,999	15.98%	15.90%	15.55%	15.43%	15.31%	15.17%	15.01%	14.83%	14.65%	14.45%	13.50%	12.46%	11.14%	9.62%
$30,000 TO $44,999	16.69%	17.42%	18.02%	18.23%	18.43%	18.64%	18.84%	19.05%	19.25%	19.44%	20.13%	20.48%	20.10%	18.44%
$45,000 TO $59,999	10.38%	11.21%	11.76%	11.93%	12.10%	12.27%	12.45%	12.64%	12.83%	13.02%	14.02%	15.23%	16.85%	18.90%
$60,000 TO $74,999	5.97%	6.93%	7.26%	7.36%	7.46%	7.57%	7.68%	7.79%	7.90%	8.01%	8.61%	9.35%	10.49%	12.18%
$75,000 TO $99,999	3.94%	5.97%	6.24%	6.32%	6.40%	6.49%	6.58%	6.67%	6.76%	6.86%	7.35%	7.97%	8.94%	10.35%
$100,000 OR MORE	4.17%	5.53%	5.80%	5.87%	5.96%	6.04%	6.13%	6.22%	6.31%	6.40%	6.87%	7.47%	8.38%	9.73%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 13 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2006.

Table 3-15

Demographic and Employment Baseline Projections for Economic Impact Area TX-2

	1990	2000	2003	2004	2005	2006	2007	2008	2009	2010	2015	2020	2025	2030
TOTAL POPULATION (THOUSANDS)	474.95	548.56	571.70	579.63	587.87	596.61	602.86	609.11	615.29	621.49	654.09	687.93	723.40	761.46
AGE UNDER 19 YEARS	31.99%	30.90%	30.30%	29.92%	29.57%	29.24%	28.97%	28.77%	28.55%	28.32%	27.72%	27.70%	27.36%	27.07%
AGE 20 TO 34 YEARS	22.57%	18.42%	19.33%	19.72%	19.85%	19.92%	20.02%	20.16%	20.37%	20.61%	21.02%	19.66%	18.99%	18.65%
AGE 35 TO 49 YEARS	20.11%	23.61%	22.66%	22.28%	22.01%	21.69%	21.38%	20.91%	20.36%	19.82%	18.14%	18.91%	19.74%	20.41%
AGE 50 TO 64 YEARS	13.05%	14.69%	15.59%	15.99%	16.49%	17.06%	17.47%	17.95%	18.40%	18.86%	19.73%	18.81%	17.13%	15.85%
AGE 65 YEARS AND OVER	12.28%	12.37%	12.13%	12.10%	12.08%	12.09%	12.14%	12.21%	12.32%	12.38%	13.39%	14.92%	16.77%	18.03%
MEDIAN AGE OF POPULATION (YEARS)	34.76	37.62	37.69	37.79	37.99	38.21	38.35	38.49	38.61	38.68	38.84	39.34	40.22	41.25
WHITE POPULATION	67.28%	61.90%	59.98%	59.33%	58.84%	58.34%	57.82%	57.32%	56.83%	56.34%	53.88%	51.39%	48.93%	46.47%
BLACK POPULATION	9.05%	8.81%	8.97%	9.10%	9.11%	9.12%	9.13%	9.14%	9.15%	9.18%	9.27%	9.35%	9.43%	9.55%
NATIVE AMERICAN POPULATION	0.24%	0.32%	0.33%	0.34%	0.33%	0.34%	0.33%	0.33%	0.33%	0.33%	0.32%	0.30%	0.28%	0.26%
ASIAN AND PACIFIC ISLANDER POP	0.77%	1.46%	1.99%	2.17%	2.24%	2.32%	2.40%	2.48%	2.56%	2.64%	3.02%	3.38%	3.79%	4.35%
HISPANIC POPULATION	22.66%	27.52%	28.74%	29.07%	29.48%	29.87%	30.31%	30.73%	31.12%	31.51%	33.51%	35.59%	37.56%	39.37%
MALE POPULATION	50.01%	50.31%	50.37%	50.39%	50.40%	50.39%	50.40%	50.40%	50.40%	50.40%	50.38%	50.34%	50.22%	50.10%
TOTAL EMPLOYMENT (THOUSANDS)	237.42	277.18	279.60	284.41	289.19	294.37	299.12	303.86	308.58	313.30	336.81	360.13	383.25	406.15
FARM EMPLOYMENT	9.36%	8.80%	8.90%	8.81%	8.73%	8.64%	8.57%	8.49%	8.42%	8.35%	8.04%	7.78%	7.55%	7.36%
AGRICULTURAL SERVICES, OTHER	1.88%	2.11%	2.28%	2.27%	2.25%	2.23%	2.22%	2.21%	2.19%	2.18%	2.13%	2.09%	2.05%	2.03%
MINING	3.47%	2.54%	2.34%	2.33%	2.33%	2.32%	2.31%	2.31%	2.30%	2.30%	2.28%	2.27%	2.26%	2.25%
CONSTRUCTION	9.28%	9.57%	9.06%	9.07%	9.09%	9.11%	9.12%	9.13%	9.15%	9.16%	9.22%	9.28%	9.34%	9.40%
MANUFACTURING	13.53%	11.99%	10.24%	10.21%	10.17%	10.14%	10.11%	10.08%	10.05%	10.03%	9.90%	9.80%	9.71%	9.64%
TRANSPORT, COMM. & PUBLIC UTIL	4.19%	4.06%	4.16%	4.16%	4.16%	4.16%	4.16%	4.16%	4.16%	4.16%	4.17%	4.17%	4.18%	4.19%
WHOLESALE TRADE	3.44%	3.36%	3.24%	3.24%	3.24%	3.24%	3.23%	3.23%	3.23%	3.22%	3.21%	3.20%	3.19%	3.18%
RETAIL TRADE	15.23%	15.30%	15.66%	15.59%	15.53%	15.47%	15.41%	15.36%	15.31%	15.26%	15.05%	14.86%	14.69%	14.53%
FINANCE, INS. & REAL ESTATE	5.01%	5.83%	6.21%	6.21%	6.22%	6.22%	6.22%	6.22%	6.22%	6.22%	6.23%	6.23%	6.24%	6.26%
SERVICES	21.20%	22.37%	23.65%	23.79%	23.93%	24.06%	24.18%	24.29%	24.40%	24.51%	24.98%	25.36%	25.67%	25.92%
FEDERAL CIVILIAN GOVT	0.53%	0.56%	0.47%	0.47%	0.46%	0.45%	0.45%	0.44%	0.44%	0.43%	0.41%	0.39%	0.37%	0.35%
FEDERAL MILITARY GOVT	0.77%	0.54%	0.54%	0.53%	0.52%	0.51%	0.50%	0.49%	0.49%	0.48%	0.44%	0.41%	0.39%	0.36%
STATE AND LOCAL GOVT	12.10%	12.98%	13.25%	13.32%	13.39%	13.45%	13.51%	13.57%	13.63%	13.69%	13.94%	14.16%	14.35%	14.53%
TOTAL EARNINGS (MILLIONS 1996 $)	6,024.98	7,752.79	7,842.02	7,978.73	8,168.80	8,375.57	8,574.20	8,773.45	8,975.67	9,180.92	10,253.64	11,407.33	12,647.26	13,979.67
FARM EARNINGS	3.05%	3.02%	2.78%	2.75%	2.77%	2.79%	2.81%	2.83%	2.85%	2.88%	2.99%	3.10%	3.22%	3.34%
AGRICULTURAL SERVICES, OTHER	0.99%	1.19%	1.10%	1.05%	1.04%	1.03%	1.03%	1.02%	1.01%	1.01%	0.98%	0.96%	0.95%	0.95%
MINING	4.71%	4.10%	4.02%	4.51%	4.47%	4.42%	4.38%	4.34%	4.30%	4.27%	4.09%	3.93%	3.78%	3.64%
CONSTRUCTION	11.59%	10.98%	9.97%	10.40%	10.40%	10.39%	10.38%	10.36%	10.34%	10.32%	10.24%	10.17%	10.12%	10.07%
MANUFACTURING	26.75%	23.49%	22.75%	22.46%	22.33%	22.23%	22.17%	22.12%	22.06%	21.99%	21.57%	20.99%	20.26%	19.40%
TRANSPORT, COMM. & PUBLIC UTIL	6.48%	6.89%	6.88%	6.47%	6.47%	6.47%	6.47%	6.46%	6.46%	6.46%	6.46%	6.47%	6.49%	6.53%
WHOLESALE TRADE	3.94%	4.43%	4.48%	3.98%	3.97%	3.96%	3.95%	3.94%	3.92%	3.91%	3.85%	3.80%	3.74%	3.69%
RETAIL TRADE	8.89%	9.06%	9.19%	9.16%	9.10%	9.05%	9.00%	8.96%	8.92%	8.88%	8.70%	8.54%	8.40%	8.28%
FINANCE, INS. & REAL ESTATE	2.81%	4.11%	3.99%	4.11%	4.14%	4.17%	4.19%	4.21%	4.23%	4.25%	4.35%	4.44%	4.54%	4.63%
SERVICES	15.92%	17.77%	18.53%	18.83%	18.97%	19.11%	19.23%	19.35%	19.48%	19.61%	20.31%	21.09%	21.94%	22.87%
FEDERAL CIVILIAN GOVT	0.99%	1.03%	0.93%	0.93%	0.92%	0.91%	0.90%	0.89%	0.87%	0.86%	0.81%	0.77%	0.73%	0.69%
FEDERAL MILITARY GOVT	0.39%	0.29%	0.57%	0.37%	0.37%	0.36%	0.36%	0.35%	0.35%	0.35%	0.33%	0.31%	0.29%	0.28%
STATE AND LOCAL GOVT	13.49%	13.65%	14.80%	14.99%	15.05%	15.11%	15.15%	15.17%	15.20%	15.22%	15.34%	15.44%	15.54%	15.63%
PERSONAL INCOME (MILLIONS 1996 $)	8,995.63	12,824.33	13,248.81	13,578.15	13,891.24	14,224.77	14,540.46	14,860.01	15,185.08	15,515.68	17,256.81	19,155.79	21,230.19	23,500.26
INCOME PER CAPITA (1996 $)	18,940.13	23,378.22	23,174.25	23,425.51	23,629.62	23,842.55	24,119.17	24,396.39	24,679.54	24,965.45	26,382.76	27,845.47	29,347.63	30,862.27
W&P WEALTH INDEX (U.S. = 100)	82.36	80.00	80.02	79.21	79.30	79.44	79.56	79.69	79.82	79.94	80.48	80.91	81.23	81.43
PERSONS PER HOUSEHOLD (PEOPLE)	2.82	2.82	2.79	2.78	2.78	2.77	2.76	2.75	2.75	2.74	2.72	2.72	2.74	2.77
MEAN HOUSEHOLD INCOME (1996 $)	46,968.25	56,902.33	56,386.33	56,113.83	56,732.50	57,188.92	57,812.83	58,451.67	59,122.58	59,803.83	63,432.08	67,669.08	72,469.42	77,850.25
NUMBER OF HOUSEHOLDS (THOUSANDS)	168.23	194.83	204.81	208.22	211.77	215.55	218.41	221.23	224.00	226.76	240.49	253.03	264.48	274.90
LESS THAN $10,000 (2000 $)	14.79%	10.45%	10.10%	9.93%	9.75%	9.61%	9.47%	9.33%	9.19%	9.06%	8.33%	7.50%	6.64%	5.80%
$10,000 TO $19,999	15.67%	14.02%	13.58%	13.37%	13.13%	12.94%	12.77%	12.59%	12.41%	12.23%	11.29%	10.22%	9.07%	7.95%
$20,000 TO $29,999	14.50%	13.93%	13.55%	13.34%	13.12%	12.94%	12.77%	12.60%	12.43%	12.26%	11.36%	10.33%	9.20%	8.09%
$30,000 TO $44,999	18.43%	17.72%	17.76%	17.62%	17.56%	17.50%	17.43%	17.35%	17.26%	17.16%	16.47%	15.25%	13.60%	11.94%
$45,000 TO $59,999	14.12%	13.59%	13.84%	13.96%	14.12%	14.24%	14.36%	14.48%	14.59%	14.70%	15.30%	15.99%	15.95%	14.99%
$60,000 TO $74,999	9.74%	10.45%	10.72%	10.90%	11.08%	11.22%	11.37%	11.52%	11.67%	11.83%	12.73%	13.94%	15.53%	17.00%
$75,000 TO $99,999	6.59%	10.11%	10.41%	10.62%	10.81%	10.96%	11.10%	11.26%	11.41%	11.57%	12.46%	13.61%	15.26%	17.41%
$100,000 OR MORE	6.15%	9.73%	10.04%	10.25%	10.43%	10.58%	10.72%	10.87%	11.03%	11.18%	12.05%	13.16%	14.74%	16.82%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 12 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2006.

Table 3-16

Demographic and Employment Baseline Projections for Economic Impact Area TX-3

	1990	2000	2003	2004	2005	2006	2007	2008	2009	2010	2015	2020	2025	2030
TOTAL POPULATION (THOUSANDS)	4,078.98	5,026.48	5,340.67	5,437.10	5,533.80	5,665.75	5,739.75	5,813.67	5,886.89	5,960.20	6,341.43	6,733.60	7,141.18	7,574.15
AGE UNDER 19 YEARS	31.95%	31.56%	31.19%	30.91%	30.76%	30.59%	30.45%	30.31%	30.12%	29.92%	29.23%	29.09%	28.73%	28.29%
AGE 20 TO 34 YEARS	26.44%	22.56%	22.43%	22.39%	22.21%	22.03%	21.90%	21.86%	21.88%	21.95%	22.09%	21.37%	20.91%	20.50%
AGE 35 TO 49 YEARS	21.92%	23.91%	23.19%	22.99%	22.82%	22.62%	22.40%	22.09%	21.79%	21.46%	20.33%	20.18%	20.11%	20.53%
AGE 50 TO 64 YEARS	11.50%	13.54%	14.79%	15.29%	15.75%	16.25%	16.62%	16.99%	17.30%	17.63%	17.94%	17.39%	16.67%	16.12%
AGE 65 YEARS AND OVER	8.18%	8.43%	8.41%	8.43%	8.46%	8.51%	8.62%	8.75%	8.90%	9.04%	10.41%	11.98%	13.58%	14.56%
MEDIAN AGE OF POPULATION (YEARS)	33.65	35.89	35.87	35.93	36.11	36.31	36.47	36.61	36.75	36.84	37.09	37.95	38.94	39.57
WHITE POPULATION	59.17%	49.94%	47.75%	47.07%	46.43%	45.82%	45.21%	44.60%	44.01%	43.44%	40.70%	38.14%	35.78%	33.52%
BLACK POPULATION	18.43%	17.89%	17.61%	17.52%	17.40%	17.28%	17.16%	17.06%	16.96%	16.86%	16.33%	15.75%	15.16%	14.60%
NATIVE AMERICAN POPULATION	0.24%	0.29%	0.29%	0.29%	0.29%	0.29%	0.28%	0.28%	0.28%	0.28%	0.26%	0.24%	0.22%	0.20%
ASIAN AND PACIFIC ISLANDER POP	3.27%	4.95%	5.29%	5.38%	5.50%	5.61%	5.73%	5.84%	5.96%	6.08%	6.65%	7.21%	7.79%	8.47%
HISPANIC POPULATION	18.89%	26.93%	29.07%	29.73%	30.39%	31.00%	31.62%	32.21%	32.79%	33.34%	36.05%	38.65%	41.04%	43.21%
MALE POPULATION	49.55%	49.77%	49.88%	49.91%	49.92%	49.92%	49.92%	49.92%	49.91%	49.91%	49.86%	49.78%	49.67%	49.55%
TOTAL EMPLOYMENT (THOUSANDS)	2,322.69	3,001.89	3,064.36	3,125.52	3,186.72	3,272.69	3,333.08	3,393.48	3,453.88	3,514.28	3,816.31	4,118.50	4,421.00	4,723.95
FARM EMPLOYMENT	0.74%	0.67%	0.67%	0.66%	0.65%	0.64%	0.63%	0.63%	0.62%	0.61%	0.58%	0.56%	0.54%	0.52%
AGRICULTURAL SERVICES, OTHER	0.85%	1.05%	1.22%	1.21%	1.21%	1.21%	1.20%	1.20%	1.19%	1.19%	1.17%	1.15%	1.14%	1.13%
MINING	3.93%	2.79%	2.50%	2.50%	2.50%	2.50%	2.50%	2.49%	2.49%	2.49%	2.48%	2.47%	2.47%	2.46%
CONSTRUCTION	7.28%	7.87%	7.65%	7.64%	7.63%	7.61%	7.60%	7.59%	7.58%	7.57%	7.53%	7.49%	7.46%	7.43%
MANUFACTURING	9.63%	8.74%	7.55%	7.51%	7.47%	7.42%	7.38%	7.35%	7.31%	7.28%	7.12%	6.99%	6.87%	6.77%
TRANSPORT, COMM. & PUBLIC UTIL	6.10%	6.61%	6.07%	6.04%	6.02%	5.99%	5.97%	5.95%	5.93%	5.91%	5.82%	5.74%	5.67%	5.61%
WHOLESALE TRADE	5.79%	5.14%	4.95%	4.93%	4.90%	4.88%	4.85%	4.83%	4.81%	4.79%	4.69%	4.61%	4.54%	4.47%
RETAIL TRADE	15.74%	15.75%	15.98%	15.88%	15.78%	15.69%	15.60%	15.52%	15.43%	15.36%	14.99%	14.69%	14.43%	14.20%
FINANCE, INS. & REAL ESTATE	7.90%	8.02%	8.41%	8.36%	8.30%	8.25%	8.20%	8.15%	8.11%	8.06%	7.86%	7.68%	7.53%	7.40%
SERVICES	30.09%	31.72%	32.99%	33.25%	33.49%	33.73%	33.96%	34.18%	34.39%	34.59%	35.51%	36.30%	36.98%	37.57%
FEDERAL CIVILIAN GOVT	1.26%	1.05%	0.99%	0.97%	0.96%	0.94%	0.93%	0.91%	0.90%	0.89%	0.83%	0.78%	0.73%	0.69%
FEDERAL MILITARY GOVT	0.71%	0.48%	0.49%	0.48%	0.47%	0.46%	0.45%	0.44%	0.43%	0.43%	0.39%	0.36%	0.33%	0.31%
STATE AND LOCAL GOVT	9.96%	10.10%	10.53%	10.58%	10.63%	10.67%	10.71%	10.76%	10.80%	10.84%	11.02%	11.18%	11.32%	11.43%
TOTAL EARNINGS (MILLIONS 1996 $)	80,160.94	137,122.30	142,073.44	145,544.54	149,249.32	154,182.98	157,992.23	161,814.77	165,710.53	169,680.92	190,707.52	213,855.46	239,367.52	267,521.65
FARM EARNINGS	0.10%	0.07%	0.09%	0.07%	0.08%	0.08%	0.08%	0.08%	0.08%	0.08%	0.08%	0.08%	0.09%	0.09%
AGRICULTURAL SERVICES, OTHER	0.40%	0.43%	0.39%	0.39%	0.39%	0.39%	0.39%	0.38%	0.38%	0.38%	0.38%	0.37%	0.37%	0.37%
MINING	8.36%	9.19%	8.85%	8.25%	8.19%	8.14%	8.08%	8.03%	7.97%	7.92%	7.64%	7.36%	7.08%	6.80%
CONSTRUCTION	8.04%	7.39%	7.55%	7.80%	7.78%	7.76%	7.73%	7.70%	7.67%	7.64%	7.51%	7.38%	7.26%	7.14%
MANUFACTURING	13.94%	12.65%	12.06%	12.03%	11.95%	11.88%	11.84%	11.80%	11.76%	11.72%	11.44%	11.07%	10.60%	10.05%
TRANSPORT, COMM. & PUBLIC UTIL	8.52%	11.17%	9.74%	9.75%	9.70%	9.66%	9.62%	9.57%	9.53%	9.49%	9.30%	9.15%	9.01%	8.89%
WHOLESALE TRADE	7.76%	6.70%	6.75%	6.76%	6.71%	6.67%	6.62%	6.58%	6.53%	6.49%	6.28%	6.08%	5.89%	5.71%
RETAIL TRADE	7.97%	7.14%	7.42%	7.38%	7.32%	7.26%	7.21%	7.16%	7.12%	7.07%	6.85%	6.66%	6.47%	6.30%
FINANCE, INS. & REAL ESTATE	6.00%	8.58%	8.53%	8.54%	8.55%	8.56%	8.56%	8.56%	8.56%	8.55%	8.55%	8.55%	8.54%	8.54%
SERVICES	27.55%	27.05%	27.96%	28.30%	28.58%	28.86%	29.12%	29.38%	29.64%	29.90%	31.24%	32.64%	34.08%	35.59%
FEDERAL CIVILIAN GOVT	2.11%	1.62%	1.65%	1.64%	1.62%	1.60%	1.57%	1.55%	1.53%	1.51%	1.40%	1.31%	1.22%	1.14%
FEDERAL MILITARY GOVT	0.31%	0.20%	0.34%	0.35%	0.35%	0.34%	0.34%	0.33%	0.33%	0.32%	0.30%	0.28%	0.27%	0.25%
STATE AND LOCAL GOVT	8.95%	7.80%	8.67%	8.74%	8.78%	8.82%	8.85%	8.88%	8.90%	8.92%	9.01%	9.07%	9.11%	9.13%
PERSONAL INCOME (MILLIONS 1996 $)	94,506.37	156,414.50	161,050.64	165,653.03	169,957.41	175,534.53	179,817.54	184,140.03	188,550.84	193,051.87	216,999.79	243,614.11	273,297.21	306,525.84
INCOME PER CAPITA (1996 $)	23,169.09	31,118.12	30,155.54	30,467.14	30,712.62	30,981.69	31,328.47	31,673.63	32,028.94	32,390.19	34,219.40	36,178.90	38,270.57	40,470.00
W&P WEALTH INDEX (U.S. = 100)	81.93	85.39	85.03	83.88	83.76	83.68	83.59	83.51	83.44	83.36	83.01	82.68	82.36	82.05
PERSONS PER HOUSEHOLD (PEOPLE)	2.77	2.83	2.80	2.80	2.79	2.79	2.78	2.78	2.78	2.77	2.77	2.78	2.81	2.85
MEAN HOUSEHOLD INCOME (1996 $)	48,808.35	63,242.82	62,440.29	61,850.00	62,292.12	62,536.76	62,973.88	63,426.65	63,910.65	64,415.41	67,195.59	70,665.71	74,755.47	79,475.18
NUMBER OF HOUSEHOLDS (THOUSANDS)	1,474.97	1,778.31	1,905.39	1,943.34	1,981.51	2,032.65	2,062.50	2,091.98	2,120.91	2,149.65	2,291.76	2,421.82	2,541.98	2,653.25
LESS THAN $10,000 (2000 $)	12.08%	9.39%	9.19%	9.07%	8.94%	8.82%	8.72%	8.62%	8.46%	8.31%	7.56%	6.80%	6.11%	5.46%
$10,000 TO $19,999	13.54%	11.84%	11.61%	11.47%	11.31%	11.16%	11.03%	10.91%	10.72%	10.53%	9.60%	8.64%	7.78%	6.96%
$20,000 TO $29,999	13.94%	12.87%	12.66%	12.51%	12.35%	12.19%	12.06%	11.92%	11.71%	11.51%	10.49%	9.45%	8.51%	7.63%
$30,000 TO $44,999	18.41%	17.72%	17.62%	17.47%	17.30%	17.13%	16.97%	16.82%	16.56%	16.30%	14.97%	13.56%	12.27%	11.02%
$45,000 TO $59,999	14.15%	13.21%	13.42%	13.52%	13.66%	13.80%	13.90%	14.00%	14.16%	14.29%	14.56%	14.12%	13.10%	12.00%
$60,000 TO $74,999	9.66%	10.12%	10.26%	10.37%	10.49%	10.61%	10.72%	10.83%	11.00%	11.19%	12.16%	13.28%	14.31%	14.76%
$75,000 TO $99,999	7.70%	10.58%	10.74%	10.88%	11.03%	11.17%	11.29%	11.42%	11.62%	11.83%	12.98%	14.43%	15.98%	17.68%
$100,000 OR MORE	10.51%	14.26%	14.50%	14.71%	14.92%	15.12%	15.30%	15.48%	15.76%	16.05%	17.68%	19.72%	21.94%	24.49%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 12 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2006.

Table 3-17

Demographic and Employment Baseline Projections for Economic Impact Area LA-1

	1990	2000	2003	2004	2005	2006	2007	2008	2009	2010	2015	2020	2025	2030
TOTAL POPULATION (THOUSANDS)	321.59	335.84	334.17	334.24	334.83	339.74	340.82	341.91	342.96	344.03	350.31	357.30	365.15	374.25
AGE UNDER 19 YEARS	32.35%	30.79%	29.95%	29.60%	29.39%	29.23%	29.16%	29.11%	28.96%	28.87%	28.69%	28.95%	28.81%	28.63%
AGE 20 TO 34 YEARS	26.04%	21.34%	21.31%	21.25%	21.22%	21.16%	21.08%	21.03%	21.06%	21.07%	20.77%	19.64%	19.45%	19.43%
AGE 35 TO 49 YEARS	18.85%	22.15%	21.68%	21.52%	21.31%	21.07%	20.79%	20.44%	20.07%	19.66%	18.34%	18.46%	18.46%	18.38%
AGE 50 TO 64 YEARS	12.61%	14.35%	15.37%	15.85%	16.25%	16.69%	17.09%	17.45%	17.85%	18.29%	19.22%	18.74%	17.44%	16.45%
AGE 65 YEARS AND OVER	10.15%	11.36%	11.69%	11.78%	11.83%	11.85%	11.89%	11.97%	12.06%	12.11%	12.98%	14.21%	15.83%	17.11%
MEDIAN AGE OF POPULATION (YEARS)	30.63	33.79	34.45	34.69	34.92	35.11	35.27	35.37	35.42	35.40	35.56	36.45	37.26	37.86
WHITE POPULATION	76.23%	75.24%	74.88%	74.90%	74.79%	74.64%	74.51%	74.38%	74.23%	74.10%	73.54%	73.03%	72.44%	71.75%
BLACK POPULATION	20.58%	20.88%	21.03%	20.95%	21.02%	21.11%	21.19%	21.26%	21.34%	21.43%	21.75%	22.03%	22.41%	22.86%
NATIVE AMERICAN POPULATION	0.39%	0.66%	0.64%	0.65%	0.65%	0.66%	0.66%	0.67%	0.68%	0.68%	0.69%	0.70%	0.71%	0.71%
ASIAN AND PACIFIC ISLANDER POP	0.71%	0.85%	0.90%	0.91%	0.93%	0.95%	0.97%	0.99%	1.02%	1.04%	1.14%	1.23%	1.32%	1.43%
HISPANIC POPULATION	2.09%	2.36%	2.55%	2.59%	2.61%	2.64%	2.67%	2.70%	2.73%	2.74%	2.88%	3.01%	3.12%	3.24%
MALE POPULATION	50.09%	49.89%	50.12%	50.18%	50.18%	50.20%	50.20%	50.21%	50.21%	50.22%	50.23%	50.17%	50.16%	50.10%
TOTAL EMPLOYMENT (THOUSANDS)	146.25	170.33	170.71	172.93	175.16	179.08	181.26	183.44	185.63	187.84	198.94	210.23	221.75	233.49
FARM EMPLOYMENT	3.26%	2.49%	2.29%	2.25%	2.21%	2.14%	2.10%	2.07%	2.03%	2.00%	1.84%	1.70%	1.57%	1.46%
AGRICULTURAL SERVICES, OTHER	1.05%	1.36%	1.44%	1.45%	1.46%	1.43%	1.44%	1.45%	1.46%	1.46%	1.50%	1.53%	1.56%	1.59%
MINING	2.20%	1.23%	0.93%	0.92%	0.92%	0.91%	0.90%	0.90%	0.90%	0.90%	0.89%	0.87%	0.86%	0.85%
CONSTRUCTION	6.80%	9.05%	7.91%	7.93%	7.94%	7.98%	7.99%	8.00%	8.02%	8.03%	8.09%	8.13%	8.16%	8.18%
MANUFACTURING	10.84%	8.84%	7.33%	7.28%	7.22%	7.18%	7.12%	7.07%	7.02%	6.96%	6.72%	6.49%	6.28%	6.08%
TRANSPORT, COMM. & PUBLIC UTIL	5.38%	4.86%	4.81%	4.78%	4.74%	4.67%	4.64%	4.61%	4.57%	4.54%	4.40%	4.28%	4.17%	4.06%
WHOLESALE TRADE	3.16%	3.03%	2.99%	2.96%	2.94%	2.92%	2.90%	2.88%	2.86%	2.84%	2.75%	2.67%	2.60%	2.53%
RETAIL TRADE	15.27%	16.04%	17.93%	17.88%	17.84%	17.85%	17.80%	17.76%	17.72%	17.67%	17.47%	17.28%	17.10%	16.93%
FINANCE, INS. & REAL ESTATE	4.14%	4.58%	4.98%	4.98%	4.98%	4.99%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	4.98%
SERVICES	20.79%	25.77%	26.50%	26.74%	26.98%	27.27%	27.50%	27.73%	27.95%	28.17%	29.22%	30.19%	31.11%	31.97%
FEDERAL CIVILIAN GOVT	3.09%	2.57%	2.21%	2.18%	2.15%	2.11%	2.08%	2.05%	2.01%	1.98%	1.83%	1.70%	1.58%	1.47%
FEDERAL MILITARY GOVT	11.90%	5.96%	6.46%	6.38%	6.31%	6.24%	6.17%	6.10%	6.03%	5.96%	5.65%	5.37%	5.11%	4.87%
STATE AND LOCAL GOVT	12.12%	14.21%	14.23%	14.27%	14.31%	14.32%	14.36%	14.40%	14.43%	14.47%	14.64%	14.79%	14.92%	15.04%
TOTAL EARNINGS (MILLIONS 1996 $)	3,991.94	4,777.57	5,296.74	5,513.77	5,609.80	5,769.25	5,868.41	5,967.72	6,068.83	6,171.81	6,716.06	7,313.71	7,971.34	8,696.76
FARM EARNINGS	0.59%	0.31%	0.22%	0.35%	0.35%	0.34%	0.34%	0.34%	0.33%	0.33%	0.31%	0.29%	0.27%	0.25%
AGRICULTURAL SERVICES, OTHER	0.53%	0.60%	0.46%	0.51%	0.51%	0.51%	0.51%	0.52%	0.52%	0.52%	0.54%	0.56%	0.57%	0.59%
MINING	3.30%	2.49%	1.66%	2.21%	2.19%	2.14%	2.12%	2.10%	2.08%	2.06%	1.97%	1.88%	1.79%	1.71%
CONSTRUCTION	6.99%	9.95%	8.14%	8.26%	8.27%	8.30%	8.30%	8.30%	8.30%	8.30%	8.29%	8.28%	8.27%	8.24%
MANUFACTURING	19.52%	18.39%	18.79%	18.73%	18.57%	18.48%	18.38%	18.29%	18.19%	18.09%	17.48%	16.72%	15.85%	14.87%
TRANSPORT, COMM. & PUBLIC UTIL	7.22%	6.80%	6.94%	6.74%	6.70%	6.61%	6.56%	6.52%	6.47%	6.43%	6.25%	6.10%	5.96%	5.85%
WHOLESALE TRADE	3.52%	3.44%	3.50%	3.46%	3.43%	3.40%	3.37%	3.34%	3.31%	3.29%	3.16%	3.05%	2.94%	2.84%
RETAIL TRADE	7.79%	8.02%	8.84%	8.62%	8.60%	8.59%	8.57%	8.56%	8.54%	8.52%	8.44%	8.36%	8.29%	8.21%
FINANCE, INS. & REAL ESTATE	2.82%	3.26%	3.07%	3.02%	3.05%	3.07%	3.09%	3.11%	3.13%	3.14%	3.23%	3.30%	3.36%	3.41%
SERVICES	16.82%	19.51%	20.68%	20.46%	20.72%	21.04%	21.29%	21.55%	21.81%	22.07%	23.48%	25.03%	26.70%	28.50%
FEDERAL CIVILIAN GOVT	4.76%	4.92%	4.40%	4.43%	4.40%	4.34%	4.29%	4.24%	4.19%	4.13%	3.88%	3.63%	3.40%	3.18%
FEDERAL MILITARY GOVT	15.40%	9.07%	10.14%	10.28%	10.22%	10.16%	10.10%	10.04%	9.99%	9.93%	9.62%	9.28%	8.91%	8.52%
STATE AND LOCAL GOVT	10.75%	13.25%	13.15%	12.93%	13.00%	13.02%	13.07%	13.10%	13.14%	13.18%	13.36%	13.53%	13.68%	13.82%
PERSONAL INCOME (MILLIONS 1996 $)	5,274.63	6,466.44	7,150.67	7,348.35	7,462.54	7,658.37	7,778.24	7,899.57	8,023.38	8,149.72	8,821.23	9,565.41	10,391.76	11,311.42
INCOME PER CAPITA (1996 $)	16,401.63	19,254.40	21,398.30	21,985.44	22,287.81	22,541.79	22,822.13	23,104.51	23,394.59	23,689.12	25,180.99	26,771.08	28,459.10	30,224.63
W&P WEALTH INDEX (U.S. = 100)	69.60	65.98	70.46	71.07	71.32	71.45	71.56	71.66	71.76	71.86	72.29	72.63	72.88	73.04
PERSONS PER HOUSEHOLD (PEOPLE)	2.90	2.74	2.72	2.71	2.70	2.69	2.69	2.68	2.67	2.66	2.64	2.63	2.65	2.68
MEAN HOUSEHOLD INCOME (1996 $)	42,255.83	46,835.00	50,833.50	51,801.67	52,484.33	52,879.50	53,422.50	53,973.33	54,545.17	55,130.83	58,235.17	61,870.83	66,015.00	70,676.83
NUMBER OF HOUSEHOLDS (THOUSANDS)	111.08	122.40	122.77	123.23	123.86	126.12	126.89	127.65	128.37	129.10	132.68	135.61	137.96	139.82
LESS THAN $10,000 (2000 $)	18.21%	13.74%	12.78%	12.47%	12.26%	12.08%	11.91%	11.74%	11.58%	11.41%	10.60%	9.49%	8.31%	7.08%
$10,000 TO $19,999	19.26%	16.79%	15.61%	15.23%	14.98%	14.75%	14.55%	14.34%	14.14%	13.94%	12.95%	11.61%	10.18%	8.68%
$20,000 TO $29,999	16.75%	14.90%	13.79%	13.42%	13.18%	12.97%	12.79%	12.61%	12.43%	12.25%	11.38%	10.21%	8.99%	7.66%
$30,000 TO $44,999	18.06%	19.05%	19.49%	19.49%	19.49%	19.47%	19.45%	19.42%	19.36%	19.29%	18.64%	17.15%	15.23%	12.97%
$45,000 TO $59,999	12.55%	13.22%	14.27%	14.67%	14.93%	15.15%	15.37%	15.59%	15.82%	16.06%	17.30%	18.91%	20.00%	19.68%
$60,000 TO $74,999	7.06%	8.44%	9.11%	9.36%	9.52%	9.66%	9.80%	9.94%	10.09%	10.24%	11.04%	12.36%	14.13%	16.64%
$75,000 TO $99,999	4.14%	7.75%	8.36%	8.60%	8.75%	8.89%	9.02%	9.14%	9.28%	9.41%	10.12%	11.35%	12.97%	15.29%
$100,000 OR MORE	3.97%	6.11%	6.59%	6.77%	6.89%	7.01%	7.11%	7.20%	7.31%	7.41%	7.96%	8.92%	10.21%	12.01%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 12 parishes in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2006.

Table 3-18

Demographic and Employment Baseline Projections for Economic Impact Area LA-2

	1990	2000	2003	2004	2005	2006	2007	2008	2009	2010	2015	2020	2025	2030
TOTAL POPULATION (THOUSANDS)	496.88	548.34	555.40	558.25	562.44	580.30	583.19	586.09	588.93	591.80	607.67	624.70	643.20	663.91
AGE UNDER 19 YEARS	33.50%	31.90%	30.49%	30.00%	29.68%	29.36%	29.14%	28.96%	28.76%	28.59%	28.34%	28.54%	28.46%	28.23%
AGE 20 TO 34 YEARS	24.46%	20.22%	20.88%	21.06%	21.17%	21.26%	21.39%	21.54%	21.69%	21.82%	21.13%	19.34%	18.61%	18.53%
AGE 35 TO 49 YEARS	18.89%	22.59%	22.19%	21.96%	21.61%	21.27%	20.80%	20.28%	19.78%	19.29%	18.26%	19.17%	19.92%	19.50%
AGE 50 TO 64 YEARS	12.54%	13.94%	15.00%	15.49%	16.00%	16.56%	17.05%	17.54%	17.99%	18.47%	19.49%	18.74%	16.89%	16.22%
AGE 65 YEARS AND OVER	10.62%	11.34%	11.44%	11.48%	11.53%	11.55%	11.63%	11.69%	11.78%	11.84%	12.77%	14.21%	16.11%	17.51%
MEDIAN AGE OF POPULATION (YEARS)	30.65	33.77	34.22	34.43	34.57	34.73	34.81	34.85	34.87	34.88	35.51	36.86	37.81	38.40
WHITE POPULATION	71.84%	70.08%	69.54%	69.33%	69.20%	69.07%	68.94%	68.80%	68.65%	68.51%	67.81%	67.17%	66.52%	65.81%
BLACK POPULATION	26.00%	27.35%	27.62%	27.71%	27.80%	27.90%	27.98%	28.08%	28.18%	28.27%	28.75%	29.18%	29.63%	30.14%
NATIVE AMERICAN POPULATION	0.15%	0.25%	0.26%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	0.26%
ASIAN AND PACIFIC ISLANDER POP	0.73%	1.00%	1.10%	1.15%	1.17%	1.20%	1.23%	1.26%	1.29%	1.32%	1.47%	1.60%	1.75%	1.92%
HISPANIC POPULATION	1.28%	1.32%	1.47%	1.54%	1.55%	1.56%	1.58%	1.60%	1.62%	1.63%	1.70%	1.77%	1.83%	1.87%
MALE POPULATION	48.16%	48.48%	48.66%	48.70%	48.73%	48.77%	48.80%	48.82%	48.84%	48.86%	48.96%	49.02%	49.00%	48.92%
TOTAL EMPLOYMENT (THOUSANDS)	224.02	277.69	286.22	290.62	295.02	307.30	311.44	315.57	319.69	323.81	344.32	364.70	385.00	405.22
FARM EMPLOYMENT	3.61%	2.58%	2.25%	2.22%	2.18%	2.12%	2.09%	2.06%	2.03%	2.00%	1.85%	1.73%	1.62%	1.52%
AGRICULTURAL SERVICES, OTHER	1.13%	1.28%	1.44%	1.45%	1.46%	1.46%	1.46%	1.47%	1.48%	1.49%	1.52%	1.54%	1.57%	1.59%
MINING	9.11%	7.47%	6.90%	6.96%	7.02%	7.10%	7.15%	7.21%	7.27%	7.32%	7.56%	7.78%	7.97%	8.14%
CONSTRUCTION	4.63%	6.53%	6.11%	6.05%	6.00%	5.94%	5.89%	5.84%	5.79%	5.74%	5.52%	5.33%	5.16%	5.00%
MANUFACTURING	9.49%	7.78%	6.69%	6.69%	6.69%	6.68%	6.67%	6.67%	6.67%	6.67%	6.67%	6.66%	6.66%	6.66%
TRANSPORT, COMM. & PUBLIC UTIL	5.49%	5.21%	5.01%	5.00%	5.00%	5.00%	5.00%	5.00%	4.99%	4.99%	4.98%	4.97%	4.96%	4.96%
WHOLESALE TRADE	4.88%	4.61%	4.64%	4.63%	4.61%	4.60%	4.58%	4.57%	4.55%	4.53%	4.47%	4.40%	4.35%	4.30%
RETAIL TRADE	16.39%	17.74%	18.29%	18.24%	18.19%	18.16%	18.11%	18.06%	18.02%	17.98%	17.77%	17.59%	17.44%	17.30%
FINANCE, INS. & REAL ESTATE	4.76%	5.21%	5.44%	5.39%	5.33%	5.28%	5.23%	5.18%	5.13%	5.08%	4.86%	4.67%	4.50%	4.35%
SERVICES	25.86%	28.38%	30.62%	30.79%	30.96%	31.16%	31.31%	31.46%	31.61%	31.76%	32.41%	32.99%	33.50%	33.95%
FEDERAL CIVILIAN GOVT	0.77%	0.72%	0.61%	0.61%	0.60%	0.60%	0.59%	0.59%	0.59%	0.58%	0.56%	0.55%	0.53%	0.52%
FEDERAL MILITARY GOVT	1.35%	1.00%	0.99%	0.98%	0.96%	0.95%	0.93%	0.92%	0.91%	0.90%	0.85%	0.80%	0.76%	0.72%
STATE AND LOCAL GOVT	12.52%	11.47%	10.99%	10.99%	10.99%	10.96%	10.97%	10.97%	10.97%	10.97%	10.98%	10.99%	10.99%	11.00%
TOTAL EARNINGS (MILLIONS 1996 $)	5,516.49	7,661.87	8,352.08	8,616.96	8,803.78	9,240.52	9,427.09	9,613.63	9,803.36	9,996.30	11,010.81	12,114.38	13,315.49	14,624.15
FARM EARNINGS	1.06%	1.03%	0.74%	0.82%	0.82%	0.82%	0.82%	0.82%	0.82%	0.82%	0.83%	0.83%	0.84%	0.84%
AGRICULTURAL SERVICES, OTHER	0.67%	0.59%	0.56%	0.53%	0.54%	0.54%	0.54%	0.54%	0.54%	0.55%	0.56%	0.57%	0.58%	0.59%
MINING	16.36%	16.09%	15.82%	16.71%	16.73%	16.76%	16.76%	16.76%	16.75%	16.75%	16.64%	16.45%	16.19%	15.88%
CONSTRUCTION	4.57%	6.43%	6.00%	6.03%	5.96%	5.89%	5.83%	5.76%	5.69%	5.63%	5.35%	5.10%	4.89%	4.70%
MANUFACTURING	11.16%	10.74%	10.10%	9.89%	9.88%	9.87%	9.90%	9.93%	9.96%	9.98%	10.01%	9.91%	9.70%	9.38%
TRANSPORT, COMM. & PUBLIC UTIL	7.38%	7.17%	6.69%	6.88%	6.87%	6.86%	6.85%	6.84%	6.83%	6.82%	6.77%	6.74%	6.71%	6.70%
WHOLESALE TRADE	5.99%	5.70%	5.65%	5.55%	5.52%	5.49%	5.46%	5.42%	5.39%	5.36%	5.20%	5.05%	4.92%	4.79%
RETAIL TRADE	9.62%	9.92%	10.53%	10.37%	10.30%	10.23%	10.18%	10.13%	10.07%	10.02%	9.79%	9.57%	9.37%	9.19%
FINANCE, INS. & REAL ESTATE	3.38%	4.15%	4.08%	4.01%	4.00%	3.98%	3.96%	3.93%	3.91%	3.89%	3.78%	3.69%	3.61%	3.53%
SERVICES	25.04%	24.71%	25.97%	25.92%	26.11%	26.35%	26.53%	26.71%	26.90%	27.09%	28.11%	29.25%	30.48%	31.82%
FEDERAL CIVILIAN GOVT	1.53%	1.45%	1.29%	1.28%	1.27%	1.27%	1.26%	1.25%	1.25%	1.24%	1.20%	1.16%	1.13%	1.09%
FEDERAL MILITARY GOVT	0.65%	0.53%	0.98%	0.51%	0.50%	0.50%	0.49%	0.49%	0.49%	0.48%	0.46%	0.44%	0.43%	0.41%
STATE AND LOCAL GOVT	12.59%	11.50%	11.60%	11.49%	11.49%	11.45%	11.44%	11.42%	11.40%	11.39%	11.31%	11.23%	11.16%	11.10%
PERSONAL INCOME (MILLIONS 1996 $)	7,879.26	10,950.32	11,782.45	12,087.79	12,321.09	12,858.54	13,083.04	13,310.07	13,541.45	13,777.36	15,027.56	16,405.99	17,927.96	19,611.90
INCOME PER CAPITA (1996 $)	15,857.52	19,969.80	21,214.19	21,652.90	21,906.65	22,158.58	22,433.58	22,709.90	22,993.23	23,280.60	24,729.97	26,262.06	27,873.11	29,539.86
W&P WEALTH INDEX (U.S. = 100)	67.30	67.64	71.85	72.24	72.20	72.25	72.28	72.32	72.35	72.38	72.52	72.60	72.64	72.62
PERSONS PER HOUSEHOLD (PEOPLE)	2.84	2.72	2.70	2.69	2.68	2.67	2.67	2.66	2.65	2.65	2.62	2.62	2.63	2.66
MEAN HOUSEHOLD INCOME (1996 $)	41,215.57	48,684.43	51,867.43	52,716.14	53,168.43	53,512.71	54,010.86	54,521.86	55,057.29	55,607.43	58,550.14	62,056.86	66,090.43	70,687.57
NUMBER OF HOUSEHOLDS (THOUSANDS)	174.79	201.47	205.72	207.45	209.65	217.04	218.74	220.40	222.01	223.61	231.50	238.29	244.17	249.23
LESS THAN $10,000 (2000 $)	23.20%	18.15%	17.10%	16.75%	16.52%	16.25%	16.02%	15.78%	15.55%	15.32%	14.19%	12.90%	11.42%	10.00%
$10,000 TO $19,999	19.96%	17.27%	16.31%	15.97%	15.74%	15.52%	15.30%	15.09%	14.88%	14.67%	13.63%	12.41%	11.00%	9.63%
$20,000 TO $29,999	15.03%	14.23%	13.72%	13.46%	13.32%	13.18%	13.05%	12.90%	12.76%	12.60%	11.78%	10.74%	9.51%	8.33%
$30,000 TO $44,999	16.95%	17.39%	17.98%	18.11%	18.20%	18.28%	18.35%	18.42%	18.48%	18.52%	18.56%	18.04%	16.73%	15.09%
$45,000 TO $59,999	11.30%	12.34%	13.07%	13.37%	13.56%	13.75%	13.94%	14.13%	14.33%	14.53%	15.63%	17.00%	18.43%	18.92%
$60,000 TO $74,999	5.69%	7.97%	8.44%	8.64%	8.76%	8.89%	9.01%	9.14%	9.27%	9.40%	10.11%	11.14%	12.66%	14.60%
$75,000 TO $99,999	3.61%	6.51%	6.88%	7.05%	7.15%	7.26%	7.36%	7.47%	7.57%	7.68%	8.27%	9.11%	10.37%	11.97%
$100,000 OR MORE	4.26%	6.15%	6.50%	6.66%	6.76%	6.87%	6.97%	7.07%	7.17%	7.28%	7.84%	8.66%	9.89%	11.46%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 7 parishes in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2006.

