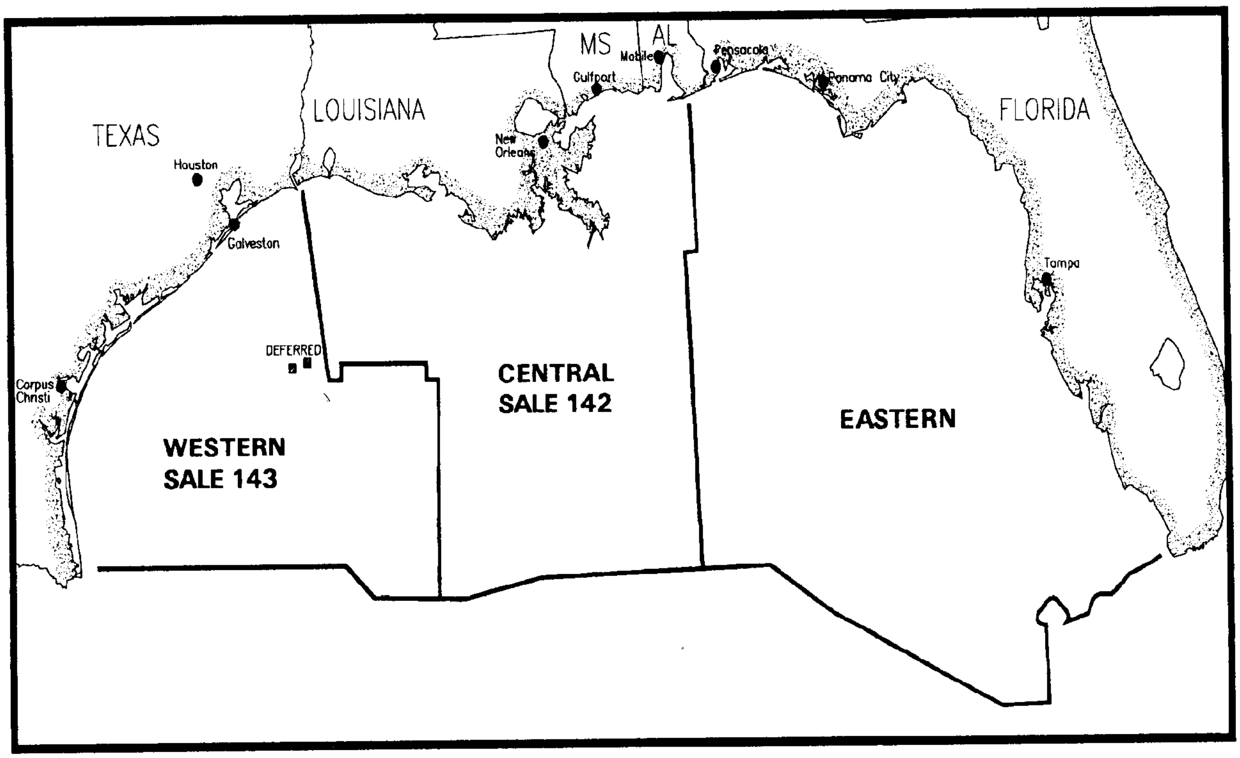
OCS EIS/EA
MMS 92-0007

# Gulf of Mexico Sales 142 and 143:

## Central and Western Planning Areas

### Draft Environmental Impact Statement

### Volume II: Sections IV.D. through IX





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

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## Central and Western Planning Areas

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Author

Minerals Management Service
Gulf of Mexico OCS Region



Published by

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

**New Orleans**
**April 1992**

# REGIONAL DIRECTOR'S NOTE

This Draft Environmental Impact Statement (EIS) covering the proposed OCS oil and gas lease sales in the Gulf of Mexico for 1993 is a product of the Minerals Management Service (MMS) in New Orleans, Louisiana. The proposed sales are Central Gulf of Mexico Sale 142 (March 1993) and Western Gulf of Mexico Sale 143 (August 1993). This document includes the purpose and background of the proposed actions, the alternatives, the description of the affected environment, and the potential environmental impacts of the proposed actions and alternatives. Mitigating measures and their effects and potential cumulative impacts are also discussed. Most of the visuals that are referred to in this document were distributed with the Draft EIS for Sales 131, 135, and 137. Visual No. 2, Areas of Multiple Use, was revised and was distributed with the Draft EIS for Sales 139 and 141.

Additional copies of this Draft EIS and the referenced visuals may be obtained from the MMS, Gulf of Mexico OCS Region, 1201 Elmwood Park Boulevard, New Orleans, Louisiana 70123-2394, Attention: MS 5034, or by telephone (504) 736-2519.

Comments on this Draft EIS should be sent to the same address, Attention: MS 5410.

J. Rogers Pearcy
Regional Director
Minerals Management Service
Gulf of Mexico OCS Region

# COVER SHEET

Environmental Impact Statement for Proposed Central Gulf of Mexico OCS Lease Sale 142 (March 1993) and Proposed Western Gulf of Mexico OCS Lease Sale 143 (August 1993)

Draft (x) Final ( )

Type of Action:

Administrative (x) Legislative ( )

Area of Potential Impact:

Offshore Marine Environment and Coastal Counties/Parishes of Alabama, Mississippi, Louisiana, and Texas

Lead Agency:

**Send Comments To:**

U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, LA 70123-2394
Attention: MS 5410

Region Contact:

Dennis L. Chew
(504) 736-2793 or (FTS) 686-2793

Washington Contact:

Richard H. Miller
U.S. Department of the Interior
Minerals Management Service
381 Elden Street (MS 4320)
Herndon, VA 22070-4817
(703) 787-1665 or (FTS) 393-1665

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# ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ac | acre |
| ACAA | Alabama Coastal Area Act |
| ACAMP | Alabama Coastal Area Management Program |
| ADECA | Alabama Department of Community Affairs |
| ADEM | Alabama Department of Environmental Management |
| AFB | Air Force Base |
| APD | Application for Permit to Drill |
| API | American Petroleum Institute |
| ARTC | Armament Research and Test Center |
| B.P. | before present |
| BACT | best available control technology |
| BAST | best available and safest technology |
| BAT | best available technology |
| Bbbl | billion barrels |
| bbl | barrels |
| BBO | billion barrels of oil |
| bcf | billion cubic feet |
| BLM | Bureau of Land Management |
| BMR | Bureau of Marine Resources |
| BOD | biological oxygen demand |
| BOP | blowout preventer |
| BPD | barrels per day |
| Btu | British thermal unit |
| CAA | Clean Air Act |
| CAB | Coastal Area Board |
| Call | Call for Information and Nominations |
| CBRA | Coastal Barrier Resources Act of 1982 |
| CBRS | Coastal Barrier Resource System |
| CEE | Center for Environmental Education |
| CEI | Coastal Environments, Inc. |
| CEQ | Council on Environmental Quality |
| CER | categorical exclusion review |
| CERCLA | Comprehensive Environmental Compensation and Liability Act |
| CFR | Code of Federal Regulations |
| CGA | Clean Gulf Associates |
| cm | centimeter |
| COE | Corps of Engineers (U.S. Army) |
| CPA | Central Planning Area |
| CRCPD | Conference of Radiation Program Directors |
| CSA | Continental Shelf Associates |
| CZM | Coastal Zone Management |
| CZMA | Coastal Zone Management Act |
| dB | decibel |
| DER | Department of Environmental Regulation |
| DM | Departmental Manual |
| DOC | Department of Commerce (U.S.) (also: USDOC) |
| DOCD | Development Operations Coordination Document |
| DOD | Department of Defense (U.S.) |
| DOE | Department of Energy (U.S.) |

| | |
|---|---|
| DOI | Department of the Interior (U.S.) (also: USDOI) |
| DOT | Department of Transportation (U.S.) (also: USDOT) |
| DPP | Development/Production Plan |
| DST | deep stratigraphic test |
| DWG | Dispersant Working Group |
| dwt | deadweight tonnage |
| EA | environmental assessment |
| EIS | environmental impact statement |
| EP | Exploration Plan |
| EPA | Eastern Planning Area |
| ESD | Emergency Shutdown System |
| ESP | Environmental Studies Program |
| ESS | Emergency Support System |
| FAA | Federal Aviation Administration |
| FCF | Fishermen's Contingency Fund |
| FCMP | Florida Coastal Management Program |
| FERC | Federal Energy Regulatory Commission |
| FMC | Fisheries Management Council |
| FMP | Fishery Management Plan |
| FR | Federal Register |
| FRS | Fast Response System |
| FSV | flow safety valve |
| ft | foot |
| FWPCA | Federal Water Pollution Control Act |
| FWS | Fish and Wildlife Service |
| FY | fiscal year |
| G&G | geological and geophysical |
| GIWW | Gulf Intracoastal Waterway |
| GMFMC | Gulf of Mexico Fishery Management Council |
| GS | Geological Survey (U.S.) (also: USGS) |
| H.R. | House Resolution (U.S. Congress) |
| ha | hectare |
| HAPC | Habitat Area of Particular Concern |
| HOSS | High-Volume Open Sea Skimmer System |
| IMCO | Intergovernmental Maritime Consultative Organization |
| in | inch |
| IPF | impact-producing factor |
| ITL | Information to Lessees and Operators |
| ITS | Incidental Take Statement |
| km | kilometer |
| kn | knots |
| LCZMP | Louisiana Coastal Zone Management Program |
| LGS | Louisiana Geological Survey |
| LNG | liquefied natural gas |
| LOOP | Louisiana Offshore Oil Port |
| LSH | level sensor high |
| LSL | level sensor low |
| LTL | Letter to Lessees and Operators |
| m | meter |
| MAFLA | Mississippi, Alabama, Florida |
| MCP | Mississippi Coastal Program |
| MFCMA | Magnuson Fishery Conservation and Management Act of 1976 |

| | |
|---|---|
| mi | mile |
| MIRG | Marine Industry Research Group |
| MMbbl | million barrels |
| MMC | Marine Mammal Commission |
| MMcf | million cubic feet |
| MMRI | Mississippi Mineral Resources Institute |
| MMS | Minerals Management Service |
| MOU | Memorandum of Understanding |
| MPA | Marine Preservation Association |
| MSRC | Marine Spill Response Corporation |
| mta | million metric tons annually |
| MWD | measurement while drilling |
| NAAQS | National Ambient Air Quality Standards |
| NAS | National Academy of Sciences |
| NCP | National Contingency Plan |
| NCSC | Naval Command System Center |
| NEPA | National Environmental Policy Act |
| NERBC | New England River Basins Commission |
| NHPA | National Historic Preservation Act |
| NMFS | National Marine Fisheries Service |
| NOAA | National Oceanic and Atmospheric Administration |
| NODC | National Oceanographic Data Center |
| NOI | Notice of Intent to Prepare an EIS |
| NORM | naturally occurring radioactive materials |
| NPA | National Planning Association Data Services, Inc. |
| NPDES | National Pollution and Discharge Elimination System |
| NPS | National Park Service |
| NRC | National Research Council |
| NRT | National Response Team |
| NSPS | new source performance standards |
| NTL | Notice to Lessees and Operators |
| OCDM | Offshore Coastal Dispersion Model |
| OCRM | Office of Ocean and Coastal Resource Management |
| OCS | Outer Continental Shelf |
| OCSLA | Outer Continental Shelf Lands Act |
| OHMSETT | Oil and Hazardous Materials Simulated Environmental Test Tank |
| OSC | On-Scene Coordinator |
| OSCP | Oil Spill Contingency Plan |
| OSRA | Oil Spill Risk Analysis |
| OTA | Office of Technology Assessment (U.S. Congress) |
| P.L. | Public Law |
| PINC | Potential Incident of Noncompliance |
| PIRS | Pollution Incident Reporting System |
| ppm | parts per million |
| PSD | Prevention of Significant Deterioration |
| PSH | high-pressure sensor |
| PSL | low-pressure sensor |
| PSV | pressure relief valve |
| PWSA | Ports and Waterways Safety Act |
| RCP | Regional Contingency Plan |
| RCRA | Resource Conservation and Recovery Act |
| RD | Regional Director |

| | |
|---|---|
| ROTAC | Regional Operations Technology Assessment Committee |
| RRT | Regional Response Team |
| RTWG | Regional Technical Working Group |
| SARA | Superfund Amendments and Reauthorizations Act of 1986 |
| SEL | Site Evaluation List |
| SIC | Standard Industrial Classification |
| SMA | Special Management Area |
| SMSA | Standard Metropolitan Statistical Area |
| SPCC | Spill Prevention Control and Countermeasure |
| SPR | Strategic Petroleum Reserve |
| SSSV | subsurface safety valve |
| STOCS | South Texas Outer Continental Shelf |
| SUSIO | State University System of Florida, Institute of Oceanography |
| tcf | trillion cubic feet |
| TSP | total suspended particulates |
| TSS | traffic separation schemes |
| U.S. | United States |
| U.S.C. | United States Code |
| USAF | U.S. Air Force |
| USCG | U.S. Coast Guard |
| USDOC | U.S. Department of Commerce (also: DOC) |
| USDOI | U.S. Department of the Interior (also: DOI) |
| USEPA | U.S. Environmental Protection Agency |
| USGS | U.S. Geological Survey |
| VOC | volatile organic compounds |
| VOSS | Vessel of Opportunity Skimming System |
| WPA | Western Planning Area |
| yd | yard |
| yr | year |

# SUMMARY

This environmental impact statement (EIS) addresses two proposed Federal actions, lease Sales 142 and 143, that will offer for lease Gulf of Mexico Outer Continental Shelf (OCS) areas that may contain economically recoverable oil and gas resources. The lease sales are proposed for 1993 and include lease blocks in the Central Gulf of Mexico Planning Area (CPA) and Western Gulf of Mexico Planning Area (WPA). Figure I-1 provides statistics on the leasing status in these two areas. Approximately 9,900 blocks will be available for lease under the two proposed actions; only a small percentage is expected to be actually leased. On average, 434 blocks in the Central Gulf and 264 blocks in the Western Gulf have been leased in individual Gulf of Mexico OCS lease sales since 1984. Of the blocks that will be leased as a result of the two proposed actions, only a portion will be drilled and result in subsequent production.

The analytical methods used in this EIS have been formulated over a period of years. The first step of the analysis is the identification of significant environmental and socioeconomic resources through the scoping process outlined in Section I.B.2.c.(1). A range of energy resource estimates is derived from geologic and economic assumptions and alternatives to the proposed action are established. Estimated levels of exploration and development activity are assumed for the purposes of the analysis. An analysis of the potential interaction between the significant environmental resources and the OCS-related activities is then conducted.

The scoping process (Section I.B.2.) was used to obtain information and comments on the proposed actions and the potential environmental effects from diverse interests, including the affected States, Federal agencies, the petroleum industry, environmental and public interest groups, and concerned individuals. The input from these sources aided in the identification of significant issues, possible alternatives to the proposed actions, and potential mitigating measures. The following are brief descriptions of the proposed actions, alternatives, mitigating measures, and issues addressed in this EIS.

*Proposed Actions and Alternatives*

*Proposed Central Gulf Sale 142 and the Alternatives*

*Alternative A (Proposed Central Gulf Sale 142)* is scheduled to be held in March 1993 and may offer approximately 5,194 unleased blocks (as of January 1992) comprising about 28.0 million acres in the CPA. This area includes acreage located from 3 to 219 mi offshore in water depths ranging from 13 to over 11,000 ft. There are no areas deferred from the CPA. This alternative includes existing regulations and proposed lease stipulations designed to reduce environmental risks. It is estimated that the proposal could result in the production of 0.14 billion bbl of oil (BBO) and 1.40 trillion cubic feet (tcf) of gas.

*Alternative B (The Proposed Action Excluding the Blocks Near Biologically Sensitive Topographic Features)* would delete all unleased blocks of the 167 total blocks on or near biologically sensitive areas of the topographic features in the Central Gulf. All of the remaining unleased area would be available for leasing.

*Alternative C (No Action)* equates to cancellation of the sale. Neither potential environmental effects nor oil and gas production, which could result from the proposed action, would occur. Alternative energy resources that might be used to replace energy resources lost by cancellation of this sale are discussed in Appendix D.

*Proposed Western Gulf Sale 143 and the Alternatives*

*Alternative A (Proposed Western Gulf Sale 143)* is scheduled to be held in August 1993 and may offer approximately 4,715 unleased blocks (as of January 1992), comprising about 25.8 million acres in the WPA. This area is located from 9 to 221 mi offshore in water depths ranging from 26 to over 9,000 ft. Excluded from this proposed action are Blocks A-375 (East Flower Garden Bank) and A-398 (West Flower Garden Bank) in the High Island Area; these blocks are deferred because of the environmentally sensitive nature of the biological communities located there. The East and West Flower Garden Banks have officially been designated as marine sanctuaries. This alternative includes existing regulations and proposed lease stipulations designed to reduce environmental risks. It is estimated that the proposal could result in the production of 0.05 BBO and 0.74 tcf of gas.

*Alternative B (The Proposed Action Excluding the Blocks Near Biologically Sensitive Topographic Features)* would delete all unleased blocks of the 200 total blocks on or near biologically sensitive areas of the topographic features in the Western Gulf. All of the remaining unleased areas would be available for leasing, except for the two deferred blocks at the Flower Garden Banks.

*Alternative C (The Proposed Action Excluding Blocks Contained in the Western Naval Operations Area)* would delete approximately 340 blocks contained in the Western Naval Operations Area near Corpus Christi, Texas.

*Alternative D (No Action)* equates to cancellation of the sale. Neither potential environmental effects nor oil and gas production, which could result from the proposed action, would occur. Alternative energy resources that might be used to replace energy resources lost by cancellation of this sale are discussed in Appendix D.

*Mitigating Measures*

Four potential stipulations have historically been applied to appropriate Gulf OCS leases, and these are analyzed as part of the proposed actions. These stipulations are the Live Bottom (Pinnacle Trend), Topographic Features, Archaeological Resource, and Military Area Stipulations for the Central Gulf sale; and the Topographic Features, Archaeological Resource, and Military Area Stipulations for the Western Gulf sale. Actual application of these stipulations to leases that may result from the proposed actions are options available to the Secretary of the Interior.

*Action Scenarios Analyzed*

Oil and gas resources estimated to be leased and developed from the proposed lease sales are the basis for environmental analyses of resources that may be impacted by OCS activities. These estimates, based on many factors such as geologic structure, economic assumptions, proximity to existing development, etc., fall within a large range. From these ranges, two scenarios are developed. The primary scenario is called the Base Case and assumes the mean or expected amounts of undiscovered, unleased hydrocarbon resources, and resultant development activities. The second scenario is the High Case, which is the relatively less likely possibility that the upper end of the range of energy resource estimates will be leased, discovered, and developed.

An additional analysis is given of the environmental impacts that result from the incremental impact of the lease sales when added to all past, present, and reasonably foreseeable future human activities. The outcome of this analysis is labeled the cumulative impact on the particular resource under discussion and covers a period of 35 years. This term, however, should not be confused with the cumulative impacts attributable to OCS activities.

The environmental analyses are based on levels of assumed development activities correlated with the amount of resources estimated to be leased (Table S-1). These activities include the number of platforms, wells, pipelines, service vessel trips, etc. The interaction of all OCS activities that result from the lease sale with environmental resources is analyzed.

*Significant Issues*

Table S-2 lists the resources and activities determined through the scoping process to be sufficiently important to warrant inclusion in this environmental analysis. The scoping process is an ongoing effort, and contacts are made with other Federal and State Agencies, the public, academia, and environmental groups to identify those resources about which there is concern. This process determines the significant resources and activities to be addressed in the EIS.

*Impact Conclusions*

Tables S-3 and S-4 provide a summary of the impacts of proposed Sales 142 and 143 and their alternatives under the Base Case, High Case, and cumulative analyses.

Table S-1

Oil and Gas Resource and OCS Development Activity Estimates: Sales 142 and 143

| | Central Planning Area Sale 142 Base Case | Western Planning Area Sale 143 Base Case |
|---|---|---|
| Acreage Available for Leasing[1] (million of acres) | 28.0 | 25.8 |
| Resources Expected to be Developed[2] | | |
| Oil (billion barrels) | 0.14 | 0.05 |
| Gas (trillion cubic feet) | 1.40 | 0.74 |
| OCS Development Activity | | |
| Exploration and Delineation Wells | 340 | 210 |
| Platform Installations | 30 | 10 |
| Development Wells | 250 | 110 |
| Pipelines (kilometers) | 240 | 80 |

[1]Unleased acreage available for leasing (deferred acreage not included) as of January 1992 for the Central and Western Gulf sales.
[2]The methodology used to estimate resources is explained in Appendix C.

Source: USDOI, Minerals Management Service, Gulf of Mexico OCS Region estimates, 1991.

Table S-2

Significant Environmental Resources and Activities Analyzed

Central Gulf Sale 142

- Coastal Environments
  - Coastal Barrier Beaches
  - Wetlands
- Offshore Environments
  - Live-bottoms (Pinnacle Trend)
  - Deep-water Benthic Communities
  - Topographic Features
- Water Quality
- Air Quality
- Coastal and Marine Mammals
  - Marine Mammals
    - Nonendangered and Nonthreatened Species
    - Endangered and Threatened Species
  - Alabama, Choctawhatchee, and Perdido Key Beach Mice
- Marine Turtles
- Coastal and Marine Birds
  - Nonendangered and Nonthreatened Species
  - Endangered and Threatened Species
- Gulf Sturgeon
- Commercial Fisheries
- Recreational Resources and Activities
  - Beach Use
  - Marine Fishing
- Archaeological Resources
  - Historic
  - Prehistoric
- Socioeconomic Conditions
  - Population, Labor, and Employment
  - Public Services and Infrastructure
  - Social Patterns

Western Gulf Sale 143

- Coastal Environments
  - Coastal Barrier Beaches
  - Wetlands
- Offshore Environments
  - Deep-water Benthic Communities
  - Topographic Features
- Water Quality
- Air Quality
- Marine Mammals
  - Nonendangered and Nonthreatened Species
  - Endangered and Threatened Species
- Marine Turtles
- Coastal and Marine Birds
  - Nonendangered and Nonthreatened Species
  - Endangered and Threatened Species
- Commercial Fisheries
- Recreational Resources and Activities
  - Beach Use
  - Marine Fishing
- Archaeological Resources
  - Historic
  - Prehistoric
- Socioeconomic Conditions
  - Population, Labor, and Employment
  - Public Services and Infrastructure
  - Social Patterns

Table S-3

Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 142)

| Alternatives | Resource Categories | | |
|---|---|---|---|
| | Coastal Barrier Beaches | Wetlands | Live Bottom (Pinnacle Trend) |
| Alternative A Base Case | The proposed action is not expected to result in permanent alterations of barrier beach configurations, except in localized areas downdrift from navigation channels that have been dredged and deepened. The contribution to this localized erosion is expected to be less than 1 percent. | The proposed action is expected to result in dieback and mortality of 10-15 ha of wetlands vegetation as a result of contacts from onshore oil spills. All but 2 ha of these wetlands will recover within 10 years; the remaining 2 ha will be converted to open water. About 5.5 ha of wetlands are projected to be eroded along channel margins as a result of OCS vessel wake erosion, and 3.5 ha of wetlands are projected to be created as a result of beneficial disposal of dredged material from channel-deepening projects. | The impact of the proposed action is expected to be such that any changes in the regional physical integrity, species diversity, or biological productivity of the Pinnacle Trend region would recover to pre-impact conditions in less than 2 years, more probably on the order of 2-4 months. |
| Alternative A High Case | Same as Alternative A - Base Case. | The proposed action is expected to result in dieback and mortality of 10-15 ha of wetlands vegetation as a result of contacts from onshore oil spills. All but 2 ha of these wetlands will recover within 10 years; the remaining 2 ha will be converted to open water. About 11 ha of wetlands are projected to be eroded along channel margins as a result of OCS vessel wake erosion, and 7 ha of wetlands are projected to be created as a result of beneficial disposal of dredged material from channel-deepening projects. | Same as Alternative A - Base Case. |
| Alternative B[1] | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative C[2] | No effect. | No effect. | No effect. |
| Cumulative Impacts | The observed erosional trend of barrier features is expected to continue in onshore Subareas C-1, C-2, and C-3. The major causes of these impacts are sediment deficits and relative sea-level rise. | Large losses of wetlands are expected to continue to occur. The main cause of these losses, particularly in coastal Louisiana where the largest amount of wetlands will be lost, is sediment deprivation and rapid coastal submergence. Other contributing factors include tideland oil and gas development, the erosion of navigation channel margins, and, to a lesser extent, impacts from oil spills. | The cumulative impacts are expected to be such that this damage to one or more components of a few regionally common habitats or communities results in changes to physical integrity, species diversity, or biological productivity that exceeds natural variability (observed prior to the damage); recovery to pre-impact conditions is expected to take longer than 10 years. |

Table S-3 Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 142) (continued)

| Alternatives | Resource Categories | | |
|---|---|---|---|
| | Deep-water Benthic Communities | Topographic Features | Water Quality |
| Alternative A Base Case | The proposed action is expected to cause little damage to the physical integrity, species diversity, or biological productivity of either the widespread, low-density chemosynthetic communities or the rarer, widely scattered, high-density Bush Hill-type chemosynthetic communities. Recovery from any damage is expected to take less than 2 years. | The proposed action is expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 $m^2$ would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks. | An identifiable change to the ambient concentration of one or more water quality parameters will be evident up to several hundred to 1,000 m from the source and for a period lasting up to several weeks in duration in marine and coastal waters. Chronic, low-level pollution related to the proposal will occur throughout the life of the proposed action. |
| Alternative A High Case | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative B[1] | Same as Alternative A - Base Case. | Alternative B is expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 $m^2$ would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks. Selection of Alternative B would preclude oil and gas operations in the unleased blocks affected by the proposed Topographic Features Stipulation. | Same as Alternative A - Base Case. |
| Alternative C[2] | No effect. | No effect. | No effect. |
| Cumulative Impacts | The cumulative impacts are expected to cause little damage to the physical integrity, species diversity, or biological productivity of either the widespread, low-density chemosynthetic communities or the rarer, widely scattered, high-density Bush Hill-type chemosynthetic communities. Recovery from any damage is expected to take less than 2 years. | The Cumulative scenario is expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 $m^2$ would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks. | Cumulative demands resulting from the proposal are expected to result in significant changes to the ambient concentration of one or more water quality parameters up to several hundred to 1,000 m from the source of activities and for a period lasting up to several weeks or months in duration. Chronic, low-level pollution related to the proposal will occur throughout the life of the proposed action. Overall cumulative impacts, which include the effects of non-OCS-related factors and OCS activities, will signifi- cantly degrade water quality, primarily within the Gulf of Mexico's coastal zone, in highly urbanized and industrialized coastal areas. Maritime activities will contribute to water quality degradation near ports and major navigation channels. In restricted or poorly flushed coastal waterbodies, localized increases in pollutant concentrations may be severe and persist for months or longer. Chronic, low-level pollution will continue to persist in marine and coastal waters. |

Table S-3 Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 142) (continued)

| Alternatives | Resource Categories | | | |
|---|---|---|---|---|
| | | Marine Mammals | | |
| | Air Quality | Nonendangered and Nonthreatened | Endangered and Threatened | Alabama, Choctawhatchee, and Perdido Key Beach Mice |
| Alternative A Base Case | Emission of pollutants into the atmosphere are expected to have concentrations that would not change onshore air quality classifications. An increase in onshore concentrations of air pollutants is estimated to be about 1 $\mu gm^{-3}$. This concentration will have minimal impacts during winter because onshore winds occur only about 37 percent of the time, with maximum impacts in summer when onshore winds occur 61 percent of the time. | The impact on nonendangered and nonthreatened marine mammals within the potentially affected area is expected to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes, as well as some degree of avoidance of the impacted area. | The impact on endangered and threatened marine mammals within the potentially affected area is expected to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes, as well as some degree of avoidance of the impacted area. | The impact on beach mice within the potentially affected area is expected to result in sublethal effects that seldom occur and may cause short-term physiological or behavioral changes. |
| Alternative A High Case | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative B[1] | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative C[2] | No effect. | No effect. | No effect. | No effect. |
| Cumulative Impacts | Emission of pollutants into the atmosphere from the activities assumed for the OCS program are expected to have concentrations that may change onshore air quality classifications. Increases in onshore concentrations of air pollutants are estimated to be between 1 and 14.5 $\mu gm^3$ (box model steady concentrations). This concentration will have minimal impact during winter because onshore winds occur only 37 percent of the time, with maximum impacts in summer when onshore winds occur 61 percent of the time. | The impact on nonendangered and nonthreatened marine mammals within the potentially affected area is expected to result in a decline in species numbers or a temporary displacement from their current distribution, a decline or displacement that will last more than one generation. | The impact on endangered and threatened marine mammals within the potentially affected area is expected to result in a decline in species numbers or a temporary displacement from their current distribution, a decline or displacement that will last more than one generation. | The cumulative impact on beach mice within the potentially affected area is expected to result in a decline in species numbers or a temporary displacement from their current distribution, a decline or displacement that will last more than one generation. |

Table S-3 Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 142) (continued)

| Alternatives | Resource Categories | | | |
|---|---|---|---|---|
| | | Coastal and Marine Birds | | |
| | Marine Turtles | Nonendangered and Nonthreatened | Endangered and Threatened | Gulf Sturgeon |
| Alternative A Base Case | The impact on marine turtles within the potentially affected area is expected to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes. | The impact on nonendangered and nonthreatened coastal and marine birds within the potentially affected area is expected to result in no discernible decline in a population or species and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to predisturbance condition in less than one generation. | The impact on endangered and threatened birds within the potentially affected area is expected to result in no discernible decline in a population or species and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to predisturbance condition in less than one generation. | The impact on the Gulf sturgeon within the potentially affected area is expected to result in sublethal effects and cause short-term physiological or behavioral changes. |
| Alternative A High Case | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative B[1] | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative C[2] | No effect. | No effect. | No effect. | No effect. |
| Cumulative Impacts | The cumulative impact on marine turtles within the potentially affected area is expected to result in a decline in species numbers or a temporary displacement from their current distribution, a decline or displacement that will last more than one generation. | The cumulative effect on coastal and marine birds within the potentially affected area is expected to result in a discernible decline in a local coastal or marine bird population or species, resulting in a change in distribution or abundance. Recruitment will return the population or affected species to their pre-impact level and/or condition within one to two generations. It is doubtful that this impact will affect regional populations. | The impact on endangered and threatened birds within the potentially affected area is expected to result in a decline in species number or a temporary displacement from their current distribution, a decline or displacement that will last more than one generation. | The impact on the Gulf sturgeon within the potentially affected area is expected to result in a decline in species number or a temporary displacement from their current distribution, a decline or displacement that will last more than one generation. |

Table S-3 Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 142) (continued)

| Alternatives | Resource Categories | | |
|---|---|---|---|
| | Commercial Fisheries | Beach Use | Marine Fishing |
| Alternative A Base Case | The impact on commercial fisheries within the potentially affected area is expected to result in a short-term decrease in a portion of a population of commercial importance, in an essential habitat, or in commercial fisheries on a local scale. Any affected population is expected to recover to predisturbance condition in one generation. | The proposed action is expected to result in minor pollution events and nearshore operations that may adversely affect the enjoyment of some beach users on Texas and Louisiana beaches. | Platforms installed within 30 mi of shore will attract fish and are likely to attract fishermen and improve fishing for a period of about 20 years, but are unlikely to affect offshore fishing patterns in general unless the platforms are installed in nearshore locations where no platforms currently exist. |
| Alternative A High Case | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | The High Case scenario will likely result in a few more platforms that will be productive sports fish areas accessible to and used by offshore recreational fishermen throughout the CPA, but it is unlikely to have a detectable impact on the recreational fishing industry at the regional level. A few local fishing markets could suffer short-term (up to one month) loss of business from a major pollution event; however, these same markets should experience long-term (15-20 yrs) benefit from platform installations accessible to local fishermen. |
| Alternative B[1] | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative C[2] | No effect. | No effect. | No effect. |
| Cumulative Impacts | The cumulative effect on the commercial fishing industry within the potentially affected area is expected to result in a discernible decline in populations of commercial importance, in the quality of essential habitats, or in commercial fishing activity. Recruitment will return any affected population, habitat, or activity to pre-impact level and/or condition within two to three generations. | Although trash and accidental oil spills will continue to affect the ambience of recreational beaches between Alabama and Texas, the level of chronic pollution should decline during the life of the proposed action. Beach use at the regional level is unlikely to change; however, closure of specific beached or parks directly impacted by one or two oil spills greater than or equal to 1,000 bbl is likely during cleanup operations. | Continued offshore oil and gas development over the next 35 years will continue to support, maintain, and facilitate offshore recreational fishing in the CPA and will extend the time offshore oil and gas structures are a focus of offshore fishing activity. |

Table S-3 Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 142) (continued)

| Alternatives | Resource Categories | |
|---|---|---|
| | Archaeological Resources | |
| | Historic | Prehistoric |
| Alternative A Base Case | There is a very small possibility of an impact between OCS oil and gas activities and a historic shipwreck or site. Should such an impact occur, unique or significant historic archaeological information could be lost. | There is a very small possibility of an impact between OCS oil and gas activities and a prehistoric site. Should such an impact occur, unique or significant prehistoric archaeological information could be lost. |
| Alternative A High Case | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative B[1] | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative C[2] | No effect. | No effect. |
| Cumulative Impacts | The total of OCS program and non-program related impact-producing factors has likely resulted in and may yet result in loss of significant or unique historic archaeological information. | The total of OCS program and non-program-related impact-producing factors has likely resulted in and may yet result in loss of significant or unique prehistoric archaeological information. |

Table S-3 Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 142) (continued)

| Alternatives | Resource Categories | | |
|---|---|---|---|
| | Socioeconomic Conditions | | |
| | Population, Labor, and Employment | Public Services and Infrastructure | Social Patterns |
| Alternative A Base Case | The impact in the Central Gulf on the population, labor, and employment of the counties and parishes of the Central and Western Gulf coastal impact area is expected to be less than 1 percent of the levels expected in the absence of the proposal. | Population and employment impacts will not result in disruptions to community infrastructure and public services beyond what is anticipated by in-place planning and development agencies. | It is expected that no net migration will occur as a result of the proposed action. Deleterious impacts to social patterns are expected to occur in some individual cases as a result of extended work schedules, displacement from traditional occupations, and relative wages. |
| Alternative A High Case | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative B[1] | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative C[2] | No effect. | No effect. | No effect. |
| Cumulative Impacts | On a regional level, the cumulative impact from prior sales, the proposed actions, and future sales on the population, labor, and employment of the counties and parishes of the Central Gulf coastal impact area is significant, amounting to approximately 3,310,400 person-years of employment over the life of the proposed action plus at least an additional 11,050 person-years of employment associated with the clean-up of three oil spills. Locally, the cumulative impact to population, labor, and employment is higher for coastal Subareas C-1 and C-2 along the western and central Louisiana coastline, lower for coastal Subarea C-3 in southeast Louisiana, and lowest for coastal Subarea C-4 in Mississippi and Alabama. Employment needs in support of OCS oil and gas activity are likely to be met with the existing population and available labor force. | The cumulative impact is expected to result in deteriorating conditions of existing infrastructure and difficulties in delivering satisfactory levels of public services. | It is expected that some loss of traditional occupations will occur. Deleterious impacts to cultural heritage and family life are also expected to occur in some individual cases. It is expected that these impacts will be greatest in coastal Subareas C-1, C-2, and C-3. |

[1]Alternative B - The Proposed Action Excluding the Blocks Near Biologically Sensitive Topographic Features.
[2]Alternative C - No Action.