Table 3-19

Demographic and Employment Baseline Projections for Economic Impact Area LA-3

	1990	2000	2003	2004	2005	2006	2007	2008	2009	2010	2015	2020	2025	2030
TOTAL POPULATION (THOUSANDS)	910.13	1009.62	1028.56	1037.30	1045.93	1149.95	1156.01	1162.08	1168.03	1174.01	1206.74	1241.59	1279.24	1321.31
AGE UNDER 19 YEARS	32.83%	31.32%	29.71%	29.25%	29.01%	28.77%	28.63%	28.56%	28.43%	28.32%	28.09%	28.44%	28.40%	28.26%
AGE 20 TO 34 YEARS	25.91%	22.07%	22.76%	22.86%	22.85%	22.81%	22.81%	22.77%	22.75%	22.69%	21.51%	20.04%	19.62%	19.61%
AGE 35 TO 49 YEARS	20.25%	22.54%	22.00%	21.83%	21.54%	21.19%	20.87%	20.50%	20.21%	19.90%	19.51%	19.80%	19.92%	19.15%
AGE 50 TO 64 YEARS	11.77%	14.14%	15.44%	15.93%	16.42%	16.95%	17.31%	17.66%	17.96%	18.33%	18.80%	18.07%	16.89%	16.81%
AGE 65 YEARS AND OVER	9.24%	9.92%	10.09%	10.13%	10.18%	10.27%	10.38%	10.51%	10.64%	10.76%	12.09%	13.64%	15.18%	16.16%
MEDIAN AGE OF POPULATION (YEARS)	30.09	33.31	34.03	34.25	34.46	34.72	34.87	35.03	35.19	35.33	36.06	37.11	37.89	38.32
WHITE POPULATION	69.51%	66.94%	66.17%	65.87%	65.59%	63.26%	63.08%	62.89%	62.70%	62.51%	61.63%	60.74%	59.80%	58.69%
BLACK POPULATION	27.19%	29.13%	29.54%	29.71%	29.93%	32.24%	32.35%	32.46%	32.58%	32.70%	33.24%	33.81%	34.44%	35.24%
NATIVE AMERICAN POPULATION	0.95%	1.03%	1.04%	1.05%	1.05%	0.93%	0.94%	0.95%	0.96%	0.97%	1.03%	1.08%	1.14%	1.20%
ASIAN AND PACIFIC ISLANDER POP	0.91%	1.23%	1.30%	1.33%	1.36%	1.43%	1.46%	1.49%	1.52%	1.54%	1.67%	1.79%	1.91%	2.03%
HISPANIC POPULATION	1.45%	1.67%	1.95%	2.04%	2.08%	2.14%	2.17%	2.21%	2.24%	2.27%	2.43%	2.58%	2.71%	2.84%
MALE POPULATION	48.43%	48.55%	48.65%	48.67%	48.68%	48.63%	48.66%	48.68%	48.70%	48.73%	48.83%	48.88%	48.89%	48.91%
TOTAL EMPLOYMENT (THOUSANDS)	445.22	575.08	589.84	598.32	606.81	668.71	675.32	681.90	688.47	695.02	727.31	759.12	790.49	821.58
FARM EMPLOYMENT	1.39%	0.95%	0.82%	0.80%	0.78%	0.77%	0.76%	0.74%	0.72%	0.71%	0.64%	0.58%	0.52%	0.47%
AGRICULTURAL SERVICES, OTHER	1.26%	1.51%	1.80%	1.81%	1.82%	1.82%	1.82%	1.83%	1.84%	1.85%	1.89%	1.93%	1.96%	1.98%
MINING	2.49%	2.00%	1.72%	1.72%	1.72%	1.70%	1.70%	1.71%	1.71%	1.71%	1.73%	1.74%	1.75%	1.76%
CONSTRUCTION	9.06%	9.74%	9.22%	9.19%	9.16%	9.11%	9.08%	9.05%	9.03%	9.00%	8.89%	8.79%	8.71%	8.63%
MANUFACTURING	9.42%	7.87%	7.21%	7.14%	7.07%	6.97%	6.90%	6.84%	6.77%	6.71%	6.43%	6.17%	5.95%	5.74%
TRANSPORT, COMM. & PUBLIC UTIL	5.81%	6.05%	6.29%	6.29%	6.29%	6.24%	6.24%	6.25%	6.25%	6.25%	6.25%	6.26%	6.26%	6.26%
WHOLESALE TRADE	4.40%	4.37%	4.22%	4.17%	4.13%	4.10%	4.06%	4.02%	3.98%	3.95%	3.78%	3.63%	3.49%	3.37%
RETAIL TRADE	16.49%	17.32%	17.13%	17.06%	16.99%	16.95%	16.89%	16.82%	16.76%	16.70%	16.42%	16.17%	15.95%	15.75%
FINANCE, INS. & REAL ESTATE	5.91%	6.05%	6.33%	6.30%	6.27%	6.24%	6.21%	6.18%	6.15%	6.12%	5.99%	5.88%	5.78%	5.69%
SERVICES	24.27%	26.48%	27.80%	28.10%	28.39%	28.70%	28.98%	29.25%	29.51%	29.76%	30.94%	31.98%	32.91%	33.74%
FEDERAL CIVILIAN GOVT	0.91%	0.72%	0.58%	0.57%	0.57%	0.56%	0.55%	0.55%	0.54%	0.53%	0.50%	0.48%	0.46%	0.44%
FEDERAL MILITARY GOVT	1.28%	0.92%	0.94%	0.92%	0.91%	0.90%	0.89%	0.87%	0.86%	0.85%	0.80%	0.75%	0.71%	0.67%
STATE AND LOCAL GOVT	17.30%	16.02%	15.94%	15.92%	15.90%	15.94%	15.91%	15.89%	15.87%	15.84%	15.74%	15.64%	15.56%	15.48%
TOTAL EARNINGS (MILLIONS 1996 $)	12,197.17	16,892.28	18,553.98	18,900.63	19,263.84	21,324.72	21,653.61	21,980.36	22,313.50	22,652.85	24,444.47	26,410.24	28,569.74	30,947.11
FARM EARNINGS	0.40	0.38	0.29	0.26	0.26	0.27	0.27	0.27	0.27	0.27	0.26	0.26	0.26	0.25
AGRICULTURAL SERVICES, OTHER	0.52	0.61	0.55	0.56	0.57	0.57	0.58	0.58	0.58	0.59	0.61	0.63	0.64	0.66
MINING	4.12	3.83	3.44	3.85	3.83	3.75	3.74	3.72	3.71	3.70	3.62	3.54	3.44	3.34
CONSTRUCTION	10.78	11.49	10.69	11.02	10.98	10.92	10.88	10.83	10.79	10.74	10.53	10.34	10.17	10.00
MANUFACTURING	17.47	14.68	15.29	14.87	14.69	14.47	14.35	14.24	14.12	14.00	13.34	12.60	11.80	10.94
TRANSPORT, COMM. & PUBLIC UTIL	7.56	8.41	8.39	8.23	8.24	8.19	8.19	8.20	8.20	8.21	8.24	8.26	8.29	8.31
WHOLESALE TRADE	5.45	5.61	5.60	5.49	5.42	5.38	5.32	5.26	5.20	5.15	4.88	4.64	4.41	4.20
RETAIL TRADE	8.97	9.34	9.48	9.44	9.38	9.36	9.32	9.27	9.23	9.18	8.97	8.77	8.58	8.39
FINANCE, INS. & REAL ESTATE	4.37	5.36	5.01	5.00	5.01	5.04	5.05	5.06	5.06	5.07	5.10	5.12	5.13	5.14
SERVICES	21.86	22.19	22.88	23.21	23.54	23.92	24.23	24.55	24.86	25.17	26.78	28.42	30.12	31.86
FEDERAL CIVILIAN GOVT	1.68	1.35	1.16	1.15	1.14	1.14	1.12	1.11	1.10	1.09	1.03	0.97	0.92	0.87
FEDERAL MILITARY GOVT	0.61	0.50	0.90	0.52	0.52	0.51	0.51	0.51	0.50	0.50	0.48	0.47	0.45	0.43
STATE AND LOCAL GOVT	16.20	16.24	16.34	16.41	16.40	16.48	16.45	16.41	16.37	16.34	16.16	15.98	15.80	15.62
PERSONAL INCOME (MILLIONS1996 $)	16,048.92	22,076.61	24,064.70	24,536.13	24,997.03	27,663.56	28,071.43	28,482.87	28,903.51	29,333.17	31,621.75	34,170.34	37,013.41	40,192.19
INCOME PER CAPITA (1996 $)	17,633.65	21,866.21	23,396.56	23,653.75	23,899.38	24,056.37	24,282.95	24,510.21	24,745.50	24,985.54	26,204.28	27,521.41	28,933.81	30,418.56
W&P WEALTH INDEX (U.S. = 100)	72.49	74.09	79.12	78.14	78.05	77.98	77.91	77.84	77.78	77.72	77.43	77.14	76.85	76.56
PERSONS PER HOUSEHOLD (PEOPLE)	2.88	2.75	2.72	2.71	2.70	2.69	2.68	2.67	2.66	2.65	2.62	2.60	2.60	2.62
MEAN HOUSEHOLD INCOME (1996 $)	46,555.00	55,713.90	60,103.20	59,584.00	59,945.10	60,125.20	60,487.10	60,869.00	61,275.30	61,696.80	64,030.50	66,952.90	70,386.20	74,328.30
NUMBER OF HOUSEHOLDS (THOUSANDS)	316.54	367.49	377.85	382.61	387.30	427.73	431.63	435.45	439.18	442.88	461.19	477.36	491.91	505.15
LESS THAN $10,000 (2000 $)	18.09%	14.00%	13.18%	12.97%	12.73%	12.60%	12.43%	12.26%	12.09%	11.93%	11.14%	10.34%	9.42%	8.44%
$10,000 TO $19,999	17.08%	14.92%	14.08%	13.86%	13.61%	13.44%	13.26%	13.09%	12.92%	12.74%	11.93%	11.08%	10.10%	9.05%
$20,000 TO $29,999	14.75%	13.57%	12.85%	12.66%	12.43%	12.28%	12.12%	11.96%	11.81%	11.65%	10.92%	10.16%	9.28%	8.31%
$30,000 TO $44,999	18.12%	17.78%	17.89%	17.81%	17.75%	17.69%	17.62%	17.54%	17.45%	17.33%	16.61%	15.67%	14.42%	12.96%
$45,000 TO $59,999	12.97%	13.03%	13.82%	14.02%	14.27%	14.43%	14.62%	14.81%	15.00%	15.19%	16.12%	16.95%	17.43%	17.17%
$60,000 TO $74,999	7.86%	9.80%	10.40%	10.58%	10.78%	10.91%	11.06%	11.21%	11.36%	11.52%	12.33%	13.29%	14.60%	16.32%
$75,000 TO $99,999	5.53%	8.82%	9.32%	9.49%	9.67%	9.77%	9.91%	10.04%	10.17%	10.31%	11.02%	11.87%	13.05%	14.64%
$100,000 OR MORE	5.59%	8.07%	8.47%	8.61%	8.76%	8.87%	8.98%	9.09%	9.21%	9.33%	9.93%	10.65%	11.71%	13.10%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 10 parishes in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2006.

Table 3-20

Demographic and Employment Baseline Projections for Economic Impact Area LA-4

	1990	2000	2003	2004	2005	2006	2007	2008	2009	2010	2015	2020	2025	2030
TOTAL POPULATION (THOUSANDS)	1,328.17	1,380.84	1,380.29	1,383.15	1,385.14	1,054.72	1,077.29	1,099.87	1,122.30	1,144.78	1,261.03	1,380.13	1,502.83	1,631.03
AGE UNDER 19 YEARS	30.62%	29.63%	28.71%	28.34%	28.14%	27.85%	27.69%	27.56%	27.45%	27.34%	27.13%	27.46%	27.42%	27.39%
AGE 20 TO 34 YEARS	24.73%	20.54%	20.36%	20.38%	20.37%	20.24%	20.23%	20.24%	20.31%	20.37%	20.01%	18.64%	18.16%	18.12%
AGE 35 TO 49 YEARS	20.96%	23.35%	22.70%	22.44%	22.12%	21.87%	21.52%	21.11%	20.66%	20.20%	18.92%	19.13%	19.31%	19.15%
AGE 50 TO 64 YEARS	12.63%	15.00%	16.68%	17.30%	17.87%	18.61%	19.05%	19.45%	19.85%	20.24%	20.57%	19.52%	18.03%	17.23%
AGE 65 YEARS AND OVER	11.06%	11.49%	11.54%	11.54%	11.51%	11.43%	11.52%	11.63%	11.74%	11.86%	13.36%	15.26%	17.09%	18.10%
MEDIAN AGE OF POPULATION (YEARS)	31.35	34.71	35.38	35.59	35.76	35.96	36.05	36.11	36.14	36.15	36.50	37.43	38.24	38.64
WHITE POPULATION	59.70%	55.62%	54.76%	54.52%	54.26%	54.54%	54.25%	53.95%	53.66%	53.37%	52.04%	50.87%	49.72%	48.49%
BLACK POPULATION	34.31%	37.50%	37.93%	38.07%	38.23%	37.58%	37.80%	38.05%	38.29%	38.53%	39.65%	40.64%	41.65%	42.74%
NATIVE AMERICAN POPULATION	0.29%	0.37%	0.37%	0.38%	0.38%	0.33%	0.34%	0.34%	0.34%	0.35%	0.36%	0.36%	0.37%	0.38%
ASIAN AND PACIFIC ISLANDER POP	1.58%	2.20%	2.31%	2.34%	2.40%	2.58%	2.62%	2.67%	2.72%	2.76%	2.97%	3.14%	3.30%	3.47%
HISPANIC POPULATION	4.11%	4.31%	4.63%	4.70%	4.73%	4.98%	4.98%	4.99%	4.99%	4.99%	4.98%	4.98%	4.96%	4.92%
MALE POPULATION	47.68%	47.88%	47.99%	48.02%	48.04%	48.10%	48.10%	48.11%	48.13%	48.14%	48.20%	48.22%	48.19%	48.14%
TOTAL EMPLOYMENT (THOUSANDS)	701.68	792.64	800.07	810.53	820.99	591.35	610.34	629.42	648.58	667.82	765.82	866.01	968.13	1,071.88
FARM EMPLOYMENT (Percent)	0.44%	0.36%	0.32%	0.31%	0.31%	0.47%	0.45%	0.43%	0.41%	0.40%	0.33%	0.28%	0.24%	0.20%
AGRICULTURAL SERVICES, OTHER	0.82%	1.11%	1.30%	1.31%	1.32%	1.37%	1.37%	1.38%	1.39%	1.39%	1.42%	1.46%	1.49%	1.52%
MINING	2.98%	1.75%	1.47%	1.46%	1.44%	1.16%	1.16%	1.16%	1.16%	1.16%	1.17%	1.17%	1.18%	1.18%
CONSTRUCTION	4.97%	5.73%	5.57%	5.52%	5.47%	6.15%	6.05%	5.95%	5.86%	5.78%	5.40%	5.09%	4.83%	4.61%
MANUFACTURING	7.45%	6.39%	5.87%	5.82%	5.76%	6.58%	6.47%	6.36%	6.25%	6.15%	5.71%	5.35%	5.03%	4.75%
TRANSPORT, COMM. & PUBLIC UTIL	7.38%	6.29%	5.78%	5.74%	5.71%	5.32%	5.31%	5.29%	5.27%	5.26%	5.19%	5.13%	5.07%	5.01%
WHOLESALE TRADE	5.23%	4.86%	4.41%	4.40%	4.38%	4.91%	4.86%	4.82%	4.77%	4.73%	4.54%	4.37%	4.22%	4.08%
RETAIL TRADE	17.10%	17.30%	17.50%	17.44%	17.37%	18.62%	18.49%	18.37%	18.24%	18.13%	17.58%	17.09%	16.64%	16.23%
FINANCE, INS. & REAL ESTATE	6.88%	7.11%	7.57%	7.53%	7.50%	7.96%	7.90%	7.85%	7.80%	7.75%	7.51%	7.29%	7.07%	6.87%
SERVICES	30.87%	33.88%	34.91%	35.18%	35.45%	33.80%	34.21%	34.60%	34.98%	35.34%	36.94%	38.28%	39.44%	40.45%
FEDERAL CIVILIAN GOVT	2.45%	2.13%	2.00%	1.98%	1.96%	1.24%	1.26%	1.28%	1.30%	1.32%	1.40%	1.47%	1.53%	1.58%
FEDERAL MILITARY GOVT	1.84%	1.42%	1.47%	1.45%	1.43%	1.18%	1.17%	1.17%	1.16%	1.15%	1.12%	1.10%	1.08%	1.06%
STATE AND LOCAL GOVT	11.60%	11.66%	11.83%	11.86%	11.89%	11.25%	11.30%	11.34%	11.39%	11.44%	11.69%	11.94%	12.19%	12.44%
TOTAL EARNINGS (MILLIONS 1996 $)	20,831.68	25,521.57	27,830.83	28,638.55	29,184.81	20,042.06	20,879.47	21,727.76	22,594.52	23,481.67	28,257.72	33,630.42	39,678.76	46,488.37
FARM EARNINGS (Percent)	0.08%	0.11%	0.07%	0.08%	0.08%	0.12%	0.12%	0.12%	0.12%	0.11%	0.10%	0.09%	0.08%	0.07%
AGRICULTURAL SERVICES, OTHER	0.45%	0.53%	0.51%	0.51%	0.52%	0.55%	0.55%	0.55%	0.55%	0.56%	0.56%	0.57%	0.58%	0.59%
MINING	6.18%	4.64%	3.93%	4.08%	4.01%	2.99%	2.99%	2.99%	2.98%	2.98%	2.94%	2.88%	2.81%	2.72%
CONSTRUCTION	5.33%	6.25%	6.04%	6.18%	6.12%	6.98%	6.84%	6.70%	6.57%	6.44%	5.90%	5.45%	5.08%	4.76%
MANUFACTURING	11.39%	9.85%	9.98%	10.01%	9.92%	12.33%	12.10%	11.90%	11.70%	11.50%	10.52%	9.58%	8.67%	7.79%
TRANSPORT, COMM. & PUBLIC UTIL	9.83%	8.32%	7.63%	7.57%	7.52%	6.98%	6.96%	6.93%	6.91%	6.89%	6.77%	6.66%	6.55%	6.44%
WHOLESALE TRADE	6.45%	6.28%	5.72%	5.66%	5.62%	6.47%	6.38%	6.29%	6.21%	6.13%	5.75%	5.41%	5.10%	4.81%
RETAIL TRADE	9.38%	9.07%	9.13%	8.99%	8.94%	9.99%	9.89%	9.79%	9.70%	9.61%	9.17%	8.76%	8.38%	8.02%
FINANCE, INS. & REAL ESTATE	5.84%	6.75%	6.73%	6.65%	6.66%	6.76%	6.77%	6.77%	6.77%	6.77%	6.74%	6.68%	6.59%	6.47%
SERVICES	28.72%	31.54%	32.77%	32.82%	33.16%	31.47%	31.98%	32.46%	32.94%	33.41%	35.66%	37.83%	39.94%	42.02%
FEDERAL CIVILIAN GOVT	4.35%	4.30%	4.03%	3.98%	3.96%	2.64%	2.68%	2.72%	2.76%	2.79%	2.93%	3.03%	3.10%	3.13%
FEDERAL MILITARY GOVT	1.46%	1.25%	1.64%	1.72%	1.70%	1.16%	1.18%	1.19%	1.21%	1.22%	1.28%	1.32%	1.34%	1.34%
STATE AND LOCAL GOVT	10.54%	11.11%	11.82%	11.74%	11.78%	11.54%	11.56%	11.57%	11.59%	11.60%	11.67%	11.74%	11.79%	11.84%
PERSONAL INCOME (MILLIONS 1996 $)	26,586.80	33,451.57	36,278.34	36,951.74	37,489.37	28,700.60	29,649.58	30,613.24	31,595.95	32,599.91	37,972.69	43,971.62	50,687.83	58,223.42
INCOME PER CAPITA (1996 $)	20,017.59	24,225.52	26,283.11	26,715.61	27,065.40	27,211.50	27,522.43	27,833.48	28,152.81	28,476.91	30,112.47	31,860.51	33,728.28	35,697.38
W&P WEALTH INDEX (U.S. = 100)	81.11	77.45	81.94	81.81	81.73	81.68	81.64	81.61	81.57	81.53	81.34	81.13	80.89	80.62
PERSONS PER HOUSEHOLD (PEOPLE)	2.73	2.64	2.62	2.61	2.60	2.62	2.60	2.59	2.58	2.57	2.52	2.50	2.49	2.49
MEAN HOUSEHOLD INCOME (1996 $)	52,350.33	58,347.78	62,229.22	62,529.78	62,884.89	63,083.33	63,472.22	63,875.44	64,305.78	64,754.00	67,190.44	70,224.22	73,772.89	77,838.56
NUMBER OF HOUSEHOLDS (THOUSANDS)	487.05	522.69	526.66	529.90	532.82	403.00	413.66	424.32	434.92	445.55	499.60	552.48	604.19	654.50
LESS THAN $10,000 (2000 $)	18.30%	14.33%	13.18%	12.86%	12.64%	10.78%	10.69%	10.60%	10.51%	10.41%	9.95%	9.35%	8.58%	7.63%
$10,000 TO $19,999	16.73%	15.10%	14.00%	13.71%	13.50%	12.54%	12.41%	12.27%	12.13%	11.99%	11.34%	10.55%	9.61%	8.51%
$20,000 TO $29,999	14.72%	14.16%	13.26%	13.02%	12.85%	12.46%	12.31%	12.16%	12.00%	11.85%	11.14%	10.31%	9.36%	8.26%
$30,000 TO $44,999	17.90%	17.53%	17.79%	17.85%	17.82%	17.38%	17.30%	17.22%	17.13%	17.02%	16.51%	15.71%	14.58%	12.96%
$45,000 TO $59,999	12.65%	12.46%	13.34%	13.57%	13.74%	14.35%	14.48%	14.62%	14.76%	14.91%	15.49%	15.78%	15.96%	15.73%
$60,000 TO $74,999	7.73%	9.03%	9.71%	9.89%	10.04%	10.93%	11.04%	11.15%	11.27%	11.40%	12.01%	12.92%	14.06%	15.52%
$75,000 TO $99,999	5.45%	8.30%	8.94%	9.12%	9.27%	10.36%	10.46%	10.56%	10.66%	10.77%	11.30%	12.15%	13.32%	15.01%
$100,000 OR MORE	6.52%	9.09%	9.78%	9.98%	10.14%	11.20%	11.31%	11.42%	11.54%	11.65%	12.26%	13.22%	14.52%	16.39%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 9 parishes in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2006.

Table 3-21

Demographic and Employment Baseline Projections for Economic Impact Area MS-1

	1990	2000	2003	2004	2005	2006	2007	2008	2009	2010	2015	2020	2025	2030
TOTAL POPULATION (THOUSANDS)	389.02	459.82	467.30	473.61	478.42	475.94	481.50	487.07	492.57	498.09	526.98	556.84	588.00	621.26
AGE UNDER 19 YEARS	31.48%	29.70%	28.65%	28.30%	28.10%	27.84%	27.67%	27.55%	27.41%	27.26%	26.91%	27.18%	27.19%	27.10%
AGE 20 TO 34 YEARS	24.06%	20.71%	20.56%	20.51%	20.42%	20.36%	20.31%	20.27%	20.33%	20.47%	20.23%	19.05%	18.58%	18.47%
AGE 35 TO 49 YEARS	19.90%	22.66%	22.39%	22.24%	22.03%	21.76%	21.49%	21.13%	20.74%	20.18%	18.68%	18.78%	19.03%	19.08%
AGE 50 TO 64 YEARS	13.74%	15.62%	16.64%	17.04%	17.38%	17.86%	18.22%	18.56%	18.86%	19.34%	20.08%	19.49%	18.04%	16.92%
AGE 65 YEARS AND OVER	10.82%	11.31%	11.76%	11.91%	12.06%	12.18%	12.31%	12.49%	12.66%	12.75%	14.09%	15.51%	17.16%	18.43%
MEDIAN AGE OF POPULATION (YEARS)	31.98	34.68	35.16	35.44	35.68	36.02	36.19	36.36	36.50	36.58	37.11	37.90	38.45	38.71
WHITE POPULATION	78.99%	77.03%	76.24%	76.03%	75.85%	75.10%	74.92%	74.75%	74.57%	74.39%	73.52%	72.68%	71.84%	70.96%
BLACK POPULATION	17.99%	18.55%	19.10%	19.16%	19.28%	19.94%	20.04%	20.14%	20.24%	20.35%	20.87%	21.37%	21.86%	22.39%
NATIVE AMERICAN POPULATION	0.27%	0.44%	0.46%	0.49%	0.48%	0.48%	0.48%	0.48%	0.48%	0.48%	0.47%	0.47%	0.46%	0.45%
ASIAN AND PACIFIC ISLANDER POP	1.45%	1.81%	1.88%	1.92%	1.96%	1.99%	2.03%	2.07%	2.10%	2.14%	2.31%	2.47%	2.62%	2.80%
HISPANIC POPULATION	1.31%	2.16%	2.32%	2.40%	2.43%	2.48%	2.52%	2.57%	2.61%	2.64%	2.84%	3.02%	3.21%	3.40%
MALE POPULATION	49.46%	49.76%	49.88%	49.88%	49.89%	49.87%	49.90%	49.91%	49.93%	49.94%	49.96%	49.98%	49.99%	49.99%
TOTAL EMPLOYMENT (THOUSANDS)	177.51	244.55	243.45	247.48	251.51	248.27	252.58	256.89	261.20	265.51	287.15	308.92	330.79	352.74
FARM EMPLOYMENT	1.62%	1.44%	1.43%	1.41%	1.38%	1.46%	1.43%	1.40%	1.36%	1.34%	1.20%	1.08%	0.98%	0.89%
AGRICULTURAL SERVICES, OTHER	1.27%	1.39%	1.48%	1.49%	1.50%	1.51%	1.51%	1.52%	1.52%	1.52%	1.54%	1.55%	1.56%	1.56%
MINING	0.23%	0.12%	0.11%	0.11%	0.11%	0.12%	0.11%	0.11%	0.11%	0.11%	0.11%	0.10%	0.10%	0.10%
CONSTRUCTION	4.79%	7.40%	6.66%	6.65%	6.64%	6.64%	6.63%	6.61%	6.60%	6.59%	6.52%	6.46%	6.40%	6.35%
MANUFACTURING	17.96%	11.31%	9.75%	9.66%	9.57%	9.42%	9.34%	9.26%	9.18%	9.11%	8.77%	8.48%	8.22%	8.00%
TRANSPORT, COMM. & PUBLIC UTIL	4.20%	4.00%	4.20%	4.18%	4.16%	4.18%	4.17%	4.15%	4.13%	4.12%	4.05%	3.98%	3.93%	3.88%
WHOLESALE TRADE	2.24%	2.01%	1.94%	1.93%	1.91%	1.92%	1.91%	1.90%	1.89%	1.88%	1.83%	1.80%	1.77%	1.74%
RETAIL TRADE	16.82%	17.23%	17.86%	17.82%	17.77%	17.85%	17.81%	17.76%	17.72%	17.68%	17.50%	17.35%	17.23%	17.12%
FINANCE, INS. & REAL ESTATE	4.28%	4.77%	5.18%	5.17%	5.15%	5.15%	5.13%	5.12%	5.10%	5.09%	5.02%	4.96%	4.90%	4.85%
SERVICES	19.70%	28.44%	28.41%	28.74%	29.05%	29.06%	29.38%	29.68%	29.98%	30.27%	31.59%	32.73%	33.73%	34.62%
FEDERAL CIVILIAN GOVT	5.53%	3.73%	3.64%	3.58%	3.53%	3.40%	3.35%	3.31%	3.27%	3.23%	3.04%	2.88%	2.73%	2.60%
FEDERAL MILITARY GOVT	9.08%	6.64%	7.28%	7.17%	7.06%	6.92%	6.83%	6.73%	6.64%	6.54%	6.13%	5.76%	5.44%	5.15%
STATE AND LOCAL GOVT	12.28%	11.52%	12.05%	12.11%	12.16%	12.36%	12.41%	12.45%	12.49%	12.53%	12.71%	12.87%	13.02%	13.14%
TOTAL EARNINGS (MILLIONS 1996 $)	4,535.88	7,040.93	7,364.91	7,533.37	7,700.43	7,593.12	7,775.11	7,957.71	8,143.57	8,332.79	9,332.11	10,426.41	11,626.45	12,944.79
FARM EARNINGS	0.19%	0.08%	0.00%	0.17%	0.16%	0.18%	0.18%	0.17%	0.17%	0.16%	0.15%	0.14%	0.12%	0.11%
AGRICULTURAL SERVICES, OTHER	0.63%	0.57%	0.50%	0.51%	0.51%	0.52%	0.52%	0.52%	0.52%	0.52%	0.53%	0.54%	0.54%	0.55%
MINING	0.22%	0.16%	0.16%	0.14%	0.14%	0.14%	0.14%	0.14%	0.13%	0.13%	0.12%	0.11%	0.11%	0.10%
CONSTRUCTION	4.09%	7.59%	6.72%	6.76%	6.74%	6.73%	6.71%	6.68%	6.65%	6.62%	6.50%	6.38%	6.28%	6.19%
MANUFACTURING	24.56%	17.11%	15.91%	15.67%	15.53%	15.27%	15.18%	15.10%	15.02%	14.93%	14.42%	13.81%	13.10%	12.31%
TRANSPORT, COMM. & PUBLIC UTIL	5.45%	5.12%	5.51%	5.54%	5.52%	5.55%	5.53%	5.50%	5.48%	5.45%	5.34%	5.25%	5.17%	5.10%
WHOLESALE TRADE	2.30%	2.23%	2.27%	1.89%	1.87%	1.89%	1.87%	1.85%	1.84%	1.83%	1.77%	1.71%	1.66%	1.62%
RETAIL TRADE	8.74%	9.14%	9.07%	9.02%	8.98%	9.04%	9.01%	8.98%	8.95%	8.92%	8.79%	8.66%	8.54%	8.43%
FINANCE, INS. & REAL ESTATE	3.05%	3.32%	3.48%	3.48%	3.49%	3.53%	3.54%	3.54%	3.55%	3.55%	3.57%	3.58%	3.60%	3.60%
SERVICES	16.01%	25.52%	24.63%	24.97%	25.32%	25.47%	25.81%	26.15%	26.49%	26.83%	28.54%	30.30%	32.11%	33.96%
FEDERAL CIVILIAN GOVT	9.93%	7.69%	7.80%	7.74%	7.67%	7.42%	7.33%	7.25%	7.16%	7.08%	6.68%	6.31%	5.97%	5.64%
FEDERAL MILITARY GOVT	12.67%	9.39%	11.14%	11.20%	11.09%	10.99%	10.87%	10.77%	10.66%	10.55%	10.03%	9.51%	9.00%	8.50%
STATE AND LOCAL GOVT	12.14%	12.08%	12.82%	12.91%	12.98%	13.27%	13.31%	13.35%	13.38%	13.41%	13.56%	13.69%	13.80%	13.88%
PERSONAL INCOME (MILLIONS 1996 $)	6,092.21	9,524.68	10,133.95	10,359.72	10,576.03	10,532.52	10,766.53	11,003.62	11,245.34	11,491.90	12,801.40	14,250.22	15,857.08	17,644.07
INCOME PER CAPITA (1996 $)	15,660.29	20,714.06	21,686.27	21,873.95	22,105.97	22,130.03	22,360.31	22,591.59	22,829.78	23,071.93	24,292.23	25,591.31	26,967.69	28,400.56
W&P WEALTH INDEX (U.S. = 100)	63.93	67.39	70.08	69.02	68.82	68.72	68.63	68.53	68.43	68.34	67.88	67.45	67.03	66.62
PERSONS PER HOUSEHOLD (PEOPLE)	2.80	2.70	2.67	2.66	2.65	2.64	2.63	2.63	2.62	2.61	2.58	2.57	2.57	2.58
MEAN HOUSEHOLD INCOME (1996 $)	38,951.14	49,159.57	51,015.43	50,358.57	50,608.00	50,766.43	51,079.14	51,399.86	51,744.43	52,102.29	54,081.14	56,585.43	59,549.71	62,979.00
NUMBER OF HOUSEHOLDS (THOUSANDS)	138.93	170.49	174.95	178.06	180.56	179.99	182.75	185.49	188.19	190.89	204.41	217.07	229.02	240.35
LESS THAN $10,000 (2000 $)	16.96%	11.89%	11.31%	11.11%	10.96%	10.87%	10.71%	10.55%	10.40%	10.24%	9.50%	8.61%	7.78%	6.89%
$10,000 TO $19,999	18.90%	14.52%	13.80%	13.56%	13.37%	13.28%	13.08%	12.89%	12.70%	12.51%	11.59%	10.48%	9.45%	8.35%
$20,000 TO $29,999	16.41%	15.05%	14.27%	14.02%	13.82%	13.64%	13.44%	13.24%	13.05%	12.86%	11.94%	10.81%	9.75%	8.63%
$30,000 TO $44,999	19.54%	20.51%	20.49%	20.44%	20.40%	20.31%	20.24%	20.15%	20.05%	19.92%	19.11%	17.58%	15.99%	14.16%
$45,000 TO $59,999	13.12%	14.42%	15.23%	15.50%	15.73%	15.94%	16.18%	16.42%	16.66%	16.92%	18.17%	19.63%	20.41%	20.36%
$60,000 TO $74,999	6.76%	9.43%	9.94%	10.13%	10.27%	10.39%	10.55%	10.70%	10.86%	11.02%	11.87%	13.13%	14.60%	16.58%
$75,000 TO $99,999	4.43%	7.83%	8.26%	8.41%	8.53%	8.58%	8.72%	8.85%	8.98%	9.12%	9.84%	10.92%	12.17%	13.85%
$100,000 OR MORE	3.88%	6.36%	6.70%	6.83%	6.92%	6.98%	7.09%	7.19%	7.30%	7.41%	7.99%	8.85%	9.85%	11.19%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 7 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2006.

Table 3-22

Demographic and Employment Baseline Projections for Economic Impact Area AL-1

	1990	2000	2003	2004	2005	2006	2007	2008	2009	2010	2015	2020	2025	2030
TOTAL POPULATION (THOUSANDS)	609.33	677.22	685.27	690.28	697.06	741.71	746.26	750.82	755.30	759.80	784.22	810.06	837.76	868.36
AGE UNDER 19 YEARS	31.12 %	29.55 %	28.62 %	28.25 %	28.03 %	27.78 %	27.58 %	27.43 %	27.29 %	27.14 %	26.75 %	26.96 %	26.99 %	26.94 %
AGE 20 TO 34 YEARS	22.69 %	19.33 %	19.52 %	19.64 %	19.60 %	19.61 %	19.64 %	19.69 %	19.74 %	19.87 %	19.69 %	18.39 %	17.79 %	17.60 %
AGE 35 TO 49 YEARS	19.91 %	22.25 %	21.69 %	21.46 %	21.22 %	20.93 %	20.61 %	20.21 %	19.80 %	19.31 %	18.10 %	18.58 %	18.97 %	19.03 %
AGE 50 TO 64 YEARS	13.53 %	15.81 %	16.82 %	17.23 %	17.68 %	18.16 %	18.57 %	18.92 %	19.22 %	19.58 %	20.00 %	19.12 %	17.58 %	16.70 %
AGE 65 YEARS AND OVER	12.75 %	13.07 %	13.35 %	13.42 %	13.47 %	13.52 %	13.60 %	13.75 %	13.94 %	14.10 %	15.47 %	16.95 %	18.67 %	19.74 %
MEDIAN AGE OF POPULATION (YEARS)	32.73	36.08	36.80	37.04	37.19	37.39	37.51	37.65	37.77	37.86	38.00	38.50	39.24	39.52
WHITE POPULATION	68.03%	66.74%	66.50%	66.50%	66.39%	66.27%	66.17%	66.05%	65.95%	65.83%	65.29%	64.75%	64.19%	63.55%
BLACK POPULATION	29.75%	30.00%	30.11%	30.05%	30.11%	30.17%	30.22%	30.28%	30.34%	30.41%	30.71%	31.02%	31.33%	31.72%
NATIVE AMERICAN POPULATION	0.81%	0.96%	0.94%	0.93%	0.93%	0.94%	0.94%	0.94%	0.94%	0.94%	0.95%	0.95%	0.96%	0.96%
ASIAN AND PACIFIC ISLANDER POP	0.62%	1.05%	1.07%	1.12%	1.14%	1.17%	1.20%	1.23%	1.25%	1.28%	1.41%	1.54%	1.68%	1.84%
HISPANIC POPULATION	0.79%	1.25%	1.38%	1.40%	1.43%	1.45%	1.47%	1.49%	1.51%	1.53%	1.63%	1.74%	1.84%	1.94%
MALE POPULATION	47.77%	48.18%	48.25%	48.26%	48.29%	48.32%	48.35%	48.37%	48.39%	48.41%	48.50%	48.57%	48.58%	48.56%
TOTAL EMPLOYMENT (THOUSANDS)	282.20	351.87	344.78	350.12	355.46	380.45	385.13	389.81	394.47	399.13	422.18	444.96	467.51	489.85
FARM EMPLOYMENT	2.41%	1.59%	1.56%	1.53%	1.50%	1.44%	1.41%	1.39%	1.37%	1.34%	1.23%	1.13%	1.05%	0.97%
AGRICULTURAL SERVICES, OTHER	1.23%	1.41%	1.61%	1.60%	1.59%	1.58%	1.58%	1.57%	1.57%	1.56%	1.54%	1.52%	1.50%	1.49%
MINING	0.59%	0.44%	0.34%	0.33%	0.33%	0.33%	0.32%	0.32%	0.32%	0.31%	0.30%	0.29%	0.27%	0.26%
CONSTRUCTION	6.78%	8.06%	7.41%	7.49%	7.57%	7.67%	7.74%	7.82%	7.88%	7.95%	8.26%	8.53%	8.77%	8.98%
MANUFACTURING	16.51%	11.98%	9.97%	9.86%	9.76%	9.57%	9.48%	9.39%	9.31%	9.23%	8.84%	8.51%	8.21%	7.95%
TRANSPORT, COMM. & PUBLIC UTIL	5.30%	6.06%	5.58%	5.58%	5.58%	5.57%	5.57%	5.57%	5.57%	5.57%	5.57%	5.57%	5.57%	5.58%
WHOLESALE TRADE	4.56%	4.43%	4.34%	4.32%	4.31%	4.33%	4.32%	4.31%	4.29%	4.28%	4.22%	4.16%	4.11%	4.07%
RETAIL TRADE	17.20%	17.68%	18.16%	18.14%	18.12%	18.04%	18.02%	18.00%	17.98%	17.96%	17.87%	17.80%	17.76%	17.72%
FINANCE, INS. & REAL ESTATE	5.54%	6.44%	6.91%	6.91%	6.91%	6.89%	6.89%	6.88%	6.88%	6.88%	6.87%	6.87%	6.88%	6.88%
SERVICES	23.94%	27.66%	29.24%	29.46%	29.68%	30.03%	30.23%	30.42%	30.61%	30.79%	31.61%	32.32%	32.95%	33.49%
FEDERAL CIVILIAN GOVT	1.30%	0.99%	0.91%	0.90%	0.89%	0.88%	0.87%	0.86%	0.84%	0.83%	0.78%	0.73%	0.69%	0.65%
FEDERAL MILITARY GOVT	2.23%	1.36%	1.36%	1.34%	1.32%	1.30%	1.29%	1.27%	1.25%	1.23%	1.16%	1.09%	1.03%	0.97%
STATE AND LOCAL GOVT	12.41%	11.91%	12.61%	12.53%	12.44%	12.36%	12.28%	12.21%	12.14%	12.07%	11.75%	11.47%	11.22%	10.99%
TOTAL EARNINGS (MILLIONS 1996 $)	7,245.54	9,751.86	9,939.87	10,105.12	10,308.78	11,120.89	11,317.03	11,512.51	11,711.31	11,913.44	12,974.74	14,128.14	15,383.24	16,751.74
FARM EARNINGS	1.43%	0.84%	0.72%	0.64%	0.64%	0.62%	0.62%	0.62%	0.62%	0.62%	0.61%	0.60%	0.58%	0.57%
AGRICULTURAL SERVICES, OTHER	0.57%	0.76%	0.70%	0.70%	0.70%	0.69%	0.69%	0.69%	0.68%	0.68%	0.68%	0.68%	0.68%	0.68%
MINING	0.71%	0.89%	0.73%	0.75%	0.74%	0.72%	0.71%	0.69%	0.68%	0.67%	0.62%	0.58%	0.54%	0.50%
CONSTRUCTION	7.33%	8.55%	7.61%	7.97%	8.04%	8.13%	8.19%	8.24%	8.29%	8.34%	8.56%	8.73%	8.88%	8.99%
MANUFACTURING	24.20%	18.50%	16.38%	16.27%	16.10%	15.82%	15.71%	15.61%	15.51%	15.41%	14.81%	14.11%	13.32%	12.47%
TRANSPORT, COMM. & PUBLIC UTIL	7.35%	8.18%	7.82%	7.85%	7.84%	7.83%	7.82%	7.81%	7.80%	7.80%	7.76%	7.74%	7.72%	7.72%
WHOLESALE TRADE	5.50%	5.91%	6.31%	6.31%	6.28%	6.31%	6.28%	6.25%	6.22%	6.19%	6.04%	5.90%	5.77%	5.64%
RETAIL TRADE	10.15%	10.59%	10.88%	10.89%	10.85%	10.76%	10.73%	10.70%	10.68%	10.65%	10.53%	10.41%	10.31%	10.21%
FINANCE, INS. & REAL ESTATE	3.87%	5.65%	6.09%	6.14%	6.18%	6.21%	6.24%	6.27%	6.30%	6.33%	6.47%	6.60%	6.72%	6.84%
SERVICES	21.54%	23.36%	24.54%	24.88%	25.11%	25.50%	25.72%	25.93%	26.15%	26.38%	27.53%	28.76%	30.04%	31.39%
FEDERAL CIVILIAN GOVT	2.61%	2.18%	2.15%	2.14%	2.12%	2.12%	2.10%	2.07%	2.05%	2.02%	1.90%	1.79%	1.68%	1.58%
FEDERAL MILITARY GOVT	1.46%	1.00%	1.62%	1.02%	1.01%	1.01%	1.00%	0.99%	0.99%	0.98%	0.94%	0.90%	0.86%	0.82%
STATE AND LOCAL GOVT	13.29%	13.61%	14.46%	14.46%	14.39%	14.28%	14.20%	14.11%	14.02%	13.94%	13.55%	13.20%	12.88%	12.59%
PERSONAL INCOME (MILLIONS 1996 $)	10,111.40	13,927.73	14,371.09	14,637.96	14,945.65	16,039.34	16,326.52	16,617.21	16,913.70	17,215.97	18,818.82	20,590.27	22,552.96	24,733.81
INCOME PER CAPITA (1996 $)	16,594.34	20,566.12	20,971.52	21,205.83	21,440.86	21,624.87	21,877.67	22,131.99	22,393.29	22,658.50	23,996.95	25,418.30	26,920.71	28,483.36
W&P WEALTH INDEX (U.S. = 100)	69.27	68.32	69.85	69.25	69.20	69.17	69.15	69.13	69.12	69.11	69.02	68.92	68.78	68.62
PERSONS PER HOUSEHOLD (PEOPLE)	2.76	2.62	2.60	2.59	2.58	2.57	2.57	2.56	2.55	2.54	2.52	2.51	2.51	2.53
MEAN HOUSEHOLD INCOME (1996 $)	41,889.13	47,825.00	48,273.50	48,067.75	48,444.63	48,690.25	49,080.75	49,492.25	49,927.00	50,370.75	52,769.63	55,647.38	58,952.38	62,691.75
NUMBER OF HOUSEHOLDS (THOUSANDS)	221.16	258.01	263.44	266.41	270.03	288.19	290.94	293.63	296.25	298.86	311.79	323.37	333.97	343.82
LESS THAN $10,000 (2000 $)	18.75%	14.69%	13.99%	13.76%	13.53%	13.31%	13.09%	12.88%	12.67%	12.46%	11.49%	10.42%	9.18%	7.94%
$10,000 TO $19,999	18.03%	15.91%	15.23%	15.02%	14.80%	14.59%	14.38%	14.17%	13.96%	13.75%	12.79%	11.69%	10.40%	9.04%
$20,000 TO $29,999	15.81%	14.12%	13.58%	13.42%	13.25%	13.08%	12.91%	12.73%	12.56%	12.39%	11.59%	10.66%	9.52%	8.30%
$30,000 TO $44,999	18.54%	18.51%	18.69%	18.72%	18.74%	18.74%	18.73%	18.70%	18.66%	18.60%	18.15%	17.12%	15.52%	13.67%
$45,000 TO $59,999	12.25%	13.58%	14.20%	14.39%	14.60%	14.82%	15.03%	15.26%	15.48%	15.71%	16.77%	18.09%	19.20%	19.08%
$60,000 TO $74,999	7.46%	8.74%	9.15%	9.28%	9.42%	9.56%	9.70%	9.85%	10.00%	10.15%	10.92%	11.95%	13.48%	15.59%
$75,000 TO $99,999	4.50%	7.63%	7.99%	8.11%	8.24%	8.37%	8.50%	8.63%	8.77%	8.90%	9.59%	10.51%	11.87%	13.76%
$100,000 OR MORE	4.67%	6.83%	7.18%	7.30%	7.42%	7.53%	7.66%	7.78%	7.91%	8.04%	8.70%	9.56%	10.84%	12.62%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 8 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2006.

Table 3-23

Demographic and Employment Baseline Projections for Economic Impact Area FL-1

	1990	2000	2003	2004	2005	2006	2007	2008	2009	2010	2015	2020	2025	2030
TOTAL POPULATION (THOUSANDS)	665.78	797.21	832.50	845.69	858.08	883.12	900.43	917.72	934.88	952.03	1,040.01	1,129.62	1,221.79	1,318.38
AGE UNDER 19 YEARS	29.48%	27.37%	27.14%	26.91%	26.52%	26.16%	25.83%	25.58%	25.33%	25.08%	24.61%	24.87%	24.95%	25.07%
AGE 20 TO 34 YEARS	25.11%	20.05%	19.41%	19.31%	19.43%	19.57%	19.71%	19.87%	20.11%	20.34%	20.56%	19.20%	18.19%	17.97%
AGE 35 TO 49 YEARS	19.83%	23.48%	22.51%	22.20%	21.88%	21.52%	21.13%	20.60%	20.03%	19.42%	17.26%	17.77%	18.84%	19.33%
AGE 50 TO 64 YEARS	14.16%	16.10%	17.48%	18.06%	18.36%	18.67%	18.91%	19.17%	19.41%	19.80%	20.40%	19.36%	17.36%	15.64%
AGE 65 YEARS AND OVER	11.42%	12.99%	13.45%	13.52%	13.81%	14.08%	14.42%	14.77%	15.12%	15.36%	17.18%	18.81%	20.66%	21.98%
MEDIAN AGE OF POPULATION (YEARS)	34.24	38.36	39.21	39.47	39.77	40.03	40.26	40.50	40.69	40.85	41.13	41.12	41.57	42.02
WHITE POPULATION	82.15%	80.37%	79.85%	79.70%	79.52%	79.28%	79.08%	78.89%	78.70%	78.50%	77.56%	76.61%	75.62%	74.51%
BLACK POPULATION	13.23%	13.58%	13.75%	13.76%	13.83%	13.93%	14.01%	14.09%	14.17%	14.26%	14.68%	15.11%	15.58%	16.13%
NATIVE AMERICAN POPULATION	0.82%	0.88%	0.86%	0.85%	0.84%	0.83%	0.83%	0.82%	0.81%	0.80%	0.76%	0.73%	0.69%	0.65%
ASIAN AND PACIFIC ISLANDER POP	1.75%	2.25%	2.32%	2.36%	2.40%	2.45%	2.49%	2.53%	2.57%	2.60%	2.76%	2.88%	2.99%	3.11%
HISPANIC POPULATION	2.05%	2.91%	3.22%	3.33%	3.41%	3.50%	3.59%	3.67%	3.75%	3.83%	4.24%	4.67%	5.12%	5.60%
MALE POPULATION	49.37%	50.14%	50.14%	50.17%	50.21%	50.24%	50.29%	50.33%	50.37%	50.40%	50.59%	50.73%	50.88%	51.04%
TOTAL EMPLOYMENT (THOUSANDS)	338.22	435.92	449.86	461.76	473.65	488.53	500.29	512.06	523.82	535.58	594.28	652.91	711.49	770.03
FARM EMPLOYMENT	0.64%	0.56%	0.56%	0.54%	0.53%	0.51%	0.50%	0.49%	0.48%	0.46%	0.41%	0.37%	0.34%	0.31%
AGRICULTURAL SERVICES, OTHER	1.18%	1.25%	1.38%	1.36%	1.35%	1.34%	1.32%	1.31%	1.30%	1.29%	1.25%	1.21%	1.19%	1.16%
MINING	0.23%	0.16%	0.12%	0.12%	0.12%	0.11%	0.11%	0.11%	0.11%	0.11%	0.10%	0.09%	0.08%	0.08%
CONSTRUCTION	5.92%	7.04%	6.20%	6.15%	6.11%	6.07%	6.02%	5.98%	5.95%	5.91%	5.75%	5.62%	5.51%	5.42%
MANUFACTURING	7.04%	4.11%	3.86%	3.76%	3.67%	3.59%	3.51%	3.43%	3.36%	3.29%	2.98%	2.72%	2.51%	2.33%
TRANSPORT, COMM. & PUBLIC UTIL	3.87%	3.77%	3.79%	3.76%	3.72%	3.69%	3.67%	3.64%	3.62%	3.59%	3.49%	3.40%	3.33%	3.27%
WHOLESALE TRADE	2.79%	2.99%	2.80%	2.80%	2.80%	2.80%	2.79%	2.79%	2.79%	2.79%	2.79%	2.78%	2.78%	2.77%
RETAIL TRADE	19.49%	18.79%	18.03%	17.80%	17.57%	17.35%	17.15%	16.95%	16.76%	16.58%	15.79%	15.15%	14.61%	14.15%
FINANCE, INS. & REAL ESTATE	5.76%	7.13%	7.38%	7.36%	7.34%	7.32%	7.30%	7.28%	7.26%	7.24%	7.17%	7.11%	7.05%	7.01%
SERVICES	25.48%	32.78%	34.41%	35.33%	36.20%	37.03%	37.81%	38.56%	39.28%	39.96%	42.97%	45.43%	47.48%	49.21%
FEDERAL CIVILIAN GOVT	6.66%	4.00%	3.66%	3.56%	3.48%	3.39%	3.31%	3.24%	3.16%	3.09%	2.79%	2.53%	2.33%	2.15%
FEDERAL MILITARY GOVT	10.46%	8.11%	8.57%	8.37%	8.18%	8.01%	7.83%	7.67%	7.51%	7.36%	6.71%	6.17%	5.73%	5.35%
STATE AND LOCAL GOVT	10.47%	9.31%	9.23%	9.08%	8.94%	8.80%	8.67%	8.55%	8.43%	8.32%	7.82%	7.41%	7.08%	6.79%
TOTAL EARNINGS (MILLIONS 1996 $)	9,140.94	12,355.71	13,536.33	14,052.87	14,498.11	15,042.32	15,500.06	15,961.31	16,433.38	16,916.65	19,515.21	22,456.99	25,800.77	29,613.16
FARM EARNINGS	0.30%	0.20%	0.21%	0.18%	0.18%	0.18%	0.17%	0.17%	0.17%	0.17%	0.16%	0.15%	0.14%	0.13%
AGRICULTURAL SERVICES, OTHER	0.52%	0.64%	0.56%	0.57%	0.56%	0.56%	0.55%	0.55%	0.55%	0.54%	0.53%	0.52%	0.50%	0.49%
MINING	0.21%	0.20%	0.19%	0.15%	0.15%	0.15%	0.14%	0.14%	0.13%	0.13%	0.12%	0.10%	0.09%	0.08%
CONSTRUCTION	5.50%	6.39%	5.28%	5.39%	5.35%	5.31%	5.26%	5.22%	5.17%	5.13%	4.93%	4.74%	4.56%	4.38%
MANUFACTURING	9.89%	5.87%	5.65%	5.60%	5.48%	5.36%	5.26%	5.17%	5.08%	4.99%	4.53%	4.08%	3.64%	3.22%
TRANSPORT, COMM. & PUBLIC UTIL	4.88%	5.38%	5.45%	5.23%	5.19%	5.15%	5.11%	5.07%	5.04%	5.00%	4.84%	4.69%	4.55%	4.42%
WHOLESALE TRADE	2.98%	3.79%	3.48%	3.44%	3.43%	3.43%	3.43%	3.42%	3.42%	3.42%	3.38%	3.33%	3.26%	3.18%
RETAIL TRADE	10.15%	10.48%	10.31%	10.15%	10.00%	9.86%	9.73%	9.60%	9.48%	9.37%	8.82%	8.33%	7.89%	7.47%
FINANCE, INS. & REAL ESTATE	3.27%	5.55%	5.86%	5.82%	5.87%	5.91%	5.95%	5.98%	6.02%	6.05%	6.20%	6.33%	6.42%	6.50%
SERVICES	20.84%	27.30%	28.18%	29.02%	29.94%	30.83%	31.69%	32.52%	33.33%	34.12%	37.88%	41.34%	44.59%	47.65%
FEDERAL CIVILIAN GOVT	11.35%	7.87%	7.44%	7.14%	7.00%	6.85%	6.70%	6.55%	6.41%	6.27%	5.63%	5.06%	4.56%	4.12%
FEDERAL MILITARY GOVT	18.23%	15.23%	16.68%	16.76%	16.46%	16.18%	15.90%	15.64%	15.38%	15.13%	13.92%	12.80%	11.74%	10.75%
STATE AND LOCAL GOVT	11.89%	11.10%	10.73%	10.53%	10.39%	10.25%	10.10%	9.96%	9.82%	9.69%	9.08%	8.54%	8.06%	7.61%
PERSONAL INCOME (MILLIONS 1996 $)	12,322.58	17,809.42	19,250.91	19,765.79	20,310.85	21,094.40	21,760.19	22,437.30	23,130.05	23,838.89	27,644.39	31,938.74	36,804.67	42,339.03
INCOME PER CAPITA (1996 $)	18,508.40	22,339.66	23,124.33	23,372.43	23,670.03	23,886.22	24,166.42	24,449.07	24,741.33	25,040.06	26,580.96	28,273.81	30,123.64	32,114.36
W&P WEALTH INDEX (U.S. = 100)	78.07	78.33	81.45	81.13	81.13	81.11	81.08	81.05	81.04	81.02	81.06	81.22	81.49	81.87
PERSONS PER HOUSEHOLD (PEOPLE)	2.65	2.60	2.57	2.56	2.55	2.54	2.53	2.52	2.51	2.50	2.47	2.46	2.47	2.49
MEAN HOUSEHOLD INCOME (1996 $)	43,452.14	51,182.86	53,480.43	53,603.29	54,007.43	54,259.43	54,665.00	55,094.14	55,553.14	56,027.43	58,720.14	62,149.14	66,270.14	71,115.71
NUMBER OF HOUSEHOLDS (THOUSANDS)	251.34	307.09	323.95	330.54	336.83	348.04	356.13	364.18	372.17	380.17	420.21	458.42	494.80	529.51
LESS THAN $10,000 (2000 $)	12.87%	9.79%	9.33%	9.14%	8.99%	8.85%	8.72%	8.59%	8.46%	8.33%	7.62%	6.75%	5.83%	5.03%
$10,000 TO $19,999	16.42%	13.94%	13.33%	13.07%	12.86%	12.67%	12.49%	12.31%	12.13%	11.96%	10.94%	9.68%	8.37%	7.24%
$20,000 TO $29,999	17.38%	15.53%	14.85%	14.56%	14.32%	14.12%	13.91%	13.72%	13.52%	13.33%	12.21%	10.81%	9.35%	8.10%
$30,000 TO $44,999	20.83%	20.51%	20.34%	20.17%	20.02%	19.91%	19.78%	19.65%	19.51%	19.36%	18.18%	16.20%	14.03%	12.16%
$45,000 TO $59,999	14.01%	14.59%	15.28%	15.61%	15.86%	16.08%	16.31%	16.52%	16.73%	16.94%	18.05%	18.98%	18.78%	17.56%
$60,000 TO $74,999	8.05%	9.91%	10.38%	10.61%	10.79%	10.95%	11.12%	11.28%	11.44%	11.61%	12.73%	14.47%	16.76%	18.77%
$75,000 TO $99,999	5.29%	8.11%	8.50%	8.69%	8.84%	8.97%	9.11%	9.24%	9.38%	9.52%	10.44%	11.89%	13.83%	16.02%
$100,000 OR MORE	5.15%	7.61%	7.99%	8.17%	8.31%	8.44%	8.57%	8.69%	8.82%	8.95%	9.83%	11.21%	13.05%	15.12%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 7 counties in the EIA; income per capita calculated using personal income/total population for the EIA; person per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2006.

Table 3-24

Demographic and Employment Baseline Projections for Economic Impact Area FL-2

	1990	2000	2003	2004	2005	2006	2007	2008	2009	2010	2015	2020	2025	2030
TOTAL POPULATION (THOUSANDS)	472.24	577.43	592.26	599.70	609.81	619.51	627.71	635.91	644.04	652.17	694.50	738.07	783.36	831.46
AGE UNDER 19 YEARS	30.41%	27.35%	26.00%	25.73%	25.51%	25.29%	25.14%	25.07%	24.97%	24.83%	24.78%	25.36%	25.54%	25.55%
AGE 20 TO 34 YEARS	25.81%	23.71%	24.46%	24.41%	24.25%	24.16%	24.10%	23.96%	23.79%	23.45%	20.97%	19.44%	19.05%	19.24%
AGE 35 TO 49 YEARS	19.89%	22.14%	21.20%	20.95%	20.80%	20.56%	20.30%	20.03%	19.88%	19.84%	20.73%	21.01%	20.37%	18.40%
AGE 50 TO 64 YEARS	12.27%	15.24%	16.53%	17.04%	17.43%	17.82%	18.14%	18.42%	18.61%	18.92%	18.86%	17.87%	17.31%	18.35%
AGE 65 YEARS AND OVER	11.62%	11.56%	11.80%	11.87%	12.01%	12.16%	12.33%	12.52%	12.74%	12.96%	14.67%	16.31%	17.73%	18.46%
MEDIAN AGE OF POPULATION (YEARS)	32.95	36.58	36.81	36.88	37.16	37.46	37.73	37.98	38.20	38.43	39.17	39.82	40.68	41.24
WHITE POPULATION	71.19%	67.94%	67.40%	67.20%	67.00%	66.69%	66.38%	66.07%	65.76%	65.45%	63.94%	62.42%	60.90%	59.25%
BLACK POPULATION	25.57%	26.84%	26.84%	26.78%	26.88%	27.07%	27.24%	27.42%	27.61%	27.80%	28.68%	29.61%	30.55%	31.59%
NATIVE AMERICAN POPULATION	0.41%	0.48%	0.48%	0.49%	0.48%	0.48%	0.47%	0.47%	0.47%	0.47%	0.45%	0.42%	0.40%	0.37%
ASIAN AND PACIFIC ISLANDER POP	0.74%	1.11%	1.22%	1.28%	1.30%	1.34%	1.37%	1.40%	1.44%	1.47%	1.64%	1.79%	1.97%	2.16%
HISPANIC POPULATION	2.09%	3.63%	4.06%	4.24%	4.33%	4.43%	4.53%	4.63%	4.72%	4.82%	5.29%	5.75%	6.19%	6.63%
MALE POPULATION	49.08%	49.87%	50.17%	50.25%	50.29%	50.29%	50.31%	50.32%	50.33%	50.34%	50.39%	50.37%	50.34%	50.32%
TOTAL EMPLOYMENT (THOUSANDS)	241.45	301.77	306.38	312.12	317.83	323.52	329.19	334.84	340.50	346.13	374.26	402.29	430.26	458.17
FARM EMPLOYMENT	3.66%	3.20%	3.15%	3.09%	3.03%	2.98%	2.93%	2.88%	2.83%	2.78%	2.56%	2.38%	2.22%	2.08%
AGRICULTURAL SERVICES, OTHER	1.34%	1.53%	1.49%	1.50%	1.51%	1.52%	1.53%	1.54%	1.55%	1.56%	1.60%	1.63%	1.66%	1.69%
MINING	0.21%	0.12%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.10%	0.10%	0.10%	0.10%	0.09%	0.09%
CONSTRUCTION	5.29%	5.23%	5.37%	5.33%	5.29%	5.24%	5.21%	5.17%	5.13%	5.10%	4.94%	4.81%	4.70%	4.60%
MANUFACTURING	7.79%	5.69%	4.96%	4.91%	4.85%	4.79%	4.74%	4.69%	4.64%	4.59%	4.38%	4.20%	4.04%	3.89%
TRANSPORT, COMM. & PUBLIC UTIL	2.76%	2.90%	2.47%	2.47%	2.47%	2.46%	2.46%	2.46%	2.46%	2.45%	2.44%	2.43%	2.43%	2.42%
WHOLESALE TRADE	2.91%	2.78%	2.56%	2.54%	2.51%	2.49%	2.47%	2.45%	2.42%	2.40%	2.31%	2.24%	2.17%	2.11%
RETAIL TRADE	17.16%	16.22%	16.01%	15.91%	15.81%	15.72%	15.63%	15.54%	15.45%	15.37%	15.00%	14.68%	14.40%	14.16%
FINANCE, INS. & REAL ESTATE	5.16%	5.05%	5.53%	5.50%	5.48%	5.46%	5.44%	5.42%	5.40%	5.38%	5.30%	5.24%	5.18%	5.12%
SERVICES	22.70%	27.86%	28.98%	29.53%	30.07%	30.58%	31.08%	31.57%	32.03%	32.48%	34.51%	36.25%	37.75%	39.07%
FEDERAL CIVILIAN GOVT	1.57%	1.38%	1.26%	1.25%	1.23%	1.21%	1.20%	1.18%	1.17%	1.15%	1.09%	1.04%	0.99%	0.95%
FEDERAL MILITARY GOVT	0.64%	0.46%	0.46%	0.45%	0.44%	0.44%	0.43%	0.42%	0.41%	0.41%	0.37%	0.34%	0.32%	0.30%
STATE AND LOCAL GOVT	28.81%	27.57%	27.65%	27.43%	27.21%	26.99%	26.79%	26.59%	26.40%	26.22%	25.38%	24.67%	24.06%	23.52%
TOTAL EARNINGS (MILLIONS 1996 $)	6,062.48	8,577.46	8,810.41	9,114.46	9,345.09	9,577.30	9,812.24	10,046.07	10,284.76	10,528.48	11,828.21	13,277.52	14,897.13	16,709.80
FARM EARNINGS	2.86%	1.91%	1.43%	1.88%	1.87%	1.87%	1.87%	1.86%	1.86%	1.86%	1.84%	1.82%	1.79%	1.77%
AGRICULTURAL SERVICES, OTHER	0.83%	0.85%	0.86%	0.80%	0.80%	0.81%	0.81%	0.82%	0.82%	0.83%	0.85%	0.87%	0.88%	0.90%
MINING	0.23%	0.17%	0.17%	0.17%	0.16%	0.16%	0.16%	0.16%	0.15%	0.15%	0.14%	0.13%	0.12%	0.11%
CONSTRUCTION	5.06%	4.82%	5.11%	5.21%	5.15%	5.10%	5.04%	4.99%	4.94%	4.88%	4.65%	4.44%	4.26%	4.08%
MANUFACTURING	9.51%	7.09%	6.29%	6.29%	6.20%	6.13%	6.07%	6.02%	5.96%	5.91%	5.61%	5.27%	4.91%	4.52%
TRANSPORT, COMM. & PUBLIC UTIL	3.72%	3.77%	3.21%	3.34%	3.33%	3.32%	3.31%	3.30%	3.29%	3.28%	3.24%	3.19%	3.15%	3.10%
WHOLESALE TRADE	3.68%	3.41%	2.96%	2.97%	2.93%	2.89%	2.86%	2.83%	2.79%	2.76%	2.61%	2.47%	2.34%	2.21%
RETAIL TRADE	9.68%	8.63%	8.66%	8.54%	8.46%	8.37%	8.30%	8.23%	8.16%	8.10%	7.78%	7.48%	7.20%	6.93%
FINANCE, INS. & REAL ESTATE	3.61%	5.02%	5.83%	5.64%	5.66%	5.67%	5.68%	5.69%	5.71%	5.72%	5.76%	5.79%	5.81%	5.81%
SERVICES	20.32%	25.49%	26.61%	26.89%	27.48%	28.06%	28.62%	29.18%	29.73%	30.27%	32.86%	35.31%	37.67%	39.95%
FEDERAL CIVILIAN GOVT	2.99%	2.86%	2.87%	3.02%	2.99%	2.96%	2.92%	2.89%	2.85%	2.82%	2.66%	2.50%	2.36%	2.22%
FEDERAL MILITARY GOVT	0.44%	0.34%	0.55%	0.35%	0.35%	0.34%	0.34%	0.34%	0.33%	0.33%	0.31%	0.29%	0.27%	0.25%
STATE AND LOCAL GOVT	37.06%	35.63%	35.44%	34.91%	34.61%	34.32%	34.02%	33.71%	33.40%	33.11%	31.71%	30.44%	29.26%	28.15%
PERSONAL INCOME (MILLIONS 1996 $)	8,106.37	11,724.84	12,111.99	12,370.14	12,665.57	12,998.34	13,338.86	13,684.21	14,036.96	14,397.35	16,321.19	18,469.10	20,873.41	23,571.75
INCOME PER CAPITA (1996 $)	17,165.88	20,305.15	20,450.60	20,627.11	20,769.67	20,981.81	21,250.03	21,519.02	21,795.34	22,076.04	23,500.60	25,023.58	26,646.07	28,349.97
W&P WEALTH INDEX (U.S. = 100)	67.72	65.14	64.61	64.60	64.26	64.24	64.22	64.20	64.18	64.16	64.06	63.96	63.87	63.77
PERSONS PER HOUSEHOLD (PEOPLE)	2.72	2.64	2.62	2.61	2.60	2.59	2.58	2.57	2.56	2.55	2.52	2.51	2.51	2.53
MEAN HOUSEHOLD INCOME (1996 $)	40,180.33	45,050.73	43,989.00	44,202.47	44,193.27	44,399.60	44,733.13	45,071.93	45,436.67	45,808.73	47,835.87	50,329.80	53,256.07	56,633.07
NUMBER OF HOUSEHOLDS (THOUSANDS)	173.52	219.00	226.45	230.12	234.68	239.39	243.46	247.51	251.51	255.51	275.58	294.40	311.87	328.05
LESS THAN $10,000 (2000 $)	17.45%	14.98%	14.47%	14.29%	14.08%	13.88%	13.68%	13.48%	13.29%	13.10%	12.19%	11.04%	9.90%	8.67%
$10,000 TO $19,999	18.14%	15.75%	15.28%	15.10%	14.91%	14.68%	14.46%	14.24%	14.02%	13.81%	12.80%	11.58%	10.38%	9.08%
$20,000 TO $29,999	16.21%	15.25%	14.83%	14.67%	14.49%	14.28%	14.07%	13.87%	13.66%	13.47%	12.51%	11.33%	10.16%	8.89%
$30,000 TO $44,999	18.65%	18.16%	18.42%	18.52%	18.63%	18.70%	18.75%	18.78%	18.80%	18.79%	18.52%	17.58%	16.23%	14.32%
$45,000 TO $59,999	11.87%	12.84%	13.27%	13.43%	13.62%	13.82%	14.02%	14.23%	14.43%	14.64%	15.73%	16.97%	17.87%	18.31%
$60,000 TO $74,999	7.14%	8.52%	8.79%	8.89%	9.01%	9.14%	9.28%	9.41%	9.55%	9.69%	10.43%	11.57%	12.97%	14.87%
$75,000 TO $99,999	5.12%	7.41%	7.65%	7.73%	7.82%	7.94%	8.06%	8.19%	8.32%	8.44%	9.11%	10.16%	11.43%	13.14%
$100,000 OR MORE	5.42%	7.08%	7.30%	7.36%	7.44%	7.56%	7.68%	7.80%	7.93%	8.05%	8.71%	9.78%	11.04%	12.71%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 15 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2006.

Table 3-25

Demographic and Employment Baseline Projections for Economic Impact Area FL-3

	1990	2000	2003	2004	2005	2006	2007	2008	2009	2010	2015	2020	2025	2030
TOTAL POPULATION (THOUSANDS)	472.24	577.43	592.26	599.70	609.81	619.51	627.71	635.91	644.04	652.17	694.50	738.07	783.36	831.46
AGE UNDER 19 YEARS	30.41%	27.35%	26.00%	25.73%	25.51%	25.29%	25.14%	25.07%	24.97%	24.83%	24.78%	25.36%	25.54%	25.55%
AGE 20 TO 34 YEARS	25.81%	23.71%	24.46%	24.41%	24.25%	24.16%	24.10%	23.96%	23.79%	23.45%	20.97%	19.44%	19.05%	19.24%
AGE 35 TO 49 YEARS	19.89%	22.14%	21.20%	20.95%	20.80%	20.56%	20.30%	20.03%	19.88%	19.84%	20.73%	21.01%	20.37%	18.40%
AGE 50 TO 64 YEARS	12.27%	15.24%	16.53%	17.04%	17.43%	17.82%	18.14%	18.42%	18.61%	18.92%	18.86%	17.87%	17.31%	18.35%
AGE 65 YEARS AND OVER	11.62%	11.56%	11.80%	11.87%	12.01%	12.16%	12.33%	12.52%	12.74%	12.96%	14.67%	16.31%	17.73%	18.46%
MEDIAN AGE OF POPULATION (YEARS)	32.95	36.58	36.81	36.88	37.16	37.46	37.73	37.98	38.20	38.43	39.17	39.82	40.68	41.24
WHITE POPULATION	71.19%	67.94%	67.40%	67.20%	67.00%	66.69%	66.38%	66.07%	65.76%	65.45%	63.94%	62.42%	60.90%	59.25%
BLACK POPULATION	25.57%	26.84%	26.84%	26.78%	26.88%	27.07%	27.24%	27.42%	27.61%	27.80%	28.68%	29.61%	30.55%	31.59%
NATIVE AMERICAN POPULATION	0.41%	0.48%	0.48%	0.49%	0.48%	0.48%	0.47%	0.47%	0.47%	0.47%	0.45%	0.42%	0.40%	0.37%
ASIAN AND PACIFIC ISLANDER POP	0.74%	1.11%	1.22%	1.28%	1.30%	1.34%	1.37%	1.40%	1.44%	1.47%	1.64%	1.79%	1.97%	2.16%
HISPANIC POPULATION	2.09%	3.63%	4.06%	4.24%	4.33%	4.43%	4.53%	4.63%	4.72%	4.82%	5.29%	5.75%	6.19%	6.63%
MALE POPULATION	49.08%	49.87%	50.17%	50.25%	50.29%	50.29%	50.31%	50.32%	50.33%	50.34%	50.39%	50.37%	50.34%	50.32%
TOTAL EMPLOYMENT (THOUSANDS)	241.45	301.77	306.38	312.12	317.83	323.52	329.19	334.84	340.50	346.13	374.26	402.29	430.26	458.17
FARM EMPLOYMENT	3.66%	3.20%	3.15%	3.09%	3.03%	2.98%	2.93%	2.88%	2.83%	2.78%	2.56%	2.38%	2.22%	2.08%
AGRICULTURAL SERVICES, OTHER	1.34%	1.53%	1.49%	1.50%	1.51%	1.52%	1.53%	1.54%	1.55%	1.56%	1.60%	1.63%	1.66%	1.69%
MINING	0.21%	0.12%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.10%	0.10%	0.10%	0.10%	0.09%	0.09%
CONSTRUCTION	5.29%	5.23%	5.37%	5.33%	5.29%	5.24%	5.21%	5.17%	5.13%	5.10%	4.94%	4.81%	4.70%	4.60%
MANUFACTURING	7.79%	5.69%	4.96%	4.91%	4.85%	4.79%	4.74%	4.69%	4.64%	4.59%	4.38%	4.20%	4.04%	3.89%
TRANSPORT, COMM. & PUBLIC UTIL	2.76%	2.90%	2.47%	2.47%	2.47%	2.46%	2.46%	2.46%	2.46%	2.45%	2.44%	2.43%	2.43%	2.42%
WHOLESALE TRADE	2.91%	2.78%	2.56%	2.54%	2.51%	2.49%	2.47%	2.45%	2.42%	2.40%	2.31%	2.24%	2.17%	2.11%
RETAIL TRADE	17.16%	16.22%	16.01%	15.91%	15.81%	15.72%	15.63%	15.54%	15.45%	15.37%	15.00%	14.68%	14.40%	14.16%
FINANCE, INS. & REAL ESTATE	5.16%	5.05%	5.53%	5.50%	5.48%	5.46%	5.44%	5.42%	5.40%	5.38%	5.30%	5.24%	5.18%	5.12%
SERVICES	22.70%	27.86%	28.98%	29.53%	30.07%	30.58%	31.08%	31.57%	32.03%	32.48%	34.51%	36.25%	37.75%	39.07%
FEDERAL CIVILIAN GOVT	1.57%	1.38%	1.26%	1.25%	1.23%	1.21%	1.20%	1.18%	1.17%	1.15%	1.09%	1.04%	0.99%	0.95%
FEDERAL MILITARY GOVT	0.64%	0.46%	0.46%	0.45%	0.44%	0.44%	0.43%	0.42%	0.41%	0.41%	0.37%	0.34%	0.32%	0.30%
STATE AND LOCAL GOVT	28.81%	27.57%	27.65%	27.43%	27.21%	26.99%	26.79%	26.59%	26.40%	26.22%	25.38%	24.67%	24.06%	23.52%
TOTAL EARNINGS (MILLIONS 1996 $)	6,062.48	8,577.46	8,810.41	9,114.46	9,345.09	9,577.30	9,812.24	10,046.07	10,284.76	10,528.48	11,828.21	13,277.52	14,897.13	16,709.80
FARM EARNINGS	2.86%	1.91%	1.43%	1.88%	1.87%	1.87%	1.87%	1.86%	1.86%	1.86%	1.84%	1.82%	1.79%	1.77%
AGRICULTURAL SERVICES, OTHER	0.83%	0.85%	0.86%	0.80%	0.80%	0.81%	0.81%	0.82%	0.82%	0.83%	0.85%	0.87%	0.88%	0.90%
MINING	0.23%	0.17%	0.17%	0.17%	0.16%	0.16%	0.16%	0.16%	0.15%	0.15%	0.14%	0.13%	0.12%	0.11%
CONSTRUCTION	5.06%	4.82%	5.11%	5.21%	5.15%	5.10%	5.04%	4.99%	4.94%	4.88%	4.65%	4.44%	4.26%	4.08%
MANUFACTURING	9.51%	7.09%	6.29%	6.29%	6.20%	6.13%	6.07%	6.02%	5.96%	5.91%	5.61%	5.27%	4.91%	4.52%
TRANSPORT, COMM. & PUBLIC UTIL	3.72%	3.77%	3.21%	3.34%	3.33%	3.32%	3.31%	3.30%	3.29%	3.28%	3.24%	3.19%	3.15%	3.10%
WHOLESALE TRADE	3.68%	3.41%	2.96%	2.97%	2.93%	2.89%	2.86%	2.83%	2.79%	2.76%	2.61%	2.47%	2.34%	2.21%
RETAIL TRADE	9.68%	8.63%	8.66%	8.54%	8.46%	8.37%	8.30%	8.23%	8.16%	8.10%	7.78%	7.48%	7.20%	6.93%
FINANCE, INS. & REAL ESTATE	3.61%	5.02%	5.83%	5.64%	5.66%	5.67%	5.68%	5.69%	5.71%	5.72%	5.76%	5.79%	5.81%	5.81%
SERVICES	20.32%	25.49%	26.61%	26.89%	27.48%	28.06%	28.62%	29.18%	29.73%	30.27%	32.86%	35.31%	37.67%	39.95%
FEDERAL CIVILIAN GOVT	2.99%	2.86%	2.87%	3.02%	2.99%	2.96%	2.92%	2.89%	2.85%	2.82%	2.66%	2.50%	2.36%	2.22%
FEDERAL MILITARY GOVT	0.44%	0.34%	0.55%	0.35%	0.35%	0.34%	0.34%	0.34%	0.33%	0.33%	0.31%	0.29%	0.27%	0.25%
STATE AND LOCAL GOVT	37.06%	35.63%	35.44%	34.91%	34.61%	34.32%	34.02%	33.71%	33.40%	33.11%	31.71%	30.44%	29.26%	28.15%
PERSONAL INCOME (MILLIONS 1996 $)	8,106.37	11,724.84	12,111.99	12,370.14	12,665.57	12,998.34	13,338.86	13,684.21	14,036.96	14,397.35	16,321.19	18,469.10	20,873.41	23,571.75
INCOME PER CAPITA (1996 $)	17,165.88	20,305.15	20,450.60	20,627.11	20,769.67	20,981.81	21,250.03	21,519.02	21,795.34	22,076.04	23,500.60	25,023.58	26,646.07	28,349.97
W&P WEALTH INDEX (U.S. = 100)	67.72	65.14	64.61	64.60	64.26	64.24	64.22	64.20	64.18	64.16	64.06	63.96	63.87	63.77
PERSONS PER HOUSEHOLD (PEOPLE)	2.72	2.64	2.62	2.61	2.60	2.59	2.58	2.57	2.56	2.55	2.52	2.51	2.51	2.53
MEAN HOUSEHOLD INCOME (1996 $)	40,180.33	45,050.73	43,989.00	44,202.47	44,193.27	44,399.60	44,733.13	45,071.93	45,436.67	45,808.73	47,835.87	50,329.80	53,256.07	56,633.07
NUMBER OF HOUSEHOLDS (THOUSANDS)	173.52	219.00	226.45	230.12	234.68	239.39	243.46	247.51	251.51	255.51	275.58	294.40	311.87	328.05
LESS THAN $10,000 (2000 $)	17.45%	14.98%	14.47%	14.29%	14.08%	13.88%	13.68%	13.48%	13.29%	13.10%	12.19%	11.04%	9.90%	8.67%
$10,000 TO $19,999	18.14%	15.75%	15.28%	15.10%	14.91%	14.68%	14.46%	14.24%	14.02%	13.81%	12.80%	11.58%	10.38%	9.08%
$20,000 TO $29,999	16.21%	15.25%	14.83%	14.67%	14.49%	14.28%	14.07%	13.87%	13.66%	13.47%	12.51%	11.33%	10.16%	8.89%
$30,000 TO $44,999	18.65%	18.16%	18.42%	18.52%	18.63%	18.70%	18.75%	18.78%	18.80%	18.79%	18.52%	17.58%	16.23%	14.32%
$45,000 TO $59,999	11.87%	12.84%	13.27%	13.43%	13.62%	13.82%	14.02%	14.23%	14.43%	14.64%	15.73%	16.97%	17.87%	18.31%
$60,000 TO $74,999	7.14%	8.52%	8.79%	8.89%	9.01%	9.14%	9.28%	9.41%	9.55%	9.69%	10.43%	11.57%	12.97%	14.87%
$75,000 TO $99,999	5.12%	7.41%	7.65%	7.73%	7.82%	7.94%	8.06%	8.19%	8.32%	8.44%	9.11%	10.16%	11.43%	13.14%
$100,000 OR MORE	5.42%	7.08%	7.30%	7.36%	7.44%	7.56%	7.68%	7.80%	7.93%	8.05%	8.71%	9.78%	11.04%	12.71%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 12 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2006.