Table S-4
Comparison and Summary of Impacts for Alternatives A-D
and Cumulative in the Western Planning Area (Sale 143)

| Alternatives | Resource Categories | | | |
|---|---|---|---|---|
| | Coastal Barrier Beaches | Wetlands | Deep-water Benthic Communities | Topographic Features |
| Alternative A Base Case | The proposed action is not expected to result in permanent alterations of barrier beach configurations, except in localized areas downdrift from channels that have been dredged and deepened. The contribution to this localized erosion is expected to be less than 1 percent. | The proposed action is expected to result in no permanent alterations of wetland habitat, except for the erosion of less than 1 ha of wetlands along navigation channel margins. These losses could be offset or even exceeded by wetland gains from the beneficial disposal of dredged material generated during channel maintenance and deepening operations. | The proposed action is expected to cause little damage to the physical integrity, species diversity, or biological productivity of either the widespread, low-density chemosynthetic communities or the rare, widely scattered, high-density Bush Hill-type chemosynthetic communities. Recovery from any damage is expected to take less than 2 years. | The proposed action is expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 $m^2$ would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks. |
| Alternative A High Case | Same as Alternative A - Base Case. | The proposed action is expected to result in no permanent alterations of wetland habitat, except for the erosion of less than 2 ha of wetlands along navigation channel margins. These losses could be offset or even exceeded by wetland gains from the beneficial disposal of dredged material generated during channel maintenance and deepening operations. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative B[1] | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Alternative B is expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 $m^2$ would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks. Selection of Alternative B would preclude oil and gas operations in the unleased blocks affected by the proposed Topographic Features Stipulation. |
| Alternative C[2] | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |

Table S-4 Comparison and Summary of Impacts for Alternatives A-D and Cumulative in the Western Planning Area (Sale 143) (continued)

| Alternatives | Resource Categories | | | |
|---|---|---|---|---|
| | Coastal Barrier Beaches | Wetlands | Deep-Water Benthic Communities | Topographic Features |
| Alternative D[3] | No effect. | No effect. | No effect. | No effect. |
| Cumulative Impacts | The observed erosional trend of barrier features will continue along the Gulf Coast in the area of potential impact. The major causes of the impacts is the reduction in sediment being delivered to the coastal littoral system, sea-level rise, the effects of navigational and erosion control structures, and some recreational impacts. | Losses of wetlands are expected to continue. The major cause of this loss is expected to be coastal submergence. | The Cumulative Scenario is expected to cause little damage to the physical integrity, species diversity, or biological productivity of either the widespread, low-density chemosynthetic communities or the rare, widely scattered, high-density Bush Hill-type chemosynthetic communities. Recovery from any damage is expected to take less than 2 years. | The Cumulative Scenario is expected to cause little to no damage to physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 $m^2$ would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks. |

Table S-4 Comparison and Summary of Impacts for Alternatives A-D and Cumulative in the Western Planning Area (Sale 143) (continued)

| Alternatives | Resource Categories | | | |
|---|---|---|---|---|
| | | | Marine Mammals | |
| | Water Quality | Air Quality | Nonendangered and Nonthreatened | Endangered and Threatened |
| Alternative A Base Case | An identifiable change to the ambient concentration of one or more water quality parameters will be evident up to several hundred to 1,000 m from the source and for a period lasting up to several weeks in duration in marine and coastal waters. Chronic, low-level pollution related to the proposal will occur throughout the life of the proposed action. | Emissions of pollutants into the atmosphere are expected to have concentrations that would not change onshore air quality classifications. Increase in onshore concentrations of air pollutants are estimated to be about 1 $\mu gm^{-3}$. This concentration will have minimal impacts during winter because onshore winds occur only about 34 percent of the time, with maximum impacts in summer when onshore winds occur 85 percent of the time. | The impact on nonendangered and nonthreatened marine mammals within the potentially affected area is expected to result in sublethal effects that occur periodically and result in short-term physiological or behavioral changes, as well as some degree of avoidance of the impacted area(s). | The impact on endangered and threatened marine mammals within the potentially affected area is expected to result in sublethal effects that occur periodically and result in short-term physiological or behavioral changes, as well as some degree of avoidance of the impacted area(s). |
| Alternative A High Case | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | The impact on nonendangered and nonthreatened marine mammals within the potentially affected area is expected to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes, as well as some degree of avoidance of the impacted area(s). | The impact on endangered and threatened marine mammals within the potentially affected area is expected to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes, as well as, some degree of avoidance of the impacted area(s). |
| Alternative B[1] | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative C[2] | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative D[3] | No effect. | No effect. | No effect. | No effect. |

Table S-4 Comparison and Summary of Impacts for Alternatives A-D and Cumulative in the Western Planning Area (Sale 143) (continued)

| Alternatives | Resource Categories | | | |
|---|---|---|---|---|
| | | | Marine Mammals | |
| | Water Quality | Air Quality | Nonendangered and Nonthreatened | Endangered and Threatened |
| Cumulative Impacts | Cumulative demands resulting from the proposal are expected to result in significant changes to the ambient concentration of one or more water quality parameters up to several hundred to 1,000 m from the source of activities and for a period lasting up to several weeks or months in duration. Chronic pollution related to the proposal will occur throughout the life of the proposed action. Overall cumulative impacts, which include the effects of non-OCS-related factors and OCS activities, will significantly degrade water quality, primarily within the Gulf of Mexico's coastal zone in highly urbanized and industrialized coastal areas. Maritime activities will contribute to water quality degradation near ports and major navigation channels. In restricted or poorly flushed coastal waterbodies, localized increases in pollutant concentration (nutrients, organic matter, trace metals, organotins, hydrocarbons, etc.) may be severe and persist for months or longer. Chronic, low-level pollution will continue to persist in marine and coastal waters. | Emission of pollutants into the atmosphere from the activities assumed for the OCS program within the WPA are expected to have concentrations that would not change onshore air quality classifications. Increases in onshore concentrations of air pollutants from the High Case are estimated to be between 1 and 14.5 $\mu gm^3$ (box model steady concentrations). This concentration will have minimal impact during winter because onshore winds occur only 34 percent of the time, with maximum impact in winter when onshore winds occur 85 percent of the time. | The impact on nonendangered and nonthreatened marine mammals within the potentially affected area is expected to result in a decline in species numbers or temporary displacement from their current distribution, a decline or displacement that will last more than one generation. | The impact on endangered and threatened marine mammals within the potentially affected area is expected to result in a decline in species numbers or temporary displacement from their current distribution, a decline or displacement that will last more than one generation. |

Table S-4 Comparison and Summary of Impacts for Alternatives A-D and Cumulative in the Western Planning Area (Sale 143) (continued)

| Alternatives | Resource Categories | | | |
|---|---|---|---|---|
| | | Coastal and Marine Birds | | |
| | Marine Turtles | Nonendangered and Nonthreatened | Endangered and Threatened | Commercial Fisheries |
| Alternative A Base Case | The impact on marine turtles within the potentially affected area is expected to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes. | The impact on nonendangered and nonthreatened coastal and marine birds within the potentially affected area is expected to result in no discernible decline in a population or species and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to predisturbance condition in less than one generation. | The impact on endangered and threatened birds within the potentially affected area is expected to result in no discernible decline in a population or species and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to predisturbance conditions in less than one generation. | The impact on commercial fisheries within the potentially affected area is expected to result in no discernible decrease in a population of commercial importance, its essential habitat, or in commercial fisheries on a local scale. Any affected population is expected to recover to predisturbance condition in one generation. |
| Alternative A High Case | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative B[1] | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative C[2] | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative D[3] | No effect. | No effect. | No effect. | No effect. |
| Cumulative Impacts | The impact on marine turtles within the potentially affected area is expected to result in a decline in species numbers or temporary displacement from their current distribution, a decline or displacement that will last more than one generation. | The cumulative effect on coastal and marine birds within the potentially affected area is expected to result in a discernible decline in a local coastal or marine bird population or species, resulting in a change in distribution or abundance. Recruitment will return the population or affected species to its pre-impact level and/or condition within one to two generations. It is doubtful that this impact will affect regional populations. | The impact of the Cumulative Case Scenario on endangered and threatened birds within the potentially affected area is expected to result in a decline in species number or temporary displacement from their current distribution, a decline or displacement that will last more than one generation. | The cumulative on the commercial fishing industry within the potentially affected area is expected to result in a discernible decline in populations of commercial importance, in the quality of essential habitats, or in commercial fishing activity. Recruitment will return any affected population, habitat, or activity to pre-impact level and/or condition within two to three generations. |

Table S-4 (continued) Comparison and Summary of Impacts for Alternatives A-D and Cumulative in the Western Planning Area (Sale 143)

| Alternatives | Resource Categories | | | |
|---|---|---|---|---|
| | Recreational Resources and Activiies | | Archaeological Resources | |
| | Beach Use | Marine Fishing | Historic | Prehistoric |
| Alternative A Base Case | The proposed action is expected to result in periodic loss of solid waste items likely to wash up on recreational beaches, which is expected to diminish enjoyment of some beach visits but is unlikely to affect the number or type of visits currently occurring on Texas beaches. | One platform complex (2-3 structures) installed as a result of this proposal within 30 mi of shore is expected to attract fishermen and improve fishing success in the vicinity of the platform complex for a period of about 20 years. | There is a very small possibility of an impact between OCS oil and gas activities and a historic shipwreck or site. Should such an impact occur, unique or significant historic archaeological information could be lost. | There is a very small possibility of an impact between OCS oil and gas activities and a prehistoric site. Should such an impact occur, unique or significant prehistoric archaeological information could be lost. |
| Alternative A High Case | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative B[1] | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative C[2] | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative D[3] | No effect. | No effect. | No effect. | No effect. |
| Cumulative Impacts | Although trash and accidental oil spills will continue to affect the ambience of Texas recreational beaches, the level of chronic pollution should decline during the life of the proposed action. Beach use at the regional level is unlikely to change; however, closure of specific beaches or parks directly impacted by one or two oil spills greater than or equal to 1,000 bbl is likely during cleanup operations. | Continued offshore oil and gas development over the next 35 years will continue to support, maintain, and facilitate offshore recreational fishing in the WPA and extend the time offshore oil and gas production structures are a focus of offshore fishing activity. | The total of OCS program and nonprogram-related impact-producing factors have likely resulted in loss and may yet result in loss of significant or unique historic archaeological information. | The total of OCS program and nonprogram-related impact-producing factors have likely resulted in loss and may yet result in loss of significant or unique prehistoric archaeological information. |

Table S-4 Comparison and Summary of Impacts for Alternatives A-D and Cumulative in the Western Planning Area (Sale 143) (continued)

| Alternatives | Resource Categories | | |
|---|---|---|---|
| | Socioeconomic Conditions | | |
| | Population, Labor, and Employment | Public Services and Infrastructure | Social Patterns |
| Alternative A Base Case | The impact in the Western Gulf on the population, labor, and employment of the counties and parishes of the Central and Western Gulf Coastal impact area is expected to be less than 1 percent of the levels expected in the absence of the proposal. | Population and employment impacts will not result in disruptions to community infrastructure and public services beyond what is anticipated by in-place planning and development agencies. | It is expected that no net migration will occur as a result of the proposed action. Deleterious impacts to social patterns are expected to occur in some individual cases as a result of extended work schedules, displacement from traditional occupations, and relative wages. |
| Alternative A High Case | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative B[1] | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative C[2] | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. | Same as Alternative A - Base Case. |
| Alternative D[3] | No effect. | No effect. | No effect. |
| Cumulative Impacts | The impact from prior sales, the proposed actions, and future sales on the population, labor, and employment of the counties and of the coastal impact area is significant, amounting to approximately 277,300 person-years of employment over the life of the proposed action. Employment needs in support of OCS oil and gas activity are likely to be met with the existing population and available labor force. | The impact on public services and community infrastructure is not expected to result in long-term (greater than 3 years) disruptions in delivery of public services or maintenance of community infrastructure because of the diversified local economy and the small percentage of impact of the OCS program on local employers and demographies. | Under the cumulative scenario, it is expected that some loss of traditional occupations will occur. Deleterious impacts to cultural heritage and family life are also expected to occur in some individual cases. |

[1]Alternative B - The Proposed Action Excluding the Blocks Near Biologically Sensitive Topographic Features
[2]Alternative C - The Proposed Action Excluding the Western Naval Operations Area
[3]Alternative D - No Action

I

II

III

IV

V

VI

VII

VIII

IX

# SECTION IV

# ENVIRONMENTAL CONSEQUENCES

IV

# D. ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTIONS AND ALTERNATIVES

## 1. Proposed Central Gulf Sale 142

Proposed Central Gulf Sale 142 is scheduled to be held in March 1993. Details of the proposal are in Section I.A. Alternatives to the proposed action and mitigating measures are described in Section II.A.

The analyses of impacts are based on scenarios for the Base Case, High Case, and Cumulative Case. These scenarios were formulated to provide sets of assumptions and estimates on the amounts, locations, and timing for OCS exploration, development, and production operations and facilities, both offshore and onshore. These are estimates only and not predictions of what will happen as a result of holding this proposed sale. A detailed discussion of the development scenarios and major, related impact-producing factors is included in Sections IV.A. and B. The four potential mitigating measures (Live Bottom (Pinnacle Trend), Topographic Features, Archaeological Resources, and Military Areas Stipulations) are considered part of the proposed actions for analysis purposes.

### a. Alternative A - The Proposed Action

To facilitate the analysis, the Federal offshore area is divided into subareas. The CPA comprises four subareas (C-1, C-2, C-3, and C-4) and the coastal region is divided into four coastal subareas (C-1, C-2, C-3, and C-4). These subareas are delineated on Figure IV-1.

#### *(1) Impacts on Sensitive Coastal Environments*

#### *(a) Coastal Barrier Beaches*

The major impact-producing factors associated with the proposed action that could affect barrier landforms include oil spills, pipeline emplacements, navigation canal dredging and maintenance dredging, and support infrastructure construction. This section considers impacts to the physical shape and structure of the landform. Impacts to other aspects of the barrier environment, such as the animals that inhabit the island, the recreational value of the beaches, and the archaeological resources that may occur here, are described in other sections.

Oil spills can affect barrier beach stability if cleanup operations remove large quantities of sand, and if the oil contacts and kills sand dune vegetation. During cleanup operations after a spill, if large quantities of sand were scraped away and removed, a new beach profile and plan configuration would be established to adjust to the lessened sand supply. The net result of these changes would be accelerated rates of shoreline erosion, especially in a sand-starved, eroding-barrier setting. Further, areas where oiling has weakened or destroyed sand dune vegetation could become eventual sites of island breaching.

Pipeline landfall sites across barrier islands have been identified as potential causes of accelerated beach erosion and island breaching. A recently completed, MMS-funded study, however, showed little to no impact to barrier beaches as a result of pipeline crossings (Wicker et al., 1989). Other investigators have monitored pipeline landfall projects on Gulf of Mexico barrier islands and have shown that, with proper construction techniques, landfall projects can be done with minor impacts to the beach topography (LeBlanc, 1985; Mendelssohn and Hester, 1988).

The dredging and stabilization of navigation channels through barrier beach passes could affect the stability of the barrier landform. A deepened channel through a barrier pass could serve as a sediment sink and deprive downdrift beach areas of sediment. Jetties constructed perpendicularly to a channel entrance could block the transport of sediments to downdrift beach areas. Periodic maintenance dredging of these channels could exacerbate these conditions by continually deepening the channel. A recently completed MMS study of navigation channel impacts on barrier beaches, however, showed little accelerated erosion near channels, except in some areas immediately downdrift from a jetty (Wicker et al., 1989).

Some onshore infrastructure used to support OCS operations has been constructed on barrier beaches in Louisiana. The construction of new facilities would result in the loss of barrier habitat and the possible need to stabilize the beach from subsequent erosion to protect the construction. Previous studies have shown that efforts to stabilize and "armor" beaches can lead to accelerated erosion in areas away from the protected beach.

*Base Case Analysis*

Oil spills associated with the proposed action can occur from a number of sources. Spills can occur offshore as a result of platform accidents, barge or tanker collisions, and pipeline breaks. Spills can also occur inshore as a result of barge, pipeline, and storage tank accidents.

According to Table IV-21, there is a 1 percent or less chance of an offshore spill greater than or equal to 1,000 bbl (one 6,500-bbl spill is assumed) occurring and contacting within 10 days a coastal barrier. Based on these low probabilities, the assumption is that no spills greater than or equal to 1,000 bbl from offshore sources will occur and contact a coastal barrier. Furthermore, no spills greater than or equal to 1,000 bbl from shuttle tankers in port are assumed to occur under the Base Case scenario.

No spills greater than 50 bbl and less than 1,000 bbl are assumed to occur and contact the coast from either offshore or inshore sources under the Base Case scenario (Section IV.C.1 and Table IV-4). Several spills greater than 1 and less than or equal to 50 bbl are assumed to occur inshore as a result of pipeline and/or barge accidents, and a few spills of this size category are assumed to occur from offshore sources and contact the coast (Table IV-4).

At least 30 percent of the volume of an offshore spill greater than 1 and less than or equal to 50 bbl will weather prior to contacting shore. As much as 35 bbl of oil could, therefore, contact a barrier feature if a 50-bbl spill occurred on the landward edge of the OCS. It is assumed that the beached oil will be spread over about a 2-km length of beach, with only light oiling over much of this distance. Cleanup crews will manually clean the small amounts of oil that contact the beach. No sand will be taken from the littoral transport system as a result of the cleanup operations. The beach is expected to readjust to its prespill configuration within a few months.

In regard to small onshore spills, terminals that receive oil barged from OCS platforms are not located on barrier features, so an accident that occurs during oil transfer operations at a terminal will not likely affect the seaward side of a barrier landform. For a barge accident to affect a barrier beach, the accident would have to occur while the barge is in transit and as a result of a collision or grounding near a barrier beach. Oil barges make extensive use of the Intracoastal Waterway when transporting cargoes to terminals or refineries. The Intracoastal Waterway is located inland from the coast in Louisiana, so oil spilled from a barge in transit will not likely contact a barrier feature. In Mississippi, the Intracoastal Waterway cuts across Mississippi Sound. Although there are no terminals located in Mississippi or Alabama that receive OCS crude directly from an offshore platform, some secondary coastwise movement of OCS crude could occur via barge in Mississippi Sound. The two barge trips projected for Texas ports (Table IV-4) are not expected to result in an oil-spill incident.

For a pipeline accident spill to contact a barrier feature, the accident would have to occur either in coastal waters near the barrier, where the pipeline crosses the barrier, or in the sound that separates a barrier island from the mainland. Such a spill occurred in Mississippi Sound in September 1989 and resulted in the oiling of the landward side of Horn Island. Pipeline accidents, however, would most likely affect barrier features in coastal Louisiana, where there are many more existing pipelines.

Of the several spills greater than 1 and less or equal to 50 bbl that occur inshore, only one or two are assumed to contact a barrier feature. The others will be too small (a few barrels) to contact a beach or will occur in locations that do not provide a route for the oil to reach a barrier. The spills that do contact a barrier will be more likely to occur on the landward side of a barrier island, given the location of barge routes and terminals and pipelines relative to barriers. These spills are assumed to contact about 2 km of backbarrier coast, with most of this length experiencing light oiling. Cleanup crews will manually clean the spill, and no impacts to beach morphology are projected. This scenario is especially likely given that the affected barrier setting is in a low-energy lagoonal environment where erosion and sediment movement activity is diminished.

Inshore spills in Mississippi Sound could contact the landward sides of barrier islands that are included in the Gulf Islands National Seashore (Ship, Horn, and Petit Bois Islands). In September 1989, a 100-bbl spill from a pipeline accident in Mississippi Sound oiled about a 1.5-km stretch of the landward side of Horn Island. The oil was removed from the beach by flushing the sand with seawater and mopping the refloated oil with sorbents. No loss of sand or change in beach morphology occurred as a result of the cleanup. An additional 10 km of beach was lightly oiled and did not require any cleanup activity. Inspection of the island by MMS seven months after the spill revealed that only a thin layer of oiled sand remained along the seaward edge of the beach berm. No impacts to barrier beaches in the Gulf Island National Seashore are expected as a result of oil-spill contacts. The spill of September 1989, however, did result in mortalities to subtidal and intertidal benthic crustaceans along the oiled stretches of the island. Marine and coastal birds were observed feeding upon these oiled crustaceans.

Oil from spills greater than 1 and less than or equal to 50 bbl is not assumed to affect sand dune vegetation. Heights of dune lines range from 0.5 to 1.3 m above mean high tide levels. For tides to reach or exceed this level, strong southerly winds would have to persist for an extended time prior to or immediately after the spill. An analysis of 37 years of tide gauge data from Grand Isle, Louisiana, shows that the probability of water levels reaching sand dune elevations ranges from 0 to 16 percent. The likelihood that a spill greater than 1 and less than or equal to 50 bbl will contact a barrier feature at the same time that tide levels exceed sand dune elevations is low. In addition, the strong winds required to produce the high tides would disperse and spread the oil slick and reduce the concentration of oil that would occur at a coastal location. Furthermore, a recent study in Texas has shown that the disposal of oiled sand on vegetated sand dunes had no deleterious effects on the existing vegetation or on the recolonization of the oiled sand (Webb, 1988). Based on all of these considerations, the expectation is that oil spills will not affect sand dune vegetation.

No new pipeline landfalls are projected to occur under the Base Case scenario (Section IV.A.3.b.(1)). Furthermore, in the event of an unforeseen hydrocarbon discovery that would require a new landfall, modern techniques of pipeline emplacement and planning procedures can reduce pipeline crossing impacts to negligible levels (LeBlanc, 1985; Mendelssohn and Hester, 1988; Wicker et al., 1989).

No new navigation facilities or infrastructure is expected under the Base Case scenario (Section IV.A.3.b.(4)); therefore, impacts from these activities are precluded. Some periodic maintenance dredging of navigation channels through barrier passes is expected, but this activity has not been documented to have a noticeable, deleterious effect on barrier morphology. Furthermore, the contribution of the Base Case scenario to the vessel traffic within navigation channels is very small (Table IV-10), so maintenance dredging cannot be attributed to activities associated with the Base Case.

Section IV.A.3.c.(3)(c) states that the channel leading to Port Fourchon, Louisiana (Belle Pass), will be deepened to 6.7 m (22 ft) to provide access for larger service vessels used for deep-water operations. It is assumed that 2 percent of the impacts of this project can be attributed to Base Case scenario activities. Wicker et al. (1989) have studied the effects of navigation channel dredging and maintenance operations on coastal processes, and at Belle Pass in particular. Prior to the dredging of the channel to Port Fourchon and to the construction of jetties at the channel entrance, the coast east (updrift) of the channel was retreating at a rate of 40 m/yr, compared to 31 m/yr west (downdrift) of the channel. The difference in retreat rates (30% higher to the west) can perhaps be attributed to the channel's acting as a sediment sink in this predominantly east-to-west littoral drift environment. After dredging and jetty construction, the difference between the east and west erosion rates increased to 50 percent, although the magnitude of the retreat rate decreased by nearly one half. In 1974, the Corps of Engineers (COE) began to use material from maintenance dredging operations in Belle Pass to nourish the beach areas west of the channel. Since then, no significant difference between east and west erosion rates has been observed, and the absolute erosion rate has decreased by about another one half. The COE's feasibility report for the Belle Pass deepening project indicates that some of the dredged material be used for beach nourishment (U.S. Dept. of the Army, COE, 1991). Based on this information, the expectation is that there will be no increase in ongoing erosion rates of barrier islands and beaches is expected as a result of channel deepening.

*Summary*

Oil-spill contact to a barrier island could result in erosional changes in the barrier if cleanup operations removed large quantities of sand. Because of the very low probability of occurrence and contact from either an offshore or onshore spill of greater than 50 bbl, however, it is assumed that no contact from such a spill will occur. Several spills greater than 1 and less than or equal to 50 bbl are assumed to contact coastal areas of the CPA under the Base Case scenario from barge and pipeline accidents and from offshore sources. These spills will contact mainly the landward side of barrier islands, will affect only a short stretch of beach, and will be cleaned within a week with no effects on beach morphology.

Impacts from onshore and nearshore construction of OCS-related infrastructure (pipeline landfalls, navigation channels, service bases, platform yards, etc.) are not expected to occur, because no new infrastructure construction is anticipated as a result of the proposed action. Although some maintenance dredging is expected to occur, this activity has not been shown to have a negative impact on barriers, and the need for dredging cannot be attributed to the small percentage of vessel traffic in these channels accounted for by Base Case activities. Deepening of the channel to Port Fourchon is not expected to affect nearby barrier features.

It follows from the above that activities resulting from the proposed action will not have a significant impact on coastal barriers.

*Conclusion*

The proposed action is not expected to result in permanent alterations of barrier beach configurations, except in localized areas downdrift from navigation channels that have been dredged and deepened. The contribution to this localized erosion is expected to be less than 1 percent.

*High Case Analysis*

According to Table IV-21, there is a 1 percent or less chance of an offshore spill greater than or equal to 1,000 bbl occurring and contacting within 10 days a coastal barrier in the CPA, although one 6,500-bbl spill is assumed to occur. Based on these low probabilities, the assumption is that no spills greater than or equal to 1,000 bbl from offshore sources will contact a coastal barrier. Furthermore, no spills greater than or equal to 1,000 bbl from shuttle tankers in port are assumed to occur under the High Case scenario.

No spills greater than 50 and less than 1,000 bbl are assumed to occur and contact coastal barriers under the High Case scenario (Section IV.C.1). Several spills greater than 1 and less than or equal to 50 bbl are assumed to occur and contact coastal barriers. The inshore spills are assumed to occur as a result of coastal pipeline or barge accidents, or during transfer operations at terminals. Terminals that receive oil barged from OCS platforms are not located near barrier features, so an accident that occurs during oil transfer operations at a terminal will not likely affect the seaward side of a barrier landform. For a barge accident to affect a barrier beach, the accident would have to occur while the barge is in transit and as a result of a collision or grounding near a barrier beach. Oil barges make extensive use of the Intracoastal Waterway when transporting cargoes to terminals or refineries. The Intracoastal Waterway is located inland from the coast in Louisiana, so oil spilled from a barge in transit will not likely contact a barrier feature. In Mississippi, the Intracoastal Waterway cuts across Mississippi Sound. Although there are no terminals located in Mississippi or Alabama that receive OCS crude directly from an offshore platform, some secondary coastwise movement of OCS crude could occur via barge in Mississippi Sound. An accident there involving a barge carrying crude oil to the Pascagoula, Mississippi, refinery could result in spilled oil contacting a barrier island. The four barge trips projected for Texas ports (Table IV-4) are not expected to result in an oil-spill incident.

For a pipeline accident spill to contact a barrier feature, the accident would have to occur either in coastal waters near the barrier, where the pipeline crosses the barrier, or in the sound that separates a barrier island from the mainland. Such a spill occurred in Mississippi Sound in September 1989 and resulted in the oiling of the landward side of Horn Island. Pipeline accidents, however, would most likely affect barrier features in coastal Louisiana, where there are many more existing pipelines.

Of the several spills greater than 1 and less than or equal to 50 bbl that occur inshore, only one or two are assumed to affect a barrier feature. The others will be too small (a few barrels) to contact the beach or will occur in locations that do not provide a route for the oil to reach a barrier. The inshore spills that do contact a barrier will occur on the landward side of a barrier island located most likely in Louisiana, but also possibly in Mississippi. Offshore spills will contact the seaward side of barriers in coastal Louisiana. These spills are expected to contact about 2 km of barrier beach, with most of this length experiencing light oiling. The spills will be manually cleaned, and no impacts to beach morphology are expected.

Oil from any of these small spills is not assumed to affect sand dune vegetation. In coastal Louisiana, dune line heights range from 0.5 to 1.3 m above mean high tide levels. For tides to exceed this level, strong southerly winds would have to persist for an extended time prior to or immediately after the spill. An in-house analysis of 37 years of tide gauge data from Grand Isle, Louisiana, shows that the probability of water levels reaching sand dune elevations ranges from 0 to 16 percent. The combined probabilities of occurrence and contact from a small spill associated with the proposed action and tidal inundation of sand dune vegetation are a very unlikely event. In addition, the strong winds required to produce the high tides would disperse and spread the oil slick and reduce the oil concentration that would occur at a coastal location. Furthermore, a recent study in Texas has shown that the disposal of oiled sand on vegetated sand dunes had no deleterious effects on the existing vegetation or on the recolonization of the oiled sand (Webb, 1988). Based on all of these considerations, the expectation is that oil spills will not affect sand dune vegetation.

No new pipeline landfalls are projected to occur under the High Case scenario (Section IV.A.3.b.(1)). Furthermore, in the event of a pipeline landfall as a result of an unforeseen hydrocarbon discovery, modern techniques of pipeline emplacement and planning procedures can eliminate pipeline crossing impacts (LeBlanc, 1985; Mendelssohn and Hester, 1988; Wicker et al., 1989).

No new navigation channels are expected to be dredged under the High Case scenario (Section IV.A.3.b.(4)); therefore, impacts from these activities are precluded. Some periodic maintenance dredging of navigation channels through barrier passes is expected, but this activity has not been documented as having a noticeable effect on barrier morphology. Furthermore, the contribution of the High Case scenario to the vessel traffic within navigation channels is very small, so only a small percentage of the maintenance dredging done during the life of the proposed action can be attributed to activities associated with the High Case.

Section IV.A.3.c.(3)(c) states that the channel leading to Port Fourchon, Louisiana (Belle Pass), will be deepened to 6.7 m (22 ft) to provide access for larger service vessels used for deep-water operations. It is assumed that four percent of the impacts of this project can be attributed to High Case scenario activities. Wicker et al. (1989) have studied the effects of navigation channel dredging and maintenance operations on coastal processes, and at Belle Pass in particular. Prior to the dredging of the channel to Port Fourchon and to the construction of jetties at the channel entrance, the coast east (updrift) of the channel was retreating at a rate of 40 m/yr, compared to 31 m/yr west (downdrift) of the channel. The difference in retreat rates (30% higher to the west) can perhaps be attributed to the channel's acting as a sediment sink in this predominantly east-to-west littoral drift environment. After dredging and jetty construction, the difference between the east and west erosion rates increased to 50 percent, although the magnitude of the retreat rate decreased by nearly one half. In 1974, COE began to use material from maintenance dredging operations in Belle Pass to nourish the beach areas west of the channel. Since then, no significant difference between east and west erosion rates has been observed, and the absolute erosion rate has decreased by about another one half. The COE's feasibility report for the Belle Pass deepening project indicates that some of the dredge material be used for beach nourishment U.S. Dept. of the Army, COE, 1991). Based on this information, the expectation is that there will be no increase in ongoing erosion rates of barrier islands and beaches is expected as a result of channel deepening. No new infrastructure construction activity is projected to occur under the High Case scenario (Section IV.A.3.a.).

*Conclusion*

The High Case scenario is not expected to result in permanent alterations of barrier beach configurations, except in localized areas downdrift from navigation channels that have been dredged and deepened. The contribution to this localized erosion is expected to be less than 1 percent.

### *(b) Wetlands*

The wetlands considered in this analysis include forested wetlands (swamps), tidal marshes, and seagrasses. Swamps and marshes occur throughout the coastal zone. Seagrasses are restricted in distribution to small areas behind barrier islands in Mississippi and Chandeleur Sounds. Impact-producing factors resulting from OCS oil and gas activities that could adversely affect wetlands include oil spills, onshore discharge of OCS-produced waters, pipeline placements, dredging of new navigation channels, maintenance dredging and vessel usage of existing navigation channels, and construction of onshore facilities in wetland areas.

Numerous investigators have studied the immediate impacts of oil spills on wetland habitats in the Gulf area. The often times seemingly contradictory impact assessment conclusions from these studies can at least partially be explained by differences in the oil concentrations contacting vegetation, the kinds of oil spilled (heavy or light crude, diesel, fuel oil, etc.), the type of vegetation affected, the season of year, the preexisting stress level of the vegetation, and numerous others factors. In general, however, the data suggest that, in the absence of heavy oiling, impacts will be short-term (plant dieback with recovery within two growing seasons or less) and reversible, i.e., the wetland area will be revegetated without artificial replanting (Webb et al., 1985; Alexander and Webb, 1987; Lytle, 1975; Delaune et al., 1979; Fischel et al., 1989).

The critical concentration of oil above which impacts to wetlands will be long term (greater than two growing seasons) and irreversible (plant mortality and some permanent wetland loss) is currently unknown. A dearth of data exists on the long-term (three years or more) effects of oil spills on wetlands. This EIS assumes that the oil concentration that results in long-term, permanent impacts will depend on the wetland type contacted. In the stressed environment of coastal Louisiana, where the wetland loss rate has been as high as 0.86 percent per year within the recent past, wetlands are assumed to be more sensitive to oil contacts than elsewhere in the Gulf. The work of Mendelssohn and his colleagues (Fischel et al., 1989; Mendelssohn et al., 1990) is providing data on the long-term effects of oil spills on coastal marshes in Louisiana. The spill (a 300-bbl spill from a pipeline rupture within the marsh) occurred in 1985. The response and recovery of the marsh vegetation have been monitored since that time. The results of these investigations are used in this EIS to develop assumptions about the anticipated effects of an oil spill on wetlands in the stressed environment of coastal Louisiana.

Wetlands in the other coastal areas that could be contacted by an oil spill associated with Sale 142 (Mississippi, Alabama, and parts of Texas) are more stable and are not experiencing the wetlands loss problem occurring in Louisiana. These Sale 142-associated wetlands occur on a more stable substrate, receive more sediment per unit of wetland area, and have not experienced the alterations (canal dredging) that characterize wetlands in Louisiana. The work of Webb and his colleagues (Webb et al., 1981 and 1985; Alexander and Webb, 1983 and 1985) is used to evaluate the impacts of spills in these settings.

The following assumptions, based on the above studies, are being used to analyze the effects of oil spills on coastal wetlands. In coastal Louisiana, it is assumed that the critical concentration of oil that will result in long-term impacts to wetlands is 0.1 $l/m^2$. Concentrations less than this value will cause dieback of the above-ground vegetation for one growing season, but only limited mortality to the vegetation. Concentrations above this value will result in 35 percent of the contacted vegetation experiencing either dieback or mortality. Within 4 years, 35 percent of this affected area will recover. Recovery will occur for 10 years. After 10 years, it is assumed that 10 percent of the affected wetland area will have been permanently lost as a result of accelerated landloss caused by the spill. If the spill contacts wetlands exposed to wave attack, additional accelerated erosion of the wetland fringe will occur, as documented by Alexander and Webb (1987). Oil will persist in the wetland soil for at least 5 years.

In more vigorous wetlands, such as along the Texas, Mississippi, and Alabama coasts, the critical concentration is assumed to be 1.0 $l/m^2$ (Alexander and Webb, 1983). Concentrations below this value will result in short-term, above-ground dieback for one growing season. Concentrations above this value will result in longer-term impacts to wetland vegetation because some complete plant mortality will occur and these areas will have to be recolonized. It is assumed that 50 percent of the contacted vegetation will dieback or be killed after contact and that 10 years will be required for complete recovery. In wetlands that border the coast or large estuaries, accelerated shore erosion will occur as a result of the weakened roots of the marsh vegetation being unable to hold the soil against wave attack.

Seagrass vegetation has generally experienced minor damage from oil-spill occurrences (Zieman et al., 1984; Chan, 1977). The relative insusceptibility of seagrasses to oil-spill impacts is partly the result of their subtidal location, which protects them from direct contact with oil, and partly the result of seagrasses having a large percentage of their biomass occurring as roots and rhizomes, which are buried in sediment. The large root mass allows the plants to regenerate from damage to their vegetative parts. The major impact to seagrass communities from oil spills has been to the associated faunal assemblages.

It is expected that an oil spill that moves into a seagrass area will cause slight damage to the vegetation. The impact will depend on the water depth in the affected area. Seagrasses generally occur at shallow depths of 50 cm or less. Because of these shallow depths, it is expected that a spill contact will cause some seagrass dieback for one growing season. No permanent loss of seagrass habitat will result from the spill. The faunal community within the bed will also be affected in terms of community composition and numbers of organisms.

Some produced waters generated on the OCS are transported via pipeline to land where they are treated prior to disposal. Produced waters contain hydrocarbons, heavy metals, salts, and other contaminants that could kill or damage contacted wetlands. Recent studies of the effects of produced water discharges in salt, brackish, and fresh marsh areas in Louisiana have not documented any impacts from the discharges on surrounding wetlands vegetation (Boesch and Rabalais, 1989b; Rabalais et al., 1991). This EIS assumes that, over the life of the proposed action, all OCS-produced waters transported to shore will either be reinjected or disposed of in nearshore open waters or in the Mississippi River and its passes, and will not affect coastal wetlands (Section IV.A.3.c.(4)(a)). This observation has been confirmed by Boesch and Rabalais (1989b).

In addition to produced waters, some offshore drilling and production wastes are expected to be brought to shore for disposal (Table IV-4). The onshore disposal of offshore wastes could affect wetlands if new disposal sites are created in wetland areas or if seepage from waste sites occurs into adjacent wetland areas.

Pipeline projects in wetland areas have both direct and indirect impacts on coastal habitats. Today, pipeline canals are backfilled after the pipeline is installed in its ditch. Backfilling, by partially filling in the canal and leveling spoil banks, greatly reduces impacts caused by drainage alterations and encourages the revegetation of the pipeline canal itself. A recent MMS study indicates that the average impact of a backfilled canal results in 1.05 ha of deteriorated or converted wetland per kilometer of pipeline on the Mississippi River Deltaic Plain and 0.68 ha/km on the Chenier Plain of Louisiana (Turner and Cahoon, 1987). In this analysis, the figure for the Chenier Plain is assumed to apply to other areas of the Central Gulf (Mississippi and Alabama) because of the firm substrate in these areas.