Table 3-26

Demographic and Employment Baseline Projections for Economic Impact Area FL-4

	1990	2000	2003	2004	2005	2006	2007	2008	2009	2010	2015	2020	2025	2030
TOTAL POPULATION (THOUSANDS)	4,409.06	5,437.77	5,741.98	5,845.19	5,947.96	6,074.63	6,185.27	6,295.73	6,405.33	6,514.93	7,078.15	7,652.58	8,244.18	8,865.40
AGE UNDER 19 YEARS	24.61%	24.99%	25.61%	25.61%	25.45%	25.33%	25.18%	25.02%	24.84%	24.61%	24.05%	24.02%	23.79%	23.61%
AGE 20 TO 34 YEARS	22.27%	18.79%	18.13%	18.02%	17.92%	17.86%	17.86%	17.99%	18.20%	18.48%	19.32%	18.91%	18.37%	18.08%
AGE 35 TO 49 YEARS	19.25%	22.36%	22.31%	22.24%	22.12%	21.98%	21.79%	21.47%	21.09%	20.60%	18.46%	17.96%	18.48%	19.18%
AGE 50 TO 64 YEARS	14.54%	15.97%	16.62%	16.99%	17.30%	17.62%	17.88%	18.13%	18.39%	18.73%	19.61%	19.32%	18.09%	16.27%
AGE 65 YEARS AND OVER	19.33%	17.88%	17.32%	17.15%	17.20%	17.20%	17.29%	17.40%	17.49%	17.57%	18.56%	19.78%	21.27%	22.85%
MEDIAN AGE OF POPULATION (YEARS)	41.33	43.38	42.93	42.88	43.04	43.16	43.28	43.40	43.49	43.54	43.62	43.43	43.19	42.69
WHITE POPULATION	58.73%	49.95%	47.64%	47.00%	46.43%	45.72%	45.07%	44.44%	43.84%	43.26%	40.56%	38.09%	35.71%	33.37%
BLACK POPULATION	14.25%	16.35%	16.61%	16.68%	16.71%	16.83%	16.93%	17.04%	17.15%	17.27%	17.83%	18.30%	18.78%	19.27%
NATIVE AMERICAN POPULATION	0.16%	0.17%	0.17%	0.17%	0.17%	0.17%	0.16%	0.16%	0.16%	0.16%	0.15%	0.15%	0.14%	0.13%
ASIAN AND PACIFIC ISLANDER POP	1.07%	1.60%	1.73%	1.78%	1.83%	1.88%	1.93%	1.98%	2.02%	2.07%	2.30%	2.51%	2.73%	2.97%
HISPANIC POPULATION	25.79%	31.93%	33.86%	34.36%	34.87%	35.40%	35.90%	36.38%	36.82%	37.24%	39.16%	40.95%	42.65%	44.27%
MALE POPULATION	48.03%	48.49%	48.64%	48.68%	48.69%	48.69%	48.69%	48.69%	48.69%	48.69%	48.65%	48.57%	48.48%	48.35%
TOTAL EMPLOYMENT (THOUSANDS)	2,307.19	2,968.79	3,152.21	3,219.53	3,286.87	3,354.95	3,422.26	3,489.59	3,556.92	3,624.25	3,961.04	4,298.01	4,635.13	4,972.38
FARM EMPLOYMENT	0.91%	0.74%	0.72%	0.70%	0.69%	0.69%	0.68%	0.67%	0.66%	0.65%	0.61%	0.58%	0.56%	0.53%
AGRICULTURAL SERVICES, OTHER	1.48%	1.62%	1.63%	1.63%	1.62%	1.62%	1.61%	1.61%	1.61%	1.60%	1.59%	1.57%	1.56%	1.55%
MINING	0.18%	0.11%	0.09%	0.09%	0.09%	0.08%	0.08%	0.08%	0.08%	0.08%	0.07%	0.07%	0.07%	0.06%
CONSTRUCTION	6.34%	6.02%	6.08%	6.06%	6.05%	6.03%	6.02%	6.00%	5.99%	5.97%	5.91%	5.86%	5.81%	5.77%
MANUFACTURING	7.13%	5.02%	4.13%	4.06%	3.99%	3.93%	3.87%	3.81%	3.75%	3.69%	3.44%	3.23%	3.05%	2.89%
TRANSPORT, COMM. & PUBLIC UTIL	5.50%	5.77%	5.25%	5.23%	5.21%	5.19%	5.16%	5.15%	5.13%	5.11%	5.03%	4.96%	4.90%	4.85%
WHOLESALE TRADE	5.62%	5.46%	5.37%	5.33%	5.30%	5.26%	5.23%	5.20%	5.17%	5.14%	5.02%	4.91%	4.82%	4.74%
RETAIL TRADE	18.95%	17.52%	16.98%	16.87%	16.77%	16.68%	16.58%	16.49%	16.41%	16.33%	15.96%	15.64%	15.38%	15.14%
FINANCE, INS. & REAL ESTATE	9.76%	9.28%	9.86%	9.75%	9.65%	9.55%	9.46%	9.37%	9.28%	9.20%	8.82%	8.51%	8.24%	8.00%
SERVICES	32.18%	37.54%	38.92%	39.28%	39.62%	39.94%	40.26%	40.56%	40.85%	41.13%	42.38%	43.44%	44.35%	45.13%
FEDERAL CIVILIAN GOVT	1.33%	1.13%	1.08%	1.07%	1.05%	1.04%	1.03%	1.01%	1.00%	0.99%	0.94%	0.90%	0.86%	0.83%
FEDERAL MILITARY GOVT	0.96%	0.54%	0.54%	0.52%	0.51%	0.50%	0.49%	0.48%	0.47%	0.46%	0.42%	0.39%	0.36%	0.33%
STATE AND LOCAL GOVT	9.66%	9.25%	9.36%	9.40%	9.45%	9.49%	9.53%	9.57%	9.61%	9.64%	9.81%	9.94%	10.06%	10.16%
TOTAL EARNINGS (MILLIONS 1996 $)	65,537.44	97,034.41	106,269.68	110,006.77	113,143.91	116,344.75	119,580.82	122,828.55	126,151.11	129,550.60	147,777.88	168,268.13	191,341.21	217,359.42
FARM EARNINGS	0.87%	0.40%	0.36%	0.52%	0.52%	0.52%	0.52%	0.52%	0.52%	0.52%	0.52%	0.52%	0.52%	0.51%
AGRICULTURAL SERVICES, OTHER	0.89%	0.84%	0.78%	0.80%	0.80%	0.79%	0.79%	0.79%	0.79%	0.79%	0.77%	0.76%	0.76%	0.75%
MINING	0.16%	0.15%	0.14%	0.10%	0.10%	0.10%	0.10%	0.09%	0.09%	0.09%	0.08%	0.07%	0.06%	0.06%
CONSTRUCTION	6.71%	5.99%	6.32%	6.66%	6.62%	6.58%	6.55%	6.51%	6.47%	6.43%	6.24%	6.06%	5.89%	5.72%
MANUFACTURING	8.35%	6.18%	5.43%	5.33%	5.23%	5.14%	5.07%	5.00%	4.93%	4.86%	4.51%	4.14%	3.77%	3.40%
TRANSPORT, COMM. & PUBLIC UTIL	7.46%	7.29%	6.56%	6.49%	6.45%	6.42%	6.38%	6.35%	6.31%	6.28%	6.12%	5.97%	5.82%	5.68%
WHOLESALE TRADE	7.58%	7.83%	7.67%	7.54%	7.46%	7.39%	7.32%	7.25%	7.18%	7.11%	6.79%	6.48%	6.19%	5.92%
RETAIL TRADE	12.47%	11.07%	10.51%	10.37%	10.28%	10.20%	10.12%	10.05%	9.99%	9.92%	9.60%	9.29%	8.98%	8.69%
FINANCE, INS. & REAL ESTATE	8.04%	11.60%	11.94%	11.77%	11.72%	11.66%	11.60%	11.53%	11.47%	11.41%	11.12%	10.85%	10.60%	10.35%
SERVICES	31.19%	34.10%	35.49%	35.68%	36.06%	36.43%	36.80%	37.16%	37.52%	37.88%	39.66%	41.42%	43.19%	44.95%
FEDERAL CIVILIAN GOVT	2.65%	2.31%	2.29%	2.25%	2.23%	2.21%	2.18%	2.15%	2.13%	2.10%	1.98%	1.86%	1.75%	1.65%
FEDERAL MILITARY GOVT	0.85%	0.42%	0.61%	0.60%	0.59%	0.58%	0.57%	0.56%	0.55%	0.54%	0.49%	0.45%	0.42%	0.38%
STATE AND LOCAL GOVT	12.78%	11.81%	11.90%	11.89%	11.94%	11.98%	12.01%	12.04%	12.06%	12.07%	12.12%	12.11%	12.06%	11.96%
PERSONAL INCOME (MILLIONS 1996 $)	107,074.07	148,829.68	159,378.99	165,192.92	170,531.47	175,696.02	180,935.65	186,274.82	191,747.27	197,357.39	227,623.10	262,015.91	301,215.82	346,011.24
INCOME PER CAPITA (1996 $)	24,284.99	27,369.63	27,756.78	28,261.34	28,670.59	28,922.93	29,252.67	29,587.47	29,935.58	30,293.09	32,158.55	34,238.88	36,536.77	39,029.40
W&P WEALTH INDEX (U.S. = 100)	115.41	108.80	109.28	109.95	110.29	110.52	110.73	110.95	111.17	111.39	112.56	113.80	115.12	116.51
PERSONS PER HOUSEHOLD (PEOPLE)	2.53	2.58	2.56	2.55	2.55	2.54	2.54	2.53	2.53	2.53	2.52	2.53	2.55	2.59
MEAN HOUSEHOLD INCOME (1996 $)	58,793.56	67,480.78	66,681.00	67,895.22	68,779.22	69,363.89	70,141.67	70,943.78	71,786.33	72,656.22	77,391.11	83,120.33	89,836.33	97,620.00
NUMBER OF HOUSEHOLDS (THOUSANDS)	1,739.76	2,104.41	2,243.27	2,289.34	2,335.58	2,390.04	2,437.85	2,485.23	2,531.94	2,578.44	2,808.96	3,024.42	3,227.09	3,418.04
LESS THAN $10,000 (2000 $)	11.70%	10.26%	9.87%	9.62%	9.38%	9.26%	9.12%	8.99%	8.86%	8.73%	7.95%	7.03%	6.21%	5.46%
$10,000 TO $19,999	14.85%	13.50%	13.06%	12.76%	12.48%	12.32%	12.15%	11.98%	11.81%	11.64%	10.64%	9.43%	8.35%	7.37%
$20,000 TO $29,999	15.28%	14.03%	13.60%	13.31%	13.04%	12.88%	12.70%	12.52%	12.34%	12.17%	11.14%	9.90%	8.77%	7.75%
$30,000 TO $44,999	19.48%	18.48%	18.27%	18.06%	17.84%	17.70%	17.53%	17.34%	17.14%	16.94%	15.61%	13.88%	12.30%	10.87%
$45,000 TO $59,999	13.98%	13.54%	13.98%	14.31%	14.61%	14.79%	14.97%	15.16%	15.33%	15.49%	16.20%	16.39%	15.53%	14.03%
$60,000 TO $74,999	8.80%	9.50%	9.82%	10.05%	10.27%	10.40%	10.55%	10.71%	10.87%	11.03%	12.11%	13.64%	15.24%	16.47%
$75,000 TO $99,999	6.49%	8.98%	9.28%	9.49%	9.70%	9.83%	9.97%	10.11%	10.26%	10.41%	11.43%	12.90%	14.59%	16.53%
$100,000 OR MORE	9.41%	11.71%	12.11%	12.40%	12.67%	12.83%	13.01%	13.20%	13.39%	13.59%	14.92%	16.82%	19.00%	21.51%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 9 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2006.

Table 3-27

Population and Employment Projections for Counties/Parishes Most Negatively Impacted by Hurricanes Katrina and Rita

Population Projections										
	2005	2006	2007	2008	2009	2010	2015	2020	2025	2030
ST. BERNARD, LA	65,364	9,288	12,188	15,090	17,982	20,878	35,537	50,333	65,310	80,569
ORLEANS, LA	454,863	153,983	164,858	175,742	186,587	197,454	253,033	309,485	366,912	425,702
PLAQUEMINES, LA	28,995	14,204	14,797	15,391	15,981	16,572	19,612	22,708	25,869	29,126
JEFFERSON, LA	452,824	405,011	411,322	417,635	423,898	430,175	462,817	496,415	531,255	568,032
CAMERON, LA	9,558	8,686	8,739	8,792	8,844	8,897	9,188	9,498	9,832	10,201
HANCOCK, MS	46,711	39,313	40,382	41,451	42,513	43,577	49,021	54,565	60,246	66,156
JACKSON, MS	135,940	130,740	132,342	133,945	135,532	137,121	145,437	154,025	162,974	172,499
HARRISON, MS	193,810	190,401	192,674	194,946	197,195	199,449	211,240	223,421	236,125	249,664

Population Level Compared with 2005 Pre-Katrina and Rita Population									
	2006	2007	2008	2009	2010	2015	2020	2025	2030
ST. BERNARD, LA	14%	19%	23%	28%	32%	54%	77%	100%	123%
ORLEANS, LA	34%	36%	39%	41%	43%	56%	68%	81%	94%
PLAQUEMINES, LA	49%	51%	53%	55%	57%	68%	78%	89%	100%
JEFFERSON, LA	89%	91%	92%	94%	95%	102%	110%	117%	125%
CAMERON, LA	91%	91%	92%	93%	93%	96%	99%	103%	107%
HANCOCK, MS	84%	86%	89%	91%	93%	105%	117%	129%	142%
JACKSON, MS	96%	97%	99%	100%	101%	107%	113%	120%	127%
HARRISON, MS	98%	99%	101%	102%	103%	109%	115%	122%	129%

Employment Projections										
	2005	2006	2007	2008	2009	2010	2015	2020	2025	2030
ST. BERNARD, LA	24,815	3,521	4,622	5,727	6,831	7,937	13,516	19,109	24,693	30,230
ORLEANS, LA	319,010	108,204	116,348	124,566	132,833	141,177	184,328	229,214	275,644	323,380
PLAQUEMINES, LA	20,787	10,306	10,889	11,483	12,092	12,710	16,014	19,622	23,516	27,682
JEFFERSON, LA	285,724	257,505	264,084	270,694	277,335	284,006	317,861	352,350	387,339	422,688
CAMERON, LA	4,980	4,588	4,684	4,786	4,887	4,988	5,495	6,015	6,537	7,070
HANCOCK, MS	22,560	18,912	19,392	19,878	20,358	20,839	23,248	25,645	28,036	30,406
JACKSON, MS	63,692	61,128	61,902	62,673	63,447	64,219	68,096	71,985	75,876	79,760
HARRISON, MS	132,051	130,648	133,435	136,226	139,020	141,817	155,867	170,005	184,196	198,438

Employment Level Compared with 2005 Pre-Katrina and Rita Employment									
	2006	2007	2008	2009	2010	2015	2020	2025	2030
ST. BERNARD, LA	14%	19%	23%	28%	32%	54%	77%	100%	122%
ORLEANS, LA	34%	36%	39%	42%	44%	58%	72%	86%	101%
PLAQUEMINES, LA	50%	52%	55%	58%	61%	77%	94%	113%	133%
JEFFERSON, LA	90%	92%	95%	97%	99%	111%	123%	136%	148%
CAMERON, LA	92%	94%	96%	98%	100%	110%	121%	131%	142%
HANCOCK, MS	84%	86%	88%	90%	92%	103%	114%	124%	135%
JACKSON, MS	96%	97%	98%	100%	101%	107%	113%	119%	125%
HARRISON, MS	99%	101%	103%	105%	107%	118%	129%	139%	150%

Source: Woods & Poole Economics, Inc., 2006.

Table 3-28

Baseline Population Projections (in thousands) by Economic Impact Area

Model Year	Calendar Year	AL-1	MS-1	LA-1	LA-2	LA-3	LA-4	TX-1	TX-2	TX-3	FL-1	FL-2	FL-3	FL-4
	2007	746.26	481.50	340.82	583.19	1,156.01	1,077.29	1,717.47	602.86	5,739.75	900.43	627.71	3,523.45	6,185.27
	2008	750.82	487.07	341.91	586.09	1,162.08	1,099.87	1,748.38	609.11	5,813.67	917.72	635.91	3,569.92	6,295.73
1	2009	755.30	492.57	342.96	588.93	1,168.03	1,122.30	1,779.06	615.29	5,886.89	934.88	644.04	3,615.97	6,405.33
2	2010	759.80	498.09	344.03	591.80	1,174.01	1,144.78	1,809.74	621.49	5,960.20	952.03	652.17	3,662.06	6,514.93
3	2011	764.69	503.87	345.29	594.97	1,180.55	1,168.03	1,841.28	628.01	6,036.44	969.63	660.64	3,709.98	6,627.57
4	2012	769.60	509.71	346.55	598.16	1,187.14	1,191.75	1,873.36	634.60	6,113.66	987.55	669.21	3,758.53	6,742.17
5	2013	774.55	515.62	347.81	601.37	1,193.76	1,215.96	1,906.01	641.26	6,191.87	1,005.80	677.90	3,807.72	6,858.74
6	2014	779.52	521.60	349.08	604.59	1,200.41	1,240.65	1,939.22	647.99	6,271.08	1,024.39	686.70	3,857.54	6,977.33
7	2015	784.22	526.98	350.31	607.67	1,206.74	1,261.03	1,967.42	654.09	6,341.43	1,040.01	694.50	3,901.67	7,078.15
8	2016	789.39	532.95	351.71	611.07	1,213.71	1,284.85	1,999.59	660.86	6,419.86	1,057.93	703.21	3,950.95	7,193.04
9	2017	794.59	538.99	353.11	614.50	1,220.72	1,309.12	2,032.29	667.70	6,499.26	1,076.16	712.04	4,000.85	7,309.79
10	2018	799.82	545.10	354.52	617.95	1,227.77	1,333.85	2,065.52	674.61	6,579.65	1,094.71	720.97	4,051.38	7,428.44
11	2019	805.09	551.27	355.94	621.41	1,234.86	1,359.04	2,099.30	681.59	6,661.03	1,113.57	730.02	4,102.55	7,549.01
12	2020	810.06	556.84	357.30	624.70	1,241.59	1,380.13	2,128.28	687.93	6,733.60	1,129.62	738.07	4,148.07	7,652.58
13	2021	815.60	563.07	358.87	628.40	1,249.12	1,404.67	2,161.42	695.03	6,815.11	1,148.06	747.13	4,199.26	7,770.90
14	2022	821.17	569.37	360.45	632.12	1,256.70	1,429.65	2,195.07	702.19	6,897.62	1,166.79	756.30	4,251.08	7,891.05
15	2023	826.79	575.75	362.03	635.87	1,264.32	1,455.07	2,229.25	709.44	6,981.12	1,185.83	765.58	4,303.54	8,013.06
16	2024	832.44	582.19	363.62	639.63	1,271.99	1,480.94	2,263.96	716.75	7,065.64	1,205.18	774.97	4,356.65	8,136.95
17	2025	837.76	588.00	365.15	643.20	1,279.24	1,502.83	2,293.97	723.40	7,141.18	1,221.79	783.36	4,404.02	8,244.18
18	2026	843.88	594.65	366.97	647.34	1,287.66	1,528.47	2,328.77	731.01	7,227.78	1,241.11	792.98	4,458.35	8,368.43
19	2027	850.04	601.38	368.80	651.51	1,296.12	1,554.55	2,364.09	738.70	7,315.42	1,260.73	802.72	4,513.35	8,494.54
20	2028	856.25	608.18	370.63	655.71	1,304.65	1,581.07	2,399.95	746.48	7,404.13	1,280.67	812.57	4,569.03	8,622.56
21	2029	862.51	615.06	372.48	659.93	1,313.23	1,608.04	2,436.35	754.33	7,493.91	1,300.92	822.55	4,625.39	8,752.50
22	2030	868.36	621.26	374.25	663.91	1,321.31	1,631.03	2,467.95	761.46	7,574.15	1,318.38	831.46	4,675.66	8,865.40
23	2031	874.70	628.29	376.11	668.19	1,329.99	1,658.86	2,505.38	769.47	7,665.99	1,339.23	841.67	4,733.34	8,999.00
24	2032	881.10	635.39	377.98	672.49	1,338.74	1,687.16	2,543.38	777.56	7,758.95	1,360.41	852.00	4,791.73	9,134.62
25	2033	887.53	642.58	379.87	676.82	1,347.54	1,715.94	2,581.96	785.74	7,853.03	1,381.92	862.46	4,850.85	9,272.29
26	2034	894.02	649.85	381.76	681.18	1,356.40	1,745.22	2,621.13	794.01	7,948.26	1,403.77	873.06	4,910.69	9,412.02
27	2035	900.55	657.20	383.66	685.57	1,365.32	1,774.99	2,660.89	802.36	8,044.64	1,425.96	883.78	4,971.26	9,553.87
28	2036	907.13	664.63	385.57	689.99	1,374.30	1,805.28	2,701.25	810.80	8,142.19	1,448.51	894.63	5,032.59	9,697.85
29	2037	913.76	672.15	387.50	694.43	1,383.34	1,836.08	2,742.22	819.33	8,240.92	1,471.42	905.62	5,094.67	9,844.00
30	2038	920.43	679.75	389.43	698.90	1,392.44	1,867.40	2,783.81	827.95	8,340.85	1,494.68	916.74	5,157.52	9,992.35
31	2039	927.16	687.44	391.37	703.41	1,401.59	1,899.26	2,826.04	836.66	8,441.99	1,518.32	927.99	5,221.15	10,142.94
32	2040	933.93	695.22	393.32	707.94	1,410.81	1,931.66	2,868.91	845.46	8,544.35	1,542.33	939.39	5,285.55	10,295.80
33	2041	940.76	703.08	395.28	712.50	1,420.09	1,964.62	2,912.42	854.36	8,647.96	1,566.71	950.93	5,350.76	10,450.96
34	2042	947.63	711.03	397.25	717.09	1,429.43	1,998.14	2,956.60	863.35	8,752.83	1,591.49	962.60	5,416.76	10,608.46
35	2043	954.55	719.08	399.23	721.70	1,438.83	2,032.23	3,001.45	872.43	8,858.96	1,616.65	974.42	5,483.59	10,768.33
36	2044	961.53	727.21	401.22	726.35	1,448.29	2,066.90	3,046.97	881.61	8,966.38	1,642.21	986.39	5,551.23	10,930.62
37	2045	968.55	735.43	403.22	731.03	1,457.81	2,102.16	3,093.19	890.88	9,075.11	1,668.18	998.50	5,619.71	11,095.34
38	2046	975.63	743.75	405.23	735.74	1,467.40	2,138.03	3,140.11	900.25	9,185.15	1,694.56	1,010.76	5,689.04	11,262.56
39	2047	982.76	752.16	407.25	740.48	1,477.05	2,174.51	3,187.74	909.72	9,296.52	1,721.36	1,023.17	5,759.23	11,432.30
40	2048	989.95	760.67	409.28	745.25	1,486.77	2,211.62	3,236.10	919.29	9,409.25	1,748.58	1,035.73	5,830.28	11,604.60

Notes: Actual Woods & Poole projections for 2006 through 2010, 2015, 2020, 2025, and 2030.
Missing estimates through 2030 calculated using average annual growth rate for the 5 year period; projections after 2030 calculated using the average annual growth rate from 2025 to 2030.

Source: Woods & Poole Economics, Inc., 2006.

Table 3-29

Baseline Employment Projections (in thousands) by Economic Impact Area

Model Year	Calendar Year	AL1	MS1	LA1	LA2	LA3	LA4	TX1	TX2	TX3	FL1	FL2	FL3	FL4
	2007	385.13	252.58	181.26	311.44	675.32	610.34	745.17	299.12	3,333.08	500.29	329.19	1,997.55	3,422.26
	2008	389.81	256.89	183.44	315.57	681.90	629.42	759.41	303.86	3,393.48	512.06	334.84	2,037.04	3,489.59
1	2009	394.47	261.20	185.63	319.69	688.47	648.58	773.64	308.58	3,453.88	523.82	340.50	2,076.54	3,556.92
2	2010	399.13	265.51	187.84	323.81	695.02	667.82	787.88	313.30	3,514.28	535.58	346.13	2,116.02	3,624.25
3	2011	403.74	269.84	190.06	327.91	701.48	687.42	802.11	318.00	3,574.69	547.32	351.75	2,155.52	3,691.61
4	2012	408.40	274.23	192.30	332.06	708.00	707.60	816.60	322.78	3,636.13	559.31	357.47	2,195.74	3,760.22
5	2013	413.12	278.70	194.58	336.27	714.58	728.36	831.35	327.62	3,698.63	571.58	363.28	2,236.72	3,830.10
6	2014	417.90	283.25	196.87	340.53	721.22	749.74	846.37	332.54	3,762.21	584.11	369.18	2,278.47	3,901.29
7	2015	422.18	287.15	198.94	344.32	727.31	765.82	859.04	336.81	3,816.31	594.28	374.26	2,313.48	3,961.04
8	2016	426.74	291.50	201.20	348.39	733.67	785.86	873.28	341.48	3,876.75	606.01	379.86	2,352.98	4,028.43
9	2017	431.34	295.92	203.48	352.52	740.09	806.42	887.75	346.20	3,938.15	617.96	385.55	2,393.15	4,096.97
10	2018	436.00	300.41	205.79	356.69	746.56	827.52	902.46	351.00	4,000.51	630.16	391.33	2,434.00	4,166.68
11	2019	440.70	304.97	208.13	360.91	753.09	849.17	917.42	355.86	4,063.87	642.59	397.19	2,475.56	4,237.57
12	2020	444.96	308.92	210.23	364.70	759.12	866.01	930.22	360.13	4,118.50	652.91	402.29	2,510.96	4,298.01
13	2021	449.47	313.29	212.54	368.76	765.39	886.43	944.46	364.76	4,179.00	664.63	407.88	2,550.45	4,365.43
14	2022	454.03	317.73	214.86	372.86	771.72	907.34	958.91	369.44	4,240.39	676.55	413.55	2,590.57	4,433.91
15	2023	458.63	322.23	217.22	377.02	778.10	928.74	973.58	374.18	4,302.68	688.69	419.30	2,631.32	4,503.47
16	2024	463.27	326.79	219.60	381.21	784.53	950.64	988.48	378.99	4,365.88	701.05	425.14	2,672.70	4,574.12
17	2025	467.51	330.79	221.75	385.00	790.49	968.13	1,001.40	383.25	4,421.00	711.49	430.26	2,708.43	4,635.13
18	2026	471.97	335.18	224.10	389.04	796.71	988.88	1,015.63	387.83	4,481.59	723.20	435.84	2,747.93	4,702.58
19	2027	476.48	339.63	226.47	393.13	802.98	1,010.07	1,030.07	392.47	4,543.01	735.10	441.50	2,788.00	4,771.01
20	2028	481.04	344.13	228.87	397.26	809.29	1,031.72	1,044.71	397.16	4,605.27	747.19	447.22	2,828.65	4,840.44
21	2029	485.64	348.70	231.30	401.43	815.66	1,053.83	1,059.56	401.90	4,668.39	759.49	453.03	2,869.90	4,910.87
22	2030	489.85	352.74	233.49	405.22	821.58	1,071.88	1,072.57	406.15	4,723.95	770.03	458.17	2,905.91	4,972.38
23	2031	494.53	357.42	235.97	409.48	828.04	1,094.85	1,087.81	411.00	4,788.69	782.70	464.11	2,948.28	5,044.73
24	2032	499.26	362.16	238.47	413.78	834.56	1,118.31	1,103.27	415.92	4,854.32	795.58	470.13	2,991.28	5,118.14
25	2033	504.03	366.97	240.99	418.12	841.12	1,142.28	1,118.96	420.89	4,920.85	808.68	476.23	3,034.90	5,192.62
26	2034	508.85	371.84	243.55	422.51	847.74	1,166.76	1,134.86	425.92	4,988.29	821.99	482.41	3,079.15	5,268.19
27	2035	513.71	376.77	246.12	426.95	854.40	1,191.77	1,150.99	431.01	5,056.66	835.51	488.67	3,124.05	5,344.85
28	2036	518.62	381.77	248.73	431.44	861.13	1,217.31	1,167.35	436.16	5,125.96	849.26	495.01	3,169.61	5,422.63
29	2037	523.58	386.84	251.37	435.97	867.90	1,243.40	1,183.94	441.37	5,196.21	863.24	501.43	3,215.83	5,501.53
30	2038	528.58	391.97	254.03	440.55	874.72	1,270.05	1,200.77	446.65	5,267.43	877.45	507.94	3,262.72	5,581.59
31	2039	533.64	397.17	256.72	445.17	881.60	1,297.27	1,217.84	451.98	5,339.62	891.89	514.53	3,310.30	5,662.81
32	2040	538.74	402.44	259.44	449.85	888.54	1,325.07	1,235.15	457.39	5,412.80	906.56	521.20	3,358.58	5,745.22
33	2041	543.89	407.78	262.19	454.57	895.53	1,353.47	1,252.71	462.85	5,486.98	921.48	527.96	3,407.55	5,828.82
34	2042	549.08	413.19	264.96	459.35	902.57	1,382.48	1,270.51	468.38	5,562.18	936.65	534.81	3,457.24	5,913.64
35	2043	554.33	418.68	267.77	464.17	909.67	1,412.11	1,288.57	473.98	5,638.41	952.06	541.75	3,507.66	5,999.70
36	2044	559.63	424.23	270.61	469.05	916.83	1,442.37	1,306.89	479.65	5,715.69	967.73	548.78	3,558.81	6,087.00
37	2045	564.98	429.86	273.47	473.98	924.04	1,473.29	1,325.46	485.38	5,794.02	983.66	555.90	3,610.70	6,175.58
38	2046	570.38	435.57	276.37	478.95	931.30	1,504.86	1,344.30	491.18	5,873.43	999.85	563.11	3,663.35	6,265.45
39	2047	575.83	441.35	279.30	483.98	938.63	1,537.11	1,363.41	497.05	5,953.93	1,016.30	570.42	3,716.78	6,356.62
40	2048	581.34	447.20	282.26	489.07	946.01	1,570.06	1,382.79	502.99	6,035.52	1,033.03	577.82	3,770.97	6,449.12

Notes: Actual Woods & Poole projections for 2006 through 2010, 2015, 2020, 2025, and 2030.
Missing estimates through 2030 calculated using average annual growth rate for the 5 year period; projections after 2030 calculated using the average annual growth rate from 2025 to 2030.

Source: Woods & Poole Economics, Inc., 2006.

Table 3-30

Waterway Depth, Traffic, and Number of Trips (2004)

Waterway	Maintained Depth (ft)	Traffic (thousand short tons)	Number of Trips	
			Foreign	Domestic
Gulf Intracoastal Waterway (GIWW)				
Pensacola Bay, FL to Mobile Bay, AL	12	NA	0	12,689
Mobile Bay, AL to New Orleans, LA	12, 14	21,808	0	37,991
Mississippi River, LA to Sabine River, TX	12, 10	69,489	0	146,176
Sabine River, TX to Galveston, TX	12	53,211	0	71,219
Galveston, TX to Corpus Christi, TX	11, 10.2	29,025	0	56,949
Corpus Christi, TX to Mexican Border, TX	10, 12, 7	2,748	0	5,225
Texas Harbors, Channels, and Waterways				
Beaumont (Neches River)	39, 40, 32	91,698	2,661	23,376
Port Arthur	38	27,570	1,088	13,196
Sabine Pass Harbor	29	929	45	3,543
Sabine-Neches Waterway	40, 37, 39, 32, 27, 20, 9, 8	150,297	3,795	72,127
Louisiana Harbors, Channels, and Waterways				
Atchafalaya River	12	8,826	0	25,464
Atchafalaya River, Morgan City to Gulf of Mexico	20	2,379	1,715	32,442
Barataria Bay Waterway	15 and less	219		9,273
Bayou Lafourche and Lafourche-Jump Waterway	28, 27, 27, 9	6,975	1,455	57,496
Bayou Little Caillou	10 and less	184	0	4,342
Bayou Teche and Vermilion River	8, 11, 9, 8, 5	978	0	6,716
Calcasieu River and Pass (Lake Charles)	42, 41-42, 36, 12, 7	54,768	1,981	99,735
Freshwater Bayou	12	1,282	0	17,038
GIWW, Morgan City-Port Allen Route	10	24,313	0	29,150
Innerharbor Navigation Canal	30, 15	18,774	469	22,866
Mermentau River	4, 7, 12, 10, 9, 11, 6, 8, 4, 7	831	17	5,000
Mississippi River Gulf Outlet via Venice Vicinity	16, 14	2,672	155	29,315
Port of Baton Rouge	40, 9, 12	57,083	1,173	80,523
Port of New Orleans	45, 30, 32, 36, 37, 12	78,085	4,881	259,087
Port of Plaquemines	45	54,405	819	100,813
Port of South Louisiana	45	224,187	3,780	149,972
Waterway from Empire to Gulf of Mexico	6, 9, 14	1,198	0	24,746
Waterway from GIWW to Bayou Dulac	12 or less	91	0	5,211
Mississippi Harbors, Channels, and Waterways				
Bayou Casotte	38	33,471	787	9,727
Pascagoula Harbor	40, 38, 38, 22, 12	34,100	999	10,733
Alabama Harbors, Channels, and Waterways				
Black Warrior and Tombigbee Rivers	9	22,026	0	31,498
Chickasaw Creek	25	1,520	0	1,455
Dauphin Island Bay	10 and less	NA	0	8,901
Mobile Harbor	47, 45, 40, 13-39, 40	56,212	2,320	43,226
Tennessee Tombigbee Waterway	9	6,677	0	8,593
Theodore Ship Channel	40	6,266	200	5,486

NA means that information is not available.

Source: U.S. Dept. of the Army, Corps of Engineers, 2006.

Table 3-31

Offshore Supply Vessel Specifications

	Old, Legacy Boats	New Generation, Deepwater Boats
Length (ft)	180	220'-295'
Brake Horsepower (BHP)	1,800-3,900	3,000-7,200
Cargo Capacity (DWT)	800-1,200	1,800-5,000
Liquid Mud Capacity (bbl)	800-1,200	3,000-6,000
Bulk Capacity (ft^3)	1,000-2,000	3,000-9,000
Station Keeping	Traditional, single bow thruster	Joystick, multi-thruster
Dynamic Positioning	No	Yes
Cost to Build (million $)	$2.5-$6	$15-$30

Source: Barrett, 2005.

Table 3-32

OCS Related Service Bases

Texas		
TX1-1	TX-2	TX-3
Aransas Pass (Nueces) Bayside (Aransas) Corpus Christi (Nueces) Harbor Island (Nueces) Ingleside (San Patricio) Port Aransas (Nueces) Port Isabel (Cameron) Port Mansfield (Willacy) Rockport (Aransas)	Freeport (Brazoria) Port O'Connor (Calhoun)	Galveston (Galveston) Pelican Island (Galveston) Port Arthur (Jefferson) Sabine Pass (Jefferson) Surfside (Harris)

Louisiana			
LA-1	LA-2	LA-3	LA-4
Cameron (Cameron) Grand Chenier (Cameron) Lake Charles (Calcasieu)	Abbeville (Vermilion) Erath (Vermilion) Freshwater City (Vermilion) Intracoastal City (Vermilion) Kaplan (Vermilion) New Iberia (Iberia) Weeks Island (Iberia)	Amelia (St. Mary) Bayou Boeuf (St Mary) Berwick (St. Mary) Cocodrie (Terrebonne) Dulac (Terrebonne) Fourchon (Lafourche) Gibson (Terrebonne) Houma (Terrebonne) Leeville (Lafourche) Louisa (St. Mary) Morgan City (St. Mary) Patterson (St. Mary) Theriot (Terrebonne)	Empire (Plaquemines) Grand Isle (Jefferson) Harvey (Jefferson) Hopedale (St. Bernard) Paradis (St. Charles) Venice (Plaquemines)

Mississippi and Alabama	
MS-1	AL-1
Pascagoula (Jackson)	Bayou LaBatre (Mobile) Mobile (Mobile) Theodore (Mobile)

Florida			
FL-1	FL-2	FL-3	FL-4
Panama City (Bay)	NA	NA	NA

NA means that information is not available.
The county or parish in which the service base is located is noted in parentheses.

Source: USDOI, MMS, 2001.

Table 3-33

Existing Coastal Infrastructure Related to OCS Activities in the Gulf of Mexico

Infrastructure	Texas	Louisiana	Mississippi and Alabama	Florida	Total
Pipeline Landfalls[1]	13	106	7	0	126
Service Bases[2]	16	29	4	1	50
Helicopter Hubs[2]	39	84	5	0	128
Platform Fabrication Yards[2]	7	31	5	0	43
Shipyards[2]	27	38	20	9	94
Pipecoating Plants[2]	7	7	2	3	19
Refineries[2]	19	14	4	0	37
Petrochemical Plants[2]	20	9	0	0	29
Gas Processing Plants[2]	14	28	6	0	48
Pipeline Shore Facilities[2]	13	37	0	0	50
Barge Terminals[2]	4	5	0	0	9
Tanker Ports[2]	4	6	0	0	10
Waste Disposal Plants[2]	9	21	4	0	34

[1] Source: USDOI, MMS, 2006c.
[2] Source: The Louis Berger Group, Inc., 2004.

Table 3-34

Summary of Federal Rules Governing OCS Discharges and Injection

MMS Planning Region	Rules	Key Features
Western Planning Area	69 FR No. 245 76740 NPDES General Permit Rules	General permit restricting discharges to 29 mg/L monthly average and 49 mg/L maximum daily total oil and grease
Territorial Seas of Texas	70 FR No. 171 53008 NPDES General Permit Rules	General permit restricting discharges to 29 mg/L monthly average and 49 mg/L maximum daily total oil and grease
Central Planning Area	69 FR No. 245 76740 NPDES General Permit Rules 69 FR No. 194 60150 NPDES General Permit Rules	General permit for >200 m of water depth, restricting discharges to 29 mg/L monthly and 49 mg/L maximum daily total oil and grease
Eastern Planning Area	69 FR No. 194 60150 NPDES General Permit Rules	General permit for >200 m of water depth, restricting discharges to 29 mg/L monthly average and 49 mg/L maximum daily total oil and grease
All of the above citations contain rules restricting discharge of domestic and sanitary sewage (including standards) and prohibiting discharge of trash in each of the MMS planning regions. Facilities located offshore of USEPA Region 6 are subject to a general Clean Water Act permit that covers all facilities in certain geographic locations. Offshore exploration and production facilities in Regions 4, 9, and 10 are also permitted individually in some cases. USEPA Regions 6 and 9 has a Memorandum of Agreement with MMS, whereby MMS agrees to conduct Clean Water Act preliminary inspections for USEPA.		
All	CWA § 308, 402, 403	Discharge rate limitations and monitoring; toxicity limitations; minimize discharge of surfactants, dispersants, and detergents; no rubbish, trash, or refuse; and no discharge in areas of biological concern
All	40 CFR 144	Underground injection control program rules

Table 3-35

Gulf of Mexico Region Counties with Concentrated Levels
of Oil- and Gas-Related Infrastructure

Low Concentration		Medium Concentration		High Concentration	
County/Parish	State	County/Parish	State	County/Parish	State
Escambia	FL	Bay	FL	Mobile	AL
Manatee	FL	Hillsborough	FL	Cameron	LA
Ascension	LA	Calcasieu	LA	Jefferson	LA
Lafayette	LA	East Baton Rouge	LA	Lafourche	LA
St. John the Baptist	LA	Iberia	LA	Plaquemines	LA
West Baton Rouge	LA	Orleans	LA	St. Mary	LA
Harrison	MS	St. Bernard	LA	Brazoria	TX
Aransas	TX	St. Charles	LA	Galveston	TX
Cameron	TX	St. James	LA	Harris	TX
Chambers	TX	Terrebonne	LA	Jefferson	TX
Fort Bend	TX	Vermilion	LA		
Matagorda	TX	Jackson	MS		
Montgomery	TX	Calhoun	TX		
Orange	TX	Nueces	TX		
		San Patricio	TX		

Source: Based on data from The Louis Berger Group, Inc., 2004.

Table 4-1

Projected Oil and Gas Production from Lease Sale 224

	Proposed Action
Reserve/Resource Production	
Oil (BBO)	0.100-0.140
Gas (Tcf)	0.160-0.340

BBO = billion barrels of oil.
Tcf = trillion cubic feet.

Table 4-2

Offshore Scenario Information Related to the
Proposed Action in the Eastern Planning Area

	Total EPA
Wells Drilled	
Exploration and Delineation Wells	5-15
Development Wells	15-20
Oil Wells	11-14
Gas Wells	4-6
Workovers and Other Well Activities	91-126
Production Structures	
Installed	1-1
Removed Using Explosives	0-1
Total Removed	1-1
Method of Oil Transportation*	
Percent Piped	100%
Length of oil pipelines	100-220 km
Length of gas pipelines	90-220 km
Blowouts	0-1
Service-Vessel Trips (1,000 round trips)	15-20
Helicopter Operations (1,000 operations)	3-5

* 100% of gas is assumed to be piped.

Table 4-3

Annual Volume of Produced Water Discharged by Depth (MMbbl)

Year	Water Depth							Total
	0-60 m	60-200 m	200-400 m	400-800 m	800-1600 m	1600-2400 m	>2400 m	
1996	397	129	10	10	no discharge	no discharge	no discharge	546
1997	415	129	10	8	no discharge	no discharge	no discharge	561
1998	451	146	12	11	no discharge	no discharge	no discharge	621
1999	466	152	14	12	0.01	no discharge	no discharge	644
2000	460	159	14	14	1	no discharge	no discharge	647
2001	502	153	12	17	2	no discharge	no discharge	686
2002	428	150	19	20	1	0.01	no discharge	617
2003	429	152	18	20	4	3	no discharge	626
2004	407	129	17	20	9	1	0.01	583
2005	296	85	12	19	15	4	0.04	431

Source: USDOI, MMS, 2006b.

Table 4-4

Average Annual Emission Rates
from OCS Infrastructures in the Gulf of Mexico

Infrastructure	NO_x	CO	SO_x	VOC	PM_{10}	$PM_{2.5}$
Platforms (tons/platform/year)	44.1	52.1	2.0	20.7	0.45	0.45
Exploration Well (tons/well)	40.5	4.3	6.8	0.4	1.0	1.0
Development Well (tons/well)[1]	21.5	5.7	2.5	2.1	0.60	0.60

[1] Assumes a 3,050-m hole, a 35-day drilling period in less than 400-m water depth, a 60-day drilling period in greater than 400-m water depth, and a power consumption of 180 horsepower hour/foot.

Source: Wilson et al., 2004.

Table 4-5

LNG Proposed or Licensed Projects (deepwater ports) in the Gulf of Mexico

Project Name	Affiliations	Proposed Location (Area and Block)	Proposed Capacity* (Cf/d)	USDOT Docket Number
Gulf Gateway (formerly Energy Bridge)	Excelerate Energy	West Cameron 603	690 million	14294
Gulf Landing	Shell US Gas & Power	West Cameron 213	1.2 billion	16860
Main Pass Energy Hub	Freeport McMoRan Energy	Main Pass 299	1.6 billion	17696
Port Pelican[1]	ChevronTexaco	Vermilion 140	N/A	14134
Bienville Offshore Energy Terminal	TORP Terminal LP	Main Pass 258	1.4 billion	24644

* Peak capacity estimates.
Cf/d = cubic feet per day.
[1]The applicant has put the Port Pelican project on hold indefinitely.

Table 4-6

Average Annual Inputs (1990-1999)
of Petroleum Hydrocarbons to Coastal Waters of the Gulf of Mexico

	Western GOM		Eastern GOM	
	(tonnes)	(bbl)	(tonnes)	(bbl)
Extraction of Petroleum				
Platforms Spills	90	630	trace[1]	trace
Atmospheric Releases (VOC's)	trace	trace	trace	trace
Permitted Produced-Water Discharges	590	4,130	trace	trace
Sum of Extraction Inputs	680	4,760	trace	trace
Transportation of Petroleum				
Pipelines Spills	890	6,230	trace	trace
Tank Vessel Spills	770	5,390	140	980
Coastal Facilities Spills[2]	740	5,180	10	70
Atmospheric Releases (VOC's)[3]	trace	trace	trace	trace
Sum of Transportation Inputs[4]	2,400	16,800	160	1,120
Consumption of Petroleum				
Land-Based Sources[5]	11,000	77,000	1,600	11,200
Recreational Vessels	770	5,390	770	5,390
Vessel >100 GT (spills)	100	700	30	210
Vessel >100 GT (operational discharges)	trace	trace	trace	trace
Vessel <100 GT (operational discharges)	trace	trace	trace	trace
Deposition of Atmospheric Releases (VOC's)	90	630	60	420
Aircraft Jettison of Fuel	NA	NA	NA	NA
Sum of Consumption	12,000	84,000	2,500	17,500

Notes:
[1] Trace indicates less than 70 bbl (10 tonnes).
[2] Coastal facility spills does not include spills in coastal waters related to exploration and production spills or spills from vessels. The category "Coastal Facilities" includes the following: aircraft, airport, refined product in coastal pipeline, industrial facilities, marinas, marine terminals, military facilities, municipal facilities, reception facilities, refineries, shipyards, and storage tanks.
[3] Volatization of light hydrocarbons during tank vessel loading, washing, and voyage.
[4] Sums may not match.
[5] Inputs from land-based sources during consumption of petroleum are the sum of diverse sources. Three categories of wastewater discharge are summed: municipal, industrial (not related to petroleum refining), and petroleum refinery wastewater. Urban runoff is included. It results from oil droplets from vehicles washing into waterways from parking lots and roads and the improper disposal of oil containing consumer products.
GT = gross tons.
NA = not available.
VOC's = volatile organic compounds.

Source: NRC, 2003.

Table 4-7

Average Annual Inputs (1990-1999)
of Petroleum Hydrocarbons to Offshore Waters of the Gulf of Mexico

	Western GOM		Eastern GOM	
	(tonnes)	(bbl)	(tonnes)	(bbl)
Natural Sources				
Seeps	70,000	490,000	70,000	490,000
Extraction of Petroleum				
Platforms	50	350	trace[1]	trace
Atmospheric Releases (VOC's)	60	420	trace	trace
Permitted Produced-Water Discharges	1,700	11,900	trace	trace
Sum of Extraction	1,800	12,600	trace	trace
Transportation of Petroleum				
Pipelines	60	420	trace	trace
Tank Vessels	1,500	10,500	10	70
Atmospheric Releases (VOC's)	trace	trace	trace	trace
Sum of Transportation	1,600	11,200	10	70
Consumption of Petroleum				
Land-Based Consumption[2]	NA	NA	NA	NA
Recreational Vessel Consumption[3]	NA	NA	NA	NA
Vessel >100 GT (spill)	120	840	70	490
Vessel >100 GT (operational discharges)	25	175	trace	trace
Vessel <100 GT (operational discharges)	trace	trace	trace	trace
Deposition of Atmospheric Releases (VOC's)	1,200	8,400	1,600	11,200
Aircraft Jettison of Fuel	80	560	80	560
Sum of Consumption[4]	1,400	9,800	1,800	12,600

Notes:
[1] Trace indicates less than 70 bbl (10 tonnes).
[2] Limited to coastal zone.
[3] Limited to within 3 mi of the coast.
[4] Sums may not match.
GT = gross tons.
NA = not available.
VOC's = volatile organic compounds.

Source: NRC, 2003.

Table 4-8

Annual Oil-Spill Occurrence within Coastal and Offshore Waters of the Gulf of Mexico (Gulfwide Estimates)

Source	Number of Spills ≥1,000 bbl	Assumed Size (bbl)	Source	Number of Spills <1,000 bbl	Assumed Size (bbl)
Offshore Spills			Offshore Spills		
Total All Sources	1 per year		Total All Sources	1,500-1,800 per year	5
Total Non-OCS Sources			Non-OCS Sources	1,000-1,300 per year	5
Tank Ship	<1 per year	14,600	Tank Ship	5-10 per year	5
Tank Barge	<1 per year	3,000	Tank Barge	2-5 per year	5
Total OCS Program Sources			Unknown and Other	1,000-1,200 per year	5
Facility	<1 per year	1,500			
Pipeline	1 per year	4,600	Total OCS Program Sources (MODU, platform, pipeline)	450-500 per year	5
Shuttle Tanker	1 in next 40 years	14,600			
Coastal Spills			Coastal Spills		
Total All Sources	1 per year		Total All Sources	440-650 per year	5
Non-OCS Sources	3 per 6 years		Non-OCS Sources	400-600 per year	
Tank Ship	1 per 6 years	4,500	Tank Ship	2 per year	5
Tank Barge	1 per 6 years	3,000	Tank Barge	1 per year	5
Other	1 per 6 years	4,200	Unknown and Other	400-600 per year	5
Total OCS Sources	1 per 6 years	4,200	Total OCS Sources	40-50 per year	5

Note: The estimated number of offshore OCS Program spills ≥1,000 bbl was determined using 40-year program resource projections (2007-2042) and Anderson and LaBelle (2000) spill rates (Table 4-15). For offshore non-OCS spills ≥1,000 bbl, coastal OCS and non-OCS spills ≥1,000, and all sources of spills <1,000 bbl, the historical number of spills per year is presented (Dickey, 2006). The assumed size of spills ≥1,000 bbl was obtained from Anderson and LaBelle (2000), and the assumed size of spills <1,000 bbl is the median size of all spills 1-999 bbl (1996-2001).

Table 4-9

OCS and Non-OCS Program Spill Rates

OCS Program Spill Rates	
<1,000 bbl	
≤1 bbl	3,357 spills/BBO handled
>1 and <50 bbl	91 spills/BBO handled
≥50 bbl and <1,000 bbl	7 spills/BBO handled
≥1,000 bbl	
Facility	0.13 spills/BBO handled
Pipeline	1.38 spills/BBO handled
Shuttle Tanker	0.73 spills/BBO handled
Offshore	0.29 spills/BBO handled
Coastal	0.44 spills/BBO handled
Barge	1.23 spills/BBO handled
Non-OCS Program Spill Rates	
<1,000 bbl	Rate based on yearly occurrence information
≥1,000 bbl	
Import Tanker	0.82 spills/BBO handled
Offshore	0.46 spills/BBO handled
Coastal	0.36 spills/BBO handled
Coastwise Tanker	0.73 spills/BBO handled
Offshore	0.29 spills/BBO handled
Coastal	0.44 spills/BBO handled
Barge	1.23 spills/BBO handled
Pipeline	Rate based on yearly occurrence information

BBO = billion barrels of oil.

Table 4-10

OCS Offshore Oil Spills[1] (1985-1999)

Spill Size Grouping	Total Number of Spills	Total Volume of Oil Spilled (bbl)	Number of Spills by Source Facility[2]/ Pipeline	Spill Rate[3] (spills/BBO)	Average Spill Size (bbl)	Median Spill Size (bbl)
0-1.0 bbl	19,506	1,365	Unavailable	3,357.31	0.07	Unavailable
1.1-9.9 bbl	434	1,302	326/108	74.70	3.0	2.8
10.0-49.9 bbl	94	1,795	66/28	16.18	19.1	17.8
50.0-499.9 bbl	37	4,551	28/9	6.37	123	87
500.0-999.9 bbl	3	2,043	2/1	0.52	681	643
≥1,000 bbl	8	53,730	0/8	0.13/1.38[4]	6,716	4,551
≥10,000 bbl	2	30,000	0/2	0.05/0.34[4]	15,000	15,000

[1] Oil spilled includes crude oil, condensate, and refined petroleum products.
[2] Facilities represent spills that have occurred during drilling, development, and production operations.
[3] Spill rate = spills per BBO handled; BBO = 10^9 bbl (from 1985 to 1999 OCS production = 5.81 BBO).
[4] Facility spills rate/pipeline spill rate.

Source: Anderson and LaBelle, 2000.

Table 4-11

Offshore Spills ≥1,000 Barrels from Accidents Associated with OCS Facility Operations (1964-2005)

Year	Volume Spilled (bbl)	Area and Block	Water Depth (ft)	Distance from Shore (mi)	Cause of Spill
1964	2,559	EI 208	94	48	Freighter struck production platform, fire
1964	5,180	EI 208	94	48	Hurricane Hilda destroyed 3 production platforms, blowout
1964	5,100	SS 149	55	33	Hurricane Hilda destroyed production platform, blowout
1964	1,589	SS 199	102	44	Hurricane Hilda destroyed production platform, caused storage oil loss
1965	1,688[1]	SS 29	15	7	Drilling blowout
1969[1]	80,000	*	190	6	Drilling blowout
1969	2,500	SS 72	30	6	Storm caused vessel to bump drilling rig resulting in blowout
1970	30,000	MP 41	39	14	Fire destroyed production platform, blowout
1970	53,000	ST 26	60	8	Workover caused fire, destroyed platform and 2 drilling rigs
1973	9,935	WD 79	110	17	Oil storage tank ruptured
1973	7,000	SP 23	61	15	Rough seas sunk stationary storage barge
1979	1,500[2]	MP 151	280	10	Collision during rough seas between service vessel and drilling rig, damaged rig's diesel tank
1980	1,456	HI 206	60	27	During ballasting, for Hurricane Jeanne, oil storage tank overflowed
1998	1,012[3]	EW 873	1,271	61	Zinc bromide solution, human error, valve left open
2002	1,800[4]	WR 206	8,180	160	SBF release, loop current and severe weather, emergency riser disconnect
2003	1,421[4]	MC 778/822	6,040	75	SBF release, weather, external forces, riser parted
2004	1,034[4]	GC 653	4,238	120	SBF release, weather, external forces, emergency riser disconnect
2005[#]	2,000[1]	EI 314	230	78	Hurricane Rita destroyed platform
2005[#]	1,572[2]	SS 250	182	48	Hurricane Rita destroyed drilling rig
2005	1,494[2]	SM 146	232	79	Hurricane Rita

Notes: Gulf of Mexico crude oil unless otherwise indicated.
[1] condensate.
[2] diesel or other refined oil.
[3] chemical spill.
[4] synthetic-based fluid.
* Occurred in Santa Barbara Channel, California.
[#] Preliminary information.

EI = Eugene Island Area
EW = Ewing Bank
GC = Green Canyon
HI = High Island Area
MC = Mississippi Canyon
MP = Main Pass Area
SM = South Marsh Island
SP = South Pass Area
SS = Ship Shoal Area
ST = South Timbalier Area
WD = West Delta Area
WR = Walker Ridge

Sources: Anderson and LaBelle, 2000; USDOI, MMS, 2006a; Anderson, personal communication, June and August 2006.

Table 4-12

Offshore Spills ≥1,000 bbl from Accidents Associated with OCS Pipeline Oil Transport (1964-2005)

Year	Volume Spilled (bbl)	Area and Block	Water Depth (ft)	Distance from Shore (mi)	Cause of Spill
1967	160,638	WD 73	168	22	Internal corrosion caused by anchor kink
1968	6,000	ST 131	160	28	Anchor drag
1969	7,532	MP 299	210	17	Anchor drag
1973	5,000	WD 73	168	22	Internal corrosion
1974	19,833	EI 317	240	75	Anchor drag
1974	3,500	MP 73	141	9	Hurricane Carmen, connection torn loose
1976	4,000	EI 297	210	71	Trawl drag
1981	5,100	SP 60	185	4	Service vessel's anchor
1988	15,576	GAL 2A	75	34	Anchor drag
1990	14,423[1]	SS 281	197	60	Anchor drag
1990	4,569	EI 314	230	78	Trawl drag
1992	2,000	PL 8	30	6	During Hurricane Andrew, drilling rig's anchor drag
1994	4,533[1]	SS 281	197	60	Trawl drag
1998	1,211[1]	EC 334	264	105	Service vessel anchor drag during rescue operation
1998	8,212	SP 38	10	6	During Hurricane Georges, damage from mudslide
1999	3,200	SS 241	133	50	Jack-up barge damage
2000	2,240	SS 332	435	75	Drilling rig anchor drag
2004[#]	1,720	MC 20	479	19	Hurricane Ivan mud slide
2004	4,834[2]	MP 261	1,475	75	Hurricane Ivan, anchor drag
2005[#]	>100-1,812[1]	EI 51	17	20	Hurricane Rita, suspected anchor or mooring drag
2005[#]	>100-1,551[1]	EI 95	17	24	Hurricane Rita, suspected anchor or mooring drag
2005[#]	200-2,000	MC 109	1,000	18	Hurricane Katrina

Notes: Crude oil unless otherwise indicated.
[1] condensate.
[2] methanol.
[#] Preliminary information.

EC = East Cameron Area
EI = Eugene Island Area
MC = Mississippi Canyon
MP = Main Pass Area
PL = South Pelto Island
SP = South Pass Area
ST = South Timbalier Area
SS = Ship Shoal Area
WD = West Delta Area

Sources: Anderson and LaBelle, 2000; Anderson, personal communication, August 2006.

Table 4-13

Mean Number and Sizes of Spills Estimated to Occur in
OCS Offshore Waters from an Accident Related
to Activities Supporting a Proposed Action Over a 40-Year Time Period

Spill Size Group	Spill Rate (spills/BBO) [1]	Number of Spills Estimated for a WPA Proposed Action [2]	Number of Spills Estimated for a CPA Proposed Action [2]	Estimated Spill Size [1]
0-1.0 bbl	3,357.31	812-1,420	2,605-4,337	0.07[3]
1.1-9.9 bbl	74.7	18-32	58-97	3[4]
10.0-49.9 bbl	16.18	4-7	13-21	20[4]
50.0-499.9 bbl	6.37	2-3	5-8	90[4]
500.0-999.9 bbl	0.52	<1	<1-1	640[4]
≥1,000 bbl	1.51	<1-1	1-2	4,600[4]
≥10,000 bbl	0.39	<1	<1-1	15,000[4]

Notes: The number of spills estimated is derived by application of the historical rate of spills per volume crude oil handled (1985-1999) (Anderson and LaBelle, 2000) to the projected production for a proposed action in the WPA or CPA (Table 4-1). Projected production is an estimate of recoverable resource and is influenced by supporting infrastructure, as well as economic and technological factors. The actual number of spills that may occur in the future could vary from the estimated number.

[1] Source: Anderson and LaBelle, 2000.
[2] Source: Table 4-1.
[3] Average spill size.
[4] Median spill size.

Table 4-14

Mass Balance of a Hypothetical Spill of 4,600 bbl Spilled over a 12-Hour Period from a Pipeline Break during the Summer, 80 km off Louisiana
(oil characteristics: API 30° and stable emulsion formation)

Time Elapsed after Spill Event Begins (hr)	Estimated Volume in Slick (spilled oil remaining on water surface)* (bbl)	Estimated Open Water Slick Thickness (mm)	Estimated Area of Open Water Covered by Slick* (ac)	Estimated Length of Shoreline Contacted, if Slick were to Reach Land (km)	Estimated Volume Lost from Slick by Natural Weathering (bbl)	Estimated Volume Removed from Slick Using Chemical Dispersants (bbl)	Estimated Volume Removed from Slick by Mechanical Cleanup (bbl)	Percent of Total Volume Cleaned Up (%)	Total Percent of Slick Lost from Natural Weathering (%)	Percent of Total Spill Mass Evaporated (%)	Percent of Total Spill Mass Naturally Dispersed (%)
4	1,260	1.4	35	5	220	0	0	0	15	15	0
12	2,620	1	200	30	920	1,050	0	23	21	20	1
24	1,330	1	100	15	1,060	1,750	460	48	24	22	2
48	270	1	20	3	1,210	2,050	1,070	68	27	24	3
72	270	1	10	1	1,250	2,050	1,070	68	28	27	1
240	50**	1	5	1	1,430	2,050	1,070	68	32	30	2

* Assumes continuous coverage of water surface by slick for first 4 hours and noncontinuous, patchy, wind-row coverage after 4 hours. 50% of the slick would become emulsified, with the remaining being a light sheen.

** After 10 days, the 50 bbl remaining is expected to occur as a rainbow sheen, the slick broken up into many, small slicks spread out over approximately 200 ac. These small sheens would dissipate in less than a day.

Table 4-15

Estimated Number of Spills that Could Happen in Gulf Coastal Waters
from an Accident Related to Activities Supporting a Proposed Action
in the WPA and CPA

Size Category	Assumed Size	WPA Proposed Action	CPA Proposed Action
Total		15-34	46-102
≤1 bbl	1 bbl	13-29	42-92
>1 bbl and <50 bbl	3 bbl	1-2	2-4
≥50 bbl and <1,000 bbl	150 bbl	1-2	2-5
≥1,000 bbl	3,000 bbl	<1-1	<1-1

Note: The estimated number of spills is obtained from the count of coastal spills for 2001 proportioned to reflect that OCS oil comprised 19 percent of the oil crossing into GOM coastal waters in 2001. Intrastate oil and refined product transport were not included. The low estimate in the range was obtained from Dickey (2006) and the high estimate was obtained from aggregated national data available on the Internet (USCG, 2006).

Sources: Dickey, 2006; USCG, 2006; National Ocean Economics Program, 2006; USDOE, EIA, 2006.

Table 4-16

Record of Past Spills Where ≥1,000 bbl of Synthetic-Based Fluid (SBF) was Released

Date	Location	Water Depth (ft)	SBF Volume Released* (bbl)	Cause
03/01/02	Walker Ridge 206	8,180	1,800	Emergency riser disconnect
05/21/03	Mississippi Canyon 822	6,040	1,421	Riser failure
04/11/04	Green Canyon 653	4,238	1,034	Emergency riser disconnect

* Volume reflects the amount of synthetic fluid, not the total drilling mud released.

Table 4-17

Number and Volume of Chemical and Synthetic-Based Fluid Spills
in the Gulf of Mexico during the Years 2001-2004

Spill Size (bbl)	2001		2002		2003		2004	
	Chemical	SBF	Chemical	SBF	Chemical	SBF	Chemical	SBF
1 - <50	9	4	6	11	2	11	16	5
50 - <100	0	0	0	2	0	2	1	1
100 - <500	2	3	2	1	1	3	2	2
500 -<1,000	0	1	0	2	0	1	0	1
≥1,000	0	0	0	1	0	1	1	1
Total	11	8	8	17	3	18	20	10

Notes: For the years 2001-2003, the total volume of drilling fluid was recorded. For 2004, the synthetic-based fluid fraction of the whole drilling fluid was recorded

The estimated number of spills is obtained from the count of coastal spills for 2001 proportioned to reflect that OCS oil comprised 19 percent of the oil crossing into GOM coastal waters in 2001. Intrastate oil and refined product transport were not included. The low estimate in the range was obtained from Dickey (2006) and the high estimate was obtained from aggregated national data available on the Internet (USCG, 2001).

Sources: Dickey, 2006; USCG, 2001; National Ocean Economics Program, 2006; USDOE, EIA, 2006.

Table 4-18

Projected Total OCS Emissions Related to the Proposed Action by Source
(tons per year)

Activity/Pollutant	NO_x	CO	SO_x	VOC	PM_{10}*
Service Vessels	494.7-1802.3	49.7-181.0	516.5-187.6	21.5-78.6	29.9-109.0
Pipeline Vessels	68.9-383.7	2.3-128.5	9.6-53.4	6.3-35.0	5.7-31.7
LTO Helicopters	0.2-1.9	0.2-1.6	0.0-0.3	0.0-0.1	0.0-0.1
Cruise Helicopters	0.3-3.3	0.9-9.4	0.1-0.7	0.1-0.7	0.1-0.9
Blowouts without Fire	0	0	0	0.3-1.2	0
Spills without Fire	0	0	0	5.8-6.5	0
Barge Loading	0	0	0	0	0
Tanker Loading	0	0	0	0	0
Tanker Loss	0	0	0	0	0
Tanker Exhaust	0	0	0	0	0
Tug Exhaust	0	0	0	0	0
Platform Construction	31.5-110.5	6.2-21.8	1.7-6.2	1.8-6.4	1.9-6.7
Exploratory Wells	37.1-229.1	9.9-61.0	4.3-26.8	3.5-22.1	1.1-6.6
Development Wells	49.2-273.1	13.1-72.8	5.7-32.0	4.7-26.3	1.4-7.8
Platforms	114.4-2580.7	26.6-60.0	19.2-43.3	86.8-195.7	2.1-4.7
Totals	796.7-5384.6	129.8-536.4	92.3-350.6	131.0-372.7	42.2-167.7

* TSP emissions were calculated in the spreadsheets. For conservative estimates of PM_{10}, it is assumed here that the ratio of PM_{10} to TSP is equal to 1.0.

Table 4-19

Class I
OCD Modeling Results for the Proposed Action
and the Corresponding Maximum Allowable Increases

Pollutant Averaging Period	Class I Maximum Allowable Increase*	Class I Modeled Impact**
SO_2		
Annual	2.0 μg/m^3	0.01 μg/m^3
24-hour	5.0 μg/m^3	0.06 μg/m^3
3-hour	25.0 μg/m^3	0.21 μg/m^3
NO_2		
Annual	2.5 μg/m^3	0.04 μg/m^3
PM_{10}		
Annual	5.0 μg/m^3	-
24-hour	10.0 μg/m^3	-

* 30 CFR 250.303.
** Calculated using MMS's Offshore and Coastal Dispersion (OCD) Model.
\- PM_{10} emissions were not calculated because they are emitted in smaller quantities than NO_2 or SO_2; hence, their impacts would be even less than those predicted and presented above (USDOI, MMS, 2001a).

Source: 40 CFR 51.166, 1996.

Table 4-20

Class II
OCD Modeling Results for the Proposed Action
and the Corresponding Maximum Allowable Increases

Pollutant Averaging Period	Class II Maximum Allowable Increase*	Class II Modeled Impact**
SO_2		
Annual	20.0 μg/m^3	0.01 μg/m^3
24-hour	91.0 μg/m^3	0.19 μg/m^3
3-hour	512.0 μg/m^3	0.60 μg/m^3
NO_2		
Annual	25.0 μg/m^3	0.10 μg/m^3
PM_{10}		
Annual	19.0 μg/m^3	-
24-hour	37.0 μg/m^3	-

* 30 CFR 250.303.
** Calculated using MMS's Offshore and Coastal Dispersion (OCD) Model.
\- PM_{10} emissions were not calculated because they are emitted in smaller quantities than NO_2 or SO_2; hence, their impacts would be even less than those predicted and presented above (USDOI, MMS, 2001a).

Source: 40 CFR 51.166, 1996.

Table 4-21

Estimated Air Emissions for OCS and Non-OCS Activities
in the Western and Central Gulf of Mexico Planning Areas

Activity	Pollutant (tons/yr)				
	NO_x	SO_2	PM_{10}	CO	VOC
Production Platforms	112,367	4,999	1,136	132,659	85,714
Exploration Wells	7,083-9,107	1,195-1,536	176-226	744-956	68-88
Platform Construction/Removal	15,552-15,691	2,650-2,674	388-392	1,936-1,956	199-201
Pipelaying Vessels	2,495-4,990	419-838	62-125	261-523	24-48
Support Vessels	46,455-48,947	7,937-8,362	1,160-1,222	5,997-6,319	621-654
Survey Vessels	111	18	3	11	1
Helicopters	1,179-1,242	145-153	88-92	4,969-5,235	1,873-1,974
Tanker/Barge Transport	3,165	544	81	528	2,572
Total	188,407-195,620	17,906-19,124	3,094-3,277	147,104-148,187	91,072-91,251
2000 Non-Oil/Gas OCS Emissions	49,923	9,280	1,371	13,536	24,444

Table 4-22

Recommended Mitigation Techniques Used to Avoid or Reduce Adverse Impact to Wetlands by Pipelines, Canals, Dredging, and Dredged Material Placement

Technique	Decision Process	Factors to Consider
	Pipeline Construction	
Avoidance	Route selection and location Evaluation of potential routes that avoid wetlands entirely Shared right-of-way (ROW) and pipelines Using all or part of an existing ROW would avoid new impacts to wetlands	Length of route Difficulty of the land for pipeline installation, i.e., access points and sediment characteristics Presence of other pipelines Presence of transportation corridors Density of surrounding developments Number of different land owners
Minimization	Necessity of pipeline contents	Environment function Timing of the project Previous pipeline installations Availability of equipment
Location/Route Selection	Early planning Considering wetland type Use of aerial photography as well as digital and topographic maps combined with field surveys to identify route of minimal impact	Most routes are predetermined by the beginning and end points Flexibility within general route to locate sections of pipelines to one side or another to take advantage of upland areas, existing ROW, etc.
Existing ROW/Corridors	Plan routes paralleling existing pipelines (safety issues) Timing right to share section of pipeline between or among users	Group pipelines in corridors where impacts are limited to smaller areas of coastal wetlands
Construction/ Installation	Methods depend on environment pipeline is constructed Flotation canals Push-pull method Single versus double ditching techniques Directional drilling *	Choice of method has implications for Type of impact Access impact Impact from specific equipment
	Dredging	
Dredge and Other Material Disposal	Features associated with pipeline canals and navigation channels Avoid levees by spray dredging, levee manipulation/spoil bank removal, and canal backfilling	Navigation channels and some canals must be left open for access Impacts associated with spoil banks include soil compaction, impoundment, and creation of upland vegetation
Dredge Material Bank Removal	Identify areas to place dredge Navigation channels Canals that cannot be backfilled Potential use for filling nearby old canal or abandoned navigation channels Off-site mitigation	Due to expense and difficulty in many coastal areas only used in sensitive areas
Levee Manipulation	Dredge material should allow water to pass through openings in the line of dredge placement	Levees used as walkways and built from material placed in a long line paralleling the length of the project is detrimental to marsh and should be built discontinuous instead Must maintain natural hydrologic pattern Technique is post-construction technique where sections of dredge banks are removed in order to restore hydrologic flow
Spray Dredge	Suggested and used to avoid completely the creation of dredge banks Spray dredging places material over a large area of marsh surface at a depth that avoids destroying vegetation or altering hydrology	Normally dredge is deposited discontinuously and unevenly, enabling the avoidance of sensitive habitats or minimize spoil over small creeks More costly than more traditional use of the bucket dredge; most contractors along the Gulf Coast have not invested in spray dredge technology
	Canals and Channels	
Backfill	Suggested as a way to minimize impacts from canals and to restore impacted habitats Based on OCS permit information, this is the most common required mitigation in recent years In Texas and Louisiana, a typical backfilled pipeline canal results in 75% reduction in direct impacts to the marsh as compared to non-backfilled canals (Baumann and Turner, 1990)	Involves returning soil into the canal so that the elevation is restored as close as possible to pre-construction elevation May occur on-site for canal restoration, as well as off-site as mitigation for other dredging operations Intended benefits of backfilling are reestablishment of marsh vegetation in the canal and on the regraded spoil bank, and restoration of marsh soils on bottom of the canal

Table 4-22

Recommended Mitigation Techniques Used to Avoid or Reduce Adverse Impact to Wetlands by Pipelines, Canals, Dredging, and Dredged Material Placement (continued)

Technique	Decision Process	Factors to Consider
Canals and Channels (continued)		
Wood Chipping	A new technique unique to forested wetlands Regulatory personnel believe the use of windrows should be avoided. Requirement for chipping on-site started approximately 1992/1993	Prior to 1996, trees removed for ROW being pushed to the side created *windrows* with the potential to act as hydrologic barriers Success of wood chipping remains undetermined. Problems encountered include equipment not adapted to the function of marshes, equipment is expensive, and process is time-consuming
Erosion Stabilization	Many impacts are from pipeline canals and navigation channels Stabilization of banks is critical Lack of stabilization can result in slumping of canal sides and blockage of natural creeks/drainage streams	Erosion control measures are required through the use of Best Management Practices Requirement is usually erosion control/siltation fences
Revegetation	Often required by permits Extremely valuable to the acceleration of marsh recover over first growing season Most extensive data exist for the revegetation of dunes, but through the use of directional drilling, is not the concern as in past cases	Stabilizes shorelines, shore banks, and areas surrounding stream crossings where erosion is most likely to occur Helps to reduce sedimentation and erosion
Plugs/Dams	Structures have been used frequently in order to mitigate adverse hydrodynamic impacts and accelerated erosion, i.e., dams, weirs, bulkheads, rip-rap, shell/gravel mats, and biodegradable mats	Reduces erosion and provides barriers to saltwater intrusion Plugs maintain elevated marsh water levels Prevent saltwater intrusion into low-salinity marshes Reduces tidal exchange thereby reducing bank erosion
Erosion Control during Project	Construction of pipelines and navigation Channels is governed by the of Best Management Practices and erosion control during the construction phase is a requirement	Natural features of each construction site should be identified for the necessary erosion control
Timing of Project	Seasonal timing of the project can minimize impacts Avoid impacts to endangered species, particularly bird breeding seasons	Expanding restrictions to ensure there will be at least part of one growing season for re-establishment of vegetation before fall/winter has been discussed, but dismissed for economic reasons to industry
Restoration	Can occur either immediately, post construction, or many years after pipeline and navigation canal construction	Backfilling of canals, resulting in levee removal, has been a requirement for most pipeline installation projects There is a benefit to backfilling old canals and navigation channels in order to reduce or reverse the trend of wetland losses in coastal Louisiana Other options include the use of imported material
Compensation	Typically occurs through the creation of new wetland habitat or through a cash payment to the appropriate land management agency Allows for the creation and restoration of lost wetland habitat In Louisiana, the payment of cash for wetlands into a State trust fund is administered by LADNR and is controversial This fund has been in existence for several years and has a significant accumulation of funds; however, no creation projects have yet to tap into it	In many cases not an option Saline marshes have yet to be successfully created, and finding appropriate locations to create salt marsh is difficult Forested wetlands are also difficult to compensate

* Trenchless, or directional drilling, is the newest and favored technique in sensitive habitats. This technique is considered to be extremely protective of sensitive habitats. At present, directional drilling is required almost without exception for crossing barrier island and shore faces. Impacts are limited to the access and staging sites for the equipment. By using directional drilling, pipeline installation can occur without having to cut through shore facings, minimizing any erosion and surface habitat disturbance.

Table 4-23

Total Employment and Population Estimates
for EPA Lease Sale 224—Low and High Scenarios

		Employment		Population	
Model Year	Calendar Year	Total Low	Total High	Total Low	Total High
1	2009	0	2.21	0.00	4.15
2	2010	0	86.08	0.00	160.66
3	2011	63.22	86.6	117.36	160.77
4	2012	268.16	325.7	495.25	601.51
5	2013	394.69	794.13	725.62	1459.97
6	2014	258.59	287.57	473.25	526.29
7	2015	2.48	11.6	4.52	21.13
8	2016	62.69	96.21	113.69	174.49
9	2017	2.23	21.27	4.03	38.45
10	2018	3.37	102.13	6.07	183.93
11	2019	4.7	38.75	8.43	69.53
12	2020	4.71	337.54	8.42	603.49
13	2021	5.86	381.39	10.44	679.43
14	2022	10.99	356.62	19.52	633.55
15	2023	13.43	162.07	23.79	287.13
16	2024	15.27	96.01	26.98	169.63
17	2025	16.14	367.22	28.44	647.02
18	2026	277.85	699.59	488.21	1229.25
19	2027	24.31	942.68	42.62	1652.85
20	2028	26.85	395.9	46.99	692.93
21	2029	26.79	136.49	46.81	238.48
22	2030	38.64	132.92	67.39	231.83
23	2031	26.83	398.37	46.71	693.60
24	2032	37.17	119.25	64.63	207.34
25	2033	16.25	388.63	28.20	674.53
26	2034	16.21	437.53	28.09	758.08
27	2035	16.19	106.67	28.00	184.50
28	2036	10.9	123.61	18.82	213.43
29	2037	10.87	371.53	18.74	640.39
30	2038	5.53	96.96	9.52	166.84
31	2039	5.53	67.75	9.50	116.38
32	2040	5.5	38.56	9.43	66.12
33	2041	5.5	44.61	9.42	76.36
34	2042	5.5	16.98	9.40	29.02
35	2043	0.11	11.67	0.19	19.91
36	2044	0.11	6.13	0.19	10.44
37	2045	0.08	0.64	0.14	1.09
38	2046	0.07	0.54	0.12	0.92
39	2047	15.72	16.12	26.64	27.31
40	2048	0.04	0.34	0.07	0.58

Source: 10% of total employment estimates in Lease Sale 181 FEIS (USDOI, MMS, 2001a, Table IV-26).

Table 4-24

Population Projected for Proposed Lease Sale 224 as a Percent
of Total Population by Economic Impact Area-Low and High Scenarios

Model Year	Calendar Year	AL-1	MS-1	LA-1	LA-2	LA-3	LA-4	TX-1	TX-2	TX-3	FL-1	FL-2	FL-3	FL-4
1	2009	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2	2010	0.02%	0.03%	0.05%	0.03%	0.01%	0.01%	0.01%	0.03%	0.00%	0.02%	0.02%	0.00%	0.00%
3	2011	0.02%	0.03%	0.05%	0.03%	0.01%	0.01%	0.01%	0.03%	0.00%	0.02%	0.02%	0.00%	0.00%
4	2012	0.08%	0.12%	0.17%	0.10%	0.05%	0.05%	0.03%	0.09%	0.01%	0.06%	0.09%	0.02%	0.01%
5	2013	0.19%	0.28%	0.42%	0.24%	0.12%	0.12%	0.08%	0.23%	0.02%	0.15%	0.22%	0.04%	0.02%
6	2014	0.07%	0.10%	0.15%	0.09%	0.04%	0.04%	0.03%	0.08%	0.01%	0.05%	0.08%	0.01%	0.01%
7	2015	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
8	2016	0.02%	0.03%	0.05%	0.03%	0.01%	0.01%	0.01%	0.03%	0.00%	0.02%	0.02%	0.00%	0.00%
9	2017	0.00%	0.01%	0.01%	0.01%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.01%	0.00%	0.00%
10	2018	0.02%	0.03%	0.05%	0.03%	0.01%	0.01%	0.01%	0.03%	0.00%	0.02%	0.03%	0.00%	0.00%
11	2019	0.01%	0.01%	0.02%	0.01%	0.01%	0.01%	0.00%	0.01%	0.00%	0.01%	0.01%	0.00%	0.00%
12	2020	0.07%	0.11%	0.17%	0.10%	0.05%	0.04%	0.03%	0.09%	0.01%	0.05%	0.08%	0.01%	0.01%
13	2021	0.08%	0.12%	0.19%	0.11%	0.05%	0.05%	0.03%	0.10%	0.01%	0.06%	0.09%	0.02%	0.01%
14	2022	0.08%	0.11%	0.18%	0.10%	0.05%	0.04%	0.03%	0.09%	0.01%	0.05%	0.08%	0.01%	0.01%
15	2023	0.03%	0.05%	0.08%	0.05%	0.02%	0.02%	0.01%	0.04%	0.00%	0.02%	0.04%	0.01%	0.00%
16	2024	0.02%	0.03%	0.05%	0.03%	0.01%	0.01%	0.01%	0.02%	0.00%	0.01%	0.02%	0.00%	0.00%
17	2025	0.08%	0.11%	0.18%	0.10%	0.05%	0.04%	0.03%	0.09%	0.01%	0.05%	0.08%	0.01%	0.01%
18	2026	0.15%	0.21%	0.33%	0.19%	0.10%	0.08%	0.05%	0.17%	0.02%	0.10%	0.16%	0.03%	0.01%
19	2027	0.19%	0.27%	0.45%	0.25%	0.13%	0.11%	0.07%	0.22%	0.02%	0.13%	0.21%	0.04%	0.02%
20	2028	0.08%	0.11%	0.19%	0.11%	0.05%	0.04%	0.03%	0.09%	0.01%	0.05%	0.09%	0.02%	0.01%
21	2029	0.03%	0.04%	0.06%	0.04%	0.02%	0.01%	0.01%	0.03%	0.00%	0.02%	0.03%	0.01%	0.00%
22	2030	0.03%	0.04%	0.06%	0.03%	0.02%	0.01%	0.01%	0.03%	0.00%	0.02%	0.03%	0.00%	0.00%
23	2031	0.08%	0.11%	0.18%	0.10%	0.05%	0.04%	0.03%	0.09%	0.01%	0.05%	0.08%	0.01%	0.01%
24	2032	0.02%	0.03%	0.05%	0.03%	0.02%	0.01%	0.01%	0.03%	0.00%	0.02%	0.02%	0.00%	0.00%
25	2033	0.08%	0.10%	0.18%	0.10%	0.05%	0.04%	0.03%	0.09%	0.01%	0.05%	0.08%	0.01%	0.01%
26	2034	0.08%	0.12%	0.20%	0.11%	0.06%	0.04%	0.03%	0.10%	0.01%	0.05%	0.09%	0.02%	0.01%
27	2035	0.02%	0.03%	0.05%	0.03%	0.01%	0.01%	0.01%	0.02%	0.00%	0.01%	0.02%	0.00%	0.00%
28	2036	0.02%	0.03%	0.06%	0.03%	0.02%	0.01%	0.01%	0.03%	0.00%	0.01%	0.02%	0.00%	0.00%
29	2037	0.07%	0.10%	0.17%	0.09%	0.05%	0.03%	0.02%	0.08%	0.01%	0.04%	0.07%	0.01%	0.01%
30	2038	0.02%	0.02%	0.04%	0.02%	0.01%	0.01%	0.01%	0.02%	0.00%	0.01%	0.02%	0.00%	0.00%
31	2039	0.01%	0.02%	0.03%	0.02%	0.01%	0.01%	0.00%	0.01%	0.00%	0.01%	0.01%	0.00%	0.00%
32	2040	0.01%	0.01%	0.02%	0.01%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.01%	0.00%	0.00%
33	2041	0.01%	0.01%	0.02%	0.01%	0.01%	0.00%	0.00%	0.01%	0.00%	0.00%	0.01%	0.00%	0.00%
34	2042	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
35	2043	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
36	2044	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
37	2045	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
38	2046	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
39	2047	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
40	2048	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Notes: There is no difference between the low and high scenarios at two decimal places.

Source: Population estimates for Lease Sale 224 (Table 4-23) as a percent of baseline population projections (Table 3-28).