Pipeline installations through seagrass beds affect the habitat due to direct losses from dredging and indirect losses that result from turbidity effects and prop washing from pipe-laying barges.

Service vessels, pipelaying barges, and crude-oil barges use navigation channels, some of which were dredged or improved mainly for OCS development, to connect onshore facilities with offshore destinations. The dredging of new navigation canals results in impacts to wetlands similar to the impacts associated with open ditch (nonbackfilled) pipeline canals. The direct impacts of navigation channels have been estimated to be 52 ha/km (Turner and Cahoon, 1987). Indirect impacts from navigation canals include saltwater intrusion through the channel into fresher marsh areas, and drainage interruptions caused by spoil banks.

Additional impacts to wetlands can occur from periodic maintenance dredging of navigation channels and the deepening of existing channels. If the spoil is deposited onto existing spoil banks, the effects of spoil banks on wetland drainage will be aggravated. The dredged material could also bury previously unaffected wetland areas.

In addition, wakes generated by sale-related vessel traffic in navigation channels can cause channel bank erosion and loss of wetlands. Although prop washing from vessel traffic resuspends sediments and increases the turbidity of nearby coastal waters, navigation routes in the area are not located near seagrass beds.

Various kinds of onshore facilities have been constructed to service OCS development (Section IV.A.). The construction of these facilities in wetland areas could result in the conversion of wetland habitat to upland.

*Base Case Analysis*

Oil spills associated with the proposed action can occur from a number of sources. Spills are expected to occur offshore as a result of platform accidents or pipeline breaks. Spills can also occur inshore as a result of barge or pipeline accidents, or during transfer operations at terminals.

According to Table IV-21, the probability of a spill of 1,000 or more bbl occurring and contacting within 10 days wetland areas under the Base Case ranges from less than 0.5 percent to 1.0 percent. Because of these low probabilities, no spills greater than or equal to 1,000 bbl from offshore sources are assumed to contact coastal wetlands. Further, no spills greater than or equal to 1,000 bbl from shuttle tankers in port are assumed to occur (Table IV-16).

No spills greater than 50 and less than 1,000 bbl are assumed to occur and contact the coast (Section IV.C.1). Twenty-one offshore spills greater than 1 and less than or equal to 50 bbl are assumed to occur, and a few of these are assumed to contact the coast. Because of evaporation losses, spreading considerations, and the fact that much of the remaining oil will wash onto barrier beaches that front the coast, contact from these spills is not expected to result in high-enough concentrations of oil (greater than 0.1 $l/m^2$) on wetland surfaces to affect wetland vegetation adversely. None of the oil is expected to contact seagrass beds located behind barrier islands.

Fewer than 10 spills (Table IV-4) greater than 1 and less than or equal to 50 bbl are assumed to occur onshore or nearshore. No spills greater than 50 and less than 1,000 bbl are assumed to occur inshore (Table IV-4). The spills greater than 1 and less than or equal to 50 bbl are assumed to occur in coastal Louisiana, where most OCS pipelines and oil terminals are located. Barge spills are estimated to occur near terminals. In Louisiana, because nearly all navigation channels used by barge traffic have spoil banks, it is assumed that most of the spilled oil will be confined to the channel. The slick will be quickly transported and spread through the channel by tidal and wind currents. The small amount of the oil transported onto wetland areas is not expected to have adverse effects on wetland vegetation. The oil will have lost its identity as a slick by the time that it could be transported near seagrass beds. No impacts to the beds are expected as a result of contact from these low concentrations of oil.

Because pipelines traverse wetland areas in coastal Louisiana, a pipeline accident could result in oil directly contacting wetland habitats. High concentrations of oil could contact limited areas of wetland vegetation as a result of these spills. Fischel et al. (1989) have investigated the impacts of a 300-bbl pipeline spill in a brackish marsh area of coastal Louisiana. Using this study site as a model, a 50-bbl spill could result in the dieback and mortality of up to 2.7 ha of wetland vegetation. The assumptions developed in the introduction to this analysis indicate that about 1 ha of these damaged wetlands will recover within four years. About 0.3 ha of wetlands are expected to be lost permanently to open-water habitat as a result of the spill. Using the data from Mendelssohn et al. (1990), the recovering vegetation is expected to be ecologically functionally equivalent to the unaffected vegetation. The impacts from the spill will therefore be confined to a reduction in plant density. Several such spills could result in 10-15 ha of wetlands damaged for up to four years, and 2 ha converted to open water and mudflats over the 35-year life of the proposed action. Because the pipeline spill could occur within the interior of a wetland, the oil could persist in the soil for more than five years because of the absence of wave-induced or tidal flushing.

Only one existing oil pipeline traverses Chandeleur and Mississippi Sounds in the vicinity of seagrass beds. During the life of the proposed action, some of the oil developed in the CPA could be transported through three additional pipelines assumed to be installed at the eastern end of Mississippi Sound as a result of previous leasing activities. These locations, however, are not near seagrass beds. It is expected that no spills will occur from these pipelines and affect seagrasses.

According to Table IV-4, 34 MMbbl of produced waters will be transported into Louisiana coastal waters under the Base Case. Most of these produced waters will be brought into coastal Subarea C-3. These produced waters will be either reinjected or discharged into nearshore open waters or the Mississippi River and its passes. It is expected, therefore, that produced-water disposal will not affect wetland vegetation.

According to Table IV-4, 69,000 bbl of produced sands and 744,000 bbl of drilling fluids will be transported to shore under the Base Case scenario for disposal. According to an in-house analysis (Section IV.B.1.c.(3)(c)), excess disposal capacity exists at operating disposal sites, and no new disposal sites will be required to accommodate these wastes. Therefore, no wetland areas will be disturbed as a result of the establishment of new disposal sites. Some seepage from waste sites may occur into adjacent wetland areas and result in damage to wetland vegetation.

Pipeline landfall projects can affect wetland and seagrass habitats in a number of ways. Modern installation methods and planning procedures, however, have reduced levels of impacts associated with pipeline projects (Turner and Cahoon, 1987). Furthermore, no onshore pipeline projects are expected as a result of the Base Case scenario (Section IV.A.3.b.). Therefore, no impacts are expected.

Navigation channel impacts on wetlands are discussed in Section IV.A.3.(3). No new navigation channel dredging is anticipated (Section IV.A.3.c.(3)(c)); however, some maintenance dredging of existing channels will occur during the 35-year life of the proposed action. The disposal of dredged material could negatively affect wetlands if it is deposited onto existing banks or if previously unaffected wetland areas are buried by spoil banks. On the other hand, dredged material could also be used as a sediment supplement in deteriorating wetland areas to enhance wetland growth. The disposal of dredged material for marsh enhancement, however, has been done only on a limited basis, as of 1988 (Section IV.B.2.b.(1)). Given the increasing emphasis on using dredged material for marsh creation purposes, it is assumed that during the 35-year life of the proposed action, dredged material will be used to enhance wetland habitats. Maintenance dredging will also temporarily increase turbidity levels, which could deleteriously affect seagrasses. Major navigation canals, however, are not located near seagrass beds in the area. Furthermore, only 0.2 percent of channel usage will be accounted for by OCS vessels under the Base Case. Because of this small percentage of usage and the likelihood that much of the dredged material will be used to enhance wetland habitats, it is expected that no impacts will occur to wetlands from maintenance dredging.

As discussed in Section IV.A.3.c.(3), OCS activities in deep water are requiring larger service vessels for efficient operations. Currently, service bases in Galveston, Texas, and Berwick, Louisiana, are accessible to the larger vessels, and Empire and Cameron, Louisiana, are considered marginally usable. This document assumes that the channel through Belle Pass, Louisiana, to Port Fourchon will be deepened to 6.7 m (22 ft). The Corps of Engineers has completed a feasibility report for the project (U.S. Dept. of the Army, COE, 1991). According to the report, dredged material from the channel will be disposed of in wetland areas to enhance marsh creation. The COE expects 192 ha (479 ac) of saline marsh will be created. On the assumptions that 90 percent of the justification of the project is for OCS activities and that the Base Case usage of channels represents 2 percent of the OCS Program usage of channels, 3.5 ha (8.6 ac) of wetlands will be created as a result of the Base Case scenario. The COE does not anticipate saltwater intrusion effects on wetlands as a result of the deepening project, probably because the project will be done in a saline environment where the existing vegetation is salt-tolerant.

Vessel traffic within navigation channels can cause channel bank erosion in wetland areas. An idea of the magnitude of OCS vessel traffic is provided in Table IV-6, which shows projected numbers of barge, service vessel, and shuttle tanker landings and dockings at various ports. Over the 35-year life of the proposed action, about 77 barge trips and 17,600 service vessel trips will occur within navigation channels. Additional vessel usage of navigation channels will be required for pipelaying barges and the movement of platforms to offshore locations. Most of this vessel traffic will use channels within the Louisiana coastal zone, where the impacts will be assessed. According to Johnson and Gosselink (1982), channels that have high navigational usage in coastal Louisiana widen about 1.5 m/yr more rapidly than channels that have little navigational usage (2.58 m/yr versus 0.95 m/yr). The average distance along a channel to a service base and other OCS facilities is assumed to be 25 km. According to Table IV-6, there are 19 channels that are used by OCS vessel traffic associated with Sale 142.

The OCS use of these channels will account for 0.2 percent of the total channel traffic. The estimate based on these figures is that 5.5 ha of wetlands will be eroded along channel banks during the 35-year life of the proposed action (1.4 ha/yr).

Thirty platform complexes are expected to be installed offshore as a result of the Base Case scenario (Table IV-2). The erosion of channel margins as a result of towing production structures through navigation channels is accounted for in the calculations in the previous paragraph. The possibility is analyzed here that future deep-water operations may require larger platforms that will cause greater amounts of channel bank erosion than has occurred in the past. As production moves into deep-water areas of the Gulf, the use of floating production systems, as opposed to fixed platforms, is being considered for developing fields, particularly those of marginal size that cannot support the great expense of fabricating a platform. The use of one such floating production system is projected under the Base Case scenario for Sale 142. In addition, compliant structures are being increasingly used for deep-water operations. These structures use tethering cables rather than massive steel legs for anchoring the platform deck to the seabed. Towing the decks of these platforms through coastal channels will not cause more erosion than towing a traditional platform. Furthermore, in recent years some compliant structure decks have been purchased from overseas manufacturers. Given the above considerations, this analysis does not expect increased erosion of wetlands from the towing of deep-water structures through navigation channels.

No new construction of onshore infrastructure is anticipated (Section IV.A.3.a.). Therefore, no impacts to wetlands from new construction projects are expected.

*Summary*

No oil spills greater than or equal to 1,000 bbl from offshore or inshore sources are assumed to occur and contact within 10 days coastal wetlands under the Base Case scenario. Several smaller spills (greater than 1 and less than or equal to 50 bbl) are assumed to contact wetlands from inshore barge and pipeline accidents or during transfer operations at terminals in coastal Louisiana. Only spills from pipeline accidents are expected to result in high-enough concentrations of oil contacting wetlands to result in impacts. These spills could result in 10-15 ha of wetland vegetation being affected for up to 10 years, and as much as 2 ha of permanent wetlands loss. Seagrass beds will be contacted by low concentrations of oil from these spills, and no impacts are expected.

No new dredging projects for pipelines or navigation channels are projected. Few to no impacts from maintenance dredging are expected given the small contribution of OCS vessel traffic to navigational usage of the channels. Furthermore, alternative dredged material disposal methods that could be used to enhance coastal wetland growth exist. Deepening of one channel to accommodate larger service vessels is expected to occur within a saline marsh environment. This project is expected to result in 3.5 ha of marsh creation attributable to the Base Case scenario.

Erosion of wetlands from OCS vessel wakes is not expected to result in more than 5.5 ha of wetlands loss during the 35-year life of the proposed action.

*Conclusion*

The proposed action is expected to result in dieback and mortality of 10-15 ha of wetlands vegetation as a result of contacts from onshore oil spills. All but 2 ha of these wetlands will recover within 10 years; the remaining 2 ha will be converted to open water. About 5.5 ha of wetlands are projected to be eroded along channel margins as a result of OCS vessel wake erosion, and 3.5 ha of wetlands are projected to be created as a result of beneficial disposal of dredged material from channel-deepening projects.

*High Case Analysis*

Oil spills associated with the proposed action can occur from a number of sources. Spills are expected to occur offshore as a result of platform accidents or pipeline breaks. Spills can also occur inshore as a result of barge or pipeline accidents, or during transfer operations at terminals.

According to Table IV-21, the probability of a spill greater than or equal to 1,000 bbl occurring and contacting wetland areas within 10 days under the High Case ranges from less than 0.5 percent to 2.0 percent. Because of these low probabilities, no spills greater than or equal to 1,000 bbl from offshore sources are assumed to occur and contact within 10 days coastal wetlands. Further, no spills greater than or equal to 1,000 bbl from shuttle tankers in port are assumed to occur (Table IV-16).

No spills greater than 50 and less than 1,000 bbl are assumed to occur and contact the coast (Section IV.C.1). Forty-seven offshore spills greater than 1 and less than or equal to 50 bbl are assumed to occur, and a few of these are assumed to contact the coast. Because of weathering losses, spreading considerations, and the fact that much of the remaining oil will wash onto barrier beaches that front the coast, contact from these spills is not expected to result in high-enough concentrations of oil (greater than 0.10 $l/m^2$) on wetland surfaces to affect wetland vegetation adversely. None of the oil is expected to contact seagrass beds located behind barrier islands.

Fewer than 10 spills (Table IV-4) greater than 1 and less than or equal to 50 bbl are assumed to occur onshore or nearshore. No spills greater than 50 and less than 1,000 bbl are assumed to occur inshore (Table IV-4). The spills greater than 1 and less than or equal to 50 bbl are assumed to occur in coastal Louisiana, where most OCS pipelines and oil terminals are located. Barge spills are expected to occur near terminals. In Louisiana, because nearly all navigation channels used by barge traffic have spoil banks, it is expected that most of the spilled oil will be confined to the channel. The slick will be quickly transported and spread through the channel by tidal and wind currents. The small amount of the oil transported onto wetland areas is not expected to have adverse effects on wetland vegetation. The oil will have lost its identity as a slick by the time that it could be transported near seagrass beds. No impacts to the beds are expected as a result of contact from these low concentrations of oil.

Because pipelines traverse wetland areas in coastal Louisiana, a pipeline accident could result in oil directly contacting wetland habitats. High concentrations of oil could contact limited areas of wetland vegetation as a result of these spills. Fischel et al. (1989) have investigated the impacts of a 300-bbl pipeline spill in a brackish marsh area of coastal Louisiana. Using this study site as a model, a 50-bbl spill could result in the dieback and mortality of up to 2.7 ha of wetland vegetation. The assumptions developed in the introduction to this analysis indicate that about 1 ha of these damaged wetlands will recover within four years. About 0.3 ha of wetlands are expected to be lost permanently to open-water habitat as a result of the spill. Using the data from Mendelssohn et al. (1990), the recovering vegetation is expected to be ecologically functionally equivalent to the unaffected vegetation. The impacts from the spill will therefore be confined to a reduction in plant density. Several such spills could result in 10-15 ha of wetlands damaged for up to four years, and 2 ha converted to open water and mudflats over the 35-year life of the proposed action. Because the pipeline spill could occur within the interior of a wetland, the oil could persist in the soil for more than five years because of the absence of wave-induced or tidal flushing.

Only one oil pipeline traverses Chandeleur and Mississippi Sounds in the vicinity of seagrass beds. During the life of the proposed action, some of the oil developed in the CPA could be transported through three additional pipelines assumed to be installed at the eastern end of Mississippi Sound as a result of pipeline leasing activities. These locations, however, are not near seagrass beds. It is expected that no spills will occur from these pipelines and contact seagrasses.

According to Table IV-4, 70.8 MMbbl of produced waters will be transported into Louisiana coastal waters under the High Case. Most of these produced waters will be brought into coastal Subarea C-3. These produced waters will be either reinjected or discharged into nearshore open waters or the Mississippi River and its passes. It is expected, therefore, that produced water disposal will not affect wetland vegetation.

According to Table IV-4, 154,000 bbl of produced sands and 1,333,000 bbl of drilling fluids will be transported to shore for disposal under the High Case scenario. According to USEPA information, sufficient disposal capacity exists at operating disposal sites, and no new disposal sites will be required to accommodate these wastes. Therefore, no wetland areas will be disturbed as a result of the establishment of new disposal sites. Some seepage from waste sites may occur into adjacent wetland areas and result in damage to wetland vegetation.

Pipeline landfall projects can affect wetland and seagrass habitats in a number of ways. Modern installation methods and planning procedures, however, have reduced levels of impacts associated with pipeline projects (Turner and Cahoon, 1987). Furthermore, no onshore pipeline projects are expected as a result of the High Case scenario (Table IV-9). Therefore, no impacts are expected.

No new navigation channel dredging is anticipated (Section IV.A.3.c.(3)(c)); however, some maintenance dredging of existing channels will occur during the 35-year life of the proposed action. The disposal of dredged material could negatively affect wetlands if it is deposited onto existing banks or if previously unaffected wetland areas are buried by spoil banks. On the other hand, dredged material could also be used as a sediment supplement in deteriorating wetland areas to enhance wetland growth. As of 1988, however, the use of dredged material for marsh enhancement has been done only on a limited basis (Section IV.B.2.b.(2)).

Given an expected increasing emphasis on using dredged material for marsh creation purposes, it is expected that, during the 35-year life of the proposed action, dredged material will be used to enhance wetland habitats. Maintenance dredging will also temporarily increase turbidity levels, which could deleteriously affect seagrasses. Major navigation canals, however, are not located near seagrass beds in the area. Only 0.4 percent of channel usage will be accounted for by OCS vessels under the High Case. Because of this small percentage of usage and the likelihood that much of the dredged material will be used to enhance wetland habitats, it is expected that no impacts will occur to wetlands from maintenance dredging.

As discussed in Section IV.A.3.c.(3), OCS activities in deep water are requiring larger service vessels for efficient operations. Currently, service bases in Galveston, Texas, and Berwick, Louisiana, are accessible to the larger vessels, and Empire and Cameron, Louisiana, are considered marginally usable. This document assumes that the channel through Belle Pass, Louisiana, to Port Fourchon will be deepened to 6.7 m (22 ft). The Corps of Engineers has completed a feasibility report for the project (U.S. Dept. of the Army, COE, 1991). According to the report, dredged material from the channel will be disposed of in wetland areas to enhance marsh creation. The COE projects that 192 ha (479 ac) of saline marsh will be created. On the assumption that 90 percent of the justification of the project is for OCS activities, and that the Base Case usage of channels represents 4 percent of the OCS Program usage of channels, 7 ha (17 ac) of wetlands will be created as a result of the High Case scenario. The COE does not anticipate saltwater intrusion effects on wetlands as a result of the deepening project, probably because the project will be done in a saline environment where the existing vegetation is salt-tolerant.

Vessel traffic within navigation channels can cause channel bank erosion in wetland areas. An idea of the magnitude of OCS vessel traffic is provided in Tables IV-4 and IV-6, which show projected numbers of barge, service vessel, and shuttle tanker landings and dockings at various ports. Over the 35-year life of the proposed action, about 178 barge trips and 30,850 service vessel trips will occur within navigation channels. Most of this vessel traffic will use channels within the Louisiana coastal zone, where the impacts will be assessed. According to Johnson and Gosselink (1982), channels that have high navigational usage in coastal Louisiana widen about 1.5 m/yr more rapidly than channels that have little navigational usage (2.58 m/yr versus 0.95 m/yr). The average distance along a channel to a service base and other OCS facilities is assumed to be 25 km. According to Table IV-6, there are 19 channels that are used by OCS vessel traffic associated with Sale 142. The OCS usage of these channels is assumed to account for 0.4 percent of the total channel traffic. The estimate based on these figures is that 11 ha of wetlands will be eroded along channel banks during the 35-year life of the proposed action (2.8 ha/yr).

Fifty platform complexes are expected to be installed offshore as a result of the High Case scenario (Table IV-2). The erosion of channel margins as a result of towing production structures through navigation channels is accounted for in the calculations in the previous paragraph. The possibility is considered here that future deep-water operations may require larger platforms that will cause increased channel bank erosion compared to the past. As production moves into deep-water areas of the Gulf, the use of floating production systems, as opposed to fixed platforms, is being considered, particularly for fields of marginal size that cannot economically justify a platform. The use of one such floating production system is projected under the High Case scenario for Sale 142. Further, compliant structures are being increasingly used for deep-water operations. These structures use tethering cables rather than massive steel legs for anchoring the platform deck to the seabed. Towing the decks of these platforms through coastal channels will not cause more erosion than towing a traditional platform. Furthermore, in recent years some compliant structure decks have been purchased from overseas manufacturers. From the above considerations, this analysis does not expect increased erosion of wetlands from the towing of deep-water structures through navigation channels.

No new construction of onshore infrastructure is anticipated (Section IV.A.3.a.). Therefore, no impacts to wetlands from new construction projects are expected.

*Conclusion*

The High Case scenario is expected to result in dieback and mortality of 10-15 ha of wetlands vegetation as a result of contacts from onshore oil spills. All but 2 ha of these wetlands will recover within 10 years; the remaining 2 ha will be converted to open water. About 11 ha of wetlands are projected to be eroded along channel margins as a result of OCS vessel wake erosion, and 7 ha of wetlands are projected to be created as a result of beneficial disposal of dredged material from channel-deepening projects.

### *(2) Impacts on Sensitive Offshore Resources*

#### *(a) Live Bottoms (Pinnacle Trend)*

Fifty-nine blocks are within the region defined as the pinnacle trend; approximately 28 are available for lease. These live bottoms of concern in the northeastern portion of the Central Gulf and adjacent areas of the Eastern Gulf are associated with the pinnacle trend, which is located between 73 and 101 m (240 and 330 ft) water depths in the Main Pass and Viosca Knoll lease areas. The pinnacles are scattered in this area and include recently documented live-bottom areas that may be sensitive to oil and gas activities. Leases in past sales have contained a live-bottom stipulation for protection of such areas, and a proposed stipulation is presented in Section II.A.1.c.(2) as a potential mitigating measure for leases resulting from the proposed action. The impact analysis presented below is for the proposed action and does include the proposed biological lease stipulation.

A number of OCS-related factors may cause adverse impacts to the pinnacle trend communities and features.

Damage caused by oil spills, blowouts, anchoring, structure emplacement and removal, drilling discharges, and pipeline emplacement can cause the immediate death of numerous organisms or the alteration of sediments to the point that recolonization of the affected areas may be delayed or impossible.

Oil spills have the potential to foul benthic communities and cause the death or disruption of organisms. Oil from a surface spill can be driven into the water column, with measurable amounts documented at depths approximating 20 m. At this depth, the oil is found only at concentrations several orders of magnitude lower than the amount shown to have an effect on marine organisms.

Blowouts have the potential of resuspending considerable amounts of sediment and releasing hydrocarbons into the water column, which may affect benthic communities. Subsurface blowouts can pose a threat to the biota of the pinnacles if a blowout were to occur near one of these pinnacles. Blowouts can result in very high concentrations of suspended sediments and increased levels of gas in the water column very near the source of the blowout. Some oil or condensate may be present in the reservoir and may also be injected into the water column. The suspended sediments may be carried some distance by currents, but the bulk of the sediments is redeposited within a few hundred meters of the blowout site. A blowout within 100 m of a pinnacle community could result in the smothering of some biota within a limited area of a pinnacle due to sedimentation.

The placement of anchors may damage lush biological communities or the structure of the pinnacles themselves, which serve as attractors. Anchor damage from support boats and ships, floating drilling units, and pipeline-laying vessels greatly disturbs areas of the seafloor and is the most serious threat to live-bottom areas at these depths. The size of the affected area will depend on depth of water, length of chain, size of anchor and chain, method of placement, wind, and current. Anchor damage would include crushing and breaking pinnacles and associated communities. Anchoring often destroys a wide swath of habitat when the anchor is dragged or the vessel swings at anchor, causing the anchor chain to drag the seafloor.

The placement of drilling rigs and platforms on the seafloor will crush the organisms directly beneath the legs or mat used to support the structure. The areas affected by the placement of the platforms and rigs will predominantly be soft-bottom regions where the infaunal and epifaunal communities are not unique.

Both explosive and nonexplosive structure-removal operations will disturb the seafloor and can potentially affect nearby pinnacle communities. Structure removal using explosives (the most common removal method) can suspend sediments throughout the water column to the surface and may cause substantial impacts to nearby habitats. Deposition of these sediments would occur much in the same manner as discussed for muds and cuttings discharges. Explosive structure removals create shock waves, which could also harm resident biota in the immediate vicinity.

Drilling discharges affect biological communities and organisms through a variety of mechanisms. Smothering of organisms through deposition of these sediments may occur, or less obvious sublethal effects may take place. Routine oil and gas operations discharge drilling muds and cuttings that will cause turbidity and smothering of the benthos in proximity to the drill site. In the Gulf of Mexico OCS, about 90 percent of the discharge settles rapidly, usually within 1,000 m of the discharge point.

Pipeline emplacement directly affects the benthic communities through burial and disruption of the benthos, and through resuspension of sediments. These resuspended sediments may clog filter-feeding mechanisms and gills of fishes and sedentary invertebrates. Pipeline emplacement also causes considerable disruption to the bottom sediments in the vicinity of the pinnacles (Section IV.A.2.).

*Base Case Analysis*

The location of the pinnacles in the Central Gulf of Mexico is within offshore Subarea C-3. Table IV-2 provides information regarding the level of OCS-related activities in the vicinity of the pinnacles. This information allows for a more detailed analysis of many of the impact-producing factors that have the potential to affect the pinnacle communities. The information presented in the following discussion is derived from Table IV-2.

For the purpose of this analysis, 21 spills greater than 1 and less than or equal to 50 bbl, one spill greater than 50 and less than 1,000 bbl, and 1 spill greater than or equal to 1,000 bbl are assumed as a result of the proposed action (Table IV-2). These surface spills would likely have no impact on the biota of the pinnacle trend because the crests of these features are much deeper than 10 m.

For the purpose of this analysis, a single subsurface oil spill (6,500 bbl) is assumed to occur as a result of the proposed action. While the probability of this spill occurring is 16 percent for the Central Gulf (Table IV-19), the probability of the spill originating from a pipeline is lower (i.e., 9%; Table IV-19). The spill would have to come in contact with a pinnacle feature, and few pipelines exist within proximity to the pinnacle region. The biota of the pinnacles of the Central Gulf could be significantly impacted by a seafloor oil spill. The spilled oil could impinge directly upon the pinnacles; impacts, including uptake of hydrocarbons or reduced visibility, could then be serious to the local biota, even fatal. However, most of the biota would likely survive and recover once the pinnacles were clear of the oil. The likelihood of a pipeline spill contacting a pinnacle community is slight. These factors would serve to limit the extent of damage from any given spill. If a contact were to occur, the severity would be slight.

Blowouts can pose a threat to pinnacle biota if one occurred nearby. A blowout within a 100 m of a pinnacle community could result in the smothering of the biota within a very limited area of a pinnacle due to sedimentation. However, much of the biota is likely adapted to life in turbid conditions and, should impacts occur, recovery of the community would be rapid.

Because of the hazardous nature of the pinnacle region to well-placement activities and because the implementation of the proposed Live Bottom Stipulation will also minimize the proximity of wells to pinnacle features, any potential blowouts would be a fair distance from the pinnacles.

Mechanical damage would be inflicted upon small portions of the benthic community by conducting routine oil and gas operations without benefit of the proposed biological stipulation in Section II.A.1.c.(2). The drilling operation itself disturbs some small areas, and the anchor placement activities of the associated vessels would cause damage to the pinnacle features and biological communities. Damage from rig and platform emplacement could be devastating to small areas of the habitat provided by the pinnacles so affected and would, in turn, affect the usefulness of the pinnacles as habitat or shelter for commercial and recreational fishes. However, it is unlikely that a rig or platform would be emplaced directly on the pinnacles because of the unevenness of the seafloor. For the purpose of this analysis, it is presumed that the Live Bottom Stipulation, or some similar protective measure, would prevent oil and gas activities in the immediate vicinity of the pinnacle communities. It is estimated that 10 platform complexes will be emplaced in offshore Subarea C-3 (in which the pinnacles occur; Table IV-2) within the 35-year life of the proposed action. It is more likely that most of the 10 platform complexes in offshore Subarea C-3 will not be located in water depths where pinnacles are known to exist. For the same reasons, anchor damage from support boats and ships would be minimal because of the implementation of the Live Bottom Stipulation in the pinnacle regions. Anchor damage from support boats and ships, floating drilling units, and pipeline-laying vessels greatly disturbs areas of the seafloor and is the most serious threat to live-bottom areas. The size of the affected area will depend on depth of water, length of chain, size of anchor and chain, method of placement, wind, and current. Anchor damage would include crushing and breaking pinnacles and associated communities. Anchoring often destroys a wide swath of habitat when the anchor is dragged or the vessel swings at anchor, causing the anchor chain to drag the seafloor. However, as noted above, any platforms placed in this region would most often be sited to avoid such hazards for safety reasons. Such events may occasionally impact the resource.

Pipeline emplacement also has the potential to cause considerable disruption to the bottom sediments in the vicinity of the pinnacles (Section IV.A.2.). However, the implementation of the proposed Live Bottom Stipulation, or some similar protective measure, would severely limit oil and gas activities in the immediate vicinity of the pinnacle communities. For the purposes of this analysis, it is presumed that pipeline-laying activities would be prohibited in the proximity of live-bottom communities. It is estimated that 5,000 $m^3$ of sediment are resuspended per kilometer of pipeline in water depths shallower than 200 ft, disrupting a total of approximately 80,000 $m^3$ (Table IV-2) in offshore Subarea C-3. However, it should be noted that data gathered for the ongoing MAMES study have shown the dense biological communities (i.e., live-bottom communities) to be concentrated on the pinnacle features themselves. The data show the extent of dense biological communities to be sparse in the bottom sediments surrounding the pinnacles, and the effect of pipeline-laying activities on the biota of the pinnacle communities would be restricted to the resuspension of sediments. For the purposes of this analysis, it is expected that enforcement of the Live Bottom Stipulation would minimize pipeline-laying activities through the pinnacle region. The severity of these actions has been judged, at the community level, to be slight, and impacts from these activities to be such that there will be no measurable interference to the general ecosystem.

Routine oil and gas operations discharge drilling muds and cuttings that will cause turbidity and smothering of the benthos in proximity to the drill sites. Estimates presented in Table IV-2 project 1,430,000 bbl of drilling muds and 344,000 bbl of drill cuttings generated from 205 exploration/delineation and development wells over the 35-year life of the proposed action in Subarea C-3. In the Gulf of Mexico OCS, about 90 percent of these discharges settle rapidly, usually within 1,000 m of the discharge points, and are rapidly diluted. Most water-based fluids are nontoxic, with their effects limited to the immediate vicinity of the discharge (NRC, 1983). Deposition of drilling muds and cuttings on the pinnacle trend area would not significantly impact the biota of the pinnacles or the habitat itself. The biota of the seafloor surrounding the pinnacles are adapted to life in turbid conditions and to high sedimentation rates. Existing currents in the regions would prevent the adverse accumulation of muds and cuttings. The depth of water would dilute the effluent to a significant degree, and the pinnacles themselves are coated with a veneer of sediment. Additional deposition and turbidity caused by a nearby well are not expected to affect the pinnacle environment adversely because such fluids are discharged into very large volumes of water (the open Gulf of Mexico) and rapidly disperse, can be measured above background at only very short distances from the discharge point, and have little biological effect except very close to the discharge point. Such an event would rarely impact the resource because of the depth of the communities.

Removal of platforms substantially impacts nearby habitats. As previously discussed, the platforms are unlikely to be constructed directly on the pinnacles because of the restraints placed by the Live Bottom Stipulation. Impacts to the pinnacle area from structure removal are expected to be minimal because of the restricted regions affected by the shock from explosives and the low number of structures, (five removed explosively) in such regions. However, some localized damage may occur. Such an event would infrequently impact the resource because of the distance of platforms from pinnacles; the impact would be such that it would result in few losses of system elements, and recovery to preinterference conditions would be accomplished in a short term.

*Summary*

Activities resulting from the proposed action are not expected to have a high level of impact on the pinnacle trend environment, because these activities would be restrained by the implementation of the Live Bottom Stipulation. The impact to the pinnacle trend area as a whole is expected to be slight because no community-wide impacts are expected. The inclusion of the Live Bottom Stipulation would preclude the occurrence of the most potentially damaging of these activities. The action is judged to be infrequent because of the limited operations in the vicinity of the pinnacles and the small size of many of the features. Potential impact levels from oil spills greater than or equal to 1,000 bbl, blowouts, pipeline emplacement, mud and cutting discharges, and structure removals are infrequent because of the proposed Live Bottom Stipulation. The frequency of impacts to the pinnacles is rare, and the severity is judged to be slight because of the widespread nature of the features.

*Conclusion*

The impact of the Base Case of the proposed action on the pinnacle region in the Gulf of Mexico is expected to be such that any changes in the regional physical integrity, species diversity, or biological productivity of the hard-bottom region would recover to pre-impact conditions in less than 2 years, more probably on the order of 2-4 months.

*Effects of the Base Case Without the Proposed Stipulation*

Activities resulting from the proposed action, particularly anchor damage to localized pinnacle areas, are expected to have a high level of impact on some individuals in portions of the pinnacle trend environment, because these activities have the potential to destroy some of the biological communities and to damage one or several individual pinnacles. However, the impact to the pinnacle trend area as a whole is expected to be slight because no community-wide impacts are expected. The most potentially damaging of these are the impacts associated with mechanical damages that may result from anchors. However, the action is judged to be infrequent because of the limited operations in the vicinity of the pinnacles and the small size of many of the features. Potential impacts from oil spills greater than or equal to 1,000 bbl, blowouts, pipeline emplacement, mud and cutting discharges, and structure removals are infrequent. The frequency of impacts to the pinnacles is rare because of the widespread nature of the features.

*High Case Analysis*

The pinnacles and the biota of the live-bottom areas would be subject to physical impact from rig emplacement, platform and pipeline installation, and anchoring due to the increased level of activity over the Base Case scenario. For the purposes of the High Case analysis, it is assumed that within the CPA (in which portions of the pinnacle trend are located), 1 spill greater than or equal to 1,000 bbl, 2 spills greater than 50 and less than 1,000 bbl, and 47 spills greater than 1 and less than or equal to 50 bbl will occur over the 35-year life of the proposed action. The offshore infrastructure estimates (wells and platforms) are slightly greater in this scenario (205 wells and 10 platform complexes under the Base Case and 365 wells and 18 platform complexes for the High Case in Subarea C-3), as are the lengths of pipeline installed (80 km for the Base Case and 144 km for the High Case) and the volume of drilling mud discharges (1,430,000 bbl for the Base Case and 2,535,000 bbl for the High Case). However, an MMS in-house analysis of proprietary data finds it more likely that most of these activities in Subarea C-3 will not be located in water depths where pinnacles are known to exist. The oil-spill occurrence probability from pipelines of one or more oil spills of 1,000 bbl or greater is estimated at 19 percent for the High Case (Table IV-17). Thus, the possibility of an oil spill will be greater than that of the Base Case. However, the implementation of the Live Bottom Stipulation would minimize operations occurring near a sensitive offshore habitat. The frequency of these types of events is judged to be occasional.

*Conclusion*

The impact of the High Case scenario for the proposed action on the pinnacle trend region is expected to be such that any changes in the regional physical integrity, species diversity, or biological productivity of the hard-bottom region would recover to pre-impact conditions in less than 2 years, more probably on the order of 2-4 months.

### *(b) Deep-water Benthic Communities*

The deep-water benthic communities consist of recently discovered organisms that are apparently most abundant in water deeper than 400 m (1,312 ft) and that derive their energy, in the absence of light, from chemosynthetic processes rather than the photosynthetic processes of shallow water (see Section III.B.2.b. for a more detailed discussion of these communities). The primary chemosynthetic organisms are bacteria, both free-living (as "bacterial mats") and symbiotic in the tissues of other organisms, especially in the gills. The predominant large animals are tube worms, clams, and mussels. The only impact-producing factor threatening these communities results from those activities that would physically disturb the bottom, such as the routine operations of anchoring, drilling, and pipeline installation, and the seldom occurring seafloor blowout accident. Because of the great water depths, routine oil and gas effluent discharges such as muds, cuttings, and sanitary wastes will not cause any deleterious impacts to chemosynthetic communities due to the rapid dilution and dispersion of effluent components (in shallower depths, cuttings tend to form a low mound or to be worked into the surrounding sediments, depending upon the nature of the local sediments, depth of disposal, and physical forces acting upon the pile). In these deep waters, such discharges rapidly disperse, can be measured above background at only very short distances from the discharge point, do not build up on the bottom, and have little biological effect except very close to the discharge point. Because these communities use petroleum hydrocarbons as a food source (and indeed have been seen to be living among oil and gas bubbles), oil spills are not considered to be a potential source of adverse impacts. Thus, oil spills will have no impact on these communities.