Table 4-25

Population Projected for the OCS Program by Economic Impact Area

Calendar Year	AL-1 Low High	MS-1 Low High	LA-1 Low High	LA-2 Low High	LA-3 Low High	LA-4 Low High	TX-1 Low High	TX-2 Low High	TX-3 Low High	FL-1 Low High	FL-2 Low High	FL-3 Low High	FL-4 Low High	Total EIA Low High
2009	9,684 - 12,730	4,387 - 5,917	6,750 - 8,739	83,458 - 109,205	65,844 - 87,659	42,493 - 56433	10,171 - 13,468	8,281 - 10,724	122,873 - 173,413	2,208 - 2,888	1,245 - 1,766	2,406 - 1,626	927 - 1,382	360,728 - 485,951
2010	10,126 - 12,933	4,578 - 5,989	7,060 - 8,937	87,243 - 111,615	68,874 - 89,113	44,466 - 57,203	10,748 - 13,920	8,808 - 11,184	129,363 - 176,638	2,340 - 2,990	1,313 - 1,780	2,548 - 1,635	1,035 - 1,383	378,502 - 495,319
2011	9,936 - 13,050	4,478 - 6,019	6,999 - 9,073	86,679 - 113,270	67,730 - 89,972	43,473 - 57,606	10,783 - 14,287	8,916 - 11,586	127,425 - 178,851	2,351 - 3,074	1,268 - 1,784	2,498 - 1,635	945 - 1,385	373,482 - 501,591
2012	10,478 - 13,326	4,714 - 6,122	7,371 - 9,325	91,218 - 116,439	71,465 - 91,955	45,973 - 58,769	11,454 - 14,815	9,514 - 12,113	135,120 - 182,814	2,505 - 3,194	1,354 - 1,808	2,670 - 1,653	1,084 - 1,403	394,921 - 513,735
2013	10,338 - 13,497	4,635 - 6,174	7,351 - 9,508	91,226 - 118,771	70,670 - 93,226	45,189 - 59,473	11,543 - 15,229	9,667 - 12,556	133,392 - 185,078	2,529 - 3,293	1,313 - 1,818	2,628 - 1,659	987 - 1,410	391,467 - 521,692
2014	10,839 - 13,643	4,852 - 6,214	7,693 - 9,677	95,461 - 120916	74,165 - 94,346	47511 - 601,36	12,178 - 15,608	10,234 - 12,971	140,428 - 186,697	2,676 - 3,387	1,395 - 1,826	2,789 - 1,662	1,121 - 1,417	411,342 - 528,501
2015	10,680 - 13,694	4,769 - 6,213	7,647 - 9,780	95,166 - 122,273	73,209 - 94,766	46,842 - 60,571	12,239 - 15,881	10,369 - 13,317	138,922 - 187,332	2,697 - 3,462	1,358 - 1,823	2,754 - 1,657	1,042 - 1,421	407,694 - 532,191
2016	11,125 - 13,831	4,960 - 6,247	7,957 - 9,941	99,110 - 124,390	76,346 - 95,803	48,936 - 61,261	12,827 - 16,238	10,901 - 13,722	145,027 - 188,596	2,834 - 3,556	1,428 - 1,830	2,896 - 1,659	1,149 - 1,432	425,496 - 538,507
2017	10,892 - 13,792	4,846 - 6,208	7,834 - 9,950	97,854 - 124,599	74,900 - 95,629	47,760 - 61079	12,729 - 16,332	10,849 - 13,859	141,820 - 187,356	2,813 - 3,584	1,381 - 1,814	2,824 - 1,642	1,056 - 1,423	417,557 - 537,266
2018	11,114 - 13,629	4,944 - 6,116	7,952 - 9862	99,359 - 123,623	76,533 - 94,630	48,862 - 60,392	13,007 - 16,279	11,074 - 13,864	145,249 - 184,745	2,873 - 3,578	1,428 - 1,785	2,904 - 1,613	1,156 - 1,407	426,454 - 531,524
2019	10,725 - 13,458	4,759 - 6,025	7,720 - 9,756	96,715 - 122436	74,002 - 93,575	47,021 - 59,631	12,745 - 16,214	10,898 - 13,845	140,359 - 182,358	2,817 - 3,566	1,361 - 1,758	2,797 - 1,585	1,054 - 1,386	412,974 - 525,593
2020	10,965 - 13,317	4,865 - 5,950	7,855 - 9,668	98,379 - 121,436	75,684 - 92,662	48,231 - 59,070	13039 - 16,166	11,146 - 13,837	143,999 - 180,358	2,883 - 3,559	1,408 - 1,733	2,882 - 1,560	1,153 - 1,360	422,488 - 520,675
2021	10,666 - 13,213	4,720 - 5893	7,687 - 9,593	96,535 - 120,685	73,762 - 92,042	46,836 - 58,577	12,857 - 16,149	11,034 - 13,837	140,014 - 178,840	2,845 - 3,556	1,351 - 1,715	2,796 - 1,542	1,057 - 1,341	412,161 - 516,983
2022	10,888 - 13,182	4,817 - 5,874	7,803 - 9,566	98,010 - 120,584	75,339 - 91,985	47,863 - 58,488	13,126 - 16,199	11254 - 13,888	143,215 - 178,454	2,905 - 3,568	1,396 - 1,713	2,874 - 1,537	1,154 - 1,345	420,645 - 516,384
2023	10,681 - 13,191	4,718 - 5,872	7,690 - 9,562	96,859 - 120,611	74,142 - 92,200	46,940 - 58513	13,037 - 16,311	11,202 - 13,998	140,554 - 179,054	2,881 - 3,588	1,354 - 1,715	2,806 - 1,536	1,057 - 1,349	413,922 - 517,501
2024	10,601 - 13,026	4,679 - 5,783	7,632 - 9455	96,362 - 119,440	73,675 - 91,097	46,514 - 57,708	13,025 - 16,201	11,195 - 13,940	139,488 - 176,119	2,881 - 3,572	1,343 - 1,687	2,789 - 1,509	1,047 - 1,336	411,232 - 510,873
2025	10,548 - 12,992	4,658 - 5,764	7,586 - 9,422	95,986 - 119,177	73,436 - 90,951	46,368 - 57,628	13,040 - 16,237	11,207 - 13,986	139,374 - 176,069	2,884 - 3,583	1,340 - 1,686	2,782 - 1,506	1,042 - 1,349	410,250 - 510,350
2026	10,558 - 13,024	4,660 - 5,774	7,585 - 9,430	96,184 - 119,512	73,639 - 91,299	46,466 - 57,782	13,109 - 16,339	11,260 - 14,075	139,464 - 176,404	2,898 - 3,606	1,343 - 1,692	2,787 - 1,509	1,043 - 1,360	410,995 - 511,806
2027	10,478 - 13,032	4,618 - 5,775	7,527 - 9,413	95,603 - 119,506	73,148 - 91,456	46,087 - 57,766	13,093 - 16,421	11,263 - 14,137	138,651 - 176,680	2,896 - 3,623	1,333 - 1,695	2,773 - 1,509	1,042 - 1,364	408,512 - 512,377
2028	10,452 - 13,001	4,604 - 5,761	7495 - 9,366	95,332 - 119,119	73,059 - 91,365	45,963 - 57,582	13128 - 16,465	11,297 - 14,164	138,599 - 176,703	2,903 - 3,628	1,332 - 1,694	2,772 - 1,506	1,051 - 1,360	407,987 - 511,717
2029	10,403 - 12,980	4,575 - 5,749	7,457 - 9,329	94,981 - 118,862	72,756 - 91,311	45,707 - 57,424	13,136 - 16,515	11,321 - 14,198	137,969 - 176,608	2,907 - 3,637	1,325 - 1,693	2,765 - 1,503	1,058 - 1,358	406,360 - 511,167
2030	10,441 - 13,013	4,590 - 5,764	7,471 - 9,332	95,269 - 119,111	73,110 - 91,644	45,917 - 57,592	13,226 - 16,608	11,398 - 14,270	138,573 - 177,177	2,926 - 3,657	1,332 - 1,700	2,778 - 1,507	1,069 - 1,366	408,100 - 512,742
2031	10,430 - 13,037	4,582 - 5,773	7,451 - 9,327	95,207 - 119,258	73,111 - 91,906	45,836 - 57,630	13268 - 16,700	11,429 - 14,338	138,419 - 177,591	2,936 - 3,677	1,332 - 1,707	2,778 - 1,511	1,073 - 1,381	407,853 - 513,836
2032	10,460 - 13,099	4,598 - 5,799	7452 - 9,347	95,388 - 119,708	73,448 - 92,428	45,955 - 57,834	13,362 - 16,840	11,491 - 14,450	139,119 - 178,636	2,952 - 3,708	1,340 - 1,719	2,787 - 1,519	1,076 - 1,403	409,427 - 516,490
2033	10,489 - 13,114	4,611 - 5,805	7,448 - 9,337	95,535 - 119,795	73,726 - 92,630	46,033 - 57,824	13,433 - 16,924	11,532 - 14,513	139,479 - 178,884	2,968 - 3,727	1,349 - 1,725	2,800 - 1,522	1,096 - 1,417	410,498 - 517,217
2034	10,458 - 13,112	4,600 - 5,802	7,400 - 9,314	95,043 - 119,718	73,562 - 92,706	45,768 - 57,758	13481 - 16,999	11,561 - 14,571	140,062 - 179,137	2,974 - 3,743	1,350 - 1,727	2,799 - 1,522	1,100 - 1,426	410,158 - 517,535
2035	10,436 - 13,088	4,588 - 5,785	7,377 - 9,284	94,962 - 119,520	73,503 - 92,607	45,596 - 57,518	13,496 - 17,038	11,566 - 14,600	139,234 - 178,441	2,980 - 3,753	1,347 - 1,723	2,791 - 1,516	1,095 - 1,423	408,972 - 516,297
2036	10,476 - 13,060	4,607 - 5,772	7,379 - 9,241	95,147 - 119,174	73,876 - 92,520	45,766 - 57,381	13,603 - 17,090	11,636 - 14,627	140,294 - 178,550	2,998 - 3,759	1,358 - 1,722	2,807 - 1,512	1,111 - 1,421	411,059 - 515,829
2037	10,460 - 13,087	4,598 - 5,786	7,358 - 9,232	95,012 - 119,260	73,859 - 92,825	45,626 - 57,416	13,660 - 17,194	11,683 - 14,694	140317 - 179,218	3,008 - 3,778	1,355 - 1,729	2,803 - 1,517	1,102 - 1,428	410,841 - 517,163
2038	10,378 - 13,073	4,560 - 5,779	7,299 - 9,197	94,448 - 119,013	73,357 - 92,789	45,145 - 57,207	13,647 - 17,251	11,675 - 14,726	139,362 - 179,228	3,006 - 3,789	1,341 - 1,730	2,781 - 1,515	1,080 - 1,433	408,080 - 516,731
2039	10,374 - 13,077	4,558 - 5,783	7,275 - 9,169	94,282 - 118,844	73,388 - 92,904	45,051 - 57,127	13,711 - 17,333	11,717 - 14,772	139,763 - 179,826	3,017 - 3,802	1,344 - 1,736	2,786 - 1,518	1,087 - 1,442	408,353 - 517,332
2040	10,412 - 13,098	4,574 - 5,791	7,283 - 9,161	94,540 - 118,938	73,743 - 93,142	45,171 - 57,135	13,811 - 17,426	11,786 - 14,837	140,356 - 180,210	3,036 - 3,821	1,351 - 1,741	2,798 - 1,521	1,095 - 1,454	409,956 - 518,272
2041	10,364 - 13,056	4,556 - 5,774	7,228 - 9,105	93,966 - 118,409	73,476 - 92,928	44,875 - 56,843	13,820 - 17,451	11,777 - 14,841	140,259 - 180,112	3,035 - 3,824	1,350 - 1,741	2,791 - 1,518	1,098 - 1,461	408,595 - 517,063
2042	10,257 - 13,011	4,499 - 5,739	7,169 - 9,069	93,451 - 118,061	72,853 - 92,674	44,435 - 56,633	13,758 - 17,466	11,739 - 14,859	138,229 - 178,849	3,023 - 3,823	1,327 - 1,725	2,757 - 1,502	1,062 - 1,444	404,558 - 514,855
2043	10,251 - 12,982	4,497 - 5,725	7,145 - 9,027	93,267 - 117,699	72,871 - 92,559	44,317 - 56,419	13,813 - 17,504	11,771 - 14,879	138,444 - 178,716	3,031 - 3,830	1,329 - 1,725	2,758 - 1,499	1,065 - 1,450	404,558 - 514,014
2044	10,272 - 12,985	4,504 - 5,727	7,145 - 9,003	93,430 - 117,578	73,129 - 92,705	44,413 - 56,408	13,887 - 17,580	11,821 - 14,921	138674 - 179,170	3,045 - 3,840	1,333 - 1,730	2,765 - 1,501	1,073 - 1,457	405,492 - 514,604
2045	10,247 - 12,949	4,493 - 5,709	7,110 - 8,959	93,109 - 117,181	73,019 - 92,527	44,229 - 56,138	13,918 - 17,607	11,835 - 14,933	138,632 - 178,779	3,050 - 3,845	1,333 - 1,727	2,763 - 1,496	1,077 - 1,460	404,815 - 513,312
2046	10,221 - 12,934	4,482 - 5,700	7,073 - 8,928	92,765 - 116,956	72,904 - 92,522	44,043 - 56,009	13,949 - 17,661	11,847 - 14,964	138,613 - 178,758	3,054 - 3,853	1,333 - 1,727	2,760 - 1,494	1,081 - 1,464	404,125 - 512,970

Source: Employment output from MMS's economic impact model MAG-PLAN.

Table 4-26

Population Projected for the OCS Program as a Percent of Total Population by Economic Impact Area

Calendar Year	AL-1 Low High	MS-1 Low High	LA-1 Low High	LA-2 Low High	LA-3 Low High	LA-4 Low High	TX-1 Low High	TX-2 Low High	TX-3 Low High	FL-1 Low High	FL-2 Low High	FL-3 Low High	FL-4 Low High	Total EIA Low High
2009	1.3 - 1.7	0.9 - 1.2	2.0 - 2.5	14.2 - 18.5	5.6 - 7.5	3.8 - 5.0	0.6 - 0.8	1.3 - 1.7	2.1 - 2.9	0.2 - 0.3	0.2 - 0.3	0.1 - 0.0	0.0 - 0.0	1.5 - 2.0
2010	1.3 - 1.7	0.9 - 1.2	2.1 - 2.6	14.7 - 18.9	5.9 - 7.6	3.9 - 5.0	0.6 - 0.8	1.4 - 1.8	2.2 - 3.0	0.2 - 0.3	0.2 - 0.3	0.1 - 0.0	0.0 - 0.0	1.5 - 2.0
2011	1.3 - 1.7	0.9 - 1.2	2.0 - 2.6	14.6 - 19.0	5.7 - 7.6	3.7 - 4.9	0.6 - 0.8	1.4 - 1.8	2.1 - 3.0	0.2 - 0.3	0.2 - 0.3	0.1 - 0.0	0.0 - 0.0	1.5 - 2.0
2012	1.4 - 1.7	0.9 - 1.2	2.1 - 2.7	15.2 - 19.5	6.0 - 7.7	3.9 - 4.9	0.6 - 0.8	1.5 - 1.9	2.2 - 3.0	0.3 - 0.3	0.2 - 0.3	0.1 - 0.0	0.0 - 0.0	1.6 - 2.0
2013	1.3 - 1.7	0.9 - 1.2	2.1 - 2.7	15.2 - 19.8	5.9 - 7.8	3.7 - 4.9	0.6 - 0.8	1.5 - 2.0	2.2 - 3.0	0.3 - 0.3	0.2 - 0.3	0.1 - 0.0	0.0 - 0.0	1.5 - 2.0
2014	1.4 - 1.8	0.9 - 1.2	2.2 - 2.8	15.8 - 20.0	6.2 - 7.9	3.8 - 4.8	0.6 - 0.8	1.6 - 2.0	2.2 - 3.0	0.3 - 0.3	0.2 - 0.3	0.1 - 0.0	0.0 - 0.0	1.6 - 2.0
2015	1.4 - 1.7	0.9 - 1.2	2.2 - 2.8	15.7 - 20.1	6.1 - 7.9	3.7 - 4.8	0.6 - 0.8	1.6 - 2.0	2.2 - 3.0	0.3 - 0.3	0.2 - 0.3	0.1 - 0.0	0.0 - 0.0	1.5 - 2.0
2016	1.4 - 1.8	0.9 - 1.2	2.3 - 2.8	16.2 - 20.4	6.3 - 7.9	3.8 - 4.8	0.6 - 0.8	1.6 - 2.1	2.3 - 2.9	0.3 - 0.3	0.2 - 0.3	0.1 - 0.0	0.0 - 0.0	1.6 - 2.0
2017	1.4 - 1.7	0.9 - 1.2	2.2 - 2.8	15.9 - 20.3	6.1 - 7.8	3.6 - 4.7	0.6 - 0.8	1.6 - 2.1	2.2 - 2.9	0.3 - 0.3	0.2 - 0.3	0.1 - 0.0	0.0 - 0.0	1.5 - 2.0
2018	1.4 - 1.7	0.9 - 1.1	2.2 - 2.8	16.1 - 20.0	6.2 - 7.7	3.7 - 4.5	0.6 - 0.8	1.6 - 2.1	2.2 - 2.8	0.3 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 0.0	1.6 - 1.9
2019	1.3 - 1.7	0.9 - 1.1	2.2 - 2.7	15.6 - 19.7	6.0 - 7.6	3.5 - 4.4	0.6 - 0.8	1.6 - 2.0	2.1 - 2.7	0.3 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 0.0	1.5 - 1.9
2020	1.4 - 1.6	0.9 - 1.1	2.2 - 2.7	15.7 - 19.4	6.1 - 7.5	3.5 - 4.3	0.6 - 0.8	1.6 - 2.0	2.1 - 2.7	0.3 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 0.0	1.5 - 1.8
2021	1.3 - 1.6	0.8 - 1.0	2.1 - 2.7	15.4 - 19.2	5.9 - 7.4	3.3 - 4.2	0.6 - 0.7	1.6 - 2.0	2.1 - 2.6	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 0.0	1.4 - 1.8
2022	1.3 - 1.6	0.8 - 1.0	2.2 - 2.7	15.5 - 19.1	6.0 - 7.3	3.3 - 4.1	0.6 - 0.7	1.6 - 2.0	2.1 - 2.6	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 0.0	1.5 - 1.8
2023	1.3 - 1.6	0.8 - 1.0	2.1 - 2.6	15.2 - 19.0	5.9 - 7.3	3.2 - 4.0	0.6 - 0.7	1.6 - 2.0	2.0 - 2.6	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 0.0	1.4 - 1.8
2024	1.3 - 1.6	0.8 - 1.0	2.1 - 2.6	15.1 - 18.7	5.8 - 7.2	3.1 - 3.9	0.6 - 0.7	1.6 - 1.9	2.0 - 2.5	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 0.0	1.4 - 1.7
2025	1.3 - 1.6	0.8 - 1.0	2.1 - 2.6	14.9 - 18.5	5.7 - 7.1	3.1 - 3.8	0.6 - 0.7	1.5 - 1.9	2.0 - 2.5	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 0.0	1.4 - 1.7
2026	1.3 - 1.5	0.8 - 1.0	2.1 - 2.6	14.9 - 18.5	5.7 - 7.1	3.0 - 3.8	0.6 - 0.7	1.5 - 1.9	1.9 - 2.4	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 0.0	1.4 - 1.7
2027	1.2 - 1.5	0.8 - 1.0	2.0 - 2.6	14.7 - 18.3	5.6 - 7.1	3.0 - 3.7	0.6 - 0.7	1.5 - 1.9	1.9 - 2.4	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 0.0	1.3 - 1.7
2028	1.2 - 1.5	0.8 - 0.9	2.0 - 2.5	14.5 - 18.2	5.6 - 7.0	2.9 - 3.6	0.5 - 0.7	1.5 - 1.9	1.9 - 2.4	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 0.0	1.3 - 1.6
2029	1.2 - 1.5	0.7 - 0.9	2.0 - 2.5	14.4 - 18.0	5.5 - 7.0	2.8 - 3.6	0.5 - 0.7	1.5 - 1.9	1.8 - 2.4	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 0.0	1.3 - 1.6
2030	1.2 - 1.5	0.7 - 0.9	2.0 - 2.5	14.3 - 17.9	5.5 - 6.9	2.8 - 3.5	0.5 - 0.7	1.5 - 1.9	1.8 - 2.3	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 0.0	1.3 - 1.6
2031	1.2 - 1.5	0.7 - 0.9	2.0 - 2.5	14.2 - 17.8	5.5 - 6.9	2.8 - 3.5	0.5 - 0.7	1.5 - 1.9	1.8 - 2.3	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 0.0	1.3 - 1.6
2032	1.2 - 1.5	0.7 - 0.9	2.0 - 2.5	14.2 - 17.8	5.5 - 6.9	2.7 - 3.4	0.5 - 0.7	1.5 - 1.9	1.8 - 2.3	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 0.0	1.2 - 1.6
2033	1.2 - 1.5	0.7 - 0.9	2.0 - 2.5	14.1 - 17.7	5.5 - 6.9	2.7 - 3.4	0.5 - 0.7	1.5 - 1.8	1.8 - 2.3	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 0.0	1.2 - 1.6
2034	1.2 - 1.5	0.7 - 0.9	1.9 - 2.4	14.0 - 17.6	5.4 - 6.8	2.6 - 3.3	0.5 - 0.6	1.5 - 1.8	1.8 - 2.3	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 0.0	1.2 - 1.5
2035	1.2 - 1.5	0.7 - 0.9	1.9 - 2.4	13.9 - 17.4	5.4 - 6.8	2.6 - 3.2	0.5 - 0.6	1.4 - 1.8	1.7 - 2.2	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 0.0	1.2 - 1.5
2036	1.2 - 1.4	0.7 - 0.9	1.9 - 2.4	13.8 - 17.3	5.4 - 6.7	2.5 - 3.2	0.5 - 0.6	1.4 - 1.8	1.7 - 2.2	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 0.0	1.2 - 1.5
2037	1.1 - 1.4	0.7 - 0.9	1.9 - 2.4	13.7 - 17.2	5.3 - 6.7	2.5 - 3.1	0.5 - 0.6	1.4 - 1.8	1.7 - 2.2	0.2 - 0.3	0.1 - 0.2	0.1 - 0.0	0.0 - 0.0	1.2 - 1.5
2038	1.1 - 1.4	0.7 - 0.9	1.9 - 2.4	13.5 - 17.0	5.3 - 6.7	2.4 - 3.1	0.5 - 0.6	1.4 - 1.8	1.7 - 2.1	0.2 - 0.3	0.1 - 0.2	0.1 - 0.0	0.0 - 0.0	1.2 - 1.5
2039	1.1 - 1.4	0.7 - 0.8	1.9 - 2.3	13.4 - 16.9	5.2 - 6.6	2.4 - 3.0	0.5 - 0.6	1.4 - 1.8	1.7 - 2.1	0.2 - 0.3	0.1 - 0.2	0.1 - 0.0	0.0 - 0.0	1.1 - 1.4
2040	1.1 - 1.4	0.7 - 0.8	1.9 - 2.3	13.4 - 16.8	5.2 - 6.6	2.3 - 3.0	0.5 - 0.6	1.4 - 1.8	1.6 - 2.1	0.2 - 0.2	0.1 - 0.2	0.1 - 0.0	0.0 - 0.0	1.1 - 1.4
2041	1.1 - 1.4	0.6 - 0.8	1.8 - 2.3	13.2 - 16.6	5.2 - 6.5	2.3 - 2.9	0.5 - 0.6	1.4 - 1.7	1.6 - 2.1	0.2 - 0.2	0.1 - 0.2	0.1 - 0.0	0.0 - 0.0	1.1 - 1.4
2042	1.1 - 1.4	0.6 - 0.8	1.8 - 2.3	13.0 - 16.5	5.1 - 6.5	2.2 - 2.8	0.5 - 0.6	1.4 - 1.7	1.6 - 2.0	0.2 - 0.2	0.1 - 0.2	0.1 - 0.0	0.0 - 0.0	1.1 - 1.4
2043	1.1 - 1.4	0.6 - 0.8	1.8 - 2.3	12.9 - 16.3	5.1 - 6.4	2.2 - 2.8	0.5 - 0.6	1.3 - 1.7	1.6 - 2.0	0.2 - 0.2	0.1 - 0.2	0.1 - 0.0	0.0 - 0.0	1.1 - 1.4
2044	1.1 - 1.4	0.6 - 0.8	1.8 - 2.2	12.9 - 16.2	5.0 - 6.4	2.1 - 2.7	0.5 - 0.6	1.3 - 1.7	1.5 - 2.0	0.2 - 0.2	0.1 - 0.2	0.0 - 0.0	0.0 - 0.0	1.1 - 1.3
2045	1.1 - 1.3	0.6 - 0.8	1.8 - 2.2	12.7 - 16.0	5.0 - 6.3	2.1 - 2.7	0.4 - 0.6	1.3 - 1.7	1.5 - 2.0	0.2 - 0.2	0.1 - 0.2	0.0 - 0.0	0.0 - 0.0	1.0 - 1.3
2046	1.0 - 1.3	0.6 - 0.8	1.7 - 2.2	12.6 - 15.9	5.0 - 6.3	2.1 - 2.6	0.4 - 0.6	1.3 - 1.7	1.5 - 1.9	0.2 - 0.2	0.1 - 0.2	0.0 - 0.0	0.0 - 0.0	1.0 - 1.3

Source: Population estimates based on employment output from MMS's economic impact model MAG-Plan as percentages of baseline population projections based on Woods & Poole Economics, Inc. (2006).

Table 4-27a

Low-Case Employment Projected for the OCS Program by Economic Impact Area (Years 1-18)

EIA	Type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
AL-1	Direct	2,989	3,134	3,093	3,267	3,242	3,406	3,370	3,516	3,460	3,537	3,430	3,511	3,430	3,505	3,453	3,438	3,428	3,438
	Indirect	632	666	648	691	676	716	701	736	717	740	710	733	708	730	713	708	706	709
	Induced	1,438	1,520	1,505	1,603	1,596	1,689	1,678	1,762	1,736	1,781	1,731	1,779	1,740	1,785	1,759	1,754	1,752	1,759
	Total	**5,058**	**5,319**	**5,246**	**5,560**	**5,514**	**5,811**	**5,750**	**6,014**	**5,913**	**6,058**	**5,871**	**6,023**	**5,878**	**6,020**	**5,925**	**5,900**	**5,886**	**5,905**
FL-1	Direct	731	776	786	838	853	903	915	962	960	981	967	989	980	1,000	997	999	1,000	1,006
	Indirect	152	162	160	172	171	182	181	191	188	194	188	194	189	195	191	191	191	192
	Induced	354	378	381	409	414	441	445	470	467	479	471	484	478	489	486	487	488	490
	Total	**1,237**	**1,317**	**1,327**	**1,419**	**1,437**	**1,526**	**1,541**	**1,624**	**1,615**	**1,654**	**1,625**	**1,666**	**1,647**	**1,685**	**1,673**	**1,676**	**1,679**	**1,689**
FL-2	Direct	395	416	402	429	416	441	429	450	436	451	430	444	426	440	427	424	423	423
	Indirect	97	103	101	108	106	114	112	119	116	120	115	119	116	119	117	116	117	117
	Induced	166	178	173	186	182	195	191	203	196	205	196	204	196	203	198	197	197	198
	Total	**658**	**697**	**675**	**723**	**704**	**750**	**732**	**772**	**748**	**775**	**741**	**767**	**738**	**763**	**741**	**737**	**736**	**738**
FL-3	Direct	690	733	724	776	770	819	813	856	841	866	840	866	845	869	853	851	850	854
	Indirect	237	252	247	267	262	281	277	293	286	296	285	296	287	297	289	288	288	289
	Induced	455	487	479	518	511	548	543	575	562	582	563	583	567	586	573	572	572	575
	Total	**1,382**	**1,472**	**1,451**	**1,560**	**1,543**	**1,648**	**1,633**	**1,725**	**1,689**	**1,745**	**1,688**	**1,745**	**1,698**	**1,751**	**1,715**	**1,711**	**1,711**	**1,718**
FL-4	Direct	217	244	219	255	228	262	240	267	241	268	241	267	241	267	240	237	235	235
	Indirect	113	126	116	132	122	138	130	142	132	143	132	143	133	144	133	132	132	132
	Induced	185	206	191	217	201	227	214	234	218	237	219	237	220	238	221	219	219	219
	Total	**515**	**576**	**527**	**605**	**551**	**627**	**583**	**644**	**592**	**648**	**592**	**648**	**594**	**648**	**594**	**589**	**586**	**586**
LA-1	Direct	2,304	2,420	2,418	2,555	2,568	2,698	2,697	2,817	2,796	2,851	2,788	2,848	2,807	2,861	2,839	2,835	2,831	2,844
	Indirect	396	420	416	446	444	472	469	495	487	502	487	502	491	505	498	497	497	500
	Induced	954	1,014	1,019	1,090	1,100	1,169	1,176	1,240	1,231	1,263	1,239	1,272	1,255	1,285	1,277	1,277	1,279	1,287
	Total	**3,654**	**3,855**	**3,853**	**4,090**	**4,112**	**4,339**	**4,343**	**4,552**	**4,514**	**4,616**	**4,514**	**4,622**	**4,553**	**4,651**	**4,614**	**4,609**	**4,607**	**4,632**
LA-2	Direct	24,558	25,801	25,767	27,231	27,378	28,772	28,782	30,081	29,866	30,466	29,806	30,441	30,004	30,587	30,363	30,341	30,321	30,488
	Indirect	6,588	6,956	6,908	7,353	7,349	7,782	7,761	8,163	8,064	8,281	8,065	8,278	8,117	8,317	8,229	8,221	8,233	8,287
	Induced	14,157	14,980	15,098	16,055	16,284	17,213	17,379	18,261	18,206	18,605	18,300	18,714	18,527	18,907	18,837	18,868	18,901	19,031
	Total	**45,304**	**47,736**	**47,772**	**50,639**	**51,011**	**53,767**	**53,923**	**56,506**	**56,135**	**57,352**	**56,172**	**57,433**	**56,649**	**57,812**	**57,430**	**57,431**	**57,454**	**57,805**
LA-3	Direct	21,676	22,637	22,284	23,452	23,218	24,309	23,986	24,954	24,538	25,058	24,261	24,798	24,193	24,693	24,328	24,198	24,125	24,193
	Indirect	6,066	6,439	6,344	6,800	6,733	7,175	7,107	7,507	7,361	7,609	7,364	7,605	7,409	7,638	7,520	7,494	7,501	7,544
	Induced	11,069	11,697	11,617	12,369	12,351	13,074	13,030	13,690	13,511	13,870	13,506	13,870	13,595	13,934	13,780	13,749	13,753	13,825
	Total	**38,810**	**40,774**	**40,245**	**42,621**	**42,303**	**44,559**	**44,124**	**46,150**	**45,410**	**46,537**	**45,130**	**46,273**	**45,197**	**46,265**	**45,629**	**45,441**	**45,379**	**45,563**
LA-4	Direct	12,112	12,660	12,473	13,153	13,035	13,671	13,501	14,070	13,853	14,169	13,733	14,058	13,743	14,040	13,854	13,789	13,757	13,824
	Indirect	4,933	5,292	5,241	5,682	5,654	6,088	6,070	6,468	6,354	6,605	6,412	6,653	6,500	6,727	6,640	6,631	6,656	6,713
	Induced	7,511	7,987	7,871	8,461	8,380	8,952	8,876	9,394	9,213	9,540	9,235	9,553	9,313	9,610	9,467	9,438	9,457	9,526
	Total	**24,557**	**25,940**	**25,585**	**27,296**	**27,068**	**28,712**	**28,447**	**29,931**	**29,420**	**30,314**	**29,380**	**30,264**	**29,556**	**30,377**	**29,961**	**29,858**	**29,870**	**30,063**
MS-1	Direct	1,513	1,585	1,558	1,646	1,626	1,708	1,684	1,757	1,723	1,763	1,704	1,746	1,699	1,738	1,708	1,698	1,694	1,698
	Indirect	245	256	250	264	258	272	266	277	270	277	266	273	264	271	265	263	262	263
	Induced	569	599	590	627	621	655	648	679	667	684	662	680	663	679	668	665	664	666
	Total	**2,326**	**2,440**	**2,398**	**2,536**	**2,505**	**2,635**	**2,598**	**2,713**	**2,660**	**2,725**	**2,633**	**2,699**	**2,626**	**2,688**	**2,641**	**2,626**	**2,620**	**2,626**
TX-1	Direct	2,603	2,745	2,751	2,915	2,936	3,089	3,101	3,242	3,217	3,282	3,215	3,284	3,236	3,298	3,274	3,268	3,269	3,281
	Indirect	582	619	616	660	659	701	700	738	727	749	729	751	734	754	745	743	744	748
	Induced	1,238	1,316	1,330	1,419	1,440	1,525	1,543	1,622	1,616	1,652	1,626	1,664	1,647	1,681	1,675	1,676	1,679	1,688
	Total	**4,423**	**4,679**	**4,697**	**4,993**	**5,035**	**5,315**	**5,344**	**5,602**	**5,560**	**5,683**	**5,570**	**5,699**	**5,618**	**5,734**	**5,694**	**5,687**	**5,692**	**5,717**
TX-2	Direct	2,727	2,902	2,951	3,146	3,213	3,399	3,454	3,629	3,629	3,704	3,660	3,743	3,718	3,791	3,785	3,791	3,799	3,819
	Indirect	492	535	537	587	591	641	646	692	683	711	695	722	709	734	727	728	732	738
	Induced	933	1,003	1,026	1,105	1,135	1,212	1,239	1,312	1,314	1,347	1,335	1,370	1,364	1,396	1,396	1,401	1,407	1,417
	Total	**4,153**	**4,440**	**4,515**	**4,839**	**4,939**	**5,252**	**5,339**	**5,633**	**5,625**	**5,762**	**5,690**	**5,835**	**5,791**	**5,921**	**5,908**	**5,920**	**5,937**	**5,974**
TX-3	Direct	32,639	34,388	34,020	36,038	35,713	37,533	37,177	38,720	38,006	38,898	37,717	38,692	37,730	38,576	37,946	37,693	37,667	37,679
	Indirect	15,582	16,591	16,457	17,650	17,556	18,700	18,640	19,663	19,318	19,935	19,365	19,972	19,497	20,053	19,758	19,706	19,770	19,855
	Induced	23,869	25,296	24,982	26,676	26,411	28,015	27,787	29,194	28,611	29,480	28,550	29,410	28,629	29,414	28,924	28,791	28,847	28,941
	Total	**72,090**	**76,276**	**75,459**	**80,364**	**79,680**	**84,247**	**83,604**	**87,577**	**85,934**	**88,314**	**85,633**	**88,075**	**85,856**	**88,043**	**86,628**	**86,190**	**86,284**	**86,475**
Total EIA	Direct	105,153	110,442	109,446	115,700	115,195	121,011	120,151	125,322	123,567	126,294	122,792	125,688	123,052	125,666	124,068	123,561	123,398	123,781
	Indirect	36,114	38,417	38,042	40,811	40,581	43,261	43,060	45,483	44,701	46,161	44,814	46,242	45,155	46,485	45,826	45,719	45,830	46,086
	Induced	62,900	66,661	66,263	70,734	70,627	74,913	74,749	78,635	77,548	79,726	77,632	79,819	78,194	80,208	79,259	79,094	79,215	79,623
	Total	**204,167**	**215,520**	**213,750**	**227,245**	**226,403**	**239,185**	**237,961**	**249,440**	**245,816**	**252,182**	**245,238**	**251,749**	**246,401**	**252,359**	**249,153**	**248,374**	**248,443**	**249,490**
Other-GOM	Direct	28,136	29,486	28,771	30,422	29,817	31,333	30,664	31,945	31,181	31,938	30,692	31,524	30,528	31,303	30,552	30,320	30,167	30,176
	Indirect	14,311	15,041	14,501	15,420	14,915	15,756	15,250	15,927	15,402	15,866	15,101	15,612	14,978	15,460	14,919	14,777	14,670	14,650
	Induced	22,944	24,166	23,506	25,012	24,426	25,820	25,217	26,380	25,674	26,408	25,321	26,125	25,238	25,993	25,257	25,082	24,954	24,963
	Total	**65,391**	**68,693**	**66,778**	**70,854**	**69,158**	**72,910**	**71,131**	**74,253**	**72,257**	**74,211**	**71,114**	**73,262**	**70,745**	**72,756**	**70,728**	**70,179**	**69,791**	**69,789**
Other-US	Direct	29,079	31,478	30,433	33,363	32,349	35,142	34,261	36,650	35,344	37,046	35,333	37,118	35,628	37,344	36,026	35,834	35,751	35,859
	Indirect	34,351	37,173	36,117	39,569	38,555	41,860	41,026	43,853	42,451	44,410	42,534	44,581	42,952	44,921	43,435	43,295	43,242	43,395
	Induced	68,176	73,722	71,555	78,325	76,247	82,720	80,958	86,501	83,680	87,545	83,773	87,814	84,542	88,431	85,522	85,175	85,040	85,333
	Total	**131,605**	**142,373**	**138,105**	**151,258**	**147,151**	**159,722**	**156,245**	**167,005**	**161,475**	**169,002**	**161,641**	**169,513**	**163,122**	**170,697**	**164,983**	**164,304**	**164,034**	**164,587**

Source: Employment output from MMS's economic impact model MAG-PLAN.

Table 4-27b

Low-Case Employment Projected for the OCS Program by Economic Impact Area (Years 19-38)

EIA	Type	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
AL-1	Direct	3,417	3,414	3,404	3,421	3,424	3,441	3,457	3,453	3,453	3,472	3,474	3,456	3,460	3,480	3,470	3,443	3,448	3,462	3,460	3,458
	Indirect	703	703	700	705	705	709	713	713	712	717	716	710	711	715	714	705	706	709	709	709
	Induced	1,752	1,754	1,753	1,764	1,767	1,777	1,787	1,787	1,788	1,800	1,803	1,795	1,799	1,811	1,808	1,795	1,799	1,808	1,809	1,809
	Total	**5,873**	**5,872**	**5,858**	**5,890**	**5,897**	**5,927**	**5,957**	**5,952**	**5,953**	**5,989**	**5,993**	**5,960**	**5,971**	**6,006**	**5,992**	**5,943**	**5,953**	**5,979**	**5,977**	**5,976**
FL-1	Direct	1,006	1,009	1,012	1,019	1,023	1,029	1,035	1,037	1,040	1,047	1,051	1,052	1,056	1,064	1,064	1,061	1,065	1,071	1,073	1,075
	Indirect	192	192	192	193	194	195	196	197	197	199	199	198	199	200	200	199	199	200	201	201
	Induced	491	492	494	497	500	503	506	507	509	513	515	514	517	521	521	519	521	524	525	526
	Total	**1,689**	**1,694**	**1,697**	**1,709**	**1,716**	**1,727**	**1,737**	**1,741**	**1,746**	**1,758**	**1,765**	**1,765**	**1,772**	**1,785**	**1,785**	**1,779**	**1,785**	**1,795**	**1,798**	**1,802**
FL-2	Direct	420	419	417	419	418	421	424	424	423	427	426	421	422	424	424	416	417	418	418	418
	Indirect	117	117	117	117	118	119	119	120	120	121	121	120	121	121	121	120	120	121	121	121
	Induced	197	197	197	198	198	200	202	202	202	204	204	202	203	204	204	201	202	203	203	203
	Total	**733**	**733**	**730**	**734**	**735**	**739**	**745**	**746**	**745**	**751**	**750**	**743**	**745**	**750**	**750**	**737**	**739**	**742**	**742**	**742**
FL-3	Direct	851	852	852	857	859	863	869	870	869	876	877	873	876	881	881	873	875	879	880	881
	Indirect	288	289	289	290	291	293	295	295	295	298	297	295	297	298	299	295	296	297	297	298
	Induced	573	575	575	579	581	584	588	590	589	594	595	592	594	598	598	592	594	597	598	599
	Total	**1,713**	**1,716**	**1,716**	**1,726**	**1,730**	**1,740**	**1,751**	**1,755**	**1,754**	**1,768**	**1,769**	**1,760**	**1,766**	**1,778**	**1,778**	**1,760**	**1,764**	**1,773**	**1,775**	**1,777**
FL-4	Direct	235	237	238	241	241	242	247	247	245	249	246	240	241	243	244	233	234	236	236	237
	Indirect	132	133	134	135	135	136	138	138	138	140	139	136	137	138	138	134	135	136	136	136
	Induced	219	221	222	224	225	226	229	230	229	232	231	227	228	230	230	224	225	226	227	228
	Total	**585**	**590**	**594**	**600**	**602**	**603**	**614**	**616**	**613**	**621**	**616**	**603**	**607**	**611**	**612**	**592**	**594**	**597**	**599**	**601**
LA-1	Direct	2,836	2,838	2,838	2,855	2,862	2,876	2,889	2,884	2,891	2,906	2,913	2,906	2,911	2,929	2,921	2,914	2,919	2,935	2,935	2,935
	Indirect	499	500	500	504	505	508	511	511	512	516	517	515	516	520	519	516	518	521	521	522
	Induced	1,287	1,291	1,293	1,303	1,308	1,317	1,324	1,325	1,329	1,338	1,343	1,341	1,346	1,355	1,354	1,351	1,355	1,364	1,366	1,367
	Total	**4,622**	**4,629**	**4,631**	**4,661**	**4,675**	**4,701**	**4,725**	**4,721**	**4,733**	**4,760**	**4,773**	**4,761**	**4,772**	**4,804**	**4,794**	**4,782**	**4,792**	**4,819**	**4,822**	**4,824**
LA-2	Direct	30,406	30,417	30,414	30,594	30,684	30,849	31,005	30,943	31,033	31,201	31,269	31,196	31,247	31,452	31,361	31,312	31,361	31,539	31,540	31,534
	Indirect	8,260	8,274	8,264	8,321	8,348	8,406	8,463	8,458	8,482	8,543	8,559	8,528	8,549	8,608	8,599	8,564	8,583	8,633	8,640	8,645
	Induced	19,021	19,066	19,098	19,232	19,312	19,436	19,551	19,550	19,624	19,750	19,822	19,811	19,873	20,014	19,991	19,987	20,042	20,162	20,189	20,209
	Total	**57,688**	**57,757**	**57,777**	**58,147**	**58,344**	**58,691**	**59,019**	**58,952**	**59,139**	**59,494**	**59,649**	**59,534**	**59,669**	**60,074**	**59,950**	**59,863**	**59,986**	**60,334**	**60,369**	**60,388**
LA-3	Direct	24,022	23,979	23,874	23,987	23,996	24,117	24,221	24,170	24,169	24,300	24,301	24,150	24,166	24,300	24,215	24,020	24,038	24,139	24,111	24,081
	Indirect	7,515	7,537	7,525	7,585	7,603	7,659	7,709	7,714	7,719	7,782	7,797	7,750	7,774	7,828	7,823	7,761	7,780	7,825	7,833	7,841
	Induced	13,780	13,804	13,791	13,887	13,920	14,011	14,088	14,091	14,109	14,208	14,240	14,183	14,221	14,316	14,297	14,220	14,253	14,329	14,340	14,348
	Total	**45,317**	**45,320**	**45,190**	**45,459**	**45,519**	**45,787**	**46,019**	**45,975**	**45,998**	**46,290**	**46,338**	**46,083**	**46,161**	**46,444**	**46,335**	**46,001**	**46,071**	**46,293**	**46,283**	**46,270**
LA-4	Direct	13,745	13,727	13,691	13,766	13,787	13,861	13,925	13,872	13,875	13,961	13,963	13,871	13,877	13,963	13,899	13,829	13,835	13,916	13,897	13,877
	Indirect	6,705	6,741	6,747	6,814	6,841	6,901	6,953	6,963	6,973	7,042	7,063	7,026	7,057	7,113	7,116	7,076	7,099	7,151	7,166	7,180
	Induced	9,495	9,525	9,516	9,596	9,624	9,700	9,765	9,763	9,767	9,857	9,872	9,807	9,838	9,910	9,900	9,838	9,860	9,926	9,935	9,943
	Total	**29,945**	**29,993**	**29,954**	**30,176**	**30,252**	**30,461**	**30,644**	**30,598**	**30,614**	**30,860**	**30,898**	**30,704**	**30,771**	**30,986**	**30,916**	**30,744**	**30,794**	**30,993**	**30,998**	**31,000**
MS-1	Direct	1,685	1,683	1,675	1,683	1,683	1,692	1,700	1,699	1,697	1,707	1,707	1,696	1,699	1,708	1,704	1,686	1,688	1,694	1,693	1,692
	Indirect	260	260	258	259	259	260	262	261	261	263	262	260	260	261	261	257	258	258	258	258
	Induced	662	662	660	664	665	668	672	672	672	676	677	673	675	679	677	671	672	675	675	675
	Total	**2,608**	**2,605**	**2,594**	**2,606**	**2,607**	**2,620**	**2,633**	**2,632**	**2,630**	**2,646**	**2,646**	**2,629**	**2,633**	**2,648**	**2,642**	**2,615**	**2,618**	**2,628**	**2,626**	**2,625**
TX-1	Direct	3,272	3,274	3,271	3,290	3,295	3,314	3,327	3,334	3,334	3,356	3,366	3,359	3,370	3,390	3,388	3,369	3,378	3,392	3,395	3,398
	Indirect	746	748	747	752	753	759	763	765	765	771	773	770	773	778	778	772	774	778	779	780
	Induced	1,688	1,693	1,695	1,707	1,712	1,723	1,732	1,737	1,739	1,752	1,759	1,758	1,766	1,778	1,778	1,772	1,778	1,787	1,790	1,794
	Total	**5,705**	**5,715**	**5,713**	**5,748**	**5,761**	**5,796**	**5,822**	**5,837**	**5,838**	**5,879**	**5,898**	**5,887**	**5,909**	**5,946**	**5,944**	**5,912**	**5,930**	**5,956**	**5,964**	**5,972**
TX-2	Direct	3,823	3,836	3,848	3,875	3,889	3,913	3,931	3,944	3,951	3,978	3,998	4,002	4,021	4,049	4,049	4,043	4,058	4,079	4,088	4,097
	Indirect	739	745	747	755	759	766	771	775	776	784	788	786	791	798	800	795	799	805	808	811
	Induced	1,422	1,430	1,437	1,449	1,457	1,467	1,476	1,482	1,486	1,498	1,507	1,509	1,518	1,529	1,531	1,531	1,537	1,547	1,552	1,556
	Total	**5,984**	**6,011**	**6,032**	**6,080**	**6,104**	**6,147**	**6,177**	**6,202**	**6,213**	**6,260**	**6,294**	**6,298**	**6,330**	**6,376**	**6,380**	**6,369**	**6,395**	**6,431**	**6,448**	**6,464**
TX-3	Direct	37,473	37,469	37,326	37,483	37,447	37,645	37,721	37,939	37,702	38,019	38,073	37,865	38,021	38,213	38,216	37,699	37,803	37,880	37,901	37,933
	Indirect	19,809	19,865	19,838	19,978	20,024	20,181	20,310	20,427	20,387	20,588	20,639	20,549	20,652	20,791	20,829	20,597	20,673	20,768	20,814	20,861
	Induced	28,822	28,873	28,784	28,967	28,995	29,213	29,369	29,537	29,430	29,716	29,763	29,596	29,728	29,910	29,947	29,545	29,638	29,751	29,795	29,843
	Total	**86,105**	**86,207**	**85,949**	**86,427**	**86,466**	**87,039**	**87,400**	**87,903**	**87,519**	**88,323**	**88,475**	**88,010**	**88,401**	**88,914**	**88,992**	**87,841**	**88,114**	**88,399**	**88,510**	**88,636**
Total EIA	Direct	123,192	123,154	122,859	123,488	123,608	124,263	124,750	124,818	124,683	125,499	125,665	125,086	125,367	126,096	125,835	124,898	125,119	125,638	125,628	125,613
	Indirect	45,966	46,103	46,057	46,408	46,535	46,890	47,203	47,338	47,336	47,763	47,871	47,643	47,837	48,171	48,198	47,792	47,940	48,202	48,283	48,363
	Induced	79,409	79,583	79,515	80,068	80,264	80,824	81,289	81,473	81,474	82,137	82,329	82,008	82,305	82,855	82,837	82,246	82,477	82,898	83,002	83,101
	Total	**248,567**	**248,840**	**248,431**	**249,964**	**250,407**	**251,977**	**253,242**	**253,629**	**253,494**	**255,399**	**255,865**	**254,737**	**255,509**	**257,122**	**256,870**	**254,936**	**255,536**	**256,738**	**256,912**	**257,076**
Other-GOM	Direct	29,953	29,888	29,760	29,869	29,850	29,952	30,080	30,047	29,972	30,141	30,093	29,848	29,886	30,036	29,950	29,570	29,602	29,693	29,668	29,641
	Indirect	14,537	14,499	14,444	14,489	14,474	14,500	14,580	14,552	14,501	14,583	14,526	14,364	14,379	14,448	14,401	14,155	14,165	14,207	14,192	14,176
	Induced	24,816	24,785	24,726	24,828	24,833	24,906	25,044	25,023	24,970	25,121	25,071	24,861	24,905	25,039	24,976	24,641	24,675	24,764	24,757	24,747
	Total	**69,306**	**69,172**	**68,930**	**69,186**	**69,157**	**69,357**	**69,704**	**69,621**	**69,443**	**69,846**	**69,691**	**69,074**	**69,170**	**69,524**	**69,327**	**68,366**	**68,442**	**68,664**	**68,617**	**68,564**
Other-US	Direct	35,786	35,967	36,035	36,350	36,411	36,584	36,852	36,917	36,868	37,186	37,162	36,839	37,003	37,257	37,261	36,721	36,832	37,029	37,101	37,165
	Indirect	43,363	43,581	43,707	44,076	44,200	44,408	44,777	44,885	44,879	45,271	45,260	44,948	45,164	45,485	45,517	44,918	45,066	45,320	45,430	45,527
	Induced	85,217	85,650	85,847	86,593	86,787	87,215	87,889	88,073	88,030	88,785	88,762	88,101	88,505	89,124	89,156	87,967	88,246	88,733	88,925	89,095
	Total	**164,366**	**165,197**	**165,589**	**167,020**	**167,398**	**168,208**	**169,518**	**169,875**	**169,777**	**171,243**	**171,184**	**169,888**	**170,672**	**171,866**	**171,935**	**169,606**	**170,143**	**171,082**	**171,456**	**171,787**

Source: Employment output from MMS's economic impact model MAG-PLAN.