The greatest potential for adverse impacts to occur to deep-water chemosynthetic communities would come from those OCS-related, bottom-disturbing activities associated with pipelaying (Section IV.A.2.b.(1)), anchoring (Section IV.A.2.d.(1)(b)), and structure emplacement (Section IV.A.2.d.(1)(a)), as well as a seafloor blowout (Section IV.A.2.d.(8)). These activities cause localized bottom disturbances and disruption of benthic communities in the immediate area of the drilling. Considerable mechanical damage would be inflicted upon the bottom by routine OCS drilling activities. The drilling operation itself disturbs a small bottom area. The presence of a conventional structure can cause scouring of the surficial sediments (Caillouet et al., 1981). It is assumed that 2 ha (5 ac) of bottom is disturbed by platform emplacement in water depths less than 457 m (1,500 ft), and 4 ha (10 ac) in depths greater than 457 m. Anchors from support boats and ships (or, as assumed in these water depths, from any buoys set out to moor these vessels), floating drilling units, and pipelaying vessels also cause severe disturbance to small areas of the seafloor. The area affected will depend on the water depth, length of the chain, size of the anchor, and current. Anchoring will destroy those sessile organisms actually hit by the anchor or anchor chain during anchoring and anchor weighing. While such an area of disturbance may be small in absolute terms, it may be large in relation to the area inhabited by chemosynthetic organisms. Normal pipelaying activities in deep-water areas consist of laying the pipe along the seafloor (it is assumed that 0.32 ha (0.8 ac) of bottom is disturbed per kilometer (0.6 mi) of pipeline installed), a practice that could destroy large areas of chemosynthetic organisms. It is likely that pipelines will be used to transport the product ashore from those deep-water areas in proximity to the current pipeline network in both the Central and the Western Gulf. In areas not near the existing pipeline network, shuttle tankering will substitute for pipelines as a means of transporting the product; therefore, impacts to these deep-water communities from this type activity would be precluded in the more isolated areas.

A blowout at the seafloor could resuspend large quantities of bottom sediments and even create a large crater, destroying any organisms in the area.

The majority of the deep-water benthic chemosynthetic communities are of low density and are widespread throughout the deep-water areas of the Gulf, so disturbance or destruction of a small area would not result in a major impact to chemosynthetic communities as an ecosystem. Areas so impacted could be repopulated from nearby undisturbed areas.

High-density, Bush Hill-type communities are areas of high biomass and, while little is known at present of the size, number, or locations of these important communities, it is known that they are associated with hydrocarbon seeps and gas- and/or oil-charged sediments. It is these chemosynthetic areas that are considered to be most at risk from oil and gas operations. The disturbance of a Bush Hill-type community could lead to the destruction of the community such that recovery would not soon occur or would not occur at all. Because of the recent discovery of this type community, the vulnerability to impact, recoverability, and general extent of the community are unknown. Notice to Lessees (NTL) 88-11 (which became effective on February 1, 1989) formalizes the MMS review process and makes mandatory the search for and avoidance of "plush" 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. Under the provisions of this NTL, lessees operating in water depths greater than 400 m (1,312 ft) are required to interpret the geophysical records of that area for conditions that might indicate that the area may support chemosynthetic communities; if such conditions exist, the lessee must either move the operation or provide photo-documentation of the presence or absence of chemosynthetic communities (of the Bush Hill type). If such communities are indeed present, no drilling operations may take place in the area (if the communities are not present, drilling may proceed). The requirements set forth in NTL 88-11 are considered to be very effective in identifying areas of chemosynthetic communities, but some small percentage (estimated by MMS to be on the order of 10-15%) of chemosynthetic community areas may not be properly identified by these procedures. As new information becomes available, the NTL will be modified as necessary.

It should be noted that NTL 88-11 is a nonsale-specific mitigation measure that is applied to all operations in appropriate water depths. These activities must conform to the protective measures outlined in the NTL and summarized above. Because of the administrative nature of an NTL, it is exercised on all applicable leases and is not an optional protective measure at the discretion of the Secretary of the Interior. The implementation of an NTL is unlike the stipulations proposed within this document. The stipulations are sale-specific protective measures that are applied to specific leases and that may or may not be adopted by the Secretary at each lease sale.

These NTL's, along with many other Federal regulations and MMS operational guidelines (as outlined in Section I.B.), form the framework within which operators in the Gulf of Mexico function. The thousands of plans, modifications, reports, and papers that document the efforts of the OCS oil and gas industry follow the framework established by MMS; NTL 88-11 is but one piece of this extensive guidance.

An issue about which little is known, but about which there has been some speculation, is the potential impact to chemosynthetic organisms by the withdrawal (by oil and gas production) of the energy source--the hydrocarbons--from beneath the community. The seeps and vents around which these animals live are presumably pressurized from the deep reservoirs that force the gas or oil to the seafloor. When all of the recoverable hydrocarbons from these reservoirs are withdrawn by production operations, it is possible that oil and gas venting or seepage would also slow or stop. Current information does not allow a determination to be made as to whether this slackening of the pressure, which drives the seeps, would be reduced quickly (as they have been on land) or whether there may be enough oil already in the "conduit" to the surface to continue the seepage for long periods. Such long-term impacts are poorly understood, but the level of development in deep-water areas may be too low to cause significant impacts from the depletion of the hydrocarbon energy source. Current and planned studies of these communities by MMS may provide information that will lead to the resolution of this issue.

*Base Case Analysis*

Because high-density chemosynthetic communities are found only in water depths greater than 400 m (1,312 ft), they will not be found in Subarea C-1; they will be found only in the southeast third of Subarea C-2 and the southern two-thirds of C-3; and they may be found throughout C-4. Thus, these communities will not be exposed to the full level of projected impact-producing factors of Table IV-2. As noted in Table IV-2, in these three subareas a total of 545 wells are assumed to be drilled, 24 platform complexes installed, and 192 km (120 mi) of pipeline installed.

As noted above, the majority of these deep-water communities are of low density and are widespread throughout the deep-water areas of the Gulf. Disturbance to a small area would not result in a major impact to the ecosystem. For purposes of this Base Case analysis, the frequency of such impact is expected to be once every six months to two years, and the severity of such an impact is judged to result in few losses of ecological elements, with no alteration of general relationships.

High-density communities are, as noted above, largely protected by the provisions of NTL 88-11. For purposes of this analysis, the frequency of some small percentage of impact is expected to be once every six months to two years, but the severity of such an impact is such that there may be some loss of ecological elements and/or some alteration of general relationships.

*Summary*

The only impact-producing factor threatening the chemosynthetic communities is physical disturbance of the bottom, which would destroy the organisms comprising these communities. Such disturbance would come from those OCS-related activities associated with pipelaying, anchoring, structure emplacement, and seafloor blowouts. Only structure emplacement is considered to be a threat, and then only to the high-density (Bush Hill-type) communities; the widely distributed low-density communities would not be at risk. The provisions of NTL 88-11 (currently in effect), requiring surveys and avoidance prior to drilling, will greatly reduce, but not completely eliminate, the risk.

*Conclusion*

The proposed action is expected to cause little damage to the physical integrity, species diversity, or biological productivity of either the widespread, low-density chemosynthetic communities or the rarer, widely scattered, high-density Bush Hill-type chemosynthetic communities. Recovery from any damage is expected to take less than two years.

*High Case Analysis*

In the High Case analysis, the deep-water benthic communities (e.g., chemosynthetic communities) would be subject to the same impact-producing factor as in the Base Case: physical disturbance of the bottom where these communities are found, such as disturbance by emplacement, platform and pipeline installation, and anchoring. No other impact-producing factor is expected to present a threat to these deep-water communities. As noted under the Base Case, it is highly unlikely that discharges from the proposed activities would adversely impact the benthos in the water depths (greater than 400 m) being discussed, due to the rapid dilution and dispersion of effluent components.

Furthermore, as in the Base Case, these communities will be found only in the southeast third of Subarea C-2 and the southern two-thirds of C-3, and they may be found throughout C-4. Thus, these communities will not be exposed to the full level of the projected impact-producing factors of Table IV-2. As noted in Table IV-2, in these three subareas a total of 980 wells are assumed to be drilled, 44 platform complexes installed, and 400 km (250 mi) of pipeline installed.

While the opportunities for impact are somewhat higher for this High Case than for the Base Case, NTL 88-11 will still be effective in detecting the high-density communities and providing for their avoidance.

For purposes of this analysis, the frequency of such impact to the widespread, low-density communities is expected to be once every six months to two years, and the severity of such an impact is judged to result in few losses of ecological elements, with no alteration of general relationships.

For purposes of this analysis, the frequency of some small percentage of impact (given NTL 88-11) to high-density communities is expected to be once every six months to two years, but the severity of such an impact is such that there may be some loss of ecological elements and/or some alteration of general relationships.

*Conclusion*

The activities associated with the High Case scenario are expected to cause little damage to the physical integrity, species diversity, or biological productivity of either the widespread, low-density chemosynthetic communities or the rarer, widely scattered high-density, Bush Hill-type chemosynthetic communities. Recovery from any damage is expected to take less than two years.

### *(c) Topographic Features*

The topographic features of the Central Gulf providing sensitive offshore habitats are listed and described in Section III.B.2.

A Topographic Features Stipulation similar to the one described in Section II.A.1.c.(1) has been included in appropriate leases since 1973 and may, at the option of the Secretary, be made a part of appropriate leases resulting from this proposal. The impact analysis presented below is for the proposed action and includes the proposed biological lease stipulation. As noted in Section II.A.1.c.(1), the stipulation establishes an area (No Activity Zone) in which no bottom-disturbing activities would be allowed and areas around the No Activity Zones (in most cases) in which shunting of all drill effluents to near the bottom would be required. The effectiveness of the stipulation in protecting the biota of the topographic features (banks) is well documented. Thus, the very high potential impacts described in previous EIS's for the biota of the banks, and which did not include the protective stipulation in the analysis of the proposed action, would not occur as a result of this proposal.

The potential impact-producing factors to the topographic features of the Central Gulf are anchoring (Section IV.A.2.d.(1)(b)), structure emplacement (Section IV.A.2.d.(1)(a)), effluent discharge (Section IV.A.2.d.(5)), blowouts (Section IV.A.2.d.(8)), oil spills (Sections IV.A.2.d.(10) and IV.C.), and structure removal (Section IV.A.2.a.(3)).

Anchoring of pipeline lay barges, drilling rigs, or service vessels, and structure emplacement (pipeline, drilling rig, or platform emplacement) results in physical disturbance of the benthic environment. Anchor damage has been shown to be the most serious threat to the biota of the offshore banks (Bright and Rezak, 1978; Rezak et al., 1985). However, the stipulation discussed above would preclude these activities in the No Activity Zone, thus preventing adverse effects from this factor.

Drilling mud and cutting discharges result in localized water turbidity, deposition on the surrounding seafloor, and potential effects of the low concentrations of toxic constituents. Some 7,134 bbl of drilling muds (on average) are assumed to be discharged per exploration well, and 6,749 bbl per development well; 1,853 bbl of cuttings are produced per exploration well, and 1,430 bbl per development well. Nearly 82 percent of these amounts are assumed to be generated offshore, with the rest brought to and disposed of onshore. Formation waters are routinely discharged during production operations. Some 450 bbl are produced per oil well per day, and 68 bbl per gas well per day; 89 percent is assumed to be discharged directly offshore. Oil and gas operations will routinely discharge drilling muds and cuttings, which may impact the biota of the banks due to turbidity and sedimentation. Most water-based fluids are relatively nontoxic, and their effects are limited to the immediate vicinity of the discharge (NRC, 1983). (The more toxic oil-based muds, if used, cannot be discharged under the conditions of the Environmental Protection Agency's NPDES permit.) The water depths from which the topographic features rise range from 50 to 175 m, depths that dramatically increase the dilution of drilling effluents. In the Gulf of Mexico OCS, about 90 percent of the discharge settles rapidly, usually within 1,000 m (NRC, 1983). Choi (1982) found that drilling discharges (muds and/or cuttings with iron flakes) were trapped in coral and coral rubble only up to 100 m from the wellhead; even so, coelobite communities therein were largely disturbed only up to 40 m from the drill site, with minor changes evident out to 100 m. Coring conducted by Hudson et al. (1982) on coral heads near drilling activities on a Philippine coral reef revealed little suppression of head coral growth due to drilling, while diver observations noted a 70-90 percent reduction of coral cover in a 115-by-85 m ellipse; coral cover beyond this small area was the same as control areas. Effluents discharged at the water's surface within 1,000 m of a bank could impact the biota of the bank, although the currents at the banks would tend to keep the bank swept clean of fine sediments and would prevent the accumulation of drilling muds at the bank. Produced water, which is relict seawater associated with produced hydrocarbons, along with injection water and other additives, may be a potential hazard to the biota of topographic features. It contains high concentrations of inorganic salts ranging from 3 to 300 parts per thousand (ppt). Hydrocarbons, other organic compounds, and trace metals may be present in parts per million (ppm) levels in the produced water discharges. The study of the Buccaneer oil field offshore Texas (USDOC, NMFS, 1977) determined that produced water was discharged at a rate of 32 $m^3$ per day between January 1975 and February 1976. The average oil content of this produced water was 25.1 ppm. However, the latest API average oil and grease content in OCS produced waters (after treatment) is 89 ppm (USEPA, 1991), and the mean discharge rate of treated produced waters in the Gulf is 286 $m^3$ per day (Walk, Haydel, and Associates, Inc., 1984). Near-platform macrobenthic populations were depressed and had a high turnover rate as compared to the surrounding sea bottom; this may have been a result of increased scour action around the platform structure itself, but no cause-effect relationship was established. However, the proposed stipulation discussed above would preclude these activities in the No Activity Zone and would require shunting of these discharges in zones around the high relief banks, thus preventing adverse effects from this factor to the biota of the banks. Section IV.A.2.d.(5)(b) provides more information on produced waters in the Gulf of Mexico.

Blowouts can occur from either oil or gas wells. Oil well blowouts may result in oil spills. Both gas and oil subsurface well blowouts result in large amounts of bottom sediment being resuspended in the water column. The resuspension of sediments disturbed during a subsurface blowout can result in localized water turbidity and deposition of the materials on the surrounding seafloor, which may in turn cause the smothering of local benthic communities or induce stress in part or all of a local community. An additional potential harmful effect could be caused by concentrations of toxic constituents that may be in the sediments (from contaminated river runoff, for example). To the extent that oil or condensate is present in the reservoir, some liquid hydrocarbons may also be injected into the water column. The suspended sediments may be carried some distance by currents, but the bulk of the sediments is redeposited within a few thousand meters of the blowout site. Low-molecular-weight hydrocarbons (gases) will dissolve in the water column until saturation is reached. A blowout directly on a bank or near a bank could have serious long-term or permanent consequences. In most cases, it is expected that the currents will sweep the contaminants around the bank rather than deposit them on the bank (Rezak et al., 1983). Some small fraction of the sediments or oil may reach a bank and come in contact with organisms; the extent of damage will depend on the amount of contaminant and the length of time it remains on the bank. Amounts are not expected to be high because of dilution, dispersion, settling, and current action (sweeping the contaminant around and from the bank). Length of time on the bank may be long for the heavier sediments, but these are likely to settle out rapidly and not reach the bank at all (Brooks and Bernard, 1977). The stipulation discussed above would preclude drilling in the No Activity Zone, thus preventing most adverse effects from blowouts.

Oil spills may occur at the surface due to tanker spillage and platform spills or at the seafloor due to pipeline rupture or well blowout. Both surface and subsurface spills could result in a steady discharge of oil over a long period of time. Surface spills could occur from tankers or oil platforms. Most of the small spills would occur from surface sources. The spills less than 1,000 bbl and spills grater than or equal to 1,000 bbl are as equally estimated to result from surface spills as seafloor spills. Oil from a surface spill can be driven into the water column; measurable amounts have been documented at depths approximating 10 m, although modeling exercises have indicated such oil may reach a depth of 20 m. At this depth, the oil is found only at concentrations several orders of magnitude lower than the amount shown to have an effect on corals (Lange, 1985; McAuliffe et al., 1975 and 1981; Knap et al., 1985). Because of the water depths in which topographic features are found, no oil from a surface spill will reach the biota of concern. Oil from a subsurface spill (pipeline spill), which is the type of spill assumed for this proposed action (Section IV.C.), could reach the biota of concern on a topographic feature. Impacts could then be serious to the local biota actually contacted by the oil. Destruction of the biota of such areas may have severe and long-lasting deleterious consequences on the specific commercial and recreational fishery habitats affected. These consequences include loss of habitat, loss of species (including prey species), destruction of hard substrate, and change in sediment characteristics, all of which may result in the reduction or loss of one or more fisheries. These areas also have intrinsic biological, ecological, and aesthetic values of their own that would be lost by such activities. Corals, however, would probably not be impacted this severely. Knap et al. (1985) found that *Diploria strigosa* dosed with oil exhibited sublethal effects that occurred rapidly; effects were short-term, and recovery of the coral was also rapid. Additionally, *Diploria* appears to be relatively tolerant of brief exposures to chemically dispersed crude oil. Nonchemically dispersed oil adhered longer to the substrate; the exposure time of coral to oil would be lengthened, thereby increasing the impacts. Of note is the fact that the cryptic fauna associated with the coral community may be more sensitive to oil dosage than the corals. Such a blowout and spill event, however, are quite unlikely. The stipulation discussed above would preclude drilling in the No Activity Zone, thus preventing adverse effects from nearby drilling. However, it is possible that oil spills originating outside the No Activity Zones could reach the area of the banks. Because of the depth of the banks, it is unlikely that the biota of the banks would be affected by subsurface oil.

The following is a brief summary of recent pertinent work on the effects of oil on coral:

> A review of the literature reveals conflicting results regarding the effects of oil on corals. However, most researchers agree that the evidence suggests a detrimental influence of oil contamination on reef corals. Differences in experimental design and the variability of field conditions must be noted whenever such comparisons are made (Dodge et al. 1984). For example, it may be misleading to draw conclusions on the long-term damage to coral reefs from studies based on short-term or qualitative observations (Loya and Rinkevich 1980).
>
> In 1986 a major spill occurred in an area along the Caribbean coast of Panama which had previously been well characterized ecologically. This has provided an unprecedented opportunity for the study of both the acute and the chronic impacts of oil on tropical marine communities (Keller and Jackson 1991), including coral reefs (Guzman et al. 1991; Guzman and Jackson 1991). The results are for the most part in agreement with previous work regarding the effects of oil spills on shallow reefs, demonstrating that growth rates, population levels, total coral cover, and species diversity decreased significantly in the shallow subtidal areas where the reefs were exposed to oil. Coral tissue samples, taken following the 1986 oil spill, indicated levels of oil on the order of 25 to 50 ug/mg lipid in specimens from a heavily oiled site (Burns and Knap 1989). However, samples taken in 1988 and 1989, demonstrated that the levels of oil in coral tissues were extremely low (<1 ug/mg extractable organic matter) (Burns, in press).
>
> While such coral species as *Montastrea annularis*, *Porites astreoides*, and *Diploria strigosa* are common to both he reefs of the Gulf such as the Flower Garden Banks and the reefs of Panama, the habitats differ markedly regarding such parameters as depth, distance from shore, and hydrography (Rezak et al. 1985; Jackson et al. 1989). While the reefs which were impacted in Panama are fringing reefs within a few tens-of-meters of the shoreline and include shallow reef-flats coming to the waters surface, the coral reefs of the Flower Garden Banks come only to within 18 m of the surface and are over 200 km from shore. The reefs of Panama are also heavily influenced by sedimentation and freshwater runoff from the mangrove forests directly adjacent to them, such coastal influences are not encountered in the much more oceanic environment of the Flower Garden Banks.
>
> The Flower Garden Banks, lacking shallow water reef structures (e.g., reef flat, emergent reefs, etc.) are much less at risk from buoyant surface-bound slicks than are the more typical shallower reefs found throughout the Caribbean. However, it may be argued that the severing of a submerged pipeline would introduce petroleum into the water column which, under the proper conditions, may result in the formation and settling of oil-saturated material with oil-sediment particles coming into contact with living coral tissue.
>
> Bak and Elgershuizen (1976) examined the patterns of oil-sediment rejection of 19 Caribbean hermatypic corals and found that physical contact with such particles was less harmful to corals than the toxic effects of oils. These experiments included the most important hermatypic corals of the Flower Garden Banks: *Montastrea annularis*, *Diploria strigosa*, *M. cavernosa*, *Colpophyllia* spp., and *Porites astreoides* (Bright et al. 1974, 1984; Tresslar 1974; Viada 1980; Kraemer 1982).

The use of chemical dispersants might also cause a surface slick to sink, exposing deeper reef environments to oil contamination. However, studies of chemically treated oil slicks under field conditions report subsurface dispersed oil concentrations ranging from less than 1 ppm to a maximum of 20 to 70 ppm; concentration exceeding 10 ppm are usually restricted to the upper 2 to 3 m of the water column (e.g., McAuliffe et al. 1981; Lichtenthaler and Daling 1983, 1985; Delvigne 1985; Gill et al. 1985; Nichols and Parker 1985).

Dodge et al. (1984) exposed colonies of *D. strigosa* for 6-24 h periods to various concentrations (1-50 ppm) of oil or chemically dispersed oil. These experiments were designed to assess the long-term effects of brief low-level concentrations of chemically dispersed oil and oil alone on corals in situations similar to that which may occur when oil slicks (treated and non-treated) passed over a reef. No significant differences between the treated corals and controls were found in any of the experiments. However, as explicitly stated by the authors, these experiments did not attempt to access chronic pollution from, for example, a slow leak from a grounded tanker or a pipeline. However, the experimental conditions used do fall within the worst case scenario (concentrations and time) which might be encountered in the event of a severing of a pipeline.

Wyers et al. (1986) examined the behavior of *D. strigosa* during 6 to 24 hour exposures to water-accommodated fractions of chemically and physically dispersed crude oil. In general, effects observed were sub-lethal, temporary, and only associated with the highest concentrations tested. Behavioral observations provided little evidence of adverse effects at 1-5 ppm concentrations. At 20 ppm, responses included mesenterial filament extrusion; extreme tissue contraction; tentacle retraction; and in certain experiments, localized tissue rupture. The nature and severity of reactions during the dosing phase varied between colonies and treatments, but colonies typically resumed normal behavior within 2 hours to 4 days. It was concluded that these observed biological effects would be unlikely to impair long-term viability.

These studies suggest that when the symptoms elicited by physically or chemically dispersed oil are temporary, they appear to be within the scope of naturally occurring defensive reactions to adverse conditions (Wyers et al. 1986). For example, extreme tissue contraction can be elicited by physical factors and may give rise to rupture as the tissue is withdrawn into the underlying corallum (Kanwisher and Wainwright 1967; Hubbard 1974). Tentacle retraction occurs in response to such stimuli as temperature extremes (Jokiel and Coles 1977) and high current velocities (Hubbard 1974). Mesenterial filament extrusion is usually reported under conditions of surface tissue damage or irritation, although it can also play a role in feeding activities (Lewis and Price 1975) and interspecific competition (Lang 1973). Similarly, tissue swelling and mucus production can be observed during cleaning and protective activities (e.g., Bak and Elgershuizen 1976; Dallmeyer et al. 1982). Specifically, Bak and Elgershuizen (1976) could find no specific reaction of corals to oil-sand particles. The rejection mechanisms utilized in oil-sand removal were the same, and apparently functioned in the same manner, as those used in the rejection of clean sediments.

It is unlikely that chemical dispersants would be used far from shore in the open ocean in the vicinity of the banks of the Gulf of Mexico.

In a series of field experiments utilizing oil containment barriers, LeGore et al. (1989) exposed portions of an Arabian Gulf coral reef to oil, dispersant, and chemically dispersed oil. Water depth over the experimental site varied from one to three meters, depending on tidal phase. *Acropora* spp. accounted for more than 95% of the corals included in each test plot. Exposures were conducted for 24 and 120 hours. Corals were examined for biological impacts immediately after the exposure, and then at three-month intervals for a year. For the most part, coral growth appeared unaffected by the exposures; however, some *Acropora* specimens exposed to the chemically dispersed oil for 120 hours exhibited delayed, but minor, effects, which became apparent only during the relatively cold stressful winter season.

Structure removal results in water turbidity, sediment deposition, and potential explosive shock wave impacts. If carried out using current explosive methods, removal of platforms constructed on or very near sensitive habitats would adversely affect benthic habitats very near the removal site. Both explosive and nonexplosive removal operations would disturb the seafloor and resuspend sediments in the water column, resulting in turbidity. Explosive methodologies create more turbidity than nonexplosive methods. Deposition of resuspended sediments would occur much in the same manner as discussed for muds and cuttings discharge, smothering and perhaps causing mortality of sessile benthic invertebrates. Turbidity can reduce light levels and clog of filter-feeding mechanisms. These conditions could lead to reduced productivity, susceptibility to infection, and mortality. Explosive structure removals create shock waves, which could also harm resident biota. However, it appears that corals and other sessile invertebrates are fairly resistant to shock. O'Keeffe and Young (1984) have described the impacts of underwater explosions on various forms of sea life. Most of their data, however, were derived from open-water explosions of a much larger size than those used in typical structure removal operations. They found that sessile organisms of the benthos, such as barnacles and oysters, and many motile forms of life (such as shrimp and crabs) that do not possess swim bladders are remarkably resistant to the blast effects from underwater explosions. Many of these organisms not actually in the immediate blast area would survive. Data from underwater explosive tests indicate that oysters exposed to the detonation of 135-kg (300-lb) charges in open water showed only 5 percent mortalities at distances of 8 m (25 ft). Crabs exposed to 14-kg (30-lb) charges of explosives in open water showed 90 percent mortalities at 8 m (25 ft), but very few died at 46 m (150 ft). These authors also noted ". . . no damage to other invertebrates such as sea anemones, polychaete worms, isopods, and amphipods." Benthic organisms appear to be further protected from the impacts of subbottom explosive detonations by the very rapid attenuations of the underwater shock wave through the seabed enroute to the benthic communities. Theoretical predictions suggest that the shock waves of explosives set 5 m below the seabed as required by MMS regulations would further attenuate blast effects. Charges used in OCS structure removals are typically much smaller than some of those cited by O'Keeffe and Young. (It should be further noted that the *Programmatic Environmental Assessment for Structural Removal Activities* [USDOI, MMS, 1987c] predicts low impacts to the sensitive offshore habitats from platform removal precisely because of the effectiveness of the proposed stipulation in preventing platform emplacement in the most sensitive areas of the topographic features of the Gulf of Mexico.) In any event, the relatively small size of the charge (normally 50 lb or less) and the fact that the charge is detonated 5 m below the mudline would serve to restrict the impacts to very close to the structure being removed. The stipulation discussed above would preclude platform installation in the No Activity Zone, thus preventing adverse effects from nearby removals. It is unlikely that more distant removals would impact the biota of the banks.

*Base Case Analysis*

Fifteen of the 16 topographic features of the Central Gulf are located in Subarea C-2; 1 is in C-3 (in both cases they occupy a very small portion of the entire area). Thus, these communities will not be exposed to the full level of the projected impact-producing factors of Table IV-2; the amounts of wastes discharged in the vicinity of a bank will be some very small fraction of those shown in Table IV-2.

As noted above, the proposed Topographic Features Stipulation would serve to eliminate most of the potential impacts to the biota of the banks from oil and gas operations. The impact-producing factors that could still affect the banks from operations outside the No Activity Zones are drilling effluent discharges, blowouts, and oil spills.

With the inclusion of the proposed Topographic Features Stipulation, no discharges of drilling effluents, including produced water, would take place within the No Activity Zones; discharges in areas of 1,000 m, 1, 3, or 4 miles, depending on the bank, around the No Activity Zone would be shunted to within 10 m of the bottom. This procedure would essentially eliminate the threat of drilling effluents reaching the biota of the bank; however, there may be some small risk of such effluents and produced waters reaching the bank. For purposes of this analysis, it is assumed that such impacts would occur 5-10 times during the life of this proposal; the severity of such impacts is judged to be such that there may be a loss of a few elements at the regional or local scale, but no interference to the general system performance. Recovery of the system to pre-interference conditions is rapid.

Blowouts seldom occur (see Section IV.A.2.d.(8) and below), and with the application of the proposed stipulation, none can occur within the No Activity Zones. Blowouts outside the No Activity Zones are unlikely to have an impact on the biota of the banks. Since only one blowout is assumed to occur in each of Subareas C-2 and C-3, where the banks are found, for purposes of this analysis, a blowout in the vicinity of a topographic feature is not expected to occur during the life of this proposal. If one were to occur, it may cause the loss of a few elements at the local scale, but no interference to the general system performance would occur, and recovery of the system to pre-interference conditions would be rapid.

There is an estimated 16 percent chance of one or more oil spills greater than or equal to 1,000 bbl occurring in the Central Gulf as a result of the proposed action (Base Case) (Table IV-19), and it is assumed that 21 spills of greater than 1 and less than or equal to 50 bbl will occur each year. It is further assumed that there will be one spill of greater than 50 and less than or equal to 1,000 bbl, and one spill of 6,500 bbl is assumed to occur during the 35-year life of the proposed action (Table IV-2 and Section IV.C.1.). In addition, it is assumed there will be four spills of diesel oil and other pollutants, the average size of which will be 34 bbl. (Section IV.C.1.). In the Central Gulf, Sonnier Bank crests the shallowest at 18 m. Therefore, a surface oil spill would likely have no impact on the biota of Sonnier Bank or the other topographic features because any oil that might be driven to 18 m or deeper would be well below the concentrations needed to cause an impact. However, spills resulting from this proposal are assumed to be subsurface. Such spills are expected to rise to the surface, and any oil remaining at depth will be swept clear of the banks by currents moving around the banks (Rezak et al., 1983). As noted above, there have been only 28 oil spills resulting from blowouts on the OCS between 1956 and 1989; only 4 blowouts are assumed for the entire CPA over the 35-year of the proposed action. In the years 1967-1986, there have been only 31 oil spills from pipelines on the OCS, 23 of which were between 50 and 1,000 bbl and only 8 more than 1,000 bbl (USDOI, MMS, 1988b). Thus, a blowout is considered very unlikely to occur near a bank. If a seafloor oil spill were to occur, the spill would have to come into contact with a biologically sensitive feature. The fact that the topographic features are widely dispersed in the Central Gulf, combined with the probable random nature of spill locations, would serve to limit the extent of damage from any given spill to only one of the sensitive areas. The currents that move around the banks will steer any spilled oil around the banks rather than directly upon them, lessening impact severity. Furthermore, the No Activity Zones established by the proposed Topographic Features Stipulation would serve to keep such occurrences from very near the banks.

*Summary*

Several impact-producing factors may threaten the communities of the topographic features.

Because of the proposed Topographic Features Stipulation, operational discharges (drilling muds and cuttings, produced waters) would have little impact on the biota of the banks. Recovery from any impact would be rapid.

Blowouts may similarly cause damage to benthic biota, but due to the application of the proposed Topographic Features Stipulation, they would have little impact on the biota of the banks. Recovery from any impact would be rapid.

Oil spills (there is an estimated 16% chance of an oil spill more than or equal to 1,000 bbl occurring in the Central Gulf as a result of this proposed action) will cause damage to benthic organisms if the oil contacts the organisms; such contact is not expected and, because of the proposed Topographic Features Stipulation, spills would not occur very near to the biota of the banks.

*Conclusion*

The proposed action is expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 $m^2$ would be impacted, and recovery from this damage to pre-impact condition is expected to take less than 2 years, probably on the order of 2-4 weeks.

*Effects of the Base Case Without the Proposed Stipulation*

Several impact-producing factors may threaten the communities of the topographic features.

Vessel anchoring and structure emplacement result in physical disturbance of the benthic environment and are the most likely activities to cause permanent or long-lasting impacts to sensitive offshore habitats, destroying large amounts of (10's to 100's of $m^2$) of corals and other reefal organisms. Recovery from damage caused by such activities may take 10 or more years. Impacts from this factor are considered to be serious and potentially irreversible.

Operational discharges (drilling muds and cuttings, produced waters) may impact the biota of the banks due to turbidity and sedimentation, resulting in death to benthic organisms in large areas. Recovery from such damage may take 10 or more years. Impacts from this factor are also considered to be serious and potentially irreversible.

Blowouts may similarly cause damage to benthic biota by resuspending sediments, causing turbidity and sedimentation, and resulting in death to benthic organisms. Recovery from such damage may take up to 10 years. As noted above, only two blowouts are assumed to occur in Subareas C-2 and C-3 where the banks are found; thus, blowouts are not expected to impact the biota of the banks.

Oil spills will cause damage to benthic organisms if the oil contacts the organisms. As noted above, impacts from this factor are not considered to be of concern.

Structure removal using explosives (as is generally the case) results in water turbidity, sediment deposition, and potential explosive shock-wave impacts. Severe damage to benthic organisms could result. Recovery from such damage could take more than 10 years. Impacts from this factor are considered to be serious.

It follows from the above that activities resulting from this proposal, especially bottom-disturbing activities, have a potential for causing serious and potentially irreversible, impacts to the biota of the topographic features.

*High Case Analysis*

Higher oil and gas activity may be expected near the topographic features of the Central Gulf as a result of the High Case scenario. The biota of the topographic features would be subject to the same impact-producing factors as in the Base Case--discharges associated with drilling, blowouts, and oil spills. As in the Base Case, the topographic features are found only in Subareas C-2 and C-3. Thus, these communities will not be exposed to the full level of the projected impact-producing factors of Table IV-2; the amounts of water discharged in the vicinity of a bank will be some very small fraction of those shown in Table IV-2.

As noted above, the proposed Topographic Features Stipulation would serve to eliminate most of the potential impacts to the biota of the banks from oil and gas operations.

Because of the proposed Topographic Features Stipulation, operational discharges (drilling muds and cuttings, produced waters) would have little impact on the biota of the banks. Recovery from any impact would be rapid.

Blowouts may similarly cause damage to benthic biota, but due to the application of the proposed Topographic Features Stipulation, they would have little impact on the biota of the banks. Recovery from any impact would be rapid.

There is an estimated 32 percent chance of one or more an oil spills greater than or equal to 1,000 bbl occurring in the Central Gulf as a result of the High Case (Table IV-19). It is also assumed that 47 spills of greater than 1 and less than or equal to 50 bbl and that 2 spills greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action. In addition, it is assumed there will be 23 spills of diesel oil and other pollutants, the average size of which will be only 34 bbl (Table IV-2). It is assumed that one oil spill of 6,500 bbl will occur (Section IV.C.1.). As with the Base Case, the widely dispersed nature of the banks, the depths of the banks, and the currents at the banks are expected to prevent oil from impacting the banks. Therefore, it is expected that no spills of any size will contact the biota of the topographic features.

*Conclusion*

The High Case scenario is expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 $m^2$ would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks.

## *(3) Impacts on Water Quality*

Sections providing supportive material for the water quality analysis include Sections III.A.6. (description of water quality), IV.A.2. (OCS infrastructure, activities, and impacts), IV.B.6. (major sources of oil contamination in the Gulf of Mexico), and IV.C.2. (oil spills--characteristics, fates, and effects).

*Coastal and Estuarine Waters*

Riverine flows into the Gulf of Mexico determine estuarine and nearshore water quality, with the Mississippi River being the most significant source of pollution to this region. Major point sources along the Gulf Coast include the petrochemical industry, hazardous waste sites and disposal facilities, agricultural and livestock farming, manufacturing industry activities, fossil fuel and nuclear power plant operations, pulp and paper mill plants, commercial and recreational fishing, municipal wastewater treatment, and maritime shipping activities. The coastal portion of the north-central Gulf of Mexico (primarily Louisiana) is characterized by water quality problems resulting from the discharge or release of industrial and domestic wastes. A more detailed discussion of the Gulf's coastal and estuarine water quality is presented in Section III.B.6.

Water quality in coastal and estuarine areas adjacent to the CPA may be altered by a number of OCS-related activities resulting from proposed Sale 142. These include routine point and nonpoint source discharges from onshore support facilities; discharges from associated support vessel traffic; canal maintenance dredging and pipeline emplacement actions; produced waters discharges; onshore disposal of OCS-generated, oil-field wastes; and oil and chemical spills greater than 50 bbl from both onshore and offshore OCS support activities.