Table 4-28a

High-Case Employment Projected for the OCS Program by Economic Impact Area (Years 1-18)

EIA	Type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
AL-1	Direct	3,916	3,999	4,052	4,154	4,224	4,287	4,314	4,370	4,373	4,336	4,296	4,264	4,242	4,243	4,258	4,216	4,214	4,232
	Indirect	853	866	872	890	900	910	912	920	918	908	898	889	883	883	886	875	875	879
	Induced	1,879	1,929	1,966	2,028	2,074	2,118	2,146	2,187	2,197	2,186	2,173	2,163	2,157	2,162	2,173	2,158	2,161	2,174
	Total	**6,648**	**6,794**	**6,890**	**7,072**	**7,199**	**7,314**	**7,372**	**7,477**	**7,487**	**7,430**	**7,367**	**7,315**	**7,282**	**7,288**	**7,317**	**7,249**	**7,250**	**7,284**
FL-1	Direct	941	981	1,014	1,060	1,099	1,136	1,166	1,202	1,216	1,218	1,218	1,219	1,221	1,227	1,236	1,234	1,239	1,248
	Indirect	210	216	220	226	231	236	239	244	244	243	241	240	239	240	241	239	240	241
	Induced	467	486	501	523	542	559	574	591	598	599	598	598	599	602	606	605	608	612
	Total	**1,618**	**1,682**	**1,735**	**1,809**	**1,871**	**1,931**	**1,978**	**2,037**	**2,058**	**2,060**	**2,058**	**2,057**	**2,059**	**2,069**	**2,084**	**2,078**	**2,086**	**2,101**
FL-2	Direct	559	564	565	573	575	577	575	576	571	562	553	545	540	539	540	531	530	532
	Indirect	136	139	140	144	146	148	150	152	152	150	149	148	147	147	148	147	147	148
	Induced	239	242	244	250	253	256	257	260	259	257	254	251	250	250	252	248	249	250
	Total	**934**	**945**	**950**	**966**	**974**	**982**	**982**	**988**	**982**	**969**	**956**	**944**	**936**	**937**	**939**	**926**	**926**	**930**
FL-3	Direct	931	956	975	1,005	1,028	1,048	1,062	1,082	1,085	1,079	1,071	1,065	1,061	1,064	1,068	1,059	1,062	1,067
	Indirect	327	335	340	350	357	363	367	373	373	370	367	365	363	364	365	362	362	364
	Induced	627	643	656	676	692	706	716	730	732	729	724	720	717	719	723	717	719	724
	Total	**1,886**	**1,934**	**1,970**	**2,031**	**2,076**	**2,117**	**2,144**	**2,184**	**2,190**	**2,178**	**2,163**	**2,149**	**2,141**	**2,147**	**2,156**	**2,138**	**2,144**	**2,155**
FL-4	Direct	329	328	327	330	330	331	330	332	329	324	319	311	306	307	307	304	307	309
	Indirect	165	167	168	171	172	174	175	177	177	175	173	170	168	169	169	168	170	171
	Induced	273	275	277	282	285	288	290	293	293	290	287	282	279	280	281	279	282	284
	Total	**767**	**770**	**771**	**782**	**787**	**792**	**795**	**802**	**798**	**789**	**778**	**764**	**753**	**756**	**758**	**751**	**759**	**764**
LA-1	Direct	2,959	3,047	3,112	3,219	3,302	3,381	3,432	3,507	3,532	3,523	3,506	3,493	3,486	3,496	3,514	3,496	3,501	3,522
	Indirect	534	549	560	578	593	607	616	630	633	631	629	626	625	627	631	627	628	632
	Induced	1,237	1,283	1,322	1,378	1,425	1,470	1,506	1,551	1,568	1,570	1,570	1,569	1,570	1,579	1,592	1,587	1,593	1,605
	Total	**4,730**	**4,879**	**4,994**	**5,175**	**5,319**	**5,458**	**5,554**	**5,687**	**5,733**	**5,725**	**5,705**	**5,688**	**5,681**	**5,703**	**5,737**	**5,710**	**5,722**	**5,759**
LA-2	Direct	32,133	33,025	33,666	34,777	35,641	36,452	36,976	37,756	38,010	37,894	37,706	37,540	37,454	37,581	37,752	37,556	37,610	37,853
	Indirect	8,849	9,072	9,236	9,525	9,751	9,969	10,115	10,324	10,376	10,339	10,292	10,246	10,230	10,277	10,331	10,259	10,279	10,347
	Induced	18,298	18,975	19,526	20,338	21,022	21,683	22,192	22,839	23,093	23,125	23,113	23,107	23,137	23,269	23,429	23,371	23,447	23,625
	Total	**59,280**	**61,071**	**62,427**	**64,640**	**66,413**	**68,104**	**69,282**	**70,919**	**71,478**	**71,358**	**71,111**	**70,894**	**70,820**	**71,128**	**71,512**	**71,185**	**71,336**	**71,825**
LA-3	Direct	28,826	29,319	29,578	30,215	30,608	30,943	31,018	31,298	31,247	30,919	30,580	30,291	30,097	30,085	30,159	29,808	29,764	29,881
	Indirect	8,205	8,399	8,545	8,796	8,986	9,169	9,287	9,461	9,492	9,449	9,397	9,346	9,319	9,359	9,430	9,347	9,372	9,434
	Induced	14,638	15,038	15,338	15,830	16,211	16,572	16,811	17,153	17,238	17,173	17,091	17,018	16,982	17,043	17,154	17,031	17,066	17,174
	Total	**51,669**	**52,756**	**53,461**	**54,841**	**55,804**	**56,684**	**57,117**	**57,912**	**57,977**	**57,541**	**57,067**	**56,654**	**56,398**	**56,487**	**56,743**	**56,186**	**56,202**	**56,489**
LA-4	Direct	15,857	16,154	16,319	16,714	16,971	17,213	17,306	17,525	17,553	17,421	17,266	17,133	17,048	17,074	17,128	16,966	16,962	17,058
	Indirect	6,663	6,870	7,046	7,312	7,532	7,754	7,930	8,150	8,220	8,228	8,222	8,210	8,215	8,279	8,363	8,316	8,360	8,434
	Induced	10,093	10,346	10,537	10,868	11,121	11,374	11,549	11,794	11,852	11,818	11,770	11,722	11,702	11,768	11,857	11,763	11,802	11,892
	Total	**32,613**	**33,370**	**33,903**	**34,893**	**35,624**	**36,341**	**36,785**	**37,469**	**37,625**	**37,467**	**37,259**	**37,065**	**36,965**	**37,120**	**37,347**	**37,044**	**37,124**	**37,383**
MS-1	Direct	2,037	2,072	2,092	2,136	2,164	2,187	2,193	2,212	2,206	2,181	2,156	2,134	2,120	2,118	2,124	2,097	2,094	2,102
	Indirect	336	340	341	347	349	351	350	351	349	344	339	335	332	331	331	326	326	326
	Induced	764	780	790	810	824	837	843	854	854	846	839	832	828	828	831	823	823	827
	Total	**3,138**	**3,192**	**3,223**	**3,294**	**3,337**	**3,375**	**3,385**	**3,417**	**3,408**	**3,371**	**3,333**	**3,301**	**3,279**	**3,278**	**3,287**	**3,246**	**3,243**	**3,255**
TX-1	Direct	3,440	3,552	3,639	3,768	3,867	3,956	4,017	4,099	4,119	4,100	4,080	4,064	4,056	4,063	4,087	4,055	4,061	4,080
	Indirect	798	822	842	871	893	914	928	947	950	946	941	937	935	937	944	935	937	942
	Induced	1,619	1,686	1,743	1,819	1,883	1,942	1,989	2,046	2,066	2,066	2,065	2,064	2,066	2,076	2,092	2,083	2,090	2,104
	Total	**5,857**	**6,060**	**6,224**	**6,458**	**6,643**	**6,812**	**6,934**	**7,092**	**7,134**	**7,112**	**7,086**	**7,066**	**7,057**	**7,076**	**7,124**	**7,073**	**7,088**	**7,126**
TX-2	Direct	3,516	3,679	3,820	4,003	4,160	4,307	4,425	4,565	4,622	4,633	4,637	4,643	4,651	4,675	4,717	4,707	4,728	4,761
	Indirect	669	700	728	763	794	825	851	881	892	896	899	900	903	910	923	920	927	935
	Induced	1,193	1,259	1,319	1,394	1,461	1,525	1,581	1,644	1,672	1,684	1,693	1,701	1,708	1,722	1,743	1,744	1,755	1,771
	Total	**5,378**	**5,638**	**5,867**	**6,161**	**6,415**	**6,657**	**6,857**	**7,090**	**7,186**	**7,214**	**7,229**	**7,244**	**7,262**	**7,307**	**7,383**	**7,371**	**7,410**	**7,467**
TX-3	Direct	46,115	47,126	47,823	49,003	49,692	50,166	50,303	50,611	50,358	49,704	49,116	48,601	48,206	48,125	48,348	47,593	47,624	47,726
	Indirect	21,918	22,528	23,011	23,721	24,240	24,702	25,019	25,435	25,440	25,269	25,116	24,979	24,907	24,982	25,170	24,893	24,971	25,099
	Induced	33,709	34,496	35,079	36,006	36,622	37,137	37,416	37,841	37,728	37,354	37,024	36,734	36,551	36,600	36,839	36,338	36,406	36,554
	Total	**101,742**	**104,150**	**105,913**	**108,730**	**110,554**	**112,005**	**112,738**	**113,887**	**113,526**	**112,327**	**111,256**	**110,313**	**109,664**	**109,707**	**110,357**	**108,825**	**109,002**	**109,379**
Total EIA	Direct	141,561	144,801	146,981	150,956	153,659	155,983	157,115	159,133	159,219	157,894	156,503	155,303	154,487	154,597	155,238	153,621	153,695	154,370
	Indirect	49,665	51,001	52,049	53,693	54,945	56,121	56,939	58,045	58,215	57,948	57,663	57,390	57,264	57,505	57,934	57,414	57,593	57,953
	Induced	85,035	87,438	89,299	92,202	94,413	96,467	97,871	99,784	100,149	99,698	99,201	98,761	98,546	98,899	99,572	98,747	99,003	99,596
	Total	**276,261**	**283,240**	**288,329**	**296,851**	**303,018**	**308,571**	**311,925**	**316,962**	**317,583**	**315,540**	**313,367**	**311,455**	**310,297**	**311,001**	**312,744**	**309,782**	**310,291**	**311,919**
Other-GOM	Direct	37,459	37,997	38,241	38,973	39,359	39,652	39,617	39,852	39,695	39,159	38,617	38,165	37,833	37,759	37,810	37,314	37,255	37,348
	Indirect	19,012	19,193	19,232	19,522	19,632	19,699	19,605	19,656	19,539	19,230	18,913	18,642	18,438	18,384	18,376	18,123	18,095	18,130
	Induced	30,407	30,864	31,101	31,736	32,095	32,388	32,428	32,693	32,614	32,219	31,802	31,448	31,188	31,154	31,201	30,851	30,845	30,945
	Total	**86,877**	**88,054**	**88,574**	**90,231**	**91,086**	**91,739**	**91,650**	**92,200**	**91,847**	**90,608**	**89,332**	**88,256**	**87,458**	**87,297**	**87,386**	**86,288**	**86,195**	**86,422**
Other-US	Direct	40,140	40,993	41,655	42,866	43,742	44,556	45,113	45,992	46,154	45,904	45,541	45,128	44,820	44,982	45,291	44,974	45,226	45,532
	Indirect	47,579	48,694	49,590	51,131	52,282	53,357	54,150	55,317	55,569	55,336	54,968	54,537	54,237	54,462	54,795	54,485	54,811	55,193
	Induced	93,831	95,987	97,702	100,683	102,895	104,959	106,440	108,658	109,127	108,633	107,885	107,021	106,408	106,837	107,552	106,894	107,507	108,251
	Total	**181,550**	**185,674**	**188,946**	**194,680**	**198,919**	**202,872**	**205,703**	**209,967**	**210,850**	**209,873**	**208,395**	**206,686**	**205,465**	**206,280**	**207,638**	**206,353**	**207,544**	**208,975**

Source: Employment output from MMS's economic impact model MAG-PLAN.

Table 4-28b

High-Case Employment Projected for the OCS Program by Economic Impact Area (Years 19-38)

EIA	Type	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
AL-1	Direct	4,242	4,240	4,241	4,259	4,275	4,303	4,316	4,323	4,324	4,323	4,341	4,345	4,355	4,370	4,365	4,359	4,358	4,367	4,363	4,367
	Indirect	881	881	881	885	888	895	897	899	898	898	902	902	905	908	907	904	904	907	905	906
	Induced	2,182	2,183	2,186	2,197	2,207	2,224	2,234	2,240	2,243	2,245	2,256	2,260	2,267	2,277	2,276	2,276	2,278	2,284	2,285	2,288
	Total	**7,305**	**7,304**	**7,308**	**7,341**	**7,371**	**7,422**	**7,448**	**7,463**	**7,466**	**7,466**	**7,499**	**7,508**	**7,526**	**7,555**	**7,548**	**7,539**	**7,539**	**7,557**	**7,553**	**7,561**
FL-1	Direct	1,254	1,257	1,261	1,269	1,276	1,287	1,295	1,301	1,306	1,309	1,316	1,321	1,326	1,333	1,335	1,337	1,340	1,345	1,347	1,351
	Indirect	242	243	243	244	246	248	249	250	251	251	252	253	254	256	256	255	255	256	256	257
	Induced	616	617	619	623	627	633	637	640	642	644	648	650	653	657	658	658	660	662	663	665
	Total	**2,112**	**2,117**	**2,123**	**2,136**	**2,149**	**2,168**	**2,181**	**2,191**	**2,199**	**2,204**	**2,216**	**2,224**	**2,234**	**2,246**	**2,249**	**2,250**	**2,255**	**2,263**	**2,267**	**2,273**
FL-2	Direct	533	532	532	534	536	540	541	542	541	540	543	543	545	546	546	541	541	543	542	542
	Indirect	148	149	149	150	150	152	152	153	153	153	154	154	155	156	156	155	155	156	156	156
	Induced	251	252	252	253	255	257	258	259	259	259	261	261	263	264	264	262	263	264	264	264
	Total	**932**	**933**	**932**	**937**	**941**	**948**	**952**	**954**	**953**	**953**	**958**	**959**	**962**	**966**	**967**	**959**	**959**	**962**	**961**	**962**
FL-3	Direct	1,071	1,071	1,072	1,077	1,083	1,091	1,096	1,100	1,100	1,102	1,107	1,109	1,113	1,119	1,119	1,117	1,118	1,121	1,122	1,124
	Indirect	365	366	366	368	369	373	374	376	375	376	378	378	380	382	382	381	381	383	383	383
	Induced	726	727	728	732	736	742	746	749	750	751	755	756	760	764	765	762	763	766	767	768
	Total	**2,162**	**2,164**	**2,166**	**2,177**	**2,188**	**2,206**	**2,217**	**2,225**	**2,225**	**2,228**	**2,239**	**2,244**	**2,253**	**2,264**	**2,266**	**2,260**	**2,262**	**2,270**	**2,271**	**2,275**
FL-4	Direct	310	308	307	309	312	317	320	322	321	320	321	322	324	327	328	323	324	326	326	327
	Indirect	171	171	171	172	173	176	177	178	178	178	179	179	180	182	182	181	181	182	182	183
	Induced	285	284	284	286	289	293	296	297	297	297	298	299	301	303	304	301	302	304	304	305
	Total	**766**	**764**	**762**	**766**	**774**	**786**	**793**	**798**	**796**	**794**	**798**	**800**	**805**	**811**	**815**	**805**	**808**	**812**	**813**	**815**
LA-1	Direct	3,533	3,532	3,536	3,553	3,570	3,596	3,611	3,620	3,628	3,629	3,644	3,649	3,657	3,673	3,669	3,674	3,676	3,685	3,687	3,693
	Indirect	634	635	636	639	642	647	650	652	653	654	657	658	660	663	663	663	664	667	667	668
	Induced	1,613	1,616	1,620	1,630	1,639	1,653	1,662	1,670	1,675	1,678	1,687	1,692	1,697	1,706	1,707	1,711	1,714	1,721	1,723	1,728
	Total	**5,780**	**5,783**	**5,793**	**5,822**	**5,851**	**5,897**	**5,923**	**5,942**	**5,956**	**5,961**	**5,989**	**5,999**	**6,014**	**6,043**	**6,040**	**6,049**	**6,055**	**6,072**	**6,076**	**6,089**
LA-2	Direct	37,978	37,969	38,016	38,206	38,395	38,690	38,860	38,969	39,043	39,059	39,224	39,282	39,364	39,547	39,507	39,528	39,548	39,649	39,662	39,734
	Indirect	10,391	10,409	10,429	10,491	10,546	10,626	10,676	10,713	10,731	10,748	10,806	10,826	10,861	10,911	10,911	10,907	10,918	10,959	10,960	10,981
	Induced	23,742	23,790	23,859	24,003	24,142	24,339	24,470	24,575	24,659	24,710	24,842	24,910	24,989	25,120	25,127	25,192	25,234	25,320	25,354	25,421
	Total	**72,111**	**72,168**	**72,303**	**72,699**	**73,083**	**73,655**	**74,006**	**74,257**	**74,433**	**74,517**	**74,872**	**75,019**	**75,214**	**75,578**	**75,546**	**75,627**	**75,699**	**75,927**	**75,976**	**76,137**
LA-3	Direct	29,938	29,905	29,896	30,013	30,112	30,297	30,375	30,404	30,385	30,362	30,479	30,485	30,538	30,635	30,574	30,497	30,471	30,531	30,489	30,504
	Indirect	9,476	9,498	9,515	9,572	9,623	9,701	9,746	9,780	9,787	9,804	9,861	9,875	9,912	9,958	9,961	9,950	9,962	10,006	10,006	10,027
	Induced	17,245	17,272	17,303	17,399	17,485	17,621	17,698	17,756	17,781	17,806	17,899	17,930	17,987	18,069	18,067	18,069	18,086	18,149	18,153	18,189
	Total	**56,659**	**56,675**	**56,714**	**56,984**	**57,220**	**57,619**	**57,819**	**57,940**	**57,953**	**57,972**	**58,238**	**58,290**	**58,437**	**58,661**	**58,602**	**58,516**	**58,519**	**58,686**	**58,649**	**58,720**
LA-4	Direct	17,098	17,077	17,079	17,156	17,222	17,339	17,389	17,416	17,404	17,409	17,470	17,464	17,488	17,552	17,507	17,511	17,497	17,543	17,519	17,538
	Indirect	8,485	8,519	8,548	8,610	8,666	8,747	8,797	8,843	8,857	8,891	8,949	8,968	9,009	9,059	9,071	9,083	9,103	9,155	9,162	9,192
	Induced	11,950	11,979	12,006	12,082	12,148	12,249	12,306	12,355	12,358	12,393	12,463	12,476	12,523	12,582	12,583	12,590	12,604	12,666	12,662	12,692
	Total	**37,534**	**37,575**	**37,633**	**37,848**	**38,036**	**38,334**	**38,493**	**38,614**	**38,619**	**38,692**	**38,882**	**38,908**	**39,020**	**39,193**	**39,161**	**39,184**	**39,203**	**39,364**	**39,344**	**39,422**
MS-1	Direct	2,106	2,104	2,104	2,112	2,119	2,133	2,138	2,141	2,139	2,138	2,147	2,148	2,154	2,161	2,158	2,149	2,148	2,152	2,150	2,150
	Indirect	327	326	326	327	328	330	331	331	330	330	331	331	332	333	333	330	330	331	330	330
	Induced	829	829	829	833	837	843	846	847	847	848	851	853	855	859	858	855	856	858	857	858
	Total	**3,262**	**3,260**	**3,259**	**3,273**	**3,284**	**3,306**	**3,315**	**3,320**	**3,317**	**3,316**	**3,330**	**3,332**	**3,341**	**3,352**	**3,349**	**3,335**	**3,333**	**3,341**	**3,337**	**3,338**
TX-1	Direct	4,095	4,099	4,106	4,125	4,142	4,172	4,187	4,200	4,204	4,211	4,231	4,240	4,255	4,273	4,273	4,271	4,274	4,287	4,288	4,296
	Indirect	946	948	950	955	959	967	970	974	974	976	982	984	988	992	993	992	993	997	998	1,000
	Induced	2,114	2,120	2,126	2,138	2,149	2,166	2,177	2,186	2,192	2,198	2,210	2,217	2,226	2,237	2,240	2,243	2,248	2,256	2,259	2,265
	Total	**7,155**	**7,167**	**7,182**	**7,218**	**7,251**	**7,305**	**7,335**	**7,360**	**7,370**	**7,385**	**7,423**	**7,441**	**7,469**	**7,502**	**7,506**	**7,505**	**7,515**	**7,540**	**7,545**	**7,561**
TX-2	Direct	4,786	4,798	4,814	4,841	4,870	4,912	4,939	4,963	4,979	4,992	5,020	5,037	5,058	5,086	5,092	5,104	5,117	5,135	5,146	5,161
	Indirect	942	947	952	959	966	976	982	989	991	996	1,003	1,007	1,013	1,019	1,022	1,023	1,027	1,034	1,036	1,040
	Induced	1,783	1,790	1,799	1,811	1,823	1,841	1,853	1,865	1,873	1,881	1,893	1,900	1,910	1,922	1,926	1,934	1,940	1,949	1,954	1,962
	Total	**7,511**	**7,536**	**7,565**	**7,611**	**7,659**	**7,729**	**7,774**	**7,816**	**7,843**	**7,869**	**7,915**	**7,944**	**7,980**	**8,026**	**8,040**	**8,061**	**8,084**	**8,118**	**8,136**	**8,164**
TX-3	Direct	47,805	47,802	47,790	47,940	48,086	48,430	48,519	48,623	48,436	48,492	48,702	48,748	48,973	49,126	49,149	48,803	48,802	48,962	48,898	48,935
	Indirect	25,221	25,311	25,375	25,523	25,651	25,857	25,970	26,078	26,069	26,156	26,323	26,391	26,531	26,651	26,699	26,610	26,661	26,793	26,804	26,867
	Induced	36,696	36,794	36,854	37,042	37,198	37,475	37,602	37,725	37,659	37,759	37,978	38,048	38,238	38,385	38,430	38,241	38,284	38,458	38,440	38,504
	Total	**109,722**	**109,907**	**110,019**	**110,504**	**110,935**	**111,762**	**112,092**	**112,426**	**112,163**	**112,407**	**113,004**	**113,186**	**113,741**	**114,162**	**114,278**	**113,654**	**113,746**	**114,213**	**114,142**	**114,307**
Total EIA	Direct	154,748	154,697	154,755	155,393	155,999	157,108	157,588	157,923	157,809	157,886	158,544	158,694	159,148	159,748	159,623	159,216	159,214	159,645	159,539	159,722
	Indirect	58,231	58,404	58,540	58,895	59,208	59,693	59,974	60,217	60,249	60,411	60,779	60,908	61,181	61,469	61,537	61,434	61,534	61,825	61,845	61,991
	Induced	100,032	100,253	100,466	101,028	101,535	102,337	102,786	103,166	103,235	103,469	104,040	104,252	104,669	105,143	105,205	105,095	105,230	105,656	105,687	105,911
	Total	**313,011**	**313,353**	**313,761**	**315,316**	**316,742**	**319,138**	**320,347**	**321,306**	**321,292**	**321,766**	**323,363**	**323,854**	**324,998**	**326,360**	**326,365**	**325,744**	**325,978**	**327,126**	**327,071**	**327,624**
Other-GOM	Direct	37,370	37,278	37,222	37,334	37,451	37,691	37,776	37,804	37,732	37,673	37,798	37,810	37,893	38,019	37,969	37,788	37,758	37,822	37,769	37,776
	Indirect	18,121	18,045	17,996	18,041	18,101	18,226	18,269	18,277	18,230	18,177	18,226	18,229	18,264	18,329	18,305	18,196	18,180	18,203	18,174	18,172
	Induced	30,973	30,892	30,852	30,954	31,077	31,308	31,407	31,454	31,415	31,366	31,471	31,501	31,578	31,705	31,683	31,549	31,545	31,603	31,580	31,600
	Total	**86,464**	**86,215**	**86,070**	**86,328**	**86,629**	**87,226**	**87,452**	**87,534**	**87,377**	**87,216**	**87,495**	**87,541**	**87,736**	**88,053**	**87,957**	**87,532**	**87,483**	**87,628**	**87,523**	**87,548**
Other-US	Direct	45,657	45,610	45,610	45,832	46,153	46,672	46,962	47,168	47,172	47,150	47,359	47,469	47,678	47,969	48,065	47,813	47,909	48,085	48,136	48,250
	Indirect	55,377	55,348	55,383	55,672	56,085	56,718	57,102	57,381	57,443	57,446	57,720	57,902	58,168	58,539	58,685	58,410	58,556	58,775	58,871	59,027
	Induced	108,597	108,545	108,603	109,160	109,941	111,161	111,879	112,399	112,491	112,479	113,006	113,324	113,825	114,531	114,778	114,271	114,533	114,955	115,117	115,410
	Total	**209,631**	**209,503**	**209,596**	**210,664**	**212,179**	**214,551**	**215,944**	**216,947**	**217,107**	**217,075**	**218,085**	**218,695**	**219,671**	**221,039**	**221,528**	**220,494**	**220,999**	**221,815**	**222,123**	**222,686**

Source: Employment output from MMS's economic impact model MAG-PLAN.

Table 4-29

Total Employment Estimates for Proposed
Lease Sale 224-Low and High Scenario

Year	Low Employment Estimate	High Employment Estimate
2008	0.0	2.2
2009	0.0	86.1
2010	63.2	86.6
2011	268.2	325.7
2012	394.7	794.1
2013	258.6	287.6
2014	2.5	11.6
2015	62.7	96.2
2016	2.2	21.3
2017	3.4	102.1
2018	4.7	38.8
2019	4.7	337.5
2020	5.9	381.4
2021	11.0	356.6
2022	13.4	162.1
2023	15.3	96.0
2024	16.1	367.2
2025	277.9	699.6
2026	24.3	942.7
2027	26.9	395.9
2028	26.8	136.5
2029	38.6	132.9
2030	26.8	398.4
2031	37.2	119.3
2032	16.3	388.6
2033	16.2	437.5
2034	16.2	106.7
2035	10.9	123.6
2036	10.9	371.5
2037	5.5	97.0
2038	5.5	67.8
2039	5.5	38.6
2040	5.5	44.6
2041	5.5	17.0
2042	0.1	11.7
2043	0.1	6.1
2044	0.1	0.6
2045	0.1	0.5
2046	15.7	16.1
2047	0.0	0.3

Source: 10% of total employment estimates in Lease Sale 181 FEIS (USDOI, MMS, 2001a; Table IV-26).

Table 4-30

Employment Projected from a Proposed CPA Lease Sale as a Percent of Total Employment by Economic Impact Area

Year	AL-1	MS-1	LA-1	LA-2	LA-3	LA-4	TX-1	TX-2	TX-3	FL-1	FL-2	FL-3	FL-4
2009	0.02%	0.03%	0.05%	0.03%	0.01%	0.01%	0.01%	0.03%	0.00%	0.02%	0.02%	0.00%	0.00%
2010	0.02%	0.03%	0.05%	0.03%	0.01%	0.01%	0.01%	0.03%	0.00%	0.02%	0.02%	0.00%	0.00%
2011	0.08%	0.12%	0.17%	0.10%	0.05%	0.05%	0.04%	0.10%	0.01%	0.06%	0.09%	0.01%	0.01%
2012	0.19%	0.28%	0.41%	0.24%	0.11%	0.11%	0.10%	0.24%	0.02%	0.14%	0.22%	0.04%	0.02%
2013	0.07%	0.10%	0.15%	0.08%	0.04%	0.04%	0.03%	0.09%	0.01%	0.05%	0.08%	0.01%	0.01%
2014	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2015	0.02%	0.03%	0.05%	0.03%	0.01%	0.01%	0.01%	0.03%	0.00%	0.02%	0.03%	0.00%	0.00%
2016	0.00%	0.01%	0.01%	0.01%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.01%	0.00%	0.00%
2017	0.02%	0.03%	0.05%	0.03%	0.01%	0.01%	0.01%	0.03%	0.00%	0.02%	0.03%	0.00%	0.00%
2018	0.01%	0.01%	0.02%	0.01%	0.01%	0.00%	0.00%	0.01%	0.00%	0.01%	0.01%	0.00%	0.00%
2019	0.08%	0.11%	0.16%	0.09%	0.04%	0.04%	0.04%	0.09%	0.01%	0.05%	0.08%	0.01%	0.01%
2020	0.08%	0.12%	0.18%	0.10%	0.05%	0.04%	0.04%	0.10%	0.01%	0.06%	0.09%	0.01%	0.01%
2021	0.08%	0.11%	0.17%	0.10%	0.05%	0.04%	0.04%	0.10%	0.01%	0.05%	0.09%	0.01%	0.01%
2022	0.04%	0.05%	0.07%	0.04%	0.02%	0.02%	0.02%	0.04%	0.00%	0.02%	0.04%	0.01%	0.00%
2023	0.02%	0.03%	0.04%	0.03%	0.01%	0.01%	0.01%	0.03%	0.00%	0.01%	0.02%	0.00%	0.00%
2024	0.08%	0.11%	0.17%	0.10%	0.05%	0.04%	0.04%	0.10%	0.01%	0.05%	0.09%	0.01%	0.01%
2025	0.15%	0.21%	0.31%	0.18%	0.09%	0.07%	0.07%	0.18%	0.02%	0.10%	0.16%	0.03%	0.01%
2026	0.20%	0.28%	0.42%	0.24%	0.12%	0.09%	0.09%	0.24%	0.02%	0.13%	0.21%	0.03%	0.02%
2027	0.08%	0.12%	0.17%	0.10%	0.05%	0.04%	0.04%	0.10%	0.01%	0.05%	0.09%	0.01%	0.01%
2028	0.03%	0.04%	0.06%	0.03%	0.02%	0.01%	0.01%	0.03%	0.00%	0.02%	0.03%	0.00%	0.00%
2029	0.03%	0.04%	0.06%	0.03%	0.02%	0.01%	0.01%	0.03%	0.00%	0.02%	0.03%	0.00%	0.00%
2030	0.08%	0.11%	0.17%	0.10%	0.05%	0.04%	0.04%	0.10%	0.01%	0.05%	0.09%	0.01%	0.01%
2031	0.02%	0.03%	0.05%	0.03%	0.01%	0.01%	0.01%	0.03%	0.00%	0.01%	0.03%	0.00%	0.00%
2032	0.08%	0.11%	0.16%	0.09%	0.05%	0.03%	0.03%	0.09%	0.01%	0.05%	0.08%	0.01%	0.01%
2033	0.09%	0.12%	0.18%	0.10%	0.05%	0.04%	0.04%	0.10%	0.01%	0.05%	0.09%	0.01%	0.01%
2034	0.02%	0.03%	0.04%	0.02%	0.01%	0.01%	0.01%	0.02%	0.00%	0.01%	0.02%	0.00%	0.00%
2035	0.02%	0.03%	0.05%	0.03%	0.01%	0.01%	0.01%	0.03%	0.00%	0.01%	0.02%	0.00%	0.00%
2036	0.07%	0.10%	0.15%	0.09%	0.04%	0.03%	0.03%	0.08%	0.01%	0.04%	0.07%	0.01%	0.01%
2037	0.02%	0.02%	0.04%	0.02%	0.01%	0.01%	0.01%	0.02%	0.00%	0.01%	0.02%	0.00%	0.00%
2038	0.01%	0.02%	0.03%	0.02%	0.01%	0.01%	0.01%	0.01%	0.00%	0.01%	0.01%	0.00%	0.00%
2039	0.01%	0.01%	0.01%	0.01%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.01%	0.00%	0.00%
2040	0.01%	0.01%	0.02%	0.01%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.01%	0.00%	0.00%
2041	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2042	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2043	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2044	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2045	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2046	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2047	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2048	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Source: Employment output from MMS's economic impact model MAG-PLAN as a percentage of baseline employment projections based on Woods & Poole Economics, Inc. (2006).