The construction and operation of onshore facilities supporting OCS activities in the Gulf may impact coastal and nearshore water quality by routine point and nonpoint source pollution. Increased effluent discharges from OCS support facilities may contribute to point source pollution within coastal areas. These effluents are commonly discharged into surface waters after treatment. The degree of environmental damage will be related to the toxic nature of the discharge, the biota present, and the characteristics of the receiving waters. Likewise, runoff from existing OCS facilities is extensive and can have significant impacts to the surrounding area. Runoff from these facilities is likely to contain oil, brine, particulate matter, heavy metals, petroleum products, process chemicals, and soluble inorganic and organic compounds leached from the soil surface (NERBC, 1976). Aside from adding contaminants to coastal waters, runoff from such facilities may alter circulation in wetland areas and may affect flushing rates and salinity gradients.

Water quality may be degraded from bilge and ballast water discharges, contaminants in antifouling ship paints released to surrounding waters, discharges of treated sanitary and domestic wastes, discharge of solid wastes, and chronic spills from support vessels. Spills greater than or equal to 1,000 bbl may also occur in connection with the offloading and onloading of crude from shuttle tankering and barging activities and from fueling activities associated with supply boat support.

Dredging operations for navigation channel construction and maintenance result in the release of sediments into the water column, resulting in short-term, localized impacts. Navigation channels serve as routes for vessel traffic traveling between OCS and onshore service and supply bases. These are also traversed by barges carrying oil from the OCS or between terminals and may be used to transport pipelines and platforms to the OCS. Likewise, pipeline landfalls and pipeline excavation and burial techniques cause increased disturbances of bottom sediments and water column turbidities. Such increases have a nominal effect on the productivity of phytoplankton and may inhibit the respiratory and feeding mechanisms of numerous benthic and pelagic marine organisms within the area of disturbance. These activities could result in the resuspension of settled pollutants, heavy metals, and pesticides, if present.

Boesch and Rabalais (1989a) estimated 434,772 bbl of OCS produced waters are discharged daily into Louisiana coastal waters. These discharges originated from 16 separation facilities located in salt marsh environments along Louisiana's coastline (of the 53 separation facilities located within Louisiana, 16 were known to discharge substantial amounts of produced waters). These 16 facilities occupy 11 sites. Rabalais et al. (1991) updated the statistics of the earlier 1989 study. These revised estimates indicate that 253,994 bbl/day, or 25 percent, of all OCS produced waters are piped ashore for separation and treatment. Produced waters are commonly characterized as those waters and particulate matter brought to the surface during oil and gas production. The amount and characteristics of these waters are highly dependent on the method of production, field characteristics, and location. These waters may contain high levels of total dissolved solids, oxygen-demanding wastes, toxic metals, oil and grease contaminants, and naturally occurring radionuclides. In March 1991, the Louisiana State Legislature approved regulations banning the discharge, into State waters, of all oil and gas activity-derived wastewaters (primarily produced waters). The State's effluent guideline standards have been revised such that there shall be no discharge of produced waters into State waters after January 1, 1995, unless authorized in an approved elimination schedule or are in effluent limitation compliance.

A large portion of the wastes generated from offshore oil and gas exploration and development activities is discharged directly into surrounding offshore waters. In addition to the wastes discharged offshore, a number of wastes are brought ashore for disposal. These include some drilling muds, liquid wastes, fracking fluids, emulsifiers, workover fluids, biocides, mud additives, etc. Once ashore, many of these wastes are transported via truck to adjacent parishes, counties, or even to other States for off-site storage and disposal. Disposal of such wastes is accomplished through a wide variety of methods, including reinjection, containment in surface impoundments, land application, landfill, and burial. Improper storage or disposal of drums, containing solvents, corrosion inhibitors, and biocides used in drilling operations, also presents a potential for environmental problems. Likewise, the improper design and management of storage tanks and multi-purpose waste pits at commercial oil-field disposal facilities pose to adversely impact surrounding surface and ground waters and wetland areas. Discarded oil-field equipment may also pose an environmental threat to areas surrounding storage sites, cleaning sites, scrap yards, and metal reclamation yards. Surfaces of production tubing, holding tanks, separators, heater treaters, and other like equipment may be contaminated with scale material containing naturally occurring radioactive material (NORM).

Bohlinger (1990) indicated that workers employed at oil field pipe and cleaning facilities may be exposed to potential health risks associated with inhalation and/or ingestion of dust particles containing elevated levels of alpha-emitting radionuclides. Furthermore, the potential exists for radium-226 to enter both aquatic and terrestrial food chains due to lax disposal requirements. Bohlinger further indicated that the health risks and environmental consequences associated with the disposal of NORM-contaminated oil-field wastes are largely unknown at this time. According to Louisiana's Department of Environmental Quality, NORM-contaminated wastes are placed in Department of Transportation approved 55-gallon waste disposal drums. As indicated above, improper storage of these drums and contaminated equipment presents the potential for causing adverse impacts to waters surrounding these sites, primarily from surface runoff. (See Sections IV.A.2.d.(5) and IV.A.3.c.(4) for more detailed discussions of NORM and solid-waste disposal practices.)

Oil spills constitute one of the most visible forms of pollution. Once spilled, the oil's chemistry is altered by a number of processes that modify its characteristics in water (Section IV.C.2.). Significant deterioration of nearshore water quality would occur proximate to a continuous source of oil and would continue until the source were removed. The impact to water quality from spills greater than or equal to 1,000 bbl is expected to result in a disturbance of sufficient severity to alter water during the year of impact. In the case of spills less than 1,000 bbl but greater than 50 bbl, there would be some change in water parameters before cleanup, but no effect to water users would occur afterwards. If a slick from an OCS oil spill greater than or equal to 1,000 bbl were to reach or occur in protected bays or wetland areas, the dissipating factors reducing its concentration in water would be slower due to the low energy of such areas and the thickness of the oil on isolated water bodies. Most of the oil would weather, and quantities of hydrocarbons in much of the originally oiled area would likely return to background levels within several months after the spill occurred. Some of the oil, however, could be pushed into clumps of marsh vegetation or into protected pools or embayments, resulting in thick layers of oil on these water bodies or marsh surfaces. These isolated pools of oil would weather more slowly, and oil coating the sediments and vegetation might be released into the surrounding water bodies for a much longer time period.

*Base Case Analysis*

Under the Base Case analysis, it is expected that the existing onshore infrastructure base in the Central Gulf is sufficient to support proposed Sale 142 activities and that no new infrastructure will be constructed. Despite this, point and nonpoint source discharges (Section IV.A.3.c.) occurring from existing onshore support facilities may impact coastal and nearshore water quality. Most of the OCS support infrastructure located in the CPA exists in coastal Louisiana, and it is here that surface-water contamination from these facilities will occur. Waters near support facilities may be expected to be contaminated with oily substances and oil-field wastes from point source effluent discharges and small chronic spills. For the purpose of this analysis, chronic spills and chronic point source contamination are examined together with nonpoint source runoff. Section IV.C.1. provides assumptions for spills from OCS facilities. It is assumed that fewer than 10 spills (greater than 1 but less than or equal to 50 bbl) are assumed to result from OCS sale-related activities in the coastal zone, primarily within Louisiana. It is further assumed that 21 spills of this size class are assumed to result from proposed offshore sale-related activities in the CPA (Table IV-2), but few of these spills will contact the coastline. Petroleum hydrocarbons introduced into marine and coastal waters would have varied effects depending on the resource impacted, stage of weathering, and local physical and meteorological parameters. Some crude oil components are highly toxic and may cause damage to marine organisms. This toxicity is directly proportional to the crude's aromatic content (Geraci and St. Aubin, 1988). Lower molecular weight hydrocarbon compounds (benzene, toluene, etc.) are considered acutely toxic, but are rapidly lost through evaporation and dissolution during the first days of a spill (Wheeler, 1978). Normal weathering processes encountered by oil spilled in open waters tend to detoxify its components, changing the oil's composition. The oxidized derivatives of petroleum hydrocarbons generated during weathering have been shown to be more water soluble than the parent hydrocarbons (Malins et al., 1982a). Boehm and Fiest (1982) indicated that the average reported concentrations of oil generally were less than 1 $\mu$g/l for pristine areas, 2-100 $\mu$g/l for spills in nearshore areas, and 100-800 $\mu$g/l in heavily polluted urban areas. Background levels in the Gulf of Mexico were reported at 0-70 $\mu$g/l. In shallow areas, oil may become entrained in suspended particles and bottom sediments, subsequently being reintroduced into the water column. From these estimates, it is estimated that the effect of chronic contamination of CPA coastal waters due to the proposed sale would be negligible, with water characteristics rapidly returning to background levels. These discharges will, however, remain continuous over the 35-year life of the proposed action.

Table IV-6 provides the number of shuttle tanker trips to each major port, the number of barge trips to terminals by waterway, and the number of service vessel trips to service bases by waterway, respectively. Up to 17,600 service vessel trips, 77 barge trips, and 2 shuttle tanker trips are estimated to result from proposed sale-related activities. The Calcasieu (C-1) and Atchafalaya (C-2) Rivers, Freshwater Bayou (C-1), Vermilion (C-1) and Terrebonne Bays (C-2), and Mississippi River passes (C-3) of Louisiana are expected to receive the bulk of sale-related support vessel trips in the CPA. Besides barge trips to and from platforms, some barge traffic carrying oil from terminals to other terminals or refineries is expected to occur along the Gulf Intracoastal Waterway and adjoining navigation channels.

Antifouling paints used on boats and tankers have been shown to have toxic effects on some marine biota. Increased loadings within coastal waters of tributylin and copper compounds contained in antifouling paints are well documented (Geochemical and Environmental Research Group, 1988; Delfino et al., 1984). Tributyltin has recently been regulated to decrease the total amounts released into the environment from marine paints. Without knowing what effects the new regulations will have, but knowing that effects have been documented and that such discharges will take place on a routine basis for some of the life of the proposed action, impacts from antifouling paints associated with sale-related marine traffic are assumed to be low. Ballast and bilge waters from shuttle tankers are assumed to be discharged at onshore reception facilities and are not expected to impact coastal water quality. While inshore, service vessels are estimated to discharge approximately 3,000 liters of bilge water per trip in support of sale-related activities. An estimated 56 million liters (4,380 liters/day) will be discharged into coastal waters from vessels supporting the proposed sale activities. The amount of bilge water discharged from service boats could result in coastal water quality impacts when discharged into confined waters. Bilge waters may contain toxic petroleum products and metallic compounds leaked from machinery. Given the small concentrations expected, the continuous nature of the discharges over the life of the proposal, the widespread nature of the receiving waters, and the assimilative capacity of water bodies, it is expected that there will be some localized, short-term (up to several weeks) changes in water quality characteristics from background levels, depending on the length of the affected channel, flushing rates, etc.

No new navigation channels are expected to be dredged; however, maintenance dredging of major navigation channels and deepening of some channels to support service vessel traffic are expected to result. Dredging activities are expected to result in localized impacts (primarily elevated water column turbidities) occurring over the duration of the activities (up to several months). Such activities would preclude some recreational and commercial uses within the immediate area. The periods for expected dredging operations will generally allow for the recovery of affected areas between such activities. Impacts from dredging are expected to be somewhat higher near the mouths of major rivers, where sediment inputs are greater.

No new pipelines or canals are projected to be constructed; 98 percent of the oil and most of the gas produced will be transported ashore via the existing pipeline network (Table IV-2). Pipelines reduce the need for barge and truck transport of petroleum and the potential for transfer spills. The environmental effects associated with chronic pipeline leakage and malfunction are generally considered small (USDOC, NOAA, 1985). Given this and the small percentage of use of the existing pipeline network in support of the proposed action, impacts from leakage and hydrologic alterations associated with pipelines are considered negligible.

In association with the proposed action, the amount of OCS produced water estimated to be transported ashore in the CPA for separation, treatment, and disposal is approximately 34 MMbbl. Annually this equates to 0.97 MMbbl or approximately 2,660 bbl per day. As indicated previously, the new Louisiana regulations banning produced water discharges require such discharges to cease after January 1, 1995, unless they are on an approved elimination schedule or are in effluent limitation compliance. The assumption, based on the new regulations and discussions with OCS produced-water separation facility operators, is that these sites will either discontinue their operations, employ reinjection methods, modify existing operations and pipe the treated waters back offshore, or discharge the treated waters into the Mississippi River (at select sites). Therefore, the disposal of sale-related produced waters onshore is not expected to impact coastal and nearshore waters.

It is assumed the 18 percent of the drilling muds (744,000 bbl) associated with sale-related drilling activities and 69,000 bbl of produced sand will be brought ashore for disposal (Table IV-4). The improper storage and disposal of such oil-field wastes and contaminated oil-field equipment could result in adverse impacts to surface- and ground-waters in proximity to disposal facilities, cleaning sites, and scrap yards. Many of these wastes may be contaminated by NORM (Section IV.A.2.d.(5)). Improper design and maintenance of such facilities could result in adverse impacts to these waters (Section IV.A.3.c.(4)). The quantities of many wastes attributable to OCS activities, and more specifically the proposed action, are largely unknown, as are the associated environmental consequences and health risks. However, study efforts are underway by Federal and State governmental agencies and the oil and gas industry to gather information on NORM, including its fate and effects and its disposal and treatment alternatives.

The OSRA model (Table IV-21) indicates a very low chance (2%) of an oil spill greater than or equal to 1,000 bbl occurring from OCS operations and contacting land along the CPA coastline within 10 days. One oil spill of this size class is assumed to occur from the proposed action, but it will not contact nearshore open waters (Section IV.C.1.). It is further assumed that one oil spill greater than 50 and less than 1,000 bbl could occur from sale-related activities in the CPA; however, this spill will not contact the coastline. It should be noted that there could be some effects from residual weathered oil reaching coastal waters following a major spill event. Impacts from low-level contamination were discussed earlier. Less than 10 oil spills greater than 1 and less than or equal to 50 bbl are assumed to occur in coastal waters from OCS pipelines crossing coastal and nearshore areas or from sale-related shuttle tankering or barging activities (Table IV-4). Petroleum hydrocarbons introduced into marine and coastal waters may have varied effects depending on the resource impacted, stage of weathering, and local physical and meteorological conditions. Some crude oil components are highly toxic and may cause damage to marine organisms due to the crude's aromatic content. It is expected that normal weathering processes will degrade the oil by breaking down its toxic components. Background levels in the Gulf of Mexico were reported at 0-70 $\mu g/l$. In shallow areas, oil may become entrained in suspended particles and bottom sediments and be subsequently reintroduced into the water column. Given these estimates and the frequent nature of spills over the life of the proposal, the effect of hydrocarbon contamination on the Gulf's coastal waters due to the proposed action is considered negligible, with water characteristics rapidly returning to background levels within several days to weeks.

*Summary*

All existing onshore infrastructure and associated coastal activities occurring in support of proposed Sale 142 will contribute to the degradation of regional coastal and nearshore water quality to a minor extent because each activity provides a low measure of continuous contamination and because discharge locations are widespread, particularly in the Mississippi Deltaic area of Louisiana. Process, cooling, boiler, and sewage water effluents will be discharged through the use of the existing infrastructure and facilities. Because of the new Louisiana regulations banning the discharge of produced waters into State waters, the onshore separation, treatment, and disposal of approximately 34 MMbbl of OCS produced water are not expected to impact coastal and nearshore water quality. Wastes and contaminated equipment from offshore will be brought ashore for disposal and storage. Adverse impacts could occur to surface and groundwater in proximity to improperly designed and maintained disposal sites and facilities. Maintenance dredging is expected to take place every one or two years and will result in short-term, low-level impacts to the surrounding waters. The OCS-related vessel traffic is likely to impact water quality through routine releases of bilge and ballast waters, chronic fuel and tank spills, trash, and low-level releases of the contaminants in antifouling paints. The improper storage and disposal of oil-field wastes and contaminated oil-field equipment would adversely impact surface and ground waters in proximity to disposal facilities, cleaning sites, and scrap yards. Surface and groundwater in proximity to improperly designed and maintained disposal sites and facilities could be adversely impacted with elevated concentrations of arsenic, chromium, zinc, cadmium, mercury, lead, barium, penta-chlorophenol, naphthalene, benzene, toluene, and radium.

One oil spill greater than or equal to 1,000 bbl and 1 oil spill greater than 50 bbl and less than 1,000 bbl are assumed to occur, but not assumed to contact coastal and nearshore waters. An additional 31 spills greater than 1 but less than or equal to 50 bbl are assumed to result from OCS sale-related activities both in the coastal zone and from offshore. Of these, fewer than 10 associated with onshore support and vessel activities are assumed to occur in coastal waters. Sale-related spills will introduce oil into nearshore waters, creating elevated hydrocarbon levels (up to 100+ $\mu g/l$) within affected waters. Much of the oil will be dispersed throughout the water column over several days to weeks. In shallow areas, oil may become entrained in suspended particles and bottom sediments. Spills would affect water uses for up to several weeks, and then only near the source of the slick. Therefore, the effect of chronic contamination of CPA coastal waters due to the proposed sale is considered negligible, with water characteristics rapidly returning to background levels.

*Marine Waters*

The Gulf of Mexico is a semi-enclosed water body with oceanic inputs through the Yucatan Channel via the Caribbean and with principal outflow through the Straits of Florida. As previously noted, the presence of the Mississippi River, as well as a host of other major drainage systems, strongly influences the northern Gulf of Mexico's marine water quality. Drainage from approximately two-thirds of the area of the United States and more than one-half the area of Mexico empties into the Gulf. This large amount of runoff, with its nonoceanic composition, mixes into the surface water of the northwestern Gulf and makes the chemistry of parts of this system quite different from that of the open ocean. Degradation of the Gulf's marine waters is associated with coastal runoff, riverine inputs, and effluent discharges from offshore enterprises consisting of OCS activities and marine transportation.

Effluents from normal offshore oil and gas operations are complex and may be transformed chemically, biologically, or through radioactive decay when introduced into the marine environment. These wastes may be dissolved and form new substances or may be mixed vertically and horizontally in the water column by small-scale turbulence or large-scale currents, and they may precipitate to the bottom and be absorbed by bottom sediments or be recycled by these same processes. This series of transformations will govern a waste's transport through the water column and its effect on marine organisms. The biological effects may be on individual organism populations, or entire ecosystems, with both long-term and short-term consequences. The method of disposal into the environment, as well as the chemical properties of each source, will influence a waste's distribution throughout the Gulf.

The impact-producing factors leading to water quality degradation resulting from offshore OCS oil and gas operations include the resuspension of bottom sediments through exploration and development activities, pipeline construction, and platform-removal operations; the discharge of deck drainage, sanitary and domestic wastes, produced waters, drilling muds and cuttings and workover fluids; and accidental hydrocarbon discharges due to spills, blowouts, or pipeline leaks. These factors are more thoroughly discussed in Section IV.A.2.

Drilling, platform construction, and pipelaying activities increase water column turbidity by resuspending bottom sediments. Such increases would only nominally impact the productivity of phytoplankton, but may temporarily inhibit the respiratory and feeding mechanisms of numerous benthic and pelagic marine organisms within the affected area.

Aside from creating increased water column turbidity, explosive platform removal may adversely impact water quality by releasing explosive by-products into the water column upon detonation of charges to sever the legs and pilings of a structure. These by-products may be gaseous, liquid, or solid, and may be soluble or insoluble in water. In the case of a water surface burst (for scare charges), virtually all of the products become airborne. Significant changes take place in surface effects when the explosion depth is increased, although the gaseous products are ejected into the air by even relatively deep explosions. In this case, the gaseous products form a spherical bubble that rises to the surface, resulting in the ejection of most of the gases.

The discharge of treated sanitary wastes from rigs and platforms will increase levels of suspended solids, nutrients, chlorine, and biological oxygen demand (BOD) in a small area near the point of discharge. These constituents are quickly diluted when discharged into the open Gulf. Treated deck drainage and domestic wastes, most of which are taken ashore for proper disposal at an approved site, are minor discharges of no consequence to offshore water quality.

The discharge of drilling muds and cuttings may degrade the quality of the waters immediately surrounding discharge points. Continuous discharges (while drilling is in progress) may come from the solids control equipment on each platform. Bulk discharges at high rates of discharge (80-110 $m^3/h$) and lasting for a period of 20 minutes to 3 hours (Mors et al., 1982; Petrazzuolo, 1981), may take place once or twice during the drilling of a well. The physical fates and biological effects of drilling discharges have been the subjects of considerable study (e.g., NRC, 1983; IMCO et al., 1969; Neff, 1981; Petrazzuolo, 1981; Menzie, 1983; Ecomar, Inc., 1980; Zingula, 1975; Symposium, 1980; Workshop, 1983). The consensus of this work is that such resuspension has only a short-term local effect of a very limited nature. When discharged into the surrounding offshore waters, drilling muds may create turbidity plumes several hundred meters in length. If encountered in the very high concentrations found at the discharge source, suspended solids associated with these discharges may cause mortality in sensitive species and juveniles by clogging and damaging gill epithelia. Benthic infauna may be affected by smothering and by the change of bottom sediment characteristics. Studies indicate that these impacts are restricted to an area within 300-500 m of the discharge site. Dilution is extremely rapid in offshore waters. A 1983 NRC study suggests that, for routine oil and gas discharges, the various components measured, including turbidity, are at background levels by a distance of 1,000 m. The findings of several studies (NRC, 1983; Symposium, 1980; Neff, 1981; Petrazzuolo, 1981; Menzie, 1982; among others) suggest that the environmental impacts of drilling discharges to OCS offshore water quality are few, restricted to a small area, and temporary. Most water-based drilling fluids are slightly toxic or nontoxic. Toxicity is not of concern at the concentrations found in the field at distances greater than 200-500 m from the discharge point. Much of the toxicity of the aqueous fraction of drilling fluids appears to be attributable to volatile organic components, including petroleum hydrocarbons and by-products of lignite and lignosulfonate.

Produced water constitutes the largest single source of materials discharged into the Gulf during normal oil and gas operations. Most of the produced waters generated from the proposal will be discharged directly to the surface waters surrounding the individual production installation; however, in some instances, produced waters will be piped ashore and treated for further disposal below ground (reinjection) or discharged in the

Mississippi River (Section IV.A.3.c.(4)). The effects of produced waters on marine flora and fauna have been examined in numerous case studies of existing production fields (Section IV.A.2.d.(5)). According to the findings of investigators, the expected effects of these discharges on offshore water quality will be limited to an area in proximity to the discharge source. Higher concentrations of trace metals, salinity, temperature, organic compounds, radionuclides, and lower dissolved oxygen may be present near the discharge source. Although the distance required to reach background levels will vary, according to the volume and characteristics of each discharge, many investigators suggest that these levels are reached within a few to several hundred (200 m) meters of the source (Section IV.B.1.b.(4)(e)). All investigators agree that rapid dilution and turbulence at the source limit the zone affected by these properties.

Contaminants from oil- and gas-related marine transportation activities may enter the Gulf as a result of routine operational discharges or accidental spills. Activities in support of the proposed action, consisting of supply boat and shuttle tanker traffic, would routinely discharge pollutants consisting of domestic waste products, such as sewage, food waste, and trash or debris, in very small amounts.

Oil spills present a threat to the water quality of any area contacted by oil. Petroleum hydrocarbons introduced into marine waters as a result of such a spill may have varied effects on the local biota, with impacts ranging from negligible to very high, depending on the resource impacted, weathering, and the local physical and meteorological parameters. Normal weathering processes tend to render the spilled oil less toxic by breaking down its toxic components. Wind and currents would rapidly disperse oil released on the surface. Section IV.C.2 provides an in-depth discussion on the fates and effects of spilled oil.

*Base Case Analysis*

Table IV-2 indicates that, under the Base Case scenario, the addition of 340 exploration and delineation wells, 250 development wells, 30 platform complexes, and up to 240 km of pipe gathering lines is estimated for the CPA. As a result, an estimated 318 MMbbl of produced waters, 4.1 MMbbl of drilling muds, 0.98 MMbbl of drill cuttings, 69,000 bbl of produced sand, and 787,000 $m^3$ of treated sanitary and domestic wastes may be expected to be generated from the proposed action.

Immediate effects would be brought about by increased drilling, construction, and pipelaying activities, increasing water column turbidities in affected offshore waters. Pipeline construction activities may result in the resuspension of some 320,000 $m^3$ of sediment during the installation of 64 km of pipelines in water depths of 61 m (200 ft) and less. Offshore Subarea C-1 will support the greatest portion of sale-related pipeline burial activities (48 km) and associated sediment resuspension (240,000 $m^3$) (Table IV-2). Pipeline construction activities may result in the resuspension of settled pollutants, toxic heavy metals, and pesticides, if present. The magnitude and extent of turbidity increases would depend on the hydrographic parameters of the area, nature and duration of the activity, and bottom-material size and composition. Sediments are known to contain the major fraction of trace metals, chlorinated hydrocarbons, and nutrients in aquatic environments. Considering the very low levels of trace metals found in the present-day ocean, despite the continuous output from land sources, sediments serve as a permanent sink for trace metals, etc. Chen et al. (1976) indicated that concerns regarding the release of significant quantities of toxic materials into solution during dredging operations and disposal are unfounded. Their studies indicate that while some trace metals may be released in the parts-per-billion range, others show no release pattern. Most of the concentrations in the soluble phase are well below the allowable concentration levels of the ocean water discharge standards. It was pointed out that trace metals and chlorinated hydrocarbons associated with organics and suspended particles released may present an unknown effect. For the purpose of this analysis, the frequency of activities resulting in resuspension of sediment is judged to occur nearly continuously throughout much of the northwestern and north-central Gulf of Mexico. However, the severity of impacts would result only in some water quality parameters (primarily increased water column turbidities) changing from background levels, and then only to a distance of 1,000 m from the activity.

Aside from creating increased water column turbidity, explosive platform removal may adversely impact water quality by releasing explosive by-products into the water column upon detonation of charges to sever the legs and pilings of a structure. Twenty platforms associated with the proposal are assumed to be removed by explosive methods (Table IV-2). The by-products of these events may be gaseous, liquid, or solid, and may be soluble or insoluble in water. Virtually all of the products become airborne in the case of a water surface burst (for scare charges), even from relatively deep explosions. In the latter, the gaseous products form a spherical bubble that rises to the surface, resulting in the ejection of most of the gases. The magnitude and extent of turbidity increases would depend upon several hydrographic parameters, the duration of the activity, and bottom-material size and composition. The consensus of this work is that such resuspension has only a short-term local effect of a very limited nature. Because most of the gases are ejected into the air during rig removal (by explosive means), the very small amounts that remain in the water column should either be dissolved or dispersed so rapidly that water quality in the area would not be seriously affected.

The discharge of 787,000 $m^3$ of treated sanitary and domestic wastes from the various rigs and platforms will increase levels of suspended solids (14-550 mg/l), nutrients, chlorine, and BOD near the point of discharge. The volume and concentration of such wastes will vary widely over time, occupancy, platform characteristics, and operational situation. Properly operating biological treatment systems at these facilities have effluents containing less than 150 mg/l of suspended solids. These are considered minor discharges and are quickly diluted. The impact to offshore water quality from sale-related, treated sanitary and domestic waste discharges will be negligible, occurring within a few meters of the discharge source.

Up to 317 MMbbl of produced waters are estimated to result from the proposed action. Of this, 284 MMbbl will be disposed of offshore (Table IV-2). Average annual estimates equate to 16 MMbbl, or approximately 43,000 bbl per day. Offshore Subareas C-3 and C-4 will receive the greatest number of these discharges with approximately 109 MMbbl and 123 MMbbl, respectively (Table IV-2). Analysis of the findings of numerous investigators (e.g., Mackin, 1973; Gallaway, 1980; Bender et al., 1979; Reid, 1980), indicates that the estimated effects of these discharges on offshore water quality will be limited to an area in proximity to the discharge source. Higher concentrations of trace metals, salinity, temperature, organic compounds, and radionuclides, and lower dissolved oxygen may be present near the discharge source. Although the distance required to reach background levels will vary according to the volume and characteristics of each discharge, investigators suggest that these levels are reached within a few hundred meters of the source (Section IV.B.1.b.(4)(c)). They agree that rapid dilution and turbulence at the source limit the zone affected by these properties. Because of the continuous nature of oil and gas activities within the northwestern and north-central Gulf of Mexico, the frequency of produced-water discharges is judged to be somewhat continuously throughout these areas. (Variable discharge volumes will be released continuously throughout the duration of any oil and gas production operation.) The proposed produced-water discharges will be rapidly diluted within the immediate vicinity of the discharge source. Significant increases in water concentrations of dissolved and particulate hydrocarbons and trace metals are not expected outside the initial mixing zone or immediate vicinity of the discharge source. Within the mixing zone of the discharge, long-term effects to water column processes, consisting of localized increases in particulate metal and soluble lower molecular weight hydrocarbon (e.g., benzene, toluene, and xylenes) concentrations, may be implicated. Trace metals and hydrocarbons associated with the discharge may be deposited within sediments near the discharge point.

Some 4.1 MMbbl of drilling muds and 988,000 bbl of drill cuttings are estimated to result from drilling activities associated with the proposed action (Table IV-2). Peak-year estimates are on the order of 563,000 bbl of drilling muds and 140,000 bbl of drill cuttings (Table IV-2). Drilling muds and cuttings are routinely discharged into offshore waters and are regulated by NPDES permits. As with produced-water discharges, offshore Subareas C-3 and C-4 would receive the greatest percentage are of these potential discharges. An estimated 1.43 MMbbl of drilling muds and 344,000 bbl of cuttings could be generated in offshore Subarea C-3, whereas in offshore Subarea C-4 an estimated 1.64 MMbbl of drilling muds and 393,000 bbl of cuttings could be generated. It is assumed that 18 percent of these drilling muds (744,000 bbl) would be brought ashore for disposal. Some 69,000 bbl of produced sands are estimated to be produced in the CPA from the proposed activities. However, these will not be discharged into offshore waters, but rather brought ashore for disposal. As with produced-water discharges, because of the continuous nature of oil and gas activities in the CPA, the frequency of drilling mud and cutting discharges is judged to be nearly continuously throughout this area. From the work of the investigators cited and previous monitoring studies, it can be concluded that the proposed discharge of drilling fluids and cuttings would encounter rapid dispersion in marine waters. Discharge plumes will be diluted to background levels within a period of several hours and/or within several hundred to 1,000 m of the discharge source. The accumulation of toxic trace metals and hydrocarbons in exposed shelf waters, due to periodic releases of water-based generic muds and cuttings, is unlikely, and the long-term degradation of the water column from such discharges is not a major concern. Few effects are expected to most water uses from drilling muds and cutting discharges and then only in an area near the source.

Crude oils contain thousands of different compounds. Hydrocarbons account for up to 98 percent of the total composition. Crude oils often contain wide concentrations of trace metals consisting of nickel, vanadium, iron, sodium, calcium, copper, and uranium. Petroleum hydrocarbons introduced into marine waters may have varied effects on the local biota with impact severity depending on the resource impacted, stage of weathering, and local physical and meteorological conditions. Oil released on the surface will be rapidly dispersed by the action of winds and currents, resulting in rapid transport, whereas for a subsurface spill, some of the oil would be distributed throughout the water column. It is assumed that one subsurface oil spill greater than or equal to 1,000 bbl, one subsurface oil spill greater than 50 and less than 1,000 bbl, and approximately 21 spills greater than or equal to 1 bbl and less than or equal to 50 bbl will occur from program-related activities offshore in the CPA. In addition, 10 spills (diesel and oil-based drilling muds) are assumed to occur. The introduction of oil into offshore waters will create elevated hydrocarbon levels (up to 100+ $\mu$g/l) within affected waters. Much of the oil will be dispersed throughout the water column over several days to weeks. Little effect on offshore water use is expected, and then only on an area near the source or slick.

*Summary*

Based on a review of projected sale-related support activities, the estimate is that offshore Subarea C-1 would receive the greatest portion of pipeline burial activities, whereas offshore Subareas C-3 and C-4 would receive the largest amounts of operational discharges. Immediate effects would be brought about by increased drilling, construction, and pipelaying activities, causing an increase in water column turbidities (lasting for several hours with mud discharges, and several weeks with dredging-pipelaying activities) to the affected offshore waters. The magnitude and extent of turbidity increases would depend on the hydrographic parameters of the area, nature, and duration of the activity, and bottom-material particle size and composition. Because of the continuous nature of oil and gas activities in the CPA, the frequency of drilling mud and cutting and produced water discharges is judged to be nearly continuously throughout these areas. Proposed produced-water discharges will be rapidly diluted within the immediate vicinity of the discharge source. Significant increases in water concentrations of dissolved and particulate hydrocarbons and trace metals are not expected outside the initial mixing zone or the immediate vicinity of the discharge source. Higher concentrations of trace metals, salinity, temperature, organic compounds, and radionuclides, and lower dissolved oxygen may be present near the discharge source (200 m). Within the mixing zone of the discharge, long-term effects to water column processes, consisting of localized increases in particulate metal and soluble lower molecular weight hydrocarbon (e.g., benzene, toluene, and xylenes) concentrations, may be implicated. Trace metals and hydrocarbons associated with the discharge may be deposited within sediments near the discharge point. The proposed discharge of drilling fluids and cuttings would encounter rapid dispersion in marine waters. Discharge plumes will be diluted to background levels within a period of several hours and/or within several hundred to 1,000 meters of the discharge source. The accumulation of toxic trace metals and hydrocarbons in exposed shelf waters, due to periodic releases of water-based generic muds and cuttings, is unlikely, and the long-term degradation of the water column from such discharges is not a major concern. Few effects are anticipated to most water uses from routine activities and discharges and then only in an area near the source.

Program-related spills will introduce oil into offshore waters and create elevated hydrocarbon levels (up to 100+ $\mu$g/l) within affected waters. Much of the oil will be dispersed throughout the water column over several days to weeks. Little effect on water use is expected from these spills, and then only in an area near the source and slick.

*Conclusion*

An identifiable change to the ambient concentration of one or more water quality parameters will be evident up to several hundred to 1,000 m from the source and periods lasting up to several weeks in duration in marine and coastal waters. Chronic, low-level pollution related to the proposal will occur throughout the life of the proposed action.

*High Case Analysis*

*Coastal and Estuarine Waters*

As indicated in the Base Case, it is expected in the High Case scenario that the existing onshore infrastructure base in the Gulf is sufficient to support the proposal. Despite this, point and nonpoint source discharges (Section IV.A.3.c.) occurring from existing onshore support facilities may impact coastal and nearshore water quality. Most of the OCS support infrastructure located in the CPA exists in coastal Louisiana and it is here that surface water contamination from these facilities will likely occur. Waters near support facilities may be expected to be contaminated with oily substances and oil-field wastes from point source effluent discharges and small chronic spills. For the purpose of this analysis, chronic spills and chronic point source contamination are examined together with nonpoint source runoff. It is assumed that approximately 57 spills greater than 1 and less than 50 bbl could result in the CPA from activities associated with the proposal. Fewer than 10 of these spills, primarily in Louisiana, are assumed in association with onshore sale-related support activities. It is estimated that 75 percent of these smaller chronic spills would range from 2 to 10 bbl and occur in association with crude and product transfer operations in port areas. Lower molecular weight hydrocarbon compounds (benzene, toluene, etc.) are considered acutely toxic, but are rapidly lost through evaporation and dissolution during the first days of a spill (Wheeler, 1978). Normal weathering processes encountered by oil spilled in open waters tend to detoxify its toxic components. In shallow areas, oil may become entrained in suspended particles and bottom sediments and subsequently be reintroduced into the water column. Given these estimates and the frequent nature of spills over the life of the proposal, the effect of chronic contamination on the Gulf's coastal waters due to the proposed action is considered negligible, with water characteristics rapidly returning to background levels.

Over 30,850 service vessel trips, 178 barge trips, and 5 shuttle tanker trips are estimated to result from the proposed action in the CPA. According to historical data, the Calcasieu (C-1) and Atchafalaya Rivers (C-2), Freshwater Bayou (C-1), Vermilion Bay (C-1) and Terrebonne Bays (C-2), and the Mississippi River passes (C-3) of Louisiana are expected to receive the bulk of support vessel trips. Besides barge trips to and from platforms, some barge traffic carrying oil from terminals to other terminals or refineries is expected to occur along the Gulf Intracoastal Waterway and adjoining navigation channels.

Antifouling paints used on support vessels have been shown to have toxic effects on some marine biota. Increased loadings within coastal waters of tributyltin and copper compounds contained in antifouling paints will take place on a routine basis over the life of the proposal. Ballast and bilge waters from shuttle tankers are assumed to be discharged at onshore reception facilities and are not expected to impact coastal water quality. While inshore, service vessels are estimated to discharge an average of approximately 3,200 liters of bilge water per trip in support of sale-related activities. An estimated 98 million liters (approximately 7,600 liters/day) will be discharged into coastal waters from vessels supporting the proposed sale activities (Table IV-4). Bilge water may contain toxic petroleum products and metallic compounds leaked from machinery and could degrade coastal water quality when discharged into confined waters. Given the small concentrations expected and the continuous and widespread nature of the discharges over the life of the proposal, it is expected that there will be some localized short-term changes (up to several weeks) in water quality characteristics from background levels, depending on the length of the affected channel, flushing rates, etc.

No new navigation channels are expected to be dredged as a result of the proposal. However, maintenance dredging of major navigation channels and deepening of some channels to support service vessel traffic are expected. Dredging activities are expected to result in localized impacts (primarily elevated water column turbidities) occurring over the duration of the activity (up to several months). Such activities would preclude some recreational and commercial water uses within the immediate area of this activity. The periods for expected dredging operations will generally allow for the recovery of affected areas between such activities. Impacts are expected to be somewhat higher in the Mississippi Delta area because of higher sediment inputs. As with the Base Case, it is estimated that no new onshore pipelines will be constructed due to the proposed action. Up to 98 percent of the oil and most of the gas produced will be transported ashore via the existing onshore pipeline network (Table IV-2). Pipelines reduce the need for surface vessel transport of petroleum and the potential for transfer spills. The environmental effects associated with chronic pipeline leakage and malfunction are generally considered small (USDOC, NOAA, 1985). Given this and the small percent of usage of the existing pipeline network in support of the proposed activities, impacts from leakage and hydrologic alterations associated with pipelines are considered negligible.

As a result of the High Case, the amount of OCS produced water estimated to be transported ashore for separation, treatment, and disposal is approximately 70.8 MMbbl over the life of the proposal. On the basis of the new regulations and discussions with OCS produced water site operators, MMS expects that many of these sites will either discontinue their operations, employ reinjection methods, modify existing operations and pipe the treated waters back offshore, or discharge the treated waters into the Mississippi River (at select sites). Therefore, the onshore disposal of sale-related produced waters is not expected to impact coastal and nearshore water quality.

As discussed under the Base Case, in addition to those wastes discharged offshore, a number of wastes are brought ashore for disposal. Approximately 1.3 MMbbl of drilling muds and 154,000 bbl of produced sand from sale-related exploration and production activities would be brought ashore for disposal (Table IV-4). In addition, discarded oilfield equipment may also pose a potential environmental threat to areas surrounding storage sites, cleaning sites, scrap yards, and metal reclamation yards. Surfaces of production tubing, holding tanks, separators, heater treaters, and other like equipment may be contaminated with scale material containing NORM. The improper storage and disposal of oil-field wastes and contaminated oil-field equipment would adversely impact surface and ground waters in proximity to disposal facilities, cleaning sites, and scrap yards. Improper design and maintenance of such storage facilities would result in adverse impacts from elevated levels of radium-226 contaminating surrounding water bodies and downstream users (human and livestock consumption, agriculture, etc. (Sections IV.A.2.d.(5) and IV.A.3.c.(4) contain more detailed discussions of NORM and solid-waste disposal practices).

Under the High Case scenario, it is assumed that 1 subsurface oil spill greater than or equal to 1,000 bbl would occur from sale-related activities in the CPA. In addition, 2 oil spills greater than 50 and less than 1,000 bbl and 47 spills greater than 1 bbl and less than or equal to 50 bbl could occur from OCS pipeline, platform, and transportation sources offshore in the CPA. It is assumed that as much as 70 percent of the original volume of oil from the spill source will be lost within 10 days as a result of weathering processes and offshore cleanup. It should be noted that there could be some effects from residual weathered oil that could reach coastal waters following a spill greater than or equal to 1,000 bbl event. Impacts from low-level contamination were discussed earlier. As indicated, petroleum hydrocarbons introduced into marine and coastal waters may have varied effects depending on the resource impacted, stage of weathering, and local physical and meteorological conditions. Some crude oil components are highly toxic and may cause damage to marine organisms due to the crude's aromatic content. It is expected that normal weathering processes will degrade the oil by breaking down its toxic components. Background levels in the Gulf of Mexico were reported at 0-70 $\mu$g/l. In shallow areas, oil may become entrained in suspended particles and bottom sediments and subsequently be reintroduced into the water column. Given these estimates and the frequent nature of spills over the life of the proposal, the effect of hydrocarbon contamination on the Gulf's coastal waters due to the proposed action is considered negligible, with water characteristics rapidly returning to background levels within several days to weeks.

*Marine Waters*

Table IV-2 indicates that, under the High Case scenario, the addition of 540 exploration and delineation wells, 520 development wells, 50 platform complexes, and 400 km of pipe gathering lines are estimated for the CPA. As a result, approximately 661 MMbbl of produced waters, 7.4 MMbbl of drilling muds, 1.7 MMbbl of drill cuttings, and 1.4 MM $m^3$ of treated sanitary and domestic wastes may be expected to be generated from the proposed action.

Immediate effects would be brought about by increased drilling, construction, and pipelaying activities, causing an increase in water column turbidities (lasting for hours with mud discharges, to several weeks with dredging-pipelaying activities) to the affected offshore waters. Installation of an estimated 400 km of new pipelines offshore will result from sale-related activities. Gulfwide, pipeline construction activities may result in the resuspension of up to 360,000 $m^3$ of sediment during the life of the proposed program (Table IV-2). All burial activities will occur in water depths of 200 ft and less. Offshore Subarea C-1 will support the greatest portion of program-related pipeline burial activities (48 km) and associated sediment resuspension (240,000 $m^3$). Pipeline construction activities may result in the resuspension of settled pollutants, toxic heavy metals, and pesticides, if present. The magnitude and extent of turbidity increases would depend on the hydrographic parameters of the area, nature and duration of the activity, and bottom-material size and composition. For the purpose of this analysis, the frequency of activities resulting in resuspension of sediment is judged to be nearly continuously throughout much of the northwestern and north-central Gulf of Mexico. However, the severity of impacts would result only in some measures of water quality (primarily increased water column turbidities) changing from background levels, and then only within a distance of 1,000 m from the activity.

Aside from creating increased water column turbidity, explosive platform removal may adversely impact water quality by releasing explosive by-products into the water column upon detonation of charges to sever the legs and pilings of a structure. Twenty-four platforms associated with the proposal are assumed to be removed by explosive methods (Table IV-2). The by-products of these events may be gaseous, liquid, or solid, and may be soluble or insoluble in water. Virtually all of the products become airborne in the case of a water surface burst (for scare charges), even from relatively deep explosions. The magnitude and extent of turbidity increases would depend upon several hydrographic parameters, the duration of the activity, and bottom-material size and composition. Because most of the gases are ejected into the air during rig removal (by explosive means), the very small amounts that remain in the water column should either be dissolved or dispersed so rapidly that water quality in the area would not be seriously affected.

The discharge of 1.4 $MMm^3$ of treated sanitary and domestic wastes from the various rigs and platforms will increase levels of suspended solids (14-550 mg/l), nutrients, chlorine, and BOD near the point of discharge. The volume and concentration of such wastes will vary widely over time, occupancy, platform characteristics, and operational situation. Properly operating biological treatment systems at these facilities have effluents containing less than 150 mg/l of suspended solids. These are considered minor discharges and are quickly diluted. The impact to offshore water quality from program-related, treated sanitary and domestic waste discharges will be negligible, occurring within a few meters of the discharge source.

Up to 661 MMbbl of produced waters are estimated to result from the High Case (Table IV-2). Of this, 592 MMbbl will be discharged offshore. Offshore Subareas C-3 and C-4 will receive the greatest number of these discharges with 161 MMbbl and 269 MMbbl, respectively, over the life of the proposal. The findings of numerous investigators (e.g., Mackin, 1973; Gallaway, 1980; Bender et al., 1979; Reid, 1980) lead MMS to expect the effects of these discharges on offshore water quality to be limited to an area in proximity to the discharge source. Higher concentrations of trace metals, salinity, temperature, organic compounds, and radionuclides, and lower dissolved oxygen may be present near the discharge source. Because of the continuous nature of oil and gas activities in the northwestern and north-central Gulf of Mexico, the frequency of produced water discharges is judged to be nearly continuously throughout these areas. The assumption, based on the work of the investigators cited and historical data, is that the produced-water discharges resulting from this proposal will be rapidly diluted within the immediate vicinity of the discharge source. Significant increases in water concentrations of dissolved and particulate hydrocarbons and trace metals are not expected outside the initial mixing zone or immediate vicinity of the discharge source. Within the mixing zone of the discharge, long-term effects to water column processes, consisting of localized increases in particulate metal and soluble lower molecular weight hydrocarbons (e.g., benzene, toluene, and xylenes) concentrations, may be implicated within the mixing zone of the discharge. Trace metals and hydrocarbons associated with the discharge may be deposited within sediments near the discharge point.

Some 7.4 MMbbl of drilling muds and 1.7 MMbbl of drill cuttings are estimated to result from drilling activities associated with the proposed action (Table IV-2). Drilling muds and cuttings are routinely discharged into offshore waters and are regulated by NPDES permits. As with produced-water discharges, offshore Subareas C-3 and C-4 would receive the greatest percentage of these potential discharges. Approximately 2.5 MMbbl of drilling muds and 600,000 bbl of cuttings could be generated in offshore Subarea C-3, whereas in offshore Subarea C-4, approximately 3 MMbbl of drilling muds and 708,000 bbl of cuttings could be discharged.

It is assumed that 18 percent of the drilling muds (1.3 MMbbl) associated with sale-related activities would be brought ashore for disposal. Some 154,000 bbl of produced sands are estimated to be produced in the CPA from the proposed activities. However, these will not be discharged into offshore waters, but rather brought ashore for disposal. When discharged into the surrounding offshore waters, drilling muds may create turbidity plumes several hundred meters in length. A 1983 NRC study suggests that for routine oil and gas discharges the various components measured, including turbidity, are at background levels by a distance of 1,000 m. Ecomar Inc. (1980) indicated that, due to settling and dilution, suspended solid levels and metal concentrations decrease significantly with distance from the source. As with produced-water discharges, because of the somewhat continuous nature of oil and gas activities in the northwestern and north-central Gulf of Mexico, the frequency of drilling mud and cutting discharges is judged to be nearly continuously throughout these areas. From the work of the investigators cited and previous monitoring studies, it can be concluded that the proposed discharge of drilling fluids and cuttings would encounter rapid dispersion in marine waters. Discharge plumes will be diluted to background levels within a period of several hours and/or within several hundred to 1,000 meters of the discharge source. The accumulation of toxic trace metals and hydrocarbons in exposed shelf waters, due to periodic releases of water-based generic muds and cuttings, is unlikely, and the long-term degradation of the water column from such discharges is not a major concern. Few effects from drilling muds and cutting discharges are expected on most water uses, and then only in an area near the source.

Crude oils contain thousands of different compounds formed during initial formation. Hydrocarbons account for up to 98 percent of the total composition. Crude oils often contain wide concentrations of the trace metals nickel, vanadium, iron, sodium, calcium, copper, and uranium. Petroleum hydrocarbons introduced into marine waters may have varied effects on the local biota with impact severity depending on the resource impacted, stage of weathering, and local physical and meteorological conditions. Oil released on the surface will be rapidly dispersed by the action of winds and currents, resulting in rapid transport, whereas for a subsurface spill, some of the oil would be distributed throughout the water column. One oil spill greater than or equal to 1,000 bbl, 2 oil spills greater than 50 and less than 1,000 bbl, and approximately 57 spills greater than or equal to 1 bbl and less than or equal to 50 bbl are assumed to occur from program-related activities in the CPA. In addition, 23 spills (diesel and oil-based drilling muds) are assumed to occur. The introduction of oil into offshore waters will create elevated hydrocarbon levels (up to 100+ $\mu$g/l) within affected waters. Background levels in the Gulf have been reported at 0-70 $\mu$g/l. Much of the oil will be dispersed throughout the water column over several days to weeks. Little effect to offshore water use is expected, and then only in an area near the source or slick.

*Conclusion*

Under the High Case scenario, an identifiable change to the ambient concentration of one or more water quality parameters will be evident up to several hundred to 1,000 m from the source and periods lasting up to several weeks in duration in marine and coastal waters. Chronic, low-level pollution related to the proposal will occur throughout the life of the proposed action.

## *(4) Impacts on Air Quality*

This discussion analyzes the potential degrading effects on air quality by the activities and developments induced by the proposed sale. The following activities will potentially degrade air quality: platform emissions; drilling activities during exploration, delineation, and development; service vessel operation; evaporation of volatile hydrocarbons from surface oil slicks; and fugitive emissions during hydrocarbon venting and offloading. Sections presenting supporting materials and discussions are Sections III.A.2. and III.A.3. (descriptions of Gulf of Mexico meteorology and the coastal counties' air quality status), IV.C.1. (oil-spill assumptions), and IV.A.2.d.(6) (air emissions).

The parameters of this analysis are the emission factors, surface winds, stability of the overlaying air column, and the height of the atmospheric mixed layer.

Emissions of certain primary pollutants are known to be detrimental to health and welfare. Nitrogen oxide and nitrogen dioxide comprise $NO_x$ emissions. Nitrogen oxide is important because it can be converted into nitrogen dioxide, which can be poisonous. Nitrogen dioxide reacts with water to form nitric acid, which is harmful to vegetation and construction materials. Further, nitrogen dioxide is involved in photochemical reactions that yield ozone, which has significant effects on the atmosphere and the global climate and causes respiratory problems. Carbon monoxide (CO) is a very toxic gas that reacts with hemoglobin in the blood and blocks the transfer of oxygen to the body. Carbon monoxide constitutes and increases cardiovascular diseases, affects the central nervous system, and contributes to the global climate cycle. Sulfur oxides ($SO_x$) can combine with water and oxygen to form very corrosive and irritating acids. These sulphur compounds produce aerosols that act as nuclei for rain, which removes sulphur from the atmosphere. Further, a correlation has been found between $SO_x$ and respiratory diseases such as bronchitis. Volatile organic compounds (VOC), or hydrocarbons, are poisonous to humans at very high concentrations only, cause eye irritation, and play important roles in atmospheric photochemical cycles. Particulate matter has a trimodal distribution, and particles that are smaller than 10 microns ($PM_{10}$) are detrimental to visibility and may cause respiratory problems. The visibility reductions are caused primarily by particle scattering and by light absorption to a lesser extent. This analysis considers mainly total particulate matter (TSP).

Ozone is a secondary pollutant and "is one of the most toxic regulated pollutants under ambient air quality standards" (Godish, 1991, p. 159). It is formed by photochemical reactions involving some of the primary pollutants. Ozone is important to the global climate and causes damage to plants and agricultural crops. At concentrations of 196-784 $\mu gm^{-3}$ and exposures of 1-2 hours, it also affects lung functions. These effects are transient and include reduction of tidal volume, increased respiration rates, increased pulmonary resistance, and changed respiration mechanics (Godish, 1991). Ozone can interfere with or inhibit the immune system.

Emissions of primary pollutants will occur during exploration, development, and production activities. Typical emissions for exploratory and development drilling activities presented in Section IV.A.2.d.(6) show that emissions of $NO_x$ are between 4 and 34 times greater than emissions for other pollutants during exploratory drilling activities. These emission estimates are based on a drilling scenario of a 10,000-ft hole during development and 13,500-ft hole during exploration activities using about 597,000 hphr energy from diesel engines over a period of 45 days. Statistics of wells drilled between 1985 and 1990 show an average hole depth of 10,318 ft and a drilling period of 33 days. These values are close to those employed in calculating typical well emissions, above.

Platform emission factors for the Gulf of Mexico region (presented in Section IV.A.2.d.(6)) show $NO_x$, VOC, and CO emissions about three orders of magnitude larger than emissions of $SO_x$ and TSP. The $NO_x$, VOC, and CO emissions seem to be about 10 times greater than emissions from exploratory wells. This discrepancy, however, is a mathematical artifact because well rates are based on a 45-day period while platform rates are on a yearly basis. Emission rates during exploration are higher than emission rates during production. Emission factors for other activities such as helicopters, tankers, loading and transit operations were obtained from Jacobs Engineering Group, Inc. (1989) and USEPA (1985).

Other sources of primary pollutants are accidents, such as oil spills and blowouts, related to OCS operations. Typical emissions from OCS accidents consist of hydrocarbons; only blowouts with fires produce other primary pollutants. Most of the emission rates presented in the table below are small; even the emissions for the 10,000-bbl spill cannot be sustained for long periods. Observe that emission rates decreased approximately 50 percent by the second hour.

Once pollutants are released into the atmosphere, transport and dispersion processes start acting. Transport processes of pollutants are carried out by the net wind circulation. The mean wind circulation is discussed in Section III.A.2. During summer the wind regime in the CPA is predominantly onshore at mean speeds of 3 to 5 $ms^{-1}$. Winter wind circulation is predominantly offshore at mean speeds of 4 to 8 $ms^{-1}$.

Pollutant dispersion or mixing depends on emission height, atmospheric stability, and mixed layer height. The emission height on platforms of the Gulf of Mexico is determined by storm wave heights, storm tides, and a safety factor. For water depths between 10 and 200 m, calculated emission heights are between 31 and 35 m, well inside the mixed layer. For emissions inside the atmospheric boundary layer, the 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 CPA

(USDOI, MMS, 1988c) indicate an upward flux year-round, being highest during winter and lowest in summer. The atmospheric stability along CPA coastal areas of the Gulf of Mexico, discussed in Section III.A.2., is either neutral or stable more than 75 percent of the time. Atmospheric stability is also important because it helps to distribute and diffuse the available energy or momentum of the atmosphere.

A mechanism in part responsible for this distribution is buoyancy. It is well known that air density is inversely proportional to temperature. When the sea surface is warmer than the overlying air, the sea heats the air in contact with it. The warmer air becomes lighter, starts to rise, and is replaced by cooler air from above. The rising air acquires a vertical velocity that, when multiplied by its density, becomes a flux of vertical momentum by buoyancy or density differences. Vertical momentum flux can also occur because of mechanically generated turbulence, which is totally unrelated to density differences.

The mixing height is very important because it determines the space available for spreading the pollutants. Although mixing height information throughout the Gulf of Mexico is scarce, measurements near Panama City (Hsu, 1979) show that the mixing height can vary between 400 and 1,300 m, with a mean of 900 m. 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, and daily changes are smaller than in summer.

*Base Case Analysis*

The scenario discussed in Section IV.A. (Table IV-2) for the 35-year life of the proposed action establishes that 340 exploration and delineation wells and 250 development wells would be drilled, and 30 platform complexes would be emplaced. The sale area has been subdivided into four offshore subareas: C-1, C-2, C-3, and C-4 (Figure IV-1). The subsequent analyses are directed towards the potential degrading effects on air quality from OCS-related activities in each subarea. Table IV-2 presents the numbers of exploration, delineation, and development wells; platforms installed; and service-vessel trips for the proposed action in each subarea. The information presented below shows total emissions from wells, platforms, vessels, and other activities in the CPA during the proposed action. Observe that $NO_x$ still is the most emitted pollutant, while $SO_x$ is the least emitted. More important is that this information shows that wells and vessels contribute mostly $NO_x$, while platforms contribute mostly $NO_x$, CO, and VOC. These emissions were calculated using an integration of well and platform emissions over time. Vessel and other emissions were calculated using the information presented in Table IV-2.

Total OCS Emissions in the CPA
(tons over the 35-year life of the proposed action)

| Activity/Pollutant | $NO_x$ | CO | $SO_x$ | THC | TSP |
|---|---|---|---|---|---|
| Service Vessels | 9,095.5 | 1,065.5 | 143.7 | 462.8 | 641.7 |
| LTO Helicopters | 39.9 | 32.2 | 6.1 | 1.7 | 1.5 |
| Cruise Helicopters | 128.8 | 368.0 | 27.6 | 30.0 | 36.8 |
| Blowouts without Fire | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 |
| Spills without Fire | 0.0 | 0.0 | 0.0 | 255.07 | 0.0 |
| Barge Loading | 0.0 | 0.0 | 0.0 | 34.7 | 0.0 |
| Tanker Loading | 0.0 | 0.0 | 0.0 | 34.7 | 0.0 |
| Transit Loss | 0.0 | 0.0 | 0.0 | 90.0 | 0.0 |
| Tanker Exhaust | 4.6 | 0.5 | 5.7 | 0.0 | 1.6 |
| Tug Exhaust | 139.2 | 13.9 | 1.8 | 6.3 | 8.4 |
| Exploratory Wells | 3,287.8 | 877.2 | 384.2 | 95.2 | 329.8 |
| Development Wells | 1,611.0 | 429.8 | 189.0 | 47.2 | 162.0 |
| Platforms | 50,592.5 | 6,590.3 | 88.5 | 19,175.0 | 123.9 |
| Totals | 64,899.3 | 9,377.4 | 846.6 | 20,232.8 | 1,305.7 |

Total emissions for each subarea in the CPA during the proposed action are presented below. Observe that Subarea C-2, would generate the smallest emissions of all pollutants, while Subarea C-3 would generate the greatest amounts of emissions.

Total Emissions in CPA Subareas
(tons over 35-year life of the proposed action)

| Pollutant | C-1 | C-2 | C-3 | C-4 |
|---|---|---|---|---|
| $NO_x$ | 12,979.9 | 10,816.6 | 21,633.1 | 19,469.8 |
| CO | 1,875.5 | 1,562.9 | 3,125.8 | 2,813.2 |
| $SO_x$ | 169.3 | 141.1 | 282.2 | 254.0 |
| THC | 4,046.6 | 3,372.1 | 6,744.3 | 6,069.8 |
| TSP | 261.1 | 217.6 | 435.2 | 391.7 |

The total pollutant emissions per year are not uniform. During the early years of the proposed action, emissions would be small but increase over time with production. After reaching a maximum, emissions would decrease rapidly to zero as all platforms and wells are removed and service vessels trips and other associated activities are no longer needed.

The peak emissions in tons per year for the primary pollutants during the proposed action are indicated below. It is very important to note that well drilling activities and platform peak emissions are not necessarily simultaneous. However, it is assumed for this analysis that service vessel and other emissions and the well and platform peak emissions occur simultaneously. In this analysis the aggregate peak emissions, which are two to five times the mean emissions, will be employed. Use of the peak emission will provide the most conservative estimates of impact levels to onshore air quality.

Peak and Mean Emissions in the CPA
(tons/year)

| Pollutant | Wells | Platforms | Vessels | Others | Mean | Aggregate |
|---|---|---|---|---|---|---|
| $NO_x$ | 716.24 | 2,572.50 | 268.80 | 0.00 | 1,854.27 | 2,877.10 |
| CO | 191.09 | 335.10 | 42.29 | 0.00 | 267.93 | 386.89 |
| $SO_x$ | 83.76 | 4.50 | 5.28 | 0.00 | 24.19 | 81.58 |
| THC | 20.79 | 975.00 | 14.31 | 15.78 | 582.02 | 1,006.09 |
| TSP | 71.88 | 6.30 | 19.71 | 0.00 | 37.31 | 85.61 |

The mean emissions were computed by dividing the total emissions by the 35-year life of the proposed action. Peak emissions from wells and platforms are obtained from their temporal distribution. Observe that platforms and wells have the greatest peak emissions, while vessels have smaller emissions. The column headed by "Others" includes emissions from accidents, helicopters, tankering, and barging operations and represents average emissions per year. The peak emissions are contrary to the emission rates, where wells have greater rates than platforms.

To estimate the potential impact of offshore emissions on offshore and onshore air quality, a steady state box model (Lyons and Scott, 1990) was employed. The model is an expression of mass conservation and assumes that pollutants are vertically dispersed and sources uniformly distributed. For the purpose of these air quality analyses, an assumption of uniform distribution of average size sources throughout the planning areas at this early stage is a reasonable approach. Predominance of unstable atmospheric conditions over the sea, as discussed in Section III.A.2., ensures that pollutants are dispersed homogeneously. The model was applied to $NO_x$ emissions because these are the largest emissions. Because VOC emissions are not inert, the box model cannot be used to assess their impacts on air quality. Concentrations for other pollutants can be estimated by multiplying the $NO_x$ concentrations by the ratio of the pollutant emissions over the $NO_x$ emissions. These concentrations are $[CO]=0.134[NO_x]$; $[SO_x]=0.028[NO_x]$; and $[TSP]=0.346[NO_x]$. Notice that concentrations of primary pollutants other than $NO_x$ would be smaller by more than 65 percent. Impacts from VOC and CO will be estimated by comparing the offshore and onshore emission rates.

The box model was applied to the following conditions: onshore and offshore winds with speeds ranging from 1 to 7 $ms^{-1}$, a mean mixing height of 900 m, and a low mixing height of 300 m. During offshore wind conditions, impacts to the onshore air quality from offshore CPA emissions are very low because the pollutants are transported offshore. Concentrations over water in the different subareas started at 0.05 $\mu gm^{-3}$ near the coastline and increased to 0.20 $\mu gm^{-3}$ over Subarea C-4, for a wind speed of 1 $ms^{-1}$ and a mixing height of 900 m. The greater the wind speed, the lower the concentration, and the smaller the mixing height, the larger the concentration. But even during the lowest wind speed and mixing height conditions, concentrations reached only 0.61 $\mu$gm-3. Conditions of onshore winds indicate that concentrations reaching land from Subarea C-3 varied between 0.22 and 0.03 $\mu gm^{-3}$ for speeds from 1 to 7 $ms^{-1}$ and a mixing height of 900 m; for a 300-m mixing height, concentrations varied from 0.65 to 0.09 $\mu gm^{-3}$ under the same wind speeds. For Subarea C-1 the concentrations varied from 0.14 to 0.01 $\mu gm^{-3}$ with a 900-m mixing height across the entire wind speed range; concentrations varied from to 0.41 to 0.03 $\mu gm^{-3}$ with a 300-m mixing height across the entire wind speed range.

Concentrations for pollutants other than VOC would be smaller, as indicated above. The MMS regulations (30 CFR 250.44) do not establish annual significance levels for CO and VOC. For these pollutants, a comparison of emission rates will be used to assess impacts. Formulas to compute the emission rates in tons/yr for CO are $3{,}400 \cdot D^{2/3}$ and $33.3 \cdot D$ for VOC. In these formulas, D represents distance in statute miles from the shoreline to the source. The CO exempt emission level in Subarea C-1 is 7,072.8 tons/yr, which is greater than peak emissions from the whole CPA. The exemption emission level of VOC in Subarea C-1 is 100 tons/yr, while the platform emissions level is estimated as 48.8 tons/yr. Therefore, VOC impacts to the air quality would be low. Transport of pollutants toward onshore areas has a frequency maximum of 61 percent during summer and only 37 percent during winter. Thus, the box model results represent a worst case scenario. The modeling effort does not consider removal processes such as rain, which in the CPA has a high frequency (Section III.A.2.) and would reduce concentration levels reaching onshore.

Further, using an approved numerical model, the Offshore and Coastal Dispersion (OCD) Model (USDOI, MMS, 1986a), MMS studied the impacts of offshore emissions. Eight offshore areas in the OCS near Grand Isle, Louisiana, containing from 19 to 85 production complexes and 19 to 195 point sources, were used in the study. Source distance from the coastline ranged from 5.6 to 45 km (3.5 to 28 mi). The study employed a 300-m mixing height, which coincides with the lower mixing height employed in the box model. Because the last model run in the study represents an aggregation of all sources and covers the entire distance range, this discussion emphasizes those results.

The highest 1-hour concentration observed was 71.89 $\mu gm^{-3}$, while the annual arithmetic mean varied between 0.82 and 1.83 $\mu gm^{-3}$, which is below the $NO_2$ national standard of 100 $\mu gm^{-3}$. All other inert pollutants would have lower concentrations. This modeling effort represents the combined effect of 85 production complexes close to onshore areas. Therefore, it is reasonable to assume that concentrations derived from emissions associated with the proposed action, 30 platform complexes (35% of that used in the model), spread over 193.4 billion square meters would have a much smaller effect.

Oil-spill effects on air quality are examined below. It is assumed that oil spills in the category greater than 1 and less than or equal to 50 bbl, as well as greater than 50 and less than 1,000 bbl, would have low impacts on air quality because their input of pollutants (it is assumed that 30% of the spill evaporates in three days) would be very small. Information from OCS accidents indicates emissions of fewer than 100 tons/hour by the second hour. For spills greater than or equal to 1,000 bbl, emissions are about 285 tons/hour or smaller. A single spill of 6,500 bbl is assumed. If the dispersion of emissions is taken into account, effects on offshore air quality would be temporary. Impacts to onshore areas from these spills would be very low because of the dispersion process, the limited input of pollutants to the atmosphere, and the transport regime present in the CPA. Nearly 1 percent of OCS crude-oil production is offloaded from surface vessels at ports. The estimated VOC emissions from offloading in the Base Case are 69.4 tons over the 35-year life of the proposed action. These emissions represent about 0.34 percent when compared to the total VOC emissions from the Base Case.

Safeguards to ensure minimum emissions from the offloading and loading operations have been adopted by the State of Louisiana (The Marine Vapor Recovery Act, 1989: LAC: III.2108). Emissions from service vessels are expected to produce negligible effects on air quality.

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 used in this analysis represents the equivalent diameter, which is the diameter of a sphere that will 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 $\mu$m and a third peak with diameters larger than 2 $\mu$m. Particles with diameters of 2 $\mu$m or larger settle very close to the source (residence time of approximately ½ day, Lyons and Scott, 1990), so their impact on these areas would be low. For particles smaller than 2 $\mu$m, which do not settle fast, wind transport determines their impacts. Results from the box model indicate that the largest concentration for TSP will be 0.22 $\mu gm^{-3}$, which is less than the allowable annual increase level of 5 $\mu gm^{-3}$.

Blowouts are accidents related to OCS activities and are defined as an uncontrolled flow of fluids from a wellhead or wellbore. In the Gulf of Mexico OCS there have been 116 blowouts over a period of 19 years (1971-1981) (Section IV.A.2.d.(8)). This represents an average of about 6 blowouts per year, but the number of wells drilled is a better indicator. The number of blowouts estimated, at a rate of 7 blowouts per 1,000 wells drilled, is 4 blowouts during the proposed action in the CPA. The air pollutant emissions from blowouts depend on the amount of oil and gas released, duration of the accident, and the occurrence or not of fire during the blowout.

Because of technological advances the duration of blowouts has decreased, and about 61 percent of recent blowouts last 1 day or less, 19 percent last between 2 and 3 days, 7 percent last between 4 and 7 days, and 13 percent last more than 7 days (Fleury, 1983). Further, most blowouts occurred without fire (MMS Database). The amount of oil released during these accidents has been small. Using the distribution of blowouts cited earlier, three blowouts will last 1 day and one blowout will last 2.5 days. No statistics exist on the amount of gas released during a blowout; however, for this analysis a rate of 1 billion cubic feet (Bcf) per day will be assumed. The total emission of THC is 138 tons over the 35-year life of the proposed action. It must be remembered that these are conservative estimates and that the total amount of THC may be less; the VOC will also be less since it is a fraction of the THC.

Ozone is of great concern because of its environmental considerations. In the CPA six parishes have nonattainment status for this pollutant (Section III.A.3.). Ozone measurements (La. Dept. of Environmental Quality, 1989) between 1989 and 1990 were examined from Morgan City in St. Martin Parish, Thibodaux in Lafourche Parish, and Westlake in Calcasieu Parish. These measurements show that in Morgan City and Thibodaux the ozone concentration never exceeded the national standard. Concentrations at these stations were between 15 and 25 $\mu gm^{-3}$ below the national standard (235 $\mu gm^{-3}$) during episodes of highest ozone concentrations. At other times concentrations were 45 to 50 units below the national standard. At Westlake in Calcasieu Parish, which is north of Cameron Parish, the ozone concentrations exceeded the national standards at least twice during 1989 and once during the first eight months of 1990. Another area with ozone problems is Baton Rouge. Recent air modeling there (Haney et al., 1990) indicates that ozone concentrations peak near 1600-1700 hours. The modeling effort, which included anthropogenic and biogenic sources, showed that some events could result from atmospheric overturning. During overturning episodes, ozone from previous days is mixed downward and, coupled with local and imported inputs of ozone, causes the concentrations to exceed the national standards. Recently, MMS awarded one study to do a preliminary ozone modeling exercise with USEPA using the Regional Oxident Model (ROM) for episodes with onshore transport. A second study is near award for a 3-year study of ozone formation and transport from OCS activities in the Gulf of Mexico.

A recent report from the Lake Charles Ozone Task Force shows that out of 12 ozone exceedances in Calcasieu Parish, 3 cases show significant ozone contributions by transport from Texas. Another 3 cases with demonstrable transport ozone input occur, but the source areas are to the south or northwest. The report cites the Lake Charles industrial area to the south and the Beaumont and Orange, Texas, areas as the possible source areas in these cases. There were 5 other cases that showed local sources as the cause for the ozone exceedance episode. One episode cannot be studied with the methods employed by the Task Force for this analysis. Thus, there are 3 out of 12 cases where the ozone transport is correlated with southerly winds and that can point to some inputs from OCS offshore sources. However, the report never indicates this as a possibility or even speculates about the OCS role. Ozone measurements made between 1989 and 1990 in Alabama show only one ozone exceedance episode near the Chickasaw station. Another station located on Highway 43 shows no episodes of ozone exceedance over the same period. Both stations showed that ozone is seasonal with a maximum during August and a decrease during the fall and winter, when ozone levels are about 50 percent below the national standard of 235 $\mu gm^{-3}$.

*Summary*

Emissions of pollutants into the atmosphere from the activities associated with the proposed action are likely to have a low impact on offshore air quality because of the prevailing atmospheric conditions, emission heights, and pollutant concentrations. Onshore impact on air quality from emissions from OCS activities is estimated to be negligible because of the atmospheric regime, the emission rates, and the distance of these emissions from the coastline. The above discussion is based on average conditions; however, there will be days of low mixing heights and wind speeds that could increase impact levels. These conditions are characterized by fog formation, which in the Gulf occurs about 35 days a year, mostly during winter. Impact from these conditions is reduced in winter because the onshore winds have the smallest frequency (37%) and rain removal is greatest. Summer is the worst time, with onshore winds having a frequency of 61 percent.

*Conclusion*

Emissions of pollutants into the atmosphere are expected to have concentrations that would not change the onshore air quality classifications. Increases in onshore concentrations of air pollutants are estimated to be about 1 $\mu gm^{-3}$ (box model steady concentrations). This concentration will have minimal impacts during winter because onshore winds occur only about 37 percent of the time and maximum impacts in summer, when onshore winds occur 61 percent of the time.

*High Case Analysis*

The scenario discussed in Section IV.A. (Table IV-2) for the High Case establishes that 540 exploration and delineation wells and 520 development wells would be drilled, and 50 platform complexes would be emplaced. The sale area has been subdivided into four offshore subareas: C-1, C-2, C-3, and C-4 (Figure IV-1). This discussion analyzes the potential degrading effects on air quality of OCS-related activities in each subarea. Table IV-2 presents for the High Case the numbers of exploration, delineation, and development wells; platforms installed; and service vessel trips for each subarea.

The following table shows total emissions from wells, platforms, vessels, and other activities in the CPA for the High Case. Observe that $NO_x$ is the most emitted pollutant, while $SO_x$ is the least emitted. More important is that this information shows that wells and vessels contribute mostly $NO_x$; while platforms contribute mostly $NO_x$, CO, and VOC. These emissions were calculated using an integration of well and platform emissions over time. Vessel emissions were calculated using the total number of service vessel trips presented in Table IV-2. Other emissions were calculated using information presented in Table IV-2 also.

Total OCS Emissions in the CPA
(tons over 35-year life of the proposed action--High Case)

| Activity | $NO_x$ | CO | $SO_x$ | THC | TSP |
|---|---|---|---|---|---|
| Service Vessels | 15,917.1 | 1,864.7 | 251.5 | 810.0 | 1,122.9 |
| LTO Helicopters | 67.1 | 54.2 | 10.3 | 2.8 | 2.6 |
| Cruise Helicopters | 216.6 | 619.0 | 46.4 | 50.5 | 61.9 |
| Blowouts without Fire | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 |
| Spills without Fire | 0.0 | 0.0 | 0.0 | 255.0 | 0.0 |
| Barge Loading | 0.0 | 0.0 | 0.0 | 76.8 | 0.0 |
| Tanker Loading | 0.0 | 0.0 | 0.0 | 76.8 | 0.0 |
| Transit Loss | 0.0 | 0.0 | 0.0 | 199.2 | 0.0 |
| Tanker Exhaust | 11.4 | 1.2 | 14.2 | 0.0 | 4.1 |
| Tug Exhaust | 321.7 | 32.1 | 4.2 | 14.5 | 19.3 |
| Exploratory Wells | 5,221.8 | 1,393.2 | 610.2 | 151.2 | 523.8 |
| Development Wells | 3,436.0 | 916.8 | 403.2 | 100.8 | 345.6 |
| Platforms | 84,463.8 | 11,002.4 | 147.8 | 32,012.5 | 206.9 |
| Total | 109,656.3 | 15,883.6 | 1,487.8 | 33,750.6 | 2,287.1 |

Total emissions for each subarea in the CPA during the High Case are presented below. Observe that Subarea C-1, which is the closest to land, generates the smallest emissions of all pollutants, while Subarea C-4, the farthest from land, generates the greatest amounts of emissions.