Table 4-31

Employment Projected for the OCS Program as a Percent of Total Employment by Economic Impact Area

Calendar	AL-1	MS-1	LA-1	LA-2	LA-3	LA-4	TX-1	TX-2	TX-3	FL-1	FL-2	FL-3	FL-4
Year	Low High	Low High	Low High	Low High	Low High	Low High	Low High	Low High	Low High	Low High	Low High	Low High	Low High
2009	1.3 - 1.7	0.9 - 1.2	2.0 - 2.6	14.5 - 19.0	5.7 - 7.7	4.0 - 5.3	0.6 - 0.8	1.4 - 1.8	2.2 - 3.1	0.2 - 0.3	0.2 - 0.3	0.1 - 0.0	0.0 - 1.6
2010	1.4 - 1.7	0.9 - 1.2	2.1 - 2.7	15.1 - 19.4	6.0 - 7.7	4.1 - 5.3	0.6 - 0.8	1.5 - 1.9	2.2 - 3.1	0.3 - 0.3	0.2 - 0.3	0.1 - 0.0	0.0 - 1.6
2011	1.3 - 1.7	0.9 - 1.2	2.1 - 2.7	14.9 - 19.5	5.8 - 7.8	3.9 - 5.2	0.6 - 0.8	1.5 - 1.9	2.2 - 3.1	0.3 - 0.3	0.2 - 0.3	0.1 - 0.0	0.0 - 1.6
2012	1.4 - 1.8	1.0 - 1.2	2.2 - 2.8	15.6 - 20.0	6.1 - 7.9	4.1 - 5.2	0.6 - 0.8	1.5 - 2.0	2.3 - 3.1	0.3 - 0.3	0.2 - 0.3	0.1 - 0.0	0.0 - 1.6
2013	1.4 - 1.8	0.9 - 1.2	2.2 - 2.8	15.6 - 20.3	6.0 - 8.0	3.9 - 5.2	0.6 - 0.8	1.6 - 2.0	2.2 - 3.1	0.3 - 0.3	0.2 - 0.3	0.1 - 0.0	0.0 - 1.6
2014	1.4 - 1.8	1.0 - 1.2	2.3 - 2.8	16.2 - 20.5	6.3 - 8.0	4.1 - 5.1	0.7 - 0.8	1.6 - 2.1	2.3 - 3.1	0.3 - 0.3	0.2 - 0.3	0.1 - 0.0	0.0 - 1.7
2015	1.4 - 1.8	0.9 - 1.2	2.2 - 2.9	16.0 - 20.6	6.2 - 8.0	3.9 - 5.1	0.6 - 0.8	1.6 - 2.1	2.3 - 3.0	0.3 - 0.3	0.2 - 0.3	0.1 - 0.0	0.0 - 1.6
2016	1.4 - 1.8	1.0 - 1.2	2.3 - 2.9	16.6 - 20.8	6.4 - 8.0	4.0 - 5.0	0.7 - 0.8	1.7 - 2.1	2.3 - 3.0	0.3 - 0.3	0.2 - 0.3	0.1 - 0.0	0.0 - 1.7
2017	1.4 - 1.8	0.9 - 1.2	2.3 - 2.9	16.3 - 20.8	6.2 - 8.0	3.8 - 4.9	0.6 - 0.8	1.7 - 2.1	2.3 - 3.0	0.3 - 0.3	0.2 - 0.3	0.1 - 0.0	0.0 - 1.6
2018	1.4 - 1.7	0.9 - 1.2	2.3 - 2.8	16.5 - 20.5	6.3 - 7.8	3.9 - 4.8	0.7 - 0.8	1.7 - 2.1	2.3 - 2.9	0.3 - 0.3	0.2 - 0.3	0.1 - 0.0	0.0 - 1.7
2019	1.4 - 1.7	0.9 - 1.1	2.2 - 2.8	15.9 - 20.2	6.1 - 7.7	3.6 - 4.6	0.6 - 0.8	1.6 - 2.1	2.2 - 2.8	0.3 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 1.6
2020	1.4 - 1.7	0.9 - 1.1	2.2 - 2.8	16.1 - 19.9	6.2 - 7.6	3.7 - 4.5	0.6 - 0.8	1.7 - 2.1	2.2 - 2.8	0.3 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 1.6
2021	1.3 - 1.7	0.9 - 1.1	2.2 - 2.7	15.7 - 19.6	6.0 - 7.5	3.5 - 4.4	0.6 - 0.8	1.6 - 2.0	2.1 - 2.7	0.3 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 1.5
2022	1.4 - 1.6	0.9 - 1.1	2.2 - 2.7	15.9 - 19.5	6.1 - 7.4	3.5 - 4.3	0.6 - 0.8	1.6 - 2.0	2.1 - 2.7	0.3 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 1.6
2023	1.3 - 1.6	0.8 - 1.0	2.2 - 2.7	15.6 - 19.4	6.0 - 7.4	3.4 - 4.2	0.6 - 0.8	1.6 - 2.0	2.1 - 2.6	0.3 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 1.5
2024	1.3 - 1.6	0.8 - 1.0	2.1 - 2.7	15.4 - 19.1	5.9 - 7.3	3.3 - 4.1	0.6 - 0.7	1.6 - 2.0	2.0 - 2.6	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 1.5
2025	1.3 - 1.6	0.8 - 1.0	2.1 - 2.6	15.2 - 18.9	5.8 - 7.2	3.2 - 4.0	0.6 - 0.7	1.6 - 2.0	2.0 - 2.5	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 1.5
2026	1.3 - 1.6	0.8 - 1.0	2.1 - 2.6	15.2 - 18.8	5.8 - 7.2	3.2 - 3.9	0.6 - 0.7	1.6 - 2.0	2.0 - 2.5	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 1.4
2027	1.3 - 1.6	0.8 - 1.0	2.1 - 2.6	15.0 - 18.7	5.7 - 7.2	3.1 - 3.9	0.6 - 0.7	1.6 - 2.0	1.9 - 2.5	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 1.4
2028	1.2 - 1.5	0.8 - 1.0	2.1 - 2.6	14.8 - 18.6	5.7 - 7.1	3.0 - 3.8	0.6 - 0.7	1.5 - 1.9	1.9 - 2.5	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 1.4
2029	1.2 - 1.5	0.8 - 1.0	2.0 - 2.6	14.7 - 18.4	5.6 - 7.1	3.0 - 3.7	0.6 - 0.7	1.5 - 1.9	1.9 - 2.4	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 1.4
2030	1.2 - 1.5	0.8 - 1.0	2.0 - 2.5	14.6 - 18.3	5.6 - 7.0	2.9 - 3.7	0.6 - 0.7	1.5 - 1.9	1.9 - 2.4	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 1.4
2031	1.2 - 1.5	0.7 - 0.9	2.0 - 2.5	14.5 - 18.2	5.6 - 7.0	2.9 - 3.6	0.5 - 0.7	1.5 - 1.9	1.9 - 2.4	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 1.4
2032	1.2 - 1.5	0.7 - 0.9	2.0 - 2.5	14.5 - 18.2	5.6 - 7.0	2.8 - 3.6	0.5 - 0.7	1.5 - 1.9	1.8 - 2.4	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 1.3
2033	1.2 - 1.5	0.7 - 0.9	2.0 - 2.5	14.4 - 18.1	5.6 - 7.0	2.8 - 3.5	0.5 - 0.7	1.5 - 1.9	1.8 - 2.3	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 1.3
2034	1.2 - 1.5	0.7 - 0.9	2.0 - 2.5	14.2 - 17.9	5.5 - 6.9	2.7 - 3.5	0.5 - 0.7	1.5 - 1.9	1.8 - 2.3	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 1.3
2035	1.2 - 1.5	0.7 - 0.9	2.0 - 2.5	14.1 - 17.8	5.5 - 6.9	2.7 - 3.4	0.5 - 0.7	1.5 - 1.9	1.8 - 2.3	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 1.3
2036	1.2 - 1.5	0.7 - 0.9	2.0 - 2.4	14.1 - 17.6	5.5 - 6.8	2.6 - 3.3	0.5 - 0.7	1.5 - 1.8	1.8 - 2.3	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 1.3
2037	1.2 - 1.5	0.7 - 0.9	1.9 - 2.4	14.0 - 17.5	5.4 - 6.8	2.6 - 3.3	0.5 - 0.6	1.5 - 1.8	1.7 - 2.2	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 1.3
2038	1.1 - 1.4	0.7 - 0.9	1.9 - 2.4	13.8 - 17.4	5.4 - 6.8	2.5 - 3.2	0.5 - 0.6	1.4 - 1.8	1.7 - 2.2	0.2 - 0.3	0.2 - 0.2	0.1 - 0.0	0.0 - 1.3
2039	1.1 - 1.4	0.7 - 0.9	1.9 - 2.4	13.7 - 17.3	5.3 - 6.7	2.5 - 3.1	0.5 - 0.6	1.4 - 1.8	1.7 - 2.2	0.2 - 0.3	0.1 - 0.2	0.1 - 0.0	0.0 - 1.2
2040	1.1 - 1.4	0.7 - 0.9	1.9 - 2.4	13.6 - 17.2	5.3 - 6.7	2.4 - 3.1	0.5 - 0.6	1.4 - 1.8	1.7 - 2.2	0.2 - 0.3	0.1 - 0.2	0.1 - 0.0	0.0 - 1.2
2041	1.1 - 1.4	0.7 - 0.8	1.9 - 2.4	13.5 - 17.0	5.3 - 6.6	2.4 - 3.0	0.5 - 0.6	1.4 - 1.8	1.7 - 2.1	0.2 - 0.3	0.1 - 0.2	0.1 - 0.0	0.0 - 1.2
2042	1.1 - 1.4	0.6 - 0.8	1.8 - 2.3	13.3 - 16.8	5.2 - 6.6	2.3 - 3.0	0.5 - 0.6	1.4 - 1.8	1.6 - 2.1	0.2 - 0.2	0.1 - 0.2	0.1 - 0.0	0.0 - 1.2
2043	1.1 - 1.4	0.6 - 0.8	1.8 - 2.3	13.2 - 16.7	5.1 - 6.5	2.3 - 2.9	0.5 - 0.6	1.4 - 1.7	1.6 - 2.1	0.2 - 0.2	0.1 - 0.2	0.1 - 0.0	0.0 - 1.2
2044	1.1 - 1.4	0.6 - 0.8	1.8 - 2.3	13.1 - 16.5	5.1 - 6.5	2.2 - 2.8	0.5 - 0.6	1.4 - 1.7	1.6 - 2.1	0.2 - 0.2	0.1 - 0.2	0.1 - 0.0	0.0 - 1.2
2045	1.1 - 1.4	0.6 - 0.8	1.8 - 2.3	13.0 - 16.4	5.1 - 6.4	2.2 - 2.8	0.5 - 0.6	1.4 - 1.7	1.6 - 2.0	0.2 - 0.2	0.1 - 0.2	0.1 - 0.0	0.0 - 1.1
2046	1.1 - 1.4	0.6 - 0.8	1.8 - 2.3	12.9 - 16.2	5.0 - 6.4	2.1 - 2.7	0.5 - 0.6	1.3 - 1.7	1.6 - 2.0	0.2 - 0.2	0.1 - 0.2	0.0 - 0.0	0.0 - 1.1

Source: Employment output from MMS's economic impact model MAG-Plan as a percentages of baseline employment projections based on Woods & Poole Economics, Inc. (2006).

Appendix E

Essential Fish Habitat Consultation

ORD

LE

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

SOUTHEAST REGIONAL OFFICE
263 13th Avenue South
St. Petersburg, Florida 33701-5511
(727)824-5317; FAX (727) 824-5300
http://sero.nmfs.noaa.gov/

July 19, 2007 F/SER4:RR/dd

Mr. Lars Herbst
Acting Regional Director
Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Blvd.
New Orleans, Louisiana 70123-2394

Dear Mr. Herbst:

The National Marine Fisheries Service (NMFS) has received the Minerals Management Service (MMS) letter of June 26, 2007, concerning future lease sales which will encompass a small portion of the Eastern Planning Area (EPA) of the Gulf of Mexico. Essential fish habitat (EFH) consultation, pursuant to the requirements of the Magnuson-Stevens Fishery Conservation and Management Act, previously was conducted for the area of concern. Your office now is proposing to amend the EFH programmatic agreement, developed jointly by MMS and NMFS for the Western and Central Planning Areas, to incorporate 134 blocks or partial blocks of the EPA, all located west of the Military Mission Line.

As proposed by your letter, the EFH conservation recommendations to which our agencies agreed and as specified in the NMFS letter of July 1, 1999, and the MMS letter of August 12, 1999, would apply to the additional blocks in the EPA. Based on our review of our previous EFH programmatic consultation and the information provided in your June 26, 2007, letter and the accompanying supplemental draft environmental impact statement for Lease Sale 224, we have no objection to amending our agencies' current EFH agreement as you have proposed. However, it should be noted that, because the Gulf of Mexico Fishery Management Council formally revised the generic EFH amendment to their fishery management plans, the subject area only contains EFH for certain tuna, billfish, and shark species managed by NMFS and common to deep water areas of the Gulf of Mexico (see enclosed guidance document).

This coordination letter should be appended to the EFH programmatic consultation documents in your files. No further EFH consultation will be required for operational activities within that portion of the EPA defined by Lease Sale 224 boundaries that are covered by and consistent with provisions of our previous programmatic consultation.

Thank you for initiating this EFH review to allow consideration of the need to amend the programmatic consultation between the MMS Gulf of Mexico OCS Region and the NMFS. If you have any questions regarding this letter or other EFH issues, please contact Rickey N. Ruebsamen, my EFH Coordinator, at 850/234-5061.

Sincerely,

Miles M. Croom

Miles M. Croom
Assistant Regional Administrator
Habitat Conservation Division

Enclosure.

Essential Fish Habitat:

A Marine Fish Habitat Conservation Mandate For Federal Agencies

Gulf of Mexico Region

National Marine Fisheries Service
Habitat Conservation Division
Southeast Regional Office
263 13th Avenue S.
St. Petersburg, FL 33701
727/824-5317

March 2006

Executive Summary

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) set forth a new mandate for NOAA's National Marine Fisheries Service (NMFS), regional fishery management councils (FMC), and other federal agencies to identify and protect important marine and anadromous fish habitat. The essential fish habitat (EFH) provisions of the Magnuson-Stevens Act support one of the nation's overall marine resource management goals - maintaining sustainable fisheries. Essential to achieving this goal is the maintenance of suitable marine fishery habitat quality and quantity. The FMCs, with assistance from NMFS, have delineated EFH for federally managed species. As new fishery management plans (FMPs) are developed, EFH for newly managed species will be defined as well. Federal action agencies which fund, permit, or carry out activities that may adversely affect EFH are required to consult with NMFS regarding the potential impacts of their actions on EFH and respond in writing to NMFS or FMC recommendations. In addition, NMFS and the FMCs may comment on and make recommendations to any state agency on their activities that may affect EFH. Measures recommended by NMFS or an FMC to protect EFH are advisory, not proscriptive.

On December 19, 1997, interim final rules, which specified procedures for implementation of the EFH provisions of the Magnuson-Stevens Act, were published in the Federal Register. These rules were subsequently revised and published as a final rule on January 17, 2002 (67 FR 2343). The rules, in two subparts, address requirements for FMP amendment, and detail the coordination, consultation, and recommendation requirements of the Magnuson-Stevens Act.

Within the area encompassed by the NMFS Southeast Region, EFH has been identified for hundreds of marine species covered by 20 FMPs, under the auspices of the Gulf of Mexico, South Atlantic, or Caribbean FMC or the NMFS. A generic FMP amendment delineating EFH for species managed by the Gulf of Mexico FMC was completed and approved in early 1999. The generic FMP subsequently was updated and revised in 2005 and became effective in January 2006 (70 FR 76216). In addition, EFH for highly migratory species managed by the NMFS was identified in two Secretarial FMPs.

Wherever possible, NMFS intends to use existing interagency coordination processes to fulfill EFH consultations for federal agency actions that may adversely affect EFH. Provided certain regulatory specifications are met, EFH consultations will be incorporated into interagency procedures established under the National Environmental Policy Act, Endangered Species Act, Clean Water Act, Fish and Wildlife Coordination Act, or other applicable statutes. If existing processes cannot adequately address EFH consultation requirements, appropriate new procedures may be developed in cooperation with the NMFS. Programmatic consultations may be implemented or General Concurrences may be developed when program or project impacts are individually and cumulatively minimal in nature. Moreover, NMFS will work closely with federal agencies on programs requiring either expanded or abbreviated individual project consultations.

An effective, interagency EFH consultation process is vital to ensure that federal actions are consistent with the Magnuson-Stevens Act resource management goals. The NMFS will strive to work with action agencies to foster an understanding of EFH consultation requirements and identify the most efficient interagency mechanisms to fulfill agency responsibilities.

ESSENTIAL FISH HABITAT:

A Marine Fish Habitat Conservation Mandate for Federal Agencies
Gulf of Mexico Region

Introduction

This document has been prepared by the Southeast Regional Office of the NOAA's National Marine Fisheries Service (NMFS) to provide an overview of the essential fish habitat (EFH) provisions of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) and implementing rules. This document provides a brief legislative and regulatory background, introduces the concept of EFH, and describes consultation requirements. Consistent with elements of the NMFS's National Habitat Plan, Strategic Plan, and Habitat Conservation Policy, this document is intended to: provide a mechanism for information exchange; foster interagency discussion and problem-solving; and enhance communication and coordination among the NMFS, Gulf of Mexico Fishery Management Council (GMFMC), and affected state and federal agencies. Ultimately, improved interagency coordination and consultation will enhance the ability of the agencies, working cooperatively, to sustain healthy and productive marine fishery habitats.

Legislative and Regulatory Background

The 1996 amendments to the Magnuson-Stevens Act (excerpted at Appendix 1) set forth a new mandate to identify and protect important marine and anadromous fisheries habitat. The regional fishery management councils (FMC), with assistance from NMFS, are required to delineate EFH in fishery management plans (FMP) or FMP amendments for all federally managed fisheries. Federal action agencies which fund, permit, or carry out activities that may adversely affect EFH are required to consult with NMFS regarding potential adverse impacts of their actions on EFH, and respond in writing to NMFS and FMC recommendations. In addition, NMFS is directed to comment on any state agency activities that would impact EFH adversely.

The purpose of addressing habitat in this act is to further one of the nation's important marine resource management goals - maintaining sustainable fisheries. Achieving this goal requires the long-term maintenance of suitable marine fishery habitat quality and quantity. Measures recommended to protect EFH by NMFS or an FMC are advisory, not proscriptive. However, federal agencies that do not adopt EFH conservation recommendations must provide a written explanation setting forth the scientific basis for that decision. An effective EFH consultation process is vital to ensuring that federal actions are consistent with the Magnuson-Stevens Act resource management goals.

Guidance and procedures for implementing the 1996 amendments of the Magnuson-Stevens Act were provided through an interim final rule established by the NMFS in 1997 and published as a final rule in 2002 (50 CFR Sections 600.805 - 600.930). These rules specify that FMP amendments be prepared to describe and identify EFH and identify appropriate actions to conserve and enhance those habitats. In addition, the rules establish procedures to promote the protection of EFH through interagency coordination and consultation on proposed federal and state actions.

EFH Designation

The Magnuson-Stevens Act requires that EFH be identified for all fisheries that are federally managed. This includes species managed by the FMCs under federal FMPs, as well as those managed by the NMFS under FMPs developed by the Secretary of Commerce. EFH is defined in the Magnuson-Stevens Act as "...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The rules promulgated by the NMFS in 1997 and 2002 further clarify EFH with the following definitions: **waters** - aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; **substrate** - sediment, hard bottom, structures underlying the waters, and associated biological communities; **necessary** - the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and **spawning, breeding, feeding, or growth to maturity** - stages representing a species' full life cycle. EFH may be a subset of all areas occupied by a species. Acknowledging that the amount of information available for EFH determinations will vary for the different life stages of each species, the rules direct the FMCs to use the best information available, to take a risk averse approach to designations, and to be increasingly specific and narrow in their delineations as more refined information becomes available.

Applicable FMP authorities for the Gulf of Mexico, and species covered by those FMPs for which EFH was designated, are listed in Appendices 2 and 3. Species listed are those for which data were adequate or could be inferred to define and describe EFH. The listed species collectively occur throughout the areas managed by the NMFS and GMFMC; therefore, inclusion of additional species for which life history data are limited would be unlikely to encompass a greater geographic area. Representative areas designated as EFH by the GMFMC NMFS are presented in Appendix 4.

The rules also direct NMFS and FMCs to consider a second, more limited habitat designation for each species in addition to EFH. Habitat Areas of Particular Concern (HAPC) are described in the rules as subsets of EFH which are rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area. In general, HAPCs include high value intertidal and estuarine habitats, offshore areas of high habitat value or vertical relief, and habitats used for migration, spawning, and rearing of fish and shellfish. Areas identified as HAPC by the NMFS and the GMFMC are presented in Appendix 5. For a complete description of designated HAPC the reader should reference the GMFMC's 2005 generic amendment and the supporting environmental impact statement (see Appendix 8). HAPCs are not afforded any additional regulatory protection under the Magnuson-Stevens Act; however, federal actions with potential adverse impacts to HAPC will be more carefully scrutinized during the consultation process and will be subject to more stringent EFH conservation recommendations.

Designating the spatial and seasonal extent of EFH has taken careful and deliberate consideration by NMFS and the GMFMC. The effort to identify and delineate EFH was a rigorous process that involved advice and input by numerous state and federal agencies and the public at large. Appendix 6 presents generalized EFH designations based on species or species assemblage habitat requirements developed by the GMFMC. Summaries of highly migratory species and the associated categories of EFH for each life stage based on information developed by the NMFS are displayed in Appendix 7. These two appendices are intended to provide a convenient summary of habitat and geographic information on species managed by the GMFMC as well as for species managed by the NMFS, where EFH has been identified for the managed species within oceanic, coastal, and estuarine habitats of the Gulf of Mexico. For detailed discussions and descriptions, the reader should refer to the relevant FMP amendments and supporting environmental impact documents.

Additional sources of information, useful for preparing EFH assessments, and to further one's understanding of EFH designations and federally managed fishery resources, are available through the NMFS and GMFMC. Appendix 8 provides citations for the FMPs for the Gulf of Mexico and identifies web sites containing information on the Magnuson-Stevens Act, the NMFS final rules governing EFH designation and consultation, and data on specific managed fisheries and associated habitats. NMFS Southeast Region and FMC points of contact for activities within the Gulf of Mexico are identified in Appendix 9.

Besides delineating EFH, the FMPs produced for managed fisheries in the Gulf of Mexico identify and describe potential threats to EFH, which include threats from development, fishing, or any other sources. Also identified are recommend EFH conservation and enhancement measures. Guidelines used in the development of EFH amendment sections for each of these issues were established by the EFH rules.

NMFS and FMCs also are required to implement management measures to minimize, to the extent practicable, any adverse impacts to EFH caused by fishing gears. Those measures can include area closures, gear restrictions, seasonal restrictions, and other measures designed to avoid or minimize degradation of EFH attributable to fishing activities. Various protective measures have been imposed for some fisheries under NMFS and FMC jurisdiction and FMCs are coordinating with the NMFS to identify research necessary to determine where additional conservation measures might be appropriate.

EFH Consultations

In the regulatory context, one of the most important provisions of the Magnuson-Stevens Act for conserving fish habitat is that which requires consultation when actions to be permitted, funded, or undertaken by a federal agency may adversely impact EFH. The consultation requirements in the Magnuson-Stevens Act direct federal agencies to consult with NMFS when any of their activities may have an **adverse affect** on EFH and defines **adverse affect** as "any impact that reduces quality and/or quantity of EFH...[and] may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey, reduction in species' fecundity), site-specific or habitat wide impacts, including individual, cumulative, or synergistic consequences of actions."

The consultation provisions have caused some concern among federal action agencies regarding potential increases in workload and the regulatory burden on the public. NMFS has addressed these concerns in the EFH rules by emphasizing and encouraging the use of existing environmental review processes and time frames. Provided the specifications outlined in the EFH regulations are met, consultations should be incorporated into interagency procedures previously established under the National Environmental Policy Act, Endangered Species Act, Clean Water Act, Fish and Wildlife Coordination Act, or other applicable statutes.

To incorporate EFH consultations into coordination, consultation and/or environmental review procedures already required by other statutes, three criteria must be met:

(1) The existing process must provide NMFS with timely notification of the action;

(2) Notification of the action must include an *EFH Assessment* of the impacts of the proposed action as outlined in the EFH rules; and

(3) NMFS must have completed a written *finding* that the existing coordination process satisfies the requirements of the Magnuson-Stevens Act.

An *EFH Assessment* is a critical review of the proposed project and its potential impacts to EFH. As set forth in the rules, *EFH Assessments* must include: (1) a description of the proposed action; (2) an analysis of the effects, including cumulative effects, of the action on EFH, the managed species, and associated species by life history stage; (3) the federal agency's views regarding the effects of the action on EFH; and (4) proposed mitigation, if applicable. If appropriate, the assessment should also include the results of an on-site inspection, the views of recognized experts on the habitat or species affects, a literature review, an analysis of alternatives to the proposed action, and any other relevant information.

Once NMFS learns of a federal or state activity that may have an adverse effect on EFH, NMFS is required to develop EFH conservation recommendations for the activity, even if consultation has not been initiated by the action agency. These recommendations may include measures to avoid, minimize, mitigate, or otherwise offset adverse effects on EFH and are to be provided to the action agency in a timely manner. The Magnuson-Stevens Act also authorizes FMCs to comment on federal and state projects, and directs FMCs to comment on any project that may substantially impact EFH. The Magnuson-Stevens Act requires that federal agencies respond to EFH conservation recommendations of the NMFS and FMCs in writing and within 30 days.

Consultations may be conducted through programmatic, general concurrence, or project specific mechanisms. Evaluation at a programmatic level may be appropriate when sufficient information is available to develop EFH conservation recommendations and address all reasonably foreseeable adverse impacts under a particular program area. General Concurrences can be utilized for categories of similar activities having minimal individual and cumulative impacts. Programmatic and General Concurrence consultations minimize the need for individual project consultation in most cases because NMFS has determined that the actions will likely result in no more than minimal adverse effects, and conservation measures would be implemented. For example, NMFS might agree to a General Concurrence for the construction of docks or piers which, with incorporation of design or siting constraints, would minimally affect federally managed fishery resources and their habitats.

Consultations at a project-specific level are required when critical decisions are made at the project implementation stage, or when sufficiently detailed information for development of EFH conservation recommendations does not exist at the programmatic level. To facilitate project-specific consultations, NMFS and the action agency should discuss how existing review or coordination processes can be used to accomplish the EFH consultation. With agreement on how existing coordination mechanisms will be used, the NMFS will transmit a *findings* letter to the action agency describing the conduct of EFH consultation within existing project review frameworks. To date, more than 20 *findings* with federal and state partners in the southeast have been completed.

Project specific consultations must follow either the abbreviated or expanded procedures. Abbreviated consultations allow NMFS to quickly determine whether, and to what degree, a federal action may adversely impact EFH, and should be used when impacts to EFH are expected to be minor. For example, the abbreviated consultation procedure would be used when the adverse effect of an action or proposed action could be alleviated through minor design or operational modifications, or the inclusion of measures to offset unavoidable adverse impacts.

Expanded consultations allow NMFS and a federal action agency the maximum opportunity to work together in the review of an activity's impact on EFH and the development of EFH conservation recommendations. Expanded consultation procedures must be used for federal actions that would result in substantial adverse effects to EFH. Federal action agencies are encouraged to contact NMFS at the earliest opportunity to discuss whether the adverse effect of a proposed action makes expanded consultation appropriate. In addition, it may be determined after review of an abbreviated consultation that a greater level of review and analysis would be appropriate and that review through expanded consultation procedures should be employed. Expanded consultation procedures provide additional time for the development of conservation recommendations, and may be appropriate for actions such as the construction of large marinas or port facilities, or activities subject to preparation of an environmental impact statement.

The Magnuson-Stevens Act mandates that a federal action agency must respond in writing to EFH conservation recommendations from NMFS and FMCs within 30 days of receiving those recommendations. The rules require that such a response be provided at least 10 days prior to final approval of the action, if a decision by the federal agency is required in fewer than 30 days and that decision is inconsistent with the recommendations of the NMFS. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NMFS conservation recommendations, the agency must explain its reasons for not following the recommendations, including the scientific rationale for any disagreements with NMFS over the anticipated effects of the proposed action and the measures needed to offset such effects.

The regulations provide an important opportunity to resolve critical and outstanding EFH issues prior to an action agency rendering a final decision. When an agency decision is inconsistent with NMFS conservation recommendations, the NMFS Assistant Administrator may request a meeting with the head of the action agency to further discuss the project and attempt to achieve a greater level protection for EFH and federally managed fisheries. The process for higher-level review of proposed actions is not specified in the regulations; rather it is to be addressed on an agency-by-agency basis. In keeping with NMFS's effort to minimize the regulatory burden of EFH consultation requirements, review by the Assistant Administrator and action agency representative should be streamlined and tightly focused.

Conclusion

The EFH mandates of the Magnuson-Stevens Act represent an integration of fishery management and habitat management by stressing the dependency of healthy, productive fisheries on the maintenance of viable and diverse estuarine and marine ecosystems. Federal action agencies are required to consult with the NMFS whenever a construction, permitting, funding, or other action may adversely affect EFH. The EFH consultation process will ensure that federal agencies explicitly consider the effects of their actions on important habitats, with the goal of supporting the sustainable management of marine fisheries. The NMFS is committed to working with federal and state agencies to implement these mandates effectively and efficiently, with the ultimate goal of sustaining of the nation's fishery resources.

Comments, questions, and suggested revisions may be directed to Rickey Ruebsamen (EFH Coordinator), 3500 Delwood Beach Road, Panama City, FL 32408; phone: 850/234-5061; email: ric.ruebsamen@noaa.gov.

Appendix 1. Selected Text from the Magnuson-Stevens Fishery Conservation and Management Act (As Amended Through October 11, 1996).

16 U.S.C. 1855

SEC. 305. OTHER REQUIREMENTS AND AUTHORITY
104-297
(b) FISH HABITAT.
(1) (A) The Secretary shall, within 6 months of the date of enactment of the Sustainable Fisheries Act, establish by regulation guidelines to assist the Councils in the description and identification of essential fish habitat in fishery management plans (including adverse impacts on such habitat) and in the consideration of actions to ensure the conservation and enhancement of such habitat. The Secretary shall set forth a schedule for the amendment of fishery management plans to include the identification of essential fish habitat and for the review and updating of such identifications based on new scientific evidence or other relevant information.
(B) The Secretary, in consultation with participants in the fishery, shall provide each Council with recommendations and information regarding each fishery under that Council's authority to assist it in the identification of essential fish habitat, the adverse impacts on that habitat, and the actions that should be considered to ensure the conservation and enhancement of that habitat.
(C) The Secretary shall review programs administered by the Department of Commerce and ensure that any relevant programs further the conservation and enhancement of essential fish habitat.
(D) The Secretary shall coordinate with and provide information to other Federal agencies to further the conservation and enhancement of essential fish habitat.
(2) Each Federal agency shall consult with the Secretary with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency that may adversely affect any essential fish habitat identified under this Act.
(3) Each Council--
(A) may comment on and make recommendations to the Secretary and any Federal or State agency concerning any activity authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by any Federal or State agency that, in the view of the Council, may affect the habitat, including essential fish habitat, of a fishery resource under its authority; and
(B) shall comment on and make recommendations to the Secretary and any Federal or State agency concerning any such activity that, in the view of the Council, is likely to substantially affect the habitat, including essential fish habitat, of an anadromous fishery resource under its authority.
(4) (A) If the Secretary receives information from a Council or Federal or State agency or determines from other sources that an action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by any State or Federal agency would adversely affect any essential fish habitat identified under this Act, the Secretary shall recommend to such agency measures that can be taken by such agency to conserve such habitat.
(B) Within 30 days after receiving a recommendation under subparagraph (A), a Federal agency shall provide a detailed response in writing to any Council commenting under paragraph (3) and the Secretary regarding the matter. The response shall include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on such habitat. In the case of a response that is inconsistent with the recommendations of the Secretary, the Federal agency shall explain its reasons for not following the recommendations.

Appendix 2. Fishery Management Plans and Managed Species for the Gulf of Mexico area.

GULF OF MEXICO FISHERY MANAGEMENT COUNCIL

Shrimp Fishery Management Plan

brown shrimp - *Farfantepenaeus aztecus*
pink shrimp - *F. duorarum*
royal red shrimp - *Pleoticus robustus*
white shrimp - *Litopenaeus setiferus*

Red Drum Fishery Management Plan

red drum - *Sciaenops ocellatus*

Reef Fish Fishery Management Plan

almaco jack – *Seriola rivoliana*
anchor tilefish - *Caulolatilus intermedius*
banded rudderfish – *S. zonata*
blackfin snapper - *Lutjanus buccanella*
blackline tilefish - *Caulolatilus cyanops*
black grouper- *Mycteroperca bonaci*
blueline tilefish – *C. microps*
cubera snapper – *L. cyanopterus*
dog snapper – *L. jocu*
dwarf sand perch - *Diplectrum bivittatum*
gag grouper - *M. microlepis*
goldface tilefish – *C. chrysops*
goliath grouper - *Epinephelus itajara*
gray snapper – *L. griseus*
gray triggerfish - *Balistes capriscus*
greater amberjack – *S. dumerili*
hogfish - *Lachnolaimus maximus*
lane snapper - *Lutjanus synagris*
lesser amberjack - *S. fasciata*
mahogany snapper – *L. mahogoni*
marbled grouper – *E. inermis*
misty grouper – *E. mystacinus*
mutton snapper – *L. analis*
Nassau grouper – *E. striatus*
queen snapper - *Etelis oculatus*
red hind - *Epinephelus guttatus*
red grouper – *E. morio*
red snapper - *L. campechanus*
rock hind – *E. adscensionis*
sand perch - *Diplectrum formosum*
scamp grouper - *M. phenax*
schoolmaster – *L. apodus*
silk snapper – *L. vivanus*
snowy grouper – *E. niveatus*
speckled hind - *E. drummondhayi*
tilefish - *Lopholatilus chamaeleonticeps*
vermilion snapper - *Rhomboplites aurorubens*
Warsaw grouper – *E. nigritus*
wenchman - *Pristipomoides aquilonaris*
yellowedge grouper *E .lavolimbatus*
yellowfin grouper – *M. venenosa*
yellowmouth grouper – *M. interstitialis*
yellowtail snapper - *Ocyurus chrysurus*

Stone Crab Fishery Management Plan

Florida stone crab - *Menippe mercenaria*
gulf stone crab – *M. adina*

Spiny Lobster Fishery Management Plan

spiny lobster - *Panulirus argus*
slipper lobster - *Scyllarides nodife*

Coral and Coral Reef Fishery Management Plan

varied coral species and coral reef communities comprised of several hundred species

Coastal Migratory Pelagic Fishery Management Plan

cobia - *Rachycentron canadum*
king mackerel – *Scomberomorus cavalla*
Spanish mackerel - *S. maculatus*

Appendix 3. Species Managed in the Gulf of Mexico under Federally Implemented Fishery Management Plans.

NATIONAL MARINE FISHERIES SERVICE

Billfish

blue marlin - *Makaira nigricans*
longbill spearfish - *Tetrapturus pfluegeri*
sailfish - *Istiophorus platypterus*
white marlin - *T. albidus*

Swordfish

swordfish - *Xiphias gladius*

Tuna

albacore - *Thunnus alalunga*
Atlantic bigeye - *T. obesus*
Atlantic yellowfin - *T. albacares*
skipjack - *Katsuwonus pelamis*
western Atlantic bluefin - *T. thynnus*

Sharks

Atlantic angel shark - *Squatina dumerili*
Atlantic sharpnose shark - *Rhizoprionodon terraenovae*
basking shark - *Cetorhinus maximus*
bigeye sand tiger - *Odontaspis noronhai*
bigeye sixgill shark - *Hexanchus vitulus*
bigeye thresher shark - *Alopias superciliosus*
bignose shark - *Carcharhinus altimus*
blacknose shark - *C. acronotus*
blacktip shark - *C. limbatus*
blue shark - *Prionace glauca*
bonnethead - *Sphyrna tiburo*
bull shark - *C. leucas*

Sharks (cont.)

Caribbean sharpnose shark - *R. porosus*
common thresher shark - *A. vulpinus*
dusky shark - *C. obscurus*
finetooth shark - *C. isodon*
Galapagos shark - *C. galapagensis*
great hammerhead - *S. mokarran*
lemon shark - *Negaprion brevirostris*
longfin mako shark - *Isurus paucus*
narrowtooth shark - *C. brachyurus*
Caribbean reef shark - *C. perezi*
oceanic whitetip shark - *C. longimanus*
porbeagle shark - *Lamna nasus*
sandbar shark - *C. plumbeus*
sand tiger shark - *O. taurus*
scalloped hammerhead - *S. lewini*
shortfin mako shark - *I. oxyrinchus*
silky shark - *C. falciformis*
sixgill shark - *H. griseus*
smalltail shark - *C. porosus*
smooth hammerhead - *S. zygaena*
spinner shark - *C. brevipinna*
whale shark - *Rhinocodon typus*
white shark - *Carcharodon carcharias*
night shark - *C. signatus*
nurse shark - *Ginglymostoma cirratum*
sharpnose sevengill shark – *Heptranchias perlo*
tiger shark - *Galeocerdo cuvieri*

Appendix 4. Representative Categories of Essential Fish Habitat Identified in the Fishery Management Plan Amendment of the Gulf of Mexico Fishery Management Council. (Gener EFH for species managed under the NMFS Billfish and Highly Migratory Species plans falls within the marine and estuarine water column habitats designated by the Council)

Estuarine areas

Estuarine emergent wetlands

Mangrove wetlands

Submerged aquatic vegetation

Algal flats

Mud, sand, shell, and rock substrates

Estuarine water column

Marine areas

Water column

Vegetated bottoms

Non-vegetated bottoms

Live bottoms

Coral reefs

Geologic features

Continental Shelf features

Appendix 5. Habitat Areas of Particular Concern Identified in the 2005 Fishery Management Plan Amendment of the Gulf of Mexico Fishery Management Council.

Florida

- Madison-Swanson Marine Reserve
- Tortugas North
- Tortugas South
- Florida Middle Grounds
- Pulley Ridge

Texas/Louisiana Topographic Features (Reefs and Banks)

- West Flower Garden Banks
- East Flower Garden Banks
- Stetson Bank
- 29 Fathom Bank
- MacNeil Bank
- Rezak Sidner Bank
- Rankin Bright Bank
- Geyer Bank
- McGrail Bank
- Bouma Bank
- Sonnier Bank
- Alderdice Bank
- Jakkula Bank

Appendix 6. EFH Designations for Species Managed by the Gulf of Mexico Fishery Management Council.[1]

Red Drum FMP – EFH for red drum consists of all Gulf of Mexico estuaries; waters and substrates extending from Vermilion Bay, Louisiana to the eastern edge of Mobile Bay, Alabama out to depths of 25 fathoms; waters and substrates extending from Crystal River, Florida to Naples, Florida between depths of 5 and 10 fathoms; waters and substrates extending from Cape Sable, Florida to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council between depths of 5 and 10 fathoms.

Reef Fish FMP – EFH for reef fish consists of Gulf of Mexico waters and substrates extending from the US/Mexico border to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council from estuarine waters out to depths of 100 fathoms.

Coastal Migratory Pelagics FMP – EFH for coastal migratory pelagics consists of Gulf of Mexico waters and substrates extending from the US/Mexico border to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council from estuarine waters out to depths of 100 fathoms.

Shrimp FMP – EFH for shrimp consists of Gulf of Mexico waters and substrates extending from the US/Mexico border to Fort Walton Beach, Florida from estuarine waters out to depths of 100 fathoms; waters and substrates extending from Grand Isle, Louisiana to Pensacola Bay, Florida between depths of 100 and 325 fathoms; waters and substrates extending from Pensacola Bay, Florida to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council out to depths of 35 fathoms, with the exception of waters extending from Crystal River, Florida to Naples, Florida between depths of 10 and 25 fathoms and in Florida Bay between depths of 5 and 10 fathoms.

Stone Crab FMP – EFH for stone crab consists of Gulf of Mexico waters and substrates extending from the US/Mexico border to Sanibel, Florida from estuarine waters out to depths of 10 fathoms; waters and substrates extending from Sanibel, Florida to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council from estuarine waters out to depths of 15 fathoms.

Spiny Lobster FMP – EFH for spiny lobster consists of Gulf of Mexico waters and substrates extending from Tarpon Springs, Florida to Naples, Florida between depths of 5 and 10 fathoms; waters and substrates extending from Cape Sable, Florida to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council out to depths of 15 fathoms.

Coral FMP – EFH for coral consists of the total distribution of coral species and life stages throughout the Gulf of Mexico including the East and West Flower Garden Banks, Florida Middle Grounds, southwest tip of the Florida reef tract, and predominant patchy hard bottom offshore of Florida from approximately Crystal River south to the Keys, and scattered along the pinnacles and banks from Texas to Mississippi, at the shelf edge.

[1] Reader should refer to the 2004 final environmental impact statement for more detailed EFH information

Appendix 7. Summary of EFH Designations for Highly Migratory Species Managed by the National Marine Fisheries Service.

Gulf of Mexico Species	Life Stage	EFH
Offshore		
Atlantic bluefin tuna	spawning/eggs/larvae adults	Gulf-wide, 15 mi offshore to EEZ 200 m to EEZ, Terrebonne LA to Galveston TX
Atlantic skipjack tuna	spawning/eggs/larvae adults	Gulf-wide, 200 m isobath to EEZ 200 to 2000 m, Terrebonne LA to Galveston TX
Atlantic yellowfin tuna	all life stages	from 200 m isobath to EEZ
Swordfish	spawning/eggs/larvae juvenile adults	Gulf-wide, 200 m isobath to EEZ as above, except to 2000 m from 88° to 86.5° W 200 to 2000 m from Tampa to Mobile Bays; MS
Blue marlin	all stages	variable, but generally Gulf-wide 200 - 2000 m except adults not shown E. of Choctawhatchee Bay, FL
White marlin	juvenile adult	Gulf-wide 200 - 2000 m isobath, except S of Galveston & Cape San Blas 100 m to EEZ, W of 86.5° W
Sailfish	all stages	Gulf-wide 200 to 2000 m isobath or EEZ, whichever is closer & within 5 mi of Padre Island & to 50 m in DeSoto Canyon
Silky shark	early juvenile late juvenile	DeSoto Canyon MS/AL, 200 - 2000 m isobath FL Keys -10,000 Islands, 50 - 2000 m isobath
Longfin mako shark	all life stages	FL Keys to 92.5° W, 200m isobath to EEZ
Nearshore/Inshore		
Great hammerhead shark	late juvenile adult	FL Bay and adjacent waters off FL, to 85.5° W (<100 m isobath)
Scalloped hammerhead shark	late juvenile/subadult	off MS/AL, shoreline to 50 m & FL Keys
Nurse shark	early juvenile late juvenile/adult	FL Keys <25 m as above & Charlotte Harbor to Tampa Bay, FL
Blacktip shark	early juvenile late juvenile adult	<25 m Ten Thousand Isl to Cedar Key, FL <25 m FL Keys to Cedar Key, Cape San Blas to MS delta, and Galveston to Mexico <50 m FL Bay to Cape San Blas, FL
Bull shark	juvenile adults	inlets, estuaries, coastal waters <25 m, Ten Thousand Isl. to Cedar Key, Appalachicola to Mobile, and Galveston to Mexico inlets, estuaries, coastal waters <25 m, Charlotte Harbor to Anclote Key, FL
Lemon shark	early juvenile late juvenile/adult	inlets, estuaries, coastal waters <25 m, FL Bay, Tampa Bay, and TX from 95.5° N to Mexico inlets, estuaries, coastal waters <25 m, FL Keys to Anclote Key, FL

Appendix 7 Continued.

Gulf of Mexico Species	Life Stage	EFH
Nearshore/Inshore		
Sandbar shark	all life stages	Key Largo to Cape San Blas, <50 m (except adults, <100 m)
Spinner shark	neonate/early juvenile	<25 m, FL Keys to 29.25° N
Tiger shark	juvenile	MS Sound to FL Kyes, < 100 m
	adults	Cape San Blas, FL to MS Sound, 25 to 200 m isobaths
Bonnethead shark	juvenile	inlets, estuaries, coastal waters <25 m, FL Keys to Cedar Key; LA and TX
	adult	FL Keys & Mobile Bay to S. Padre Isl. TX (<25 m)
Atlantic sharpnose shark	juvenile	<25 m Galveston to Mexico; <40 m MS & Atchafalaya deltas
	adults	<50 m MS Sound & Galveston to Laguna Madre
Blacknose shark	juvenile	FL Keys to Tampa <25 m isobath
	adults	FL Keys to Cedar Key <25 m; Mobile Bay to Terrebonne Parish, LA 25 to 100 m isobath

Note:

Only the bull, lemon, and bonnethead sharks are reported to <u>commonly</u> occur and have identified EFH in estuaries of the Gulf of Mexico, as identified above.

No HAPCs have been designated for Highly Migratory Pelagic species in the Gulf of Mexico.

Appendix 8. Sources of EFH and Related Resource Information for the Gulf of Mexico.

Fishery Management Plan Documents

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

Gulf of Mexico Fishery Management Council. 2005. Final generic amendment number 3 for addressing Essential Fish Habitat requirements, Habitat Areas of Particular Concern, and adverse effects of fishing in the following fishery management plans of the Gulf of Mexico: Shrimp Fishery of the Gulf of Mexico, United States Waters; Red Drum Fishery of the Gulf of Mexico; Reef Fish Fishery of the Gulf of Mexico; Coastal Migratory Pelagic Resources (Mackerels) in the Gulf of Mexico and South Atlantic; Stone Crab Fishery of the Gulf of Mexico; Spiny Lobster in the Gulf of Mexico and South Atlantic; Coral and Coral Reefs of the Gulf of Mexico. Gulf of Mexico Fishery Management Council. Tampa, FL.

National Marine Fisheries Service. 1999. Amendment 1 to the Atlantic billfish fishery management plan amendment. National Marine Fisheries Service. Silver Spring, MD.

National Marine Fisheries Service. 1999. Fishery management plan for Atlantic tunas, swordfish, and sharks. National Marine Fisheries Service. Silver Spring, MD. 2 vols.

EFH Related Web Sites

Gulf of Mexico FMC	http://www.gulfcouncil.org
EFH Rules	http://nmfs.noaa.gov/habitat/efh
EFH Amendment/FEIS	http://www.gulfcouncil.org/downloads.htm
NMFS Southeast Region	http://sero.nmfs.noaa.gov
Highly migratory pelagic and billfish EFH amendments	http://www.nmfs.noaa.gov/sfa/hms/Final.html

Appendix 9. Points of Contact for Essential Fish Habitat Activities within the Southeast Region of the National Marine Fisheries Service.

National Marine Fisheries Service
Southeast Region

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Gulf of Mexico Fishery Management Council

Executive Director
Gulf of Mexico Fishery Management Council
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KEYWORD INDEX

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Minerals Revenue Management** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.