Total Emissions in CPA Subareas
(tons over the 35-year Life of the proposed action--High Case)

| Pollutant | C-1 | C-2 | C-3 | C-4 |
|---|---|---|---|---|
| $NO_x$ | 13,158.8 | 19,738.1 | 39,476.3 | 37,283.1 |
| CO | 1,906.0 | 2,859.0 | 5,718.1 | 5,400.4 |
| $SO_x$ | 178.5 | 267.8 | 535.6 | 505.9 |
| THC | 4,050.1 | 6,075.1 | 12,150.7 | 11,475.2 |
| TSP | 274.5 | 411.7 | 823.4 | 777.6 |

The total pollutant emissions per year are not uniform. During the early years of the proposed action, emissions would be small and increase over time with production. After reaching a maximum, emissions would decrease rapidly to zero as all platforms and wells are removed and service vessel trips and other related activities are no longer needed.

The following table presents the peak emissions in tons per year for the primary pollutants during the High Case. It is very important to note that well drilling activities and platform peak emissions are not necessarily simultaneous. However, it is assumed that service vessel emissions and well and platform peak emissions occur simultaneously. In this analysis the aggregate peak emissions, which are two to five times the mean emissions, will be employed.

Peak and Mean Emissions in the CPA
(tons/year)

| Pollutant | Wells | Platforms | Vessels | Others | Mean | Aggregate |
|---|---|---|---|---|---|---|
| $NO_x$ | 1,070.78 | 4,287.50 | 472.40 | 0.00 | 3,133.04 | 4,903.10 |
| CO | 285.68 | 558.50 | 73.46 | 0.00 | 453.82 | 670.16 |
| $SO_x$ | 125.76 | 7.50 | 9.33 | 0.00 | 42.51 | 127.23 |
| THC | 31.08 | 1,625.00 | 25.08 | 25.08 | 972.00 | 1,679.36 |
| TSP | 107.46 | 10.50 | 34.59 | 0.00 | 65.35 | 136.29 |

The mean emissions were computed by dividing the total emissions by the 35-year life of the proposed action. Peak emissions from wells and platforms are obtained from their temporal distribution. Platforms and wells have the greatest peak emissions, while vessels have smaller emissions. The other activities have very small emissions except for THC. The peak emission rates are contrary to the emission rates, where wells have greater rates than platforms.

The effects of the pollutants considered in this analysis were described in the Base Case analysis and will not be repeated here. The reader may consult that section.

Because the meteorological conditions described in the Base Case will not change for this analysis, neither will they be repeated. The only changes that occur in the High Case are those related to infrastructures and resources. These changes are reflected in an increase of emissions for all analyzed pollutants. A comparison of High Case emissions per year with those of the Base Case shows that these would increase by 1.5 to 2 times.

To estimate the potential impact of offshore emissions on offshore and onshore air quality, a steady state box model (Lyons and Scott, 1990) was employed. The model is an expression of mass conservation and assumes that pollutants are vertically dispersed and sources uniformly distributed. Lack of knowledge about the final source positions allows the distribution of sources uniformly throughout the planning area. Predominance of unstable atmospheric conditions over the sea, as discussed in Section III.A.2., ensures that pollutants are dispersed homogeneously. The model was applied to $NO_x$ emissions because these are the largest emissions. Because VOC emissions are not inert, the box model cannot be used to assess their impacts on air quality. Concentrations for other pollutants can be estimated by multiplying the $NO_x$ concentrations by the ratio of the pollutant emissions over the $NO_x$ emissions. Concentrations of primary pollutants other than $NO_x$ would be smaller by more than 65 percent. Impacts from VOC and CO will be estimated by comparing the offshore and onshore emission rates.

The box model was applied to the following conditions: onshore and offshore winds with speeds ranging from 1 to 7 $ms^{-1}$, a mean mixing height of 900 m, and a low mixing height of 300 m. During offshore wind conditions, impacts to the onshore air quality from offshore CPA emissions are very low because the pollutants are transported offshore. Concentrations over water in the different subareas started at 0.03 $\mu gm^{-3}$ near the coastline and increased to 0.36 $\mu gm^{-3}$ over Subarea C-4 for a wind speed of 1 $ms^{-1}$ and a mixing height of 900 m. The greater the wind speed, the lower the concentration, and the smaller the mixing height, the larger the concentration. But even during the lowest wind speed and mixing height conditions, concentrations reached only 1.07 $\mu gm^{-3}$. Conditions of onshore winds indicate that concentrations reaching land from Subarea C-3 varied between 0.40 and 0.04 $\mu gm^{-3}$ for speeds from 1 to 7 $ms^{-1}$ and a mixing height of 900-m; for a 300-m mixing height, concentrations varied from 1.12 to 0.21 $\mu gm^{-3}$ under the same wind speeds. For Subarea C-1 the concentrations varied from 0.23 to 0.01 $\mu gm^{-3}$ with a 900-m mixing height across the entire wind speed range; concentrations varied from 0.04 to 0.70 $\mu gm^{-3}$ with a 300-m mixing height across the entire wind speed range.

Concentrations for pollutants other than VOC would be smaller, as indicated above. Impacts to air quality for $NO_x$, $SO_x$, and TSP are low because the concentrations arriving onshore are less than USDOI significance levels for these pollutants. The MMS regulations (30 CFR 250.44) do not establish annual significance levels for CO and VOC. For these pollutants, comparison of emission rates will be used to assess impacts. Formulas to compute the emission rates in tons/yr for CO are $3{,}400 \cdot D^{2/3}$ and $33.3 \cdot D$ for VOC. In these formulas, D represents distance in statute miles from the shoreline to the source. The CO exempt emission level in Subarea

C-1 is 7,072.8 tons/yr, which is greater than peak emissions from the whole CPA. The exemption emission level of VOC in Subarea C-1 is 100 tons/yr, while the platform emissions level is estimated at 32.5 tons/yr. Transport of pollutants toward onshore areas has a frequency maximum of 61 percent during summer and only 37 percent during winter. Thus, the box model results represent a worst case scenario. The modeling effort does not consider removal processes such as rain, which in the CPA has a high frequency (Section III.A.2.) and would reduce concentration levels reaching onshore.

Further, using an approved numerical model, the OCD Model (USDOI, MMS, 1986a), MMS studied the impacts of offshore emissions. Eight offshore areas near Grand Isle, Louisiana, containing from 19 to 85 production complexes and 19 to 195 point sources, were used in the study. Source distance from the coastline ranged from 5.6 to 45 km (3.5 to 28 mi). The study employed a 300-m mixing height, which coincides with the lower mixing height employed in the box model. Because the last model run in the study represents an aggregation of all sources and covers the entire distance range, this discussion emphasizes those results.

The highest 1-hour concentration observed was 71.89 $\mu gm^{-3}$, while the annual arithmetic mean varied between 0.82 and 1.83 $\mu gm^{-3}$, which is below the national standard of 100 $\mu gm^{-3}$. All other inert pollutants will have lower concentrations. This modeling effort represents the combined effect of 85 production complexes close to onshore areas. Therefore, it is reasonable to assume that concentrations derived from emissions associated with the proposed action, 60 platforms (71% of that used in the model), spread over 193.4 billion square meters would have a much smaller effect.

Oil-spill effects on air quality are examined below. It is assumed that oil spills in the category greater than 1 and less than or equal to 50 bbl, as well as greater than 50 and less than 1,000 bbl, would have low impacts on air quality because their input of pollutants (it is assumed that 30% of the spill evaporates in three days) would be very small. Information from OCS accidents indicates emissions of fewer than 100 tons/hour by the second hour. For spills greater than or equal to 1,000 bbl, emissions are about 285 tons/hour or smaller. A single spill of 6,500 bbl is assumed. Under the High Case, it is estimated that about 255 tons of THC would be emitted in a 2-hour period sometime during the 35-year life of the proposed action. If the dispersion of emissions is taken into account, effects on offshore air quality would be temporary.

Nearly 1 percent of OCS crude-oil production is offloaded from surface vessels at ports. The estimated VOC emissions from offloading in the High Case are 153.6 tons over the 35-year life of the proposed action. These emissions represent about 0.45 percent when compared to the total VOC emissions from the High Case. Safeguards to ensure minimum emissions from the offloading and loading operations have been adopted by the State of Louisiana (The Marine Vapor Recovery Act, 1989: LAC: III.2108). Current industry practice is to extend pipelines to new production facilities when feasible; barging, then, would be needed only during the construction phase. Emissions from service vessels are expected to produce negligible effects on air quality.

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 used in this analysis represents the equivalent diameter, which is the diameter of a sphere that will 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 $\mu m$ and a third peak with a diameter larger than 2 $\mu m$. Particles with diameters of 2 $\mu m$ or larger settle very close to the source (residence time of approximately ½ day, Lyons and Scott, 1990), so their impact on these areas would be low. For particles smaller than 2 $\mu m$, which do not settle fast, wind transport determines their impacts. Results from the box model indicate that the largest concentration for TSP will be 0.25 $\mu gm^{-3}$, which is less than the allowable annual increase level of 5 $\mu gm^{-3}$.

Blowouts are accidents related to OCS activities and are defined as an uncontrolled flow of fluids from a wellhead or wellbore. In the Gulf of Mexico OCS there have been 116 blowouts over a period of 19 years (1971-1981) (Section IV.A.2.d.(8)). This represents an average of about 6 blowouts per year, but the number of wells drilled is a better indicator. The estimated number of blowouts, at a rate of 7 blowouts per 1,000 wells drilled, is 8 blowouts during the High Case in the CPA. 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.

Because of technological advances, the duration of blowouts has decreased, and about 61 percent of the recent blowouts last 1 day or less, 19 percent last between 2 and 3 days, 7 percent last between 4 and 7 days, and 13 percent last more than 7 days (Fleury, 1983). Further, most blowouts occurred without fire (MMS Database). The amount of oil released during these accidents has been small. Using the distribution of blowouts cited earlier, five blowouts will last 1 day, two blowouts will last 2.5 days, and one blowout will last 5.5 days. The total emission of THC is 270 tons over the 35-year life of the proposed action. It must be remembered that these are conservative estimates and that the total amount of THC may be less; the VOC will also be less because it is a fraction of the THC.

Ozone is of great concern because of its environmental considerations. In the CPA six parishes have nonattainment status for this pollutant (Section III.B.3.). Ozone measurements (La. Dept. of Environmental Quality, 1989) between 1989 and 1990 were examined from Morgan City in St. Mary Parish, Thibodaux in Lafourche Parish, and Westlake in Calcasieu Parish. These measurements show that in Morgan City and Thibodaux the ozone concentration never exceeded the national standard. Concentrations were between 15 and 25 $\mu gm^{-3}$, below the national standard during episodes of highest ozone concentrations. At other times concentrations were 45 to 50 units below the national standard. At Westlake in Calcasieu Parish, which is north of Cameron Parish, the ozone concentrations exceeded the national standards at least twice during 1989 and once during the first eight months of 1990. Another area with ozone problems is Baton Rouge. Recent air modeling there (Haney et al., 1990) indicates that ozone concentrations peak near 1600-1700 hours. The modeling effort, which included anthropogenic and biogenic sources, showed that some events could result from atmospheric overturning. During overturning episodes, ozone from previous days is mixed downward and, coupled with local and imported input of ozone, causes the concentrations to exceed the national standards.

A recent report from the Lake Charles Ozone Task Force shows that out of 12 ozone exceedances in Calcasieu Parish, 3 cases show significant ozone contributions by transport from Texas. Another 3 cases with demonstrable transport ozone input occur, but the source areas are to the south or northwest. The report cites the Lake Charles industrial area to the south and the Beaumont and Orange, Texas, areas as the possible source areas in these cases. There were 5 other cases that showed local sources as the cause for the ozone exceedance episode. One episode cannot be studied with the methods employed by the Task Force for this analysis. Thus, there are 3 out of 12 cases where the ozone transport is correlated with southerly winds and that can point to some inputs from OCS offshore sources. However, the report never indicates this as a possibility or even speculates about the OCS role. Ozone measurements made between 1989 and 1990 in Alabama show only one ozone exceedance episode near the Chickasaw station. Another station located on Highway 43 shows no episodes of ozone exceedance over the same period. Both stations showed that ozone is seasonal with a maximum during August and a decrease during the fall and winter, when ozone levels are about 50 percent below the national standard of 235 $\mu gm^{-3}$.

*Conclusion*

Emissions of pollutants into the atmosphere from the activities assumed for the High Case are expected to have concentrations that would not change onshore air quality classifications. Increases in onshore concentrations of air pollutants from the High Case are estimated to be about 1 $\mu m^3$ (box model steady concentrations). This concentration will have minimal impact during winter because onshore winds occur only 37 percent of the time and a maximum impact in summer, when onshore winds occur 61 percent.

## *(5) Impacts on Coastal and Marine Mammals*

## *(a) Marine Mammals*

*Nonendangered and Nonthreatened Species*

This section discusses the effects of the proposed action on nonendangered marine mammals. Twenty-eight nonendangered species of marine mammals of the Order Cetacea, which includes whales and dolphins, have been identified in the Gulf of Mexico (Table III-1). By an order of magnitude, the bottlenose dolphin is the most common cetacean in this area. Its distribution and movement suggest that there are several distinctive populations in the Gulf.

The major impact-producing factors related to the proposed action that may affect Gulf nonendangered cetaceans include operational discharges, helicopter and service-vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills and oil-spill response activities. These impact-producing factors are discussed in detail by the National Research Council (1985), Boesch and Rabalais (1987), Geraci and St. Aubin (1988), USDOI, MMS (1982a and 1987d), and API (1989), and are described below.

Produced waters, drilling muds, and drill cutting discharges can potentially impact cetaceans by displacing or reducing their food sources. Offshore operational discharges are not lethal to cetaceans and are diluted and dispersed rapidly to the extent that adverse effects to cetacean food sources do not occur (API, 1989; NRC, 1983). The suspended particulate matter in the discharge plume could temporarily inhibit the ability of a cetacean to locate its prey visually or acoustically.

Noise from helicopter and service-vessel traffic may elicit a startle reaction from cetaceans or mask their sound reception. This effect is sublethal and at worst of a short-term, temporary nature (Gales, 1982). Dolphins are known to actively seek out and accompany service vessels for some distance with no adverse effects. Service vessels could collide with and directly impact cetaceans, but due to dolphin maneuverability and echo-location, encounters of this type seldom occur (Slijper, 1979; Kraus, personal comm., 1987).

Exploration, delineation, and production structures produce sounds at intensities and frequencies that can be heard by cetaceans. The decibel levels of these sounds dissipate to the tolerance of most cetaceans within 15 m of the sound source. Odontocetes (toothed cetaceans) communicate and echo-locate at frequencies higher than the dominant sounds generated by offshore drilling and production activities. For example, bottlenose dolphins are sensitive to sound levels in the 143-180 db range; this high range is unlikely to be generated by offshore drilling operations (Gales, 1982).

Explosive platform removals can interfere with communications, disturb behavior, reduce hearing sensitivity or cause hemorrhaging in cetaceans (USDOI, MMS, 1990c). The effects are primarily sublethal and short-term; however, cetaceans proximate to detonation would likely sustain fatal injuries. Mortalities and fatal injuries have been speculated, but none has been documented. In order to minimize the likelihood of removals occurring when cetaceans may be nearby, MMS has issued guidelines for explosive platform removal to offshore operators. These guidelines include daylight detonation only, staggered charges, placement of charges 5 m below the seafloor, and pre- and post-detonation surveys of surrounding waters.

The sources of acoustical pulse used in seismic surveys are generated by airguns. Should seismic-generated sound waves exceed the ambient "background" noise they may interfere with cetacean communication or disturb behavior. Although ambient sound levels in marine environments are highly variable, effects from seismic surveys are limited because seismic sound pressure dissipates to under 200 dB at distances beyond 30 m from the acoustic source (Gales, 1982). Of course, cetaceans in proximity to the source of acoustic transmission could be disturbed by noise. However, the pressure encountered by cetaceans during dives and from natural underwater sounds are often in excess of those produced by seismic activities at the acoustic source. In addition, cetacean populations are highly dispersed, and individual cetaceans easily avoid acoustic interference. The effects on cetaceans from seismic surveys are primarily sublethal and mostly constitute short-term avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans, causing skin and eye irritation, asphyxiation from inhalation of toxic fumes, food reduction or contamination, oil ingestion, and displacement from preferred habitats or migration routes (Goodale et al., 1981; Gruber, 1981; Geraci and St. Aubin, 1988). When an oil spill occurs, many factors interact to delimit the severity of effects and the extent of damage to cetaceans. Determining factors include geographic location, oil type, oil dosage, impact area, oceanographic conditions, meteorological conditions, and season (NRC, 1985; USDOI, MMS, 1987b). Cetaceans themselves may actively avoid an oil spill, thereby limiting the effects and lessening the extent of damage to their populations. Less severe, sublethal effects are defined as those that impair the ability of an organism to function effectively without causing direct mortality (NRC, 1985).

Geraci and St. Aubin (1988) noted that determining the risk to cetaceans from an interaction with oil was extremely difficult because of the host of variables involved in the interaction. Generally, species with large ranges and mobility that feed in the water column versus at the surface or on the bottom are less vulnerable to oil. This suggests that Mysticetes (baleen whales) are the most vulnerable, followed by bottlenose dolphins and wide-ranging odontocetes. Although the coastal habitats of the bottlenose dolphin are more likely to be oiled than offshore areas, Geraci and St. Aubin (1982) suggest that dolphins are able to detect and avoid oil. Skin and eye irritation and respiratory disorders caused by contacting oil are sublethal and of a temporary nature (Geraci and St. Aubin, 1988). Death or debilitating illness caused by oil ingestion or by consumption of contaminated food requires large volumes and long-term chronic interactions. Long-term interactions, which could shorten life expectancy or reduce fecundity, have not been studied.

*Base Case Analysis*

The major impact-producing factors analyzed below are related to the proposed action and include operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills, and oil-spill response activities.

An estimated 4,113 bbl of drilling muds, 988 bbl of drill cuttings, and 317 MMbbl of produced waters are assumed to be generated offshore as a result of the proposed action (Table IV-2). These effluents are routinely discharged into offshore marine waters and are regulated by the U.S. Environmental Protection Agency's NPDES permits. It is expected that nonendangered cetaceans will have some interaction with these discharges. Direct effects to cetaceans are expected to be sublethal, and effects to cetacean food sources are not expected due to the rapid offshore dilution and dispersion of operational discharges. It is expected that operational discharges will seldom contact and affect nonendangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis, averaging about 18,000 trips per year. The FAA Advisory Circular 91-36C encourages the use of fixed-wing aircraft above an elevation of 152 m and helicopters above 300 m. It is expected that at these elevations no cetaceans will be affected by OCS helicopter traffic. It is also expected that helicopter traffic will seldom disturb and affect nonendangered cetaceans because of special prohibitions and adherence to the general, FAA-recommended minimum ceiling of 300 m.

It is assumed that about 500 OCS-related oil/gas service-vessel trips will occur annually and that 2 shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-2). Noise from service-vessel traffic may elicit a startle reaction from cetaceans or mask their sound reception. This effect is sublethal and, at worst, of a short-term temporary nature. Cetaceans can avoid service vessels, and operators can avoid cetaceans. It is expected that service-vessel traffic will seldom contact and affect nonendangered cetaceans.

It is assumed that 340 exploration and delineation wells and 250 development wells will be drilled and will produce sounds at intensities and frequencies that could be heard by cetaceans. It is expected that noise from drilling activities will last no longer than two months at each location. However, the decibel level of these sounds dissipates to the tolerance of most cetaceans within 15 m of the source. Odontocetes communicate at higher frequencies than the dominant sounds generated by drilling platforms. Sound levels in this range are not likely to be generated by drilling operations (Gales, 1982). The effects on cetaceans from platform noise are expected to be sublethal. It is expected that drilling noise will seldom disturb and affect nonendangered cetaceans.

Explosive platform removals can interfere with communication, disturb behavior, reduce hearing sensitivity, or cause hemorrhaging in cetaceans. It is estimated that 20 structures will be removed by explosives from the Gulf of Mexico as a result of the proposed action. These removals are assumed to occur during the last 12 years of the life of the proposed action and no more than 5 in any single year (Table IV-12). It is expected that structure removals will cause sublethal effects on cetaceans. No mortalities are expected because of the MMS guidelines for explosive removals (USDOI, MMS, 1990a, Appendix B). It is expected that structure removals will seldom disturb and affect nonendangered cetaceans.

Seismic surveys use airguns to generate pulses. It is assumed that only these methods will be used in seismic surveys as a result of the proposed action (Section IV.A.2.). It is expected that effects on cetaceans from seismic surveys are primarily sublethal, constituting short-term avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans, causing skin and eye irritation, asphyxiation from inhalation of toxic fumes, food reduction or contamination, oil ingestion, and displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from sale-related oil spills greater than or equal to 1,000 bbl (one spill of 6,500 bbl is assumed), the effects would primarily be sublethal; few mortalities are expected. The effects of sale-related oil spills less than 1,000 bbl are expected to be solely sublethal due to the inconsiderable area affected and their rapid dispersion. It is expected that the extent and severity of effects from sale-related oil spills of any size will be lessened by improved coastal oil-spill contingency planning (Section IV.C.5.) and by active avoidance of oil spills by cetaceans.

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring from the proposed action in the CPA. It is assumed that 21 spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action. It is estimated that the 21 spills will occur offshore and that a few will contact land. It is assumed that 1 spill greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action, and it is estimated that the spill will occur offshore and that none of it will contact land. Although an interaction with spills less than 1,000 bbl may occur, only sublethal effects are expected. It is estimated that small spills will infrequently contact and affect nonendangered cetaceans.

Section IV.C.1. estimates the mean number of spills greater than or equal to 1,000 bbl resulting from the proposed action in the CPA. It is assumed that 1 crude oil spill (median size of 6,500 bbl) will occur from a pipeline in the Central Gulf during the 35-year life of the proposed action. Table IV-21 identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting areas within 10 days where cetaceans have been surveyed. There is a 5 percent probability that an oil spill greater than or equal to 1,000 bbl will occur and contact within 10 days cetacean habitats at or beyond the shelf break of the CPA. There is a 1-2 percent probability that an oil spill greater than or equal to 1,000 bbl will occur and contact areas of the Mississippi Delta (survey blocks in Table IV-21) within 10 days of where cetaceans have been sighted. Although an interaction with spills greater than or equal to 1,000 bbl may occur, infrequent mortalities are expected with primarily sublethal effects. It is expected that an oil spill greater than or equal to 1,000 bbl will seldom contact and affect nonendangered cetaceans in the CPA.

*Summary*

Activities resulting from the proposed action have a potential to affect endangered cetaceans detrimentally. These cetaceans could be impacted by operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills, and oil-spill response activities. The effects of the majority of these activities are expected to be sublethal. Lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl. Sale-related oil spills of any size are expected to seldom contact nonendangered and nonthreatened cetaceans.

*Conclusion*

The impact of the Base Case scenario on nonendangered and nonthreatened cetaceans within the potentially affected area is expected to result in sublethal effects that are chronic and could cause persistent physiological or behavioral changes, as well as some degree of avoidance of the impacted area(s).

*High Case Analysis*

The major impact-producing factors analyzed below are related to the proposed action and include operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills and oil-spill response activities.

An estimated 7,362,000 bbl of drilling muds, 1,744,000 bbl of drill cuttings, and 660 MMbbl of produced waters are assumed to be generated offshore as a result of the proposed action (Table IV-2). These effluents are routinely discharged into offshore marine waters and are regulated by the U.S. Environmental Protection Agency's NPDES permits. It is expected that nonendangered cetaceans will have some interaction with these discharges. Direct effects to cetaceans are expected to be sublethal, and effects to cetacean food sources are not expected due to the rapid offshore dilution and dispersion of operational discharges. It is expected that operational discharges will seldom contact and affect nonendangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis, averaging about 31,000 trips per year. The FAA Advisory Circular 91-36C encourages the use of fixed-wing aircraft above an elevation of 152 m and helicopters above 300 m. It is expected that at these elevations no cetaceans will be affected by OCS helicopter traffic. It is also expected that helicopter traffic will seldom disturb and affect nonendangeredcetaceans because of special prohibitions and adherence to the general, FAA-recommended minimum ceiling of 300 m.

It is assumed that about 880 OCS-related oil/gas service-vessel trips will occur annually as a result of the proposed action and that 5 shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-2). Noise from service-vessel traffic may elicit a startle reaction from cetaceans or mask their sound reception. This effect is sublethal and at worst of a short-term, temporary nature. Cetaceans can avoid service vessels, and operators can avoid cetaceans. It is expected that service-vessel traffic will seldom contact and affect nonendangered cetaceans.

It is assumed that 540 exploration and delineation wells and 520 development wells will be drilled and will produce sounds at intensities and frequencies that could be heard by cetaceans. It is estimated that noise from drilling activities will last no longer than two months at only one location. However, the decibel level of these sounds dissipates to the tolerance of most cetaceans within 15 m of the source. Odontocetes communicate at higher frequencies than the dominant sounds generated by drilling platforms. Sound levels in this range are not likely to be generated by drilling operations (Gales, 1982). The effects on cetaceans from platform noise are expected to be sublethal. It is expected that drilling noise will seldom disturb and affect nonendangered cetaceans.

Explosive platform removals can interfere with communication, disturb behavior, reduce hearing sensitivity, or cause hemorrhaging in cetaceans. It is estimated that 24 structures will be removed by explosives from the Gulf of Mexico as a result of the proposed action. These removals are assumed to occur during the last 12 years of the life of the proposed action and no more than 8 in any single year (Table IV-2). It is expected that structure removals will cause sublethal effects on cetaceans. No mortalities are expected because of the MMS guidelines for explosive removals (USDOI, MMS, 1990a, Appendix B). It is expected that structure removals will seldom disturb and affect nonendangered cetaceans.

Seismic surveys use airguns to generate pulses. It is assumed that only these methods will be used in seismic surveys as a result of the proposed action (Section IV.A.2.). It is expected that effects on cetaceans from seismic surveys are primarily sublethal, constituting short-term avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans, causing skin and eye irritation, asphyxiation from inhalation of toxic fumes, food reduction or contamination, oil ingestion, and displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from sale-related oil spills greater than or equal to 1,000 bbl (one spill of 6,500 bbl is assumed), the effects would primarily be sublethal; few mortalities are expected. The effects of sale-related oil spills less than 1,000 bbl are expected to be solely sublethal due to the small area affected and their rapid dispersion. It is expected that the extent and severity of effects from sale-related oil spills of any size will be lessened by improved coastal oil-spill contingency planning (Section IV.C.5.) and by active avoidance of oil spills by cetaceans.

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring from the proposed action in the CPA. It is assumed that 47 spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action. It is estimated that the 47 spills will occur offshore and that a few will contact land. It is assumed that 2 spills greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action, and it is estimated that the spill will occur offshore and that none will contact land. Although an interaction with these spills may occur, only sublethal effects are expected. It is estimated that spills less than 1,000 bbl will infrequently contact and affect nonendangered cetaceans.

Section IV.C.1. estimates the mean number of spills greater than or equal to 1,000 bbl resulting from the proposed action in the CPA. It is assumed that one crude oil spill greater than or equal to 1,000 bbl (6,500 bbl) will occur from either a platform or pipeline in the Central Gulf during the 35-year life of the proposed action. Table IV-21 identifies the risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days areas where cetaceans have been surveyed. There is an 11 percent probability that an oil spill greater than or equal to 1,000 bbl will occur and contact, within 10 days, cetacean habitats at or beyond the shelf break of the CPA. There is a 1-4 percent probability that an oil spill greater than or equal to 1,000 bbl will occur and contact the Mississippi Delta (survey blocks in Table IV-21) within 10 days where cetaceans have been sighted and a 1-4 percent probability of occurrence and contact within 10 days in coastal areas of Louisiana (Table IV-21). Although an interaction with spills greater than or equal to 1,000 bbl may occur, infrequent mortalities are expected, with primarily sublethal effects. It is expected that an oil spill greater than or equal to 1,000 bbl will seldom contact and affect nonendangered cetaceans in the CPA.

Activities resulting from the proposed action have a potential to affect nonendangered cetaceans detrimentally. These cetaceans could be impacted by operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills, and oil-spill response activities. The effects of the majority of these activities are expected to be sublethal. Lethal effects are expected only from oil spills greater than or equal to 1,000 bbl. Sale-related oil spills of any size are expected to seldom contact nonendangered and nonthreatened cetaceans.

*Conclusion*

The impact of the High Case scenario on nonendangered and nonthreatened cetaceans within the potentially affected area is expected to result in sublethal effects that are chronic and may result in persistent physiological or behavioral changes, as well as some degree of avoidance of the impacted area(s).

*Endangered and Threatened Species*

This section discusses the effects of the proposed action on blue, right, sei, humpback, fin, and sperm whales. For a detailed discussion of these species, see Section III.B.3.a.(2). The sperm whale is the species most commonly seen in the Gulf of Mexico.

The major impact-producing factors related to the proposed action are discussed in detail by the National Research Council (1985), Boesch and Rabalais (1987), Geraci and St. Aubin (1988), USDOI, MMS (1982a and 1987d), and API (1989), and are described in the preceding section (Section IV.D.1.a.(5)(a), nonendangered and nonthreatened species).

*Base Case Analysis*

The major impact-producing factors analyzed below are related to the proposed action and include operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills, and oil-spill response activities.

An estimated 4,113,000 bbl of drilling muds, 988,000 bbl of drill cuttings, and 317 MMbbl of produced waters are assumed to be generated offshore as a result of the proposed action (Table IV-2). These effluents are routinely discharged into offshore marine waters and are regulated by the U.S. Environmental Protection Agency's NPDES permits. It is expected that endangered cetaceans will have some interaction with these discharges. Direct effects to cetaceans are expected to be sublethal, and effects to cetacean food sources are not expected due to the rapid offshore dilution and dispersion of operational discharges. It is expected that operational discharges will seldom contact and affect endangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis, averaging about 18,000 trips per year. The FAA Advisory Circular 91-36C encourages the use of fixed-wing aircraft above an elevation of 152 m and helicopters above 300 m. It is expected that at these elevations no cetaceans will be affected by OCS helicopter traffic. It is also expected that helicopter traffic will seldom disturb and affect endangered cetaceans because of special prohibitions and adherence to the general FAA-recommended minimum ceiling of 300 m.

It is assumed that about 500 OCS-related oil/gas service-vessel trips will occur annually as a result of the proposed action and that 2 shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-2). Noise from service-vessel traffic may elicit a startle reaction from cetaceans or mask their sound reception. This effect is sublethal, and at worst, of a short-term, temporary nature. Cetaceans can avoid service vessels, and operators can avoid cetaceans. It is expected that service-vessel traffic will seldom contact and affect endangered cetaceans.

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Explosive platform removals can temporarily interfere with communication, disturb behavior, permanently reduce hearing sensitivity, or cause hemorrhaging in cetaceans. It is estimated that 20 structures will be removed by explosives from the Gulf of Mexico as a result of the proposed action. These removals are assumed to occur during the last 12 years of the life of the proposed action and no more than five in any single year (Table IV-2). It is expected that structure removals will cause sublethal effects on cetaceans. No mortalities are expected because of the MMS guidelines for explosive removals (USDOI, MMS, 1990a, Appendix B). It is expected that structure removals will seldom disturb and affect endangered cetaceans.

Seismic surveys use airguns to generate pulses. It is assumed that only these methods will be used in seismic surveys as a result of the proposed action (Section IV.A.2.). It is expected that effects on cetaceans from seismic surveys are primarily sublethal, constituting short-term avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans, causing skin and eye irritation, asphyxiation from inhalation of toxic fumes, food reduction or contamination, oil ingestion, and displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from sale-related oil spills greater than or equal to 1,000 bbl (1 spill of 6,500 bbl is assumed), the effects would primarily be sublethal; few mortalities are expected. The effects of sale-related oil spills less than 1,000 bbl are expected to be solely sublethal due to the small area affected and their rapid dispersion. It is expected that the extent and severity of effects from sale-related oil spills of any size will be lessened by improved coastal oil-spill contingency planning (Section IV.C.5.) and by active avoidance of oil spills by cetaceans.

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring from the proposed action in the CPA. It is assumed that 21 spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action. It is estimated that the 21 spills will occur offshore and that a few will contact land. It is assumed that 1 spill greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action, and it is estimated that the spill will occur offshore and that none of it will contact land. Although an interaction with spills less than 1,000 bbl may occur, only sublethal effects are expected. It is estimated that spills less than 1,000 bbl will infrequently contact and affect endangered cetaceans.

Section IV.C.1. estimates the mean number of spills greater than or equal to 1,000 bbl resulting from the proposed action in the CPA. It is assumed that one crude oil spill greater than or equal to 1,000 bbl will occur from either a platform or pipeline in the Central Gulf during the 35-year life of the proposed action (median size is 6,500 bbl). Table IV-21 identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting, within 10 days, areas where cetaceans have been surveyed. There is a 5 percent probability that an oil spill greater than or equal to 1,000 bbl will occur and contact within 10 days cetacean habitats at or beyond the shelf break of the CPA. There is a 1-2 percent probability that an oil spill greater than or equal to 1,000 bbl will occur and contact areas of the Mississippi Delta (survey blocks in Table IV-21) within 10 days where cetaceans have been sighted. Although an interaction with spills greater than or equal to 1,000 bbl may occur, infrequent mortalities are expected with primarily sublethal effects. It is expected that an oil spill greater than or equal to 1,000 bbl will seldom contact and affect endangered cetaceans in the CPA.

*Summary*

Activities resulting from the proposed action have a potential to affect endangered cetaceans detrimentally. These cetaceans could be impacted by operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills, and oil-spill response activities. The effects of the majority of these activities are expected to be sublethal. Lethal effects are expected only from oil spills greater than or equal to 1,000 bbl. Sale-related oil spills of any size are expected to seldom contact endangered and threatened cetaceans.

*Conclusion*

The impact of the Base Case scenario on endangered and threatened cetaceans within the potentially affected area is expected to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes, as well as some degree of avoidance of the impacted areas.

*High Case Analysis*

The major impact-producing factors analyzed below are related to the proposed action and include operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills and oil-spill response activities.

An estimated 7,362,000 bbl of drilling muds, 1,744,000 bbl of drill cuttings, and 660 MMbbl of produced waters are assumed to be generated offshore as a result of the proposed action. These effluents are routinely discharged into offshore marine waters and are regulated by the U.S. Environmental Protection Agency's NPDES permits. It is expected that endangered cetaceans will have some interaction with these discharges. Direct effects to cetaceans are expected to be sublethal, and effects to cetacean food sources are not expected due to the rapid offshore dilution and dispersion of operational discharges. It is expected that operational discharges will seldom contact and affect endangered cetaceans.

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It is assumed that about 880 OCS-related oil/gas service-vessel trips will occur annually as a result of the proposed action and that 5 shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-2). Noise from service-vessel traffic may elicit a startle reaction from cetaceans or mask their sound reception. This effect is sublethal and, at worst, of a short-term, temporary nature. Cetaceans can avoid service vessels, and operators can avoid cetaceans. It is expected that service-vessel traffic will seldom contact and affect endangered cetaceans.

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Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring from the proposed action in the CPA. It is assumed that 47 spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action. It is estimated that the 47 spills will occur offshore and that few will contact land. It is assumed that 2 spills greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action, and it is estimated that the spill will occur offshore and that none will contact land. Although an interaction with spills less than 1,000 bbl may occur, only sublethal effects are expected. It is estimated that spills less than 1,000 bbl will seldom contact and affect endangered cetaceans.

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Activities resulting from the proposed action have a potential to affect endangered cetaceans detrimentally. These cetaceans could be impacted by operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills, and oil-spill response activities. The effects of the majority of these activities are expected to be sublethal. Lethal effects are expected only from oil spills greater than or equal to 1,000 bbl. Sale-related oil spills of any size are expected to seldom contact endangered and threatened cetaceans.

*Conclusion*

The impact of the High Case scenario on endangered and threatened cetaceans within the potentially affected area is expected to result in sublethal effects that are chronic and may result in persistent physiological or behavioral changes, as well as some degree of avoidance of the impacted area(s).

### *(b) Alabama, Choctawhatchee, and Perdido Key Beach Mice*

This section discusses the effects of the proposed action on the Alabama, Choctawhatchee, and Perdido Key beach mice. Alabama, Choctawhatchee, and Perdido Key beach mice occupy restricted habitats behind coastal foredunes of Florida and Alabama. Their range is chiefly in Perdido Key State Preserve (Florida), Grayton Beach State Recreational Area (Florida), St. Andrews State Recreation Area (Florida), Gulf Islands National Seashore (Alabama), and Gulf State Park (Alabama). Portions of these areas have been designated as critical habitat for these endangered species. The major impact-producing factors related to the proposed action that may effect Alabama, Choctawhatchee, and Perdido Key beach mice include oil spills and oil-spill response activities.

Direct contact with spilled oil can cause skin and eye irritation, asphyxiation from inhalation of toxic fumes, food reduction, food contamination, oil ingestion, and displacement from preferred habitat. Vehicular traffic associated with oil-spill cleanup activities can degrade preferred habitat and cause displacement from these areas.

The preferred habitat of Alabama, Choctawhatchee, and Perdido Key beach mice is not on the beach, but behind the barrier dunes. An oil spill would have to breach the dunes to reach either the mice or their preferred habitat. This could occur only if an oil spill coincided with a storm surge. The home range of the beach mice is within those areas, described above, that receive particular consideration during oil-spill cleanup. Because of the critical designation and general status of those areas, oil-spill contingency plans include special notices to minimize adverse effects from vehicular traffic during cleanup activities and to maximize the protection efforts to prevent contact of these areas with spilled oil (Section IV.C.5.).

*Base Case Analysis*

The major impact-producing factors analyzed below are related to the proposed action and include oil spills and oil-spill response activities.

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring from the proposed action in the CPA. It is assumed that fewer than 10 spills greater than 1 and less than or equal to 50 bbl will occur onshore during the 35-year life of the proposed action. It is estimated that spills less than 1,000 bbl will not breach barrier dunes and contact or affect beach mice or their habitats.

Section IV.C.1. estimates the mean number of spills greater than or equal to 1,000 bbl resulting from the proposed action in the CPA. It is assumed that 1 crude oil spill greater than or equal to 1,000 bbl will occur from either a platform or pipeline in the Central Gulf during the 35-year life of the proposed action. It is expected that an oil spill greater than or equal to 1,000 bbl could breach beach barriers only if the spill coincided with a storm surge strong enough to lift oil over the foredunes. Table IV-21 identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days the coast near beach mice habitats. There is less than a 0.5 percent probability of an oil spill greater than or equal to 1,000 bbl occurring and contacting within 10 days the coastal areas of the Alabama, Choctawhatchee, and Perdido Key beach mice. It is expected that oil spills greater than or equal to 1,000 bbl will not contact or affect beach mice or their habitats.

Vehicular traffic associated with oil-spill cleanup activities is assumed to contact beach mouse habitat in the event of a spill greater than or equal to 1,000 bbl breaching barrier dunes. Table IV-21 indicates that there is less than a 0.5 percent probability of an oil spill greater than or equal to 1,000 bbl occurring and contacting within 10 days, the coastal areas of the Alabama, Choctawhatchee, and Perdido Key beach mice. It is expected that vehicular traffic associated with oil-spill cleanup activities will seldom contact or affect beach mice or their habitats.

*Summary*

Activities resulting from the proposed action have a potential to affect Alabama, Choctawhatchee, and Perdido Key beach mice detrimentally. Beach mice could be impacted by oil spills and oil-spill response activities. It is expected that there will seldom be interaction between these events and beach mice or their habitats.

*Conclusion*

The impact of the Base Case scenario on Alabama, Choctawhatchee, and Perdido Key beach mice within the potentially affected area is expected to result in sublethal effects that seldom occur and may cause short-term physiological or behavioral changes.

*High Case Analysis*

The major impact-producing factors analyzed below are related to the proposed action and include oil spills and oil-spill cleanup activities.

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring from the proposed action in the CPA. It is assumed that fewer than 10 spills greater than 1 and less than or equal to 50 bbl will occur onshore during the 35-year life of the proposed action. It is expected that spills less than 1,000 bbl will not breach barrier dunes and contact or affect beach mice or their habitats.

Section IV.C.1. estimates the mean number of spills greater than or equal to 1,000 bbl resulting from the proposed action in the CPA. It is assumed that 1 crude oil spill greater than or equal to 1,000 bbl will occur from either a platform or pipeline in the Central Gulf during the 35-year life of the proposed action (median size of 6,500 bbl). It is expected that an oil spill greater than or equal to 1,000 bbl could breach beach barriers only if the spill coincided with a storm surge strong enough to lift oil over the foredunes. Table IV-21 identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days coastal areas near beach mice habitats. There is less than a 0.5 percent probability of an oil spill greater than or equal to 1,000 bbl occurring and contacting within 10 days the coastal areas of the Alabama, Choctawhatchee, and Perdido Key beach mice. It is estimated that oil spills greater than or equal to 1,000 bbl will not contact or affect beach mice or their habitats.

Vehicular traffic associated with oil-spill cleanup is assumed to contact beach mouse habitat in the event of a spill greater than or equal to 1,000 bbl breaching barrier dunes. Table IV-21 indicates that there is less than a 0.5 percent probability of an oil spill greater than or equal 1,000 bbl occurring and contacting within 10 days the coastal areas of the Alabama, Choctawhatchee, and Perdido Key beach mice. It is expected that vehicular traffic associated with oil-spill cleanup activities will not contact or affect beach mice or their habitats.

Activities resulting from the proposed action have a potential to affect Alabama, Choctawhatchee, and Perdido Key beach mice detrimentally. Beach mice could be impacted by oil spills and oil-spill response activities. It is expected that there will be no interaction between these events and beach mice or their habitats.

*Conclusion*

The impact of the High Case scenario on Alabama, Choctawhatchee, and Perdido Key beach mice within the potentially affected area is expected to result in sublethal effects that seldom occur and may cause short-term physiological or behavioral changes.

### *(6) Impacts on Marine Turtles*

This section discusses the effect of the proposed action on the loggerhead, Kemp's ridley, hawksbill, green, and leatherback marine turtles of the Gulf of Mexico. The major impact-producing factors related to the proposed action are discussed in detail in *Decline of the Sea Turtles: Causes and Prevention* (NRC, 1990) and are described below.

The major impact-producing factors related to the proposed action that may affect Gulf marine turtles include anchoring, structure installation, pipeline placement, dredging, operational discharges, vessel traffic, explosive platform removals, OCS-related trash and debris, oil-spill response activities, and oil spills.

Anchoring, structure installation, pipeline placement, dredging, and operational discharges may adversely affect marine turtle habitat through destruction of seagrass beds and live-bottom communities. Effects to these habitats from the above mentioned impact-producing factors are described and analyzed in detail in Sections IV.D.1.a.(1) and (2).

Noise from service-vessel traffic may elicit a startle reaction from marine turtles. This effect is sublethal, and at worst, of a short-term, temporary nature (NRC, 1990). Service vessels could collide with and directly impact marine turtles. Vessel-related injuries were noted in 9 percent of the marine turtles stranded in the Gulf of Mexico during 1988 (USDOC, NMFS, 1989b). This observation was not able to distinguish between live and dead turtles struck by boats. Marine turtles spend no more than 4 percent of their time at the surface, and less time than that during the winter (Byles, 1989; Lohoefener et al., 1990).

Explosive platform removals can cause capillary damage, disorientation, and loss of motor control in marine turtles (Duronslet et al., 1986). The effects are primarily sublethal and short-term; however, marine turtles proximate to detonation would likely sustain fatal injuries. Mortalities and fatal injuries have been speculated, but none has been documented. Although marine turtles occur near offshore oil and gas structures, aerial surveys in the Central Gulf have shown no statistical correlation between marine turtles and offshore structures, except near the Chandeleur Islands, Louisiana (Lohoefener, personal comm., 1989). To minimize the likelihood of removals occurring when marine turtles may be nearby, MMS has issued guidelines for explosive platform removal to offshore operators. These guidelines include daylight detonation only, staggered charges, placement of charges 5 m below the seafloor, and pre- and post-detonation surveys of surrounding waters.

Marine turtles can become entangled in monofilament fishing line, netting, 6-pack yokes, etc., which may result in injury or mortality. Marine turtles are known to be attracted to floating plastic debris because of its resemblance to their preferred food, the jellyfish. Ingestion of plastic and styrofoam materials could result in drowning, lacerations, digestive disorders or blockage, and reduced mobility resulting in starvation (Balazs, 1985; Carr, 1987; USDOC, NOAA, 1988d; Heneman and the Center for Environmental Education, 1988; USDOI, MMS, 1989a). 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), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989.

Oil-spill response activities, such as vehicular and vessel traffic in shallow areas of seagrass beds and live-bottom communities, can adversely affect sea turtle habitat and cause displacement from these preferred areas. These habitats receive particular consideration during oil-spill cleanup. Because of the special designation and general status of those areas, oil-spill contingency plans include special notices to minimize adverse effects from vehicular traffic during cleanup activities and to maximize the protection efforts to prevent contact of these areas with spilled oil (Section IV.C.5.).

Oil spills can adversely affect marine turtles by toxic external contact, toxic ingestion or blockage of the digestive tract, asphyxiation, entrapment in tar or oil slicks, habitat destruction, and displacement from preferred habitats (Fritts and McGehee, 1981; Vargo et al., 1986; Boesch and Rabalais, 1987; Lutz, 1989). Pelagic life stages are particularly vulnerable to contacting or ingesting oil because the currents that concentrate oil spills also form the debris mats that these life stages inhabit (Vargo et al., 1986). Fritts and McGehee (1982) noted that sea turtle eggs were rendered infertile on contact with oil.

When an oil spill occurs, many factors interact to delimit the severity of effects and the extent of damage to marine turtles. Determining factors include geographic location, oil type, oil dosage, impact area, oceanographic conditions, meteorological conditions, and season (NRC, 1985; USDOI, MMS, 1987b). Marine turtles themselves may actively avoid an oil spill, thereby limiting the effects and lessening the extent of damage to their populations. Less severe, sublethal effects are defined as those that impair the ability of an organism to function effectively without causing direct mortality (NRC, 1985).

*Base Case Analysis*

The major impact-producing factors related to the proposed action that may affect Gulf marine turtles include anchoring, structure installation, pipeline placement, dredging, operational discharges, OCS-related trash and debris, vessel traffic, explosive platform removals, oil-spill response activities, and oil spills.

The impact from anchoring, structure installation, pipeline placement, dredging, and operational discharges on seagrass bed and live-bottom sea turtle habitat are analyzed in detail in Sections IV.D.1.a.(1) and (2).

To summarize the effects on wetlands and estuaries, it is expected that a dieback of up to 10-15 ha of wetlands will occur for less than one growing season from contact with spilled oil. Up to 5.5 ha of wetlands and estuaries could be eroded along navigation channels as a result of vessel traffic within the channels. Effects to wetlands and estuaries will occur in Louisiana and along the north Texas coast. To summarize the effects on seafloor habitats, little or no damage is expected to the physical integrity, species, diversity, or biological productivity of topographic features or live bottoms. Small areas of 5-10 $m^2$ would be affected for less than two years, probably on the order of four weeks. Offshore operational discharges are not lethal to marine turtles and are diluted and dispersed rapidly within 1 km of the discharge point to the extent that adverse effects to marine turtle food sources do not occur (API, 1989; NRC, 1983). It is expected that effects on marine turtles from anchoring, structure installation, pipeline emplacement, and dredging will be indistinguishable from the long-term (25-50 years) natural variability within populations of marine turtles. It is expected that marine turtles will avoid 5-10 $m^2$ of live-bottom areas for up to a month and that this avoidance of impoverished foraging areas will have no effect on marine turtles. The suspended particulate matter in operational discharges offshore is expected to cause sublethal effects by inhibition of the ability of marine turtles to locate their prey visually within 1 km of the discharge point for the short time period (less than one hour) spent traversing the plume.

Sublethal effects on marine turtles or their habitats are expected from these impact-producing factors. Based on the aforementioned analyses, the estimate is that anchoring, structure installation, pipeline placement, dredging, and operational discharges will seldom contact and affect marine turtles or their habitats.

Marine turtles can become entangled in or ingest trash and debris. It is assumed that some OCS-related trash and debris will be accidentally lost into the Gulf and available for interaction with marine turtles. Although mortalities could occur, primarily sublethal effects are expected. It is expected marine turtles will seldom interact with OCS oil- and gas-related trash and debris.

Explosive platform removals can cause capillary damage, disorientation, loss of motor control, and fatal injuries in marine turtles. It is estimated that 20 structures will be removed by explosives from the Gulf of Mexico as a result of the proposed action. It is assumed that these removals occur during the last 12 years of the life of the proposed action. No more than 5 structures will be removed in any given year. Some of the platform removals will occur beyond the continental shelf. As benthic feeders, Gulf of Mexico hard-shell marine turtles do not use habitats beyond the shelf break. Although the pelagic life stages of all marine turtles use these habitats, there is no correlation between marine turtles and the presence of offshore structures beyond the shelf break. It is expected that structure removals will cause sublethal effects on marine turtles. No mortalities are expected because of the MMS guidelines for explosive removals (USDOI, MMS, 1990a, Appendix B) and because the removals occur away from preferred offshore habitats. It is expected that structure removals will seldom disturb and affect marine turtles.

It is assumed that about 500 OCS-related oil and gas service-vessel trips will occur annually as a result of the proposed action and that 2 shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-2). Noise from service-vessel traffic may elicit a startle reaction from marine turtles. This effect is sublethal and, at worst, of a short-term, temporary nature. Collision between service vessels and surfaced marine turtles would likely cause fatal injuries. It is assumed that service-vessel traffic and marine turtles will seldom be in close proximity. Although a low percentage of stranded marine turtles have shown indications of vessel collision, it cannot be determined what types of vessel were involved and whether these injuries occurred before or after death. The OCS-related vessel traffic is a meager amount of the total vessel traffic in the Gulf of Mexico. Marine turtles are known to spend 4 percent or less of their time at the surface and to sound upon vessel approach. In addition, marine vessel operators can avoid marine turtles. It is expected that service-vessel traffic will seldom contact and affect marine turtles.

Oil spills and oil-spill response activities can adversely affect marine turtles by toxic external contact, toxic ingestion or blockage of the digestive tract, asphyxiation, entrapment in tar or oil slicks, habitat destruction, and displacement from preferred habitats. Oil-spill response activities such as vehicular and vessel traffic are assumed to contact marine turtle habitat, such as shallow areas of seagrass beds and live-bottom communities, in the event of contact with an oil spill greater than or equal to 1,000 bbl. Sublethal effects are expected due to the particular consideration these areas receive during oil-spill cleanup to minimize adverse effects from traffic during cleanup activities and to maximize protection efforts to prevent contact of these areas with spilled oil. It is expected that oil-spill response activities will seldom contact and affect marine turtle habitat.

In the event that oiling of marine turtles should occur from sale-related oil spills greater than or equal to 1,000 bbl (1 spill of 6,500 is assumed) the effects would primarily be sublethal; few mortalities are expected. The effects of sale-related oil spills less than 1,000 bbl are expected to be solely sublethal due to the small area affected and their rapid dispersion. It is expected that the extent and severity of effects from sale-related oil spills of any size will be lessened by improved coastal oil-spill contingency planning (Section IV.C.5.) and by active avoidance of oil spills by marine turtles.

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring from the proposed action in the CPA. It is assumed that 21 spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action. It is estimated that the 21 spills will occur offshore and that a few will contact land. It is assumed that 1 spill greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action, and it is estimated that the spill will occur offshore and that none of it will contact land. Although an interaction with spills less than 1,000 bbl may occur, only sublethal effects are expected. It is expected that spills less than 1,000 bbl will seldom contact and affect marine turtles.

Section IV.C.1. estimates the mean number of spills greater than or equal to 1,000 bbl resulting from the proposed action in the CPA. It is assumed that 1 crude oil spill greater than or equal to 1,000 bbl will occur from either a platform or pipeline in the Central Gulf during the 35-year life of the proposed action (median size is 6,500 bbl). Table IV-21 identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days marine turtle habitat. The highest estimated probability of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days marine turtle habitat in the Central Gulf is 1 percent (Plaquemines and Terrebonne Parishes). There is a 5 percent probability that one or more oil spill greater than or equal to 1,000 bbl will occur and contact within 10 days pelagic turtle habitat beyond the shelf break of the CPA. Although an interaction with spills greater than or equal to 1,000 bbl may occur, infrequent mortalities are expected with primarily sublethal effects. It is expected that an oil spill greater than or equal to 1,000 bbl will seldom contact and affect marine turtles in the CPA.

*Summary*

Activities resulting from the proposed action have a potential to affect marine turtles detrimentally. Marine turtles could be impacted by anchoring, structure installation, pipeline placement, dredging, operational discharges, OCS-related trash and debris, vessel traffic, explosive platform removals, oil-spill response activities, and oil spills. The effects of the majority of these activities are expected to be sublethal. Lethal effects are expected only from oil spills greater than or equal to 1,000 bbl. Sale-related oil spills of any size are expected to seldom contact marine turtles.

*Conclusion*

The impact of the Base Case scenario on marine turtles within the potentially affected area is expected to result in sublethal effects that are chronic and may cause persistent physiological or behavioral changes.

*High Case Analysis*

The major impact-producing factors related to the proposed action that may affect Gulf marine turtles include anchoring, structure installation, pipeline placement, dredging, operational discharges, OCS-related trash and debris, vessel traffic, explosive platform removals, oil-spill response activities, and oil spills.

The impact from anchoring, structure installation, pipeline placement, dredging, and operational discharges on seagrass bed and live-bottom sea turtle habitat is analyzed in detail in Sections IV.D.1.a.(1) and (2).

To summarize the effects on wetlands and estuaries, it is expected that a dieback of up to 10-15 ha of wetlands will occur for less than one growing season from contact with spilled oil. Up to 11 ha of wetlands and estuaries could be eroded along navigation channels as a result of OCS-vessel traffic within the channels. Effects to wetlands and estuaries will occur in Louisiana and along the north Texas coast. To summarize the effects on seafloor habitats, little or no damage is expected to the physical integrity, species, diversity, or biological productivity of topographic features or live bottoms. Small areas of 5-10 $m^2$ would be affected for less than two years, probably on the order of four weeks.

Offshore operational discharges are not lethal to marine turtles and are diluted and dispersed rapidly within 1 km of the discharge point to the extent that adverse effects to marine turtle food sources do not occur (API, 1989; NRC, 1983). It is expected that effects on marine turtles from anchoring, structure installation, pipeline emplacement, and dredging will be indistinguishable from the long-term (25-50 years) natural variability within populations of marine turtles. It is expected that marine turtles will avoid 5-10 $m^2$ of live-bottom areas for up to a month and that this avoidance of impoverished foraging areas will have no effect on marine turtles. The suspended particulate matter in operational discharges offshore are expected to cause sublethal effects by inhibition of the ability of marine turtles to locate their prey visually within 1 km of the discharge point for the short time period (less than one hour) spent traversing the plume.

Sublethal effects on marine turtles or their habitats are expected from these impact-producing factors. Based on the aforementioned analyses, the estimate is that anchoring, structure installation, pipeline placement, dredging, and operational discharges will seldom contact and affect marine turtles or their habitats.

Marine turtles can become entangled in or ingest trash and debris. It is assumed that some OCS-related trash and debris will be accidentally lost into the Gulf and available for interaction with marine turtles.

Although mortalities could occur, primarily sublethal effects are expected. It is expected that marine turtles will seldom interact with OCS oil- and gas-related trash and debris.

Explosive platform removals can cause capillary damage, disorientation, loss of motor control, and fatal injuries in marine turtles. It is estimated that 24 structures will be removed using explosives from the Gulf of Mexico as a result of the proposed action. It is assumed that these removals occur during the last 12 years of the life of the proposed action, no more than 8 in any single year, and that some of the platform removals will occur in habitats beyond the continental shelf. As benthic feeders, Gulf of Mexico hard-shell marine turtles do not use habitats beyond the shelf break. Although the pelagic life stages of all marine turtles use these habitats, there is no correlation between marine turtles and the presence of offshore structures beyond the shelf break. It is expected that structure removals will cause sublethal effects on marine turtles. No mortalities are expected because of the MMS guidelines for explosive removals (USDOI, MMS, 1990a, Appendix B) and because the removals occur away from preferred offshore habitat. It is expected that structure removals will seldom disturb and affect marine turtles.

It is assumed that about 880 OCS-related oil and gas service-vessel trips will occur annually as a result of the proposed action and that 5 shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-2). Noise from service-vessel traffic may elicit a startle reaction from marine turtles. This effect is sublethal and, at worst, of a short-term, temporary nature. Collision between service vessels and surfaced marine turtles would likely cause fatal injuries. It is expected that service-vessel traffic and marine turtles will seldom be in close proximity. Although a low percentage of stranded marine turtles have shown indications of vessel collision, it cannot be determined what types of vessel were involved and whether these injuries occurred before or after death. Marine turtles are known to spend 4 percent or less of their time at the surface and to sound upon vessel approach. In addition, marine vessel operators can avoid marine turtles. It is expected that service-vessel traffic will seldom contact and affect marine turtles.

Oil spills and oil-spill response activities can adversely affect marine turtles by toxic external contact, toxic ingestion or blockage of the digestive tract, asphyxiation, entrapment in tar or oil slicks, habitat destruction, and displacement from preferred habitats. Oil-spill response activities such as vehicular and vessel traffic are assumed to contact marine turtle habitat, such as shallow areas of seagrass beds and live-bottom communities, in the event of contact with an oil spill greater than or equal to 1,000 bbl. Sublethal effects are expected due to the particular consideration these areas receive during oil-spill cleanup to minimize adverse effects from traffic during cleanup activities and to maximize protection efforts to prevent contact of these areas with spilled oil. It is expected that oil-spill response activities will seldom contact and affect marine turtle habitat.

In the event that oiling of marine turtles should occur from sale-related oil spills greater than or equal to 1,000 bbl (1 spill of 6,500 bbl is assumed), the effects would primarily be sublethal; few mortalities are expected. The effects of sale-related oil spills less than 1,000 bbl are expected to be solely sublethal due to the small area affected and their rapid dispersion. It is expected that the extent and severity of effects from sale-related oil spills of any size will be lessened by improved coastal oil-spill contingency planning (Section IV.C.5.) and by active avoidance of oil spills by marine turtles.

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring from the proposed action in the CPA. It is assumed that 47 spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action. It is estimated that the 47 spills will occur offshore and that few will contact land. It is assumed that 2 spills greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action, and it is estimated that the spills will occur offshore and that none will contact land. Although an interaction with spills less than 1,000 bbl may occur, only sublethal effects are expected. It is expected that spills less than 1,000 bbl will seldom contact and affect marine turtles.

Section IV.C.1. estimates the mean number of spills greater than or equal to 1,000 bbl resulting from the proposed action in the CPA. It is assumed that 1 crude oil spill greater than or equal to 1,000 bbl will occur from either a platform or pipeline in the Central Gulf during the 35-year life of the proposed action (median size is 6,500 bbl). Table IV-21 identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days marine turtle habitat. The highest estimated probability of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days marine turtle habitat in the Central Gulf is 1 percent (Plaquemines and Terrebonne Parishes). There is an 11 percent estimated probability that an oil spill greater than or equal to 1,000 bbl will occur and contact within 10 days pelagic turtle habitat beyond the shelf break of the CPA. Although an interaction with spills greater than or equal to 1,000 bbl may occur, infrequent mortalities are expected with primarily sublethal effects. It is expected that an oil spill greater than or equal to 1,000 bbl will seldom contact and affect marine turtles in the CPA.

Activities resulting from the proposed action have a potential to affect marine turtles detrimentally. Marine turtles could be impacted by anchoring, structure installation, pipeline placement, dredging, and operational discharges, OCS-related trash and debris, vessel traffic, explosive platform removals, oil-spill response activities, and oil spills. The effects of the majority of these activities are expected to be sublethal. Lethal effects are expected only from oil spills greater than or equal to 1,000 bbl. Sale-related oil spills of any size are expected to seldom contact marine turtles.

*Conclusion*

The impact of the High Case scenario on marine turtles within the potentially affected area is expected to result sublethal effects that are chronic and may cause persistent physiological or behavioral changes.

### *(7) Impacts on Coastal and Marine Birds*

Effects on coastal and marine birds from activities associated with the proposed action could come from oil spills, disturbance from OCS service-vessel and helicopter traffic near coastal areas, displacement from onshore pipeline landfalls and facility construction near coastal areas, and entanglement and ingestion of offshore oil- and gas-related plastic debris. Potential effects from these impact-producing factors are described below.

Sections providing supportive material for the coastal and marine bird analysis include Sections III.B.5. (description of coastal and marine birds), IV.C.1. and IV.C.3. (oil spills), IV.A.2.c. (support activities), IV.A.3.a.(1) (service and construction facilities), and IV.A.2.d.(5) (loss of trash and debris).

When an oil spill occurs, many factors interact to delimit the severity of effects and the extent of damage to coastal and marine bird populations. The direct effect of oiling on birds occurs through the matting of feathers and subsequent loss of body insulation and water-repellency, the ingestion of oil, the depression of egg-laying activity, and the reduction of hatching success (Holmes and Cronshaw, 1977; Ainley et al., 1981; Peakall et al., 1981). Transfer of oil from adults to eggs and young during nesting results in significant mortality for new eggs and deformities in hatchlings from eggs further along in incubation (Clapp et al., 1982a). Stress from ingested oil can be additive to ordinary environmental stresses such as low winter temperatures, migration, or molting (Holmes, 1984). Direct contact by birds with appreciable amounts of oil is usually fatal (NRC, 1985).

The impacts from spills less than 1,000 bbl differ in severity and kind from those of spills greater than or equal to 1,000 bbl. An OCS-related spill greater than or equal to 1,000 bbl certainly can be a long-term catastrophic event; however, if the frequency of such an event is low, the spill will eventually disappear due to physical-chemical processes and complex degradation (NRC, 1985). On a much smaller scale, spills less than 1,000 bbl may not have the same immediate effect that a spill greater than or equal to 1,000 bbl has on seabirds, but if the frequency of sublethal effects is relatively high, spills less than 1,000 bbl may be a more serious problem causing continued irritation and/or sublethal toxic effects. Less severe, sublethal effects are defined as those that impair the ability of an organism to function effectively without causing direct mortality (NRC, 1985).

Those birds most susceptible to oiling either raft at sea or congregate in large numbers--gulls, terns, white pelicans, and certain waterfowl such as scaup--or dive to feed, such as cormorants and anhinga. Because of the strong visual impact, the death of coastal and marine birds from oiling due to an OCS-related spill receives a large amount of publicity (Clapp et al., 1982a; NRC, 1985). Although mortality among marine birds may appear high as the result of an oil spill greater than or equal to 1,000 bbl, there is no evidence at this time that this mortality has adversely affected any species on a population level on the United States OCS (NRC, 1985).

Rehabilitation of oiled birds and deterrence away from the immediate area of an oil spill are procedures proven to limit the severity of the effect and lessen the extent of damage to populations of coastal and marine birds. More than 95 percent of the oil type found on the OCS in the Gulf of Mexico, South Louisiana Crude, dissipates quickly, is easy to saponify, and is not as highly toxic to birds as more refined oils (Section IV.C.2.). Survival of rehabilitated oiled birds varies from 30 percent (Sims, 1970) to 90 percent (Mueller and Mendoza, 1983). The success of rehabilitation is primarily due to three factors: advance preparation in the stockpiling of supplies and training of volunteers; the availability of a cleanup station with adequate indoor space, hot running water, and outdoor pens; and, most importantly, the efforts and cooperation of willing volunteers and the government agencies involved (Mueller and Mendoza, 1983). Refer to Section IV.C.5. for further information on oil-spill response options and rehabilitation of oiled coastal and marine birds in the Gulf of Mexico.

Supplies, services, and personnel are transported by service vessels and helicopters to OCS oil and gas structures. Disturbance created from OCS-related service-vessel traffic could affect coastal and marine birds in coastal feeding, resting, or breeding/nesting habitats. Disturbance can result in reduced use or desertion of the affected habitats by coastal and marine birds (USDOI, MMS, 1985a). Similarly, OCS-related helicopter traffic could disturb feeding, resting, breeding or nesting behavior of birds, or cause abandonment of preferred habitat. Disturbance by either service-vessel or helicopter traffic could contribute to population declines by relocation of birds to areas where they may experience increased environmental or physiological stress.

Pipeline landfalls and coastal construction can displace coastal and marine birds from coastal feeding, roosting, or nesting habitats (Wicker and Rabalais, 1988). The dredging of pipeline channels across coastal habitats can alter coastal processes and create zones of weakness that can result in accelerated erosion and landscape changes in the vicinity of the landfall. The actual dredging can displace coastal and marine birds, and the resultant habitat may be so changed that it is no longer suitable as feeding, resting, or nesting habitat. Coastal construction may require dredging or filling of coastal habitats to create the necessary foundation for facilities that will service OCS oil and gas activities. The altered habitat, plus some small amount of surrounding area, will no longer be suitable as feeding, resting, or nesting habitat for coastal and marine birds. Displacement could contribute to population declines by relocation of birds to areas where they may experience increased environmental or physiological stress.

Coastal and marine birds can become entangled in monofilament fishing line, netting, 6-pack yokes, etc., which may result in injury or mortality. Ingestion of plastic and styrofoam materials may cause internal blockage, resulting in injury or mortality (Centaur Associates, Inc. and Center for Environmental Education, 1986). Ingested plastic may impair feeding activity where plastic reduces the food storage volume of the stomach and limits the accumulation of fat reserves essential for reproduction and migration (Ryan, 1988). 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), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989.

### *(a) Nonendangered and Nonthreatened Species*

*Base Case Analysis*

The Gulf of Mexico is populated by migrant and nonmigrant species of coastal and marine birds. This broad category consists of four main groups: seabirds, waterfowl, wading birds, and shorebirds. The major impact-producing factors analyzed below are related to the proposed action and include oil spills, OCS helicopter and service-vessel traffic, pipeline landfalls and coastal facility construction, and oil- and gas-related plastic debris.

In the event that oiling of coastal and marine birds should occur from sale-related spills, the effect of any oiling is expected to be lessened due to the nature of Southern Louisiana crude: directly, by its chemical composition and traits; and indirectly, by an increase in the percentage of survival from rehabilitation efforts. The effect of spilled oil on coastal and marine birds is expected to result in a partial, short-term decrease in a local population within the vicinity of spilled oil.

In the event that sale-related oil spills should occur in critical feeding habitats of coastal and marine birds, sublethal and some lethal effects are expected. Sublethal effects are expected to be lessened by deterrence of birds away from the oiled area and improved coastal oil-spill contingency planning and response (Section

IV.C.5.). Sublethal effects of spilled oil reaching critical feeding habitats are expected to result in a partial, short-term decrease in a local population within the vicinity of the affected feeding habitats.

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring from the proposed action in the CPA. It is assumed that 21 offshore spills and fewer than 10 onshore spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action. Few of the total spills will contact the coastline. It is assumed that 1 spill greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action and that it will not contact the coastline. For the purpose of this analysis, it is assumed that spills less than 1,000 bbl will seldom contact and affect feeding, resting, or nesting habitats. The effect from spills less than 1,000 bbl on Gulf coastal and marine birds is expected to be negligible.

Section IV.C.1. estimates the mean number of oil spills greater than or equal to 1,000 bbl resulting from the proposed action in the CPA. It is assumed that one crude oil spill greater than or equal to 1,000 bbl will occur from either a platform or pipeline in the Central Gulf during the 35-year life of the proposed action (median size is 6,500 bbl). Table IV-21 identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days feeding, resting, or nesting habitats of coastal and marine birds in the CPA. The highest probability of one or more oil spills greater than or equal to 1,000 bbl greater than 1,000 bbl occurring and contacting within 10 days a coastal bay in the Central Gulf is 1 percent (Timbalier Bay). The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days deltaic marshes is 1 percent. For the purpose of this analysis, it is assumed that an oil spill greater than or equal to 1,000 bbl will seldom contact and affect the feeding, resting, or nesting habitats in the CPA. The effect from an oil spill greater than or equal to 1,000 bbl on Gulf coastal and marine birds is expected to be negligible.

The majority of coastal and marine bird feeding habitats occur nearshore. The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days nearshore areas and coastline along the Central Gulf is 2 percent. For the purpose of this analysis, it is estimated that an oil spill greater than or equal to 1,000 bbl will seldom contact and affect nearshore areas and coastline critical to the feeding of coastal and marine birds in the CPA. The effect on Gulf coastal and marine birds is expected to be negligible.

It is assumed that no spills greater than equal to 1,000 bbl originating from OCS tankering, will occur and contact within 10 days a Central Gulf bay, estuary, or nearshore area. For the purpose of this analysis, it is assumed that an oil spill greater than or equal to 1,000 bbl and originating from OCS-related tankering will not interact with Gulf coastal and marine birds.

Helicopter and service-vessel traffic related to OCS activities could disturb feeding, resting, or nesting behavior of birds or cause abandonment of preferred habitat. This impact-producing factor could contribute to population losses by displacement of birds to areas where they may experience increased environmental or physiological stress.

The FAA Advisory Circular 91-36C prohibits the use of fixed-wing aircraft lower than an elevation of 152 m and helicopters lower than 300 m during the period of October 15 through April 15 in the vicinity of numerous national wildlife refuges along the Gulf Coast in order to prevent disturbances to the birds (Biological Opinion Section 7 Consultation, Proposed Exploration Plans for OCS in the Gulf of Mexico; FWS/OES 375.0). The majority of these wildlife refuges provide important feeding, resting, and nesting areas for coastal and marine birds. Although an incident may occur and be disruptive, the effect is, at worst, of a temporary nature. It is assumed that helicopter traffic will not disturb Gulf coastal and marine birds because of special prohibitions and adherence to the general, FAA-recommended minimum ceiling of 300 m. For the purpose of this analysis, it is assumed that OCS-related flights at the appropriate altitude will seldom disturb Gulf coastal and marine birds. The effect of OCS-related flights on Gulf coastal and marine birds is expected to be negligible.

It is assumed that about 500 OCS-related oil and gas service-vessel trips will occur annually as a result of the proposed action and that 2 shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-2). For the purpose of this analysis, it is assumed that service-vessel traffic will seldom disturb Gulf coastal and marine birds. The effect of service-vessel traffic on Gulf coastal and marine birds will be negligible.

Disturbance of coastal and marine bird nesting and feeding habitats from pipeline landfalls and onshore construction could result in a reduction of or desertion by birds that use the habitats. It is assumed that no new OCS oil- and gas-related pipeline landfalls or coastal facilities will be constructed as a result of the proposed action in the CPA. For the purpose of this analysis, it is estimated that pipeline landfalls and onshore construction will not interact with feeding, resting, or nesting habitats of Gulf coastal and marine birds.

Coastal and marine birds can become entangled in or ingest trash and debris. Interaction with plastic materials can be especially injurious and cause mortalities. It is expected that coastal and marine birds will seldom become entangled in or ingest OCS-related trash and debris. 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), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. For the purpose of this analysis, it is assumed that OCS oil- and gas-related plastic debris will seldom interact with Gulf coastal and marine birds, and therefore, the effect will be negligible.

*Summary*

Activities resulting from the proposed action have the potential to affect Central Gulf coastal and marine birds detrimentally. It is expected that the effects from the major impact-producing factors on coastal and marine birds are negligible and of nominal occurrence. As a result, there will no discernible disturbance to Gulf coastal and marine birds.

*Conclusion*

The impact of the Base Case scenario on nonendangered and nonthreatened coastal and marine birds within the potentially affected area is expected to result in no discernible decline in a population or species and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to predisturbance condition in less than one generation.

*High Case Analysis*

The major impact-producing factors analyzed below are related to the proposed action and include oil spills, OCS helicopter and service-vessel traffic, pipeline landfalls and coastal facility construction, and oil- and gas-related plastic debris.

In the event that oiling of coastal and marine birds should occur from sale-related spills, the effect of any oiling is expected to be lessened due to the nature of Southern Louisiana Crude: directly, by its chemical composition and traits; and indirectly, by an increase in the percentage of survival from rehabilitation efforts. The effect of spilled oil on coastal and marine birds is expected to result in a partial, short-term decrease in a local population within the vicinity of spilled oil.

In the event that sale-related oil spills should occur in critical feeding habitats of coastal and marine birds, sublethal effects are expected. These are expected to be lessened by deterrence of birds away from the oiled area and improved coastal oil-spill contingency planning and response (Section IV.C.5.). Sublethal effects of spilled oil within critical feeding habitats of coastal and marine birds are expected to result in a partial, short-term decrease in a local population within the vicinity of the affected feeding habitats.

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring from the proposed action in the CPA. It is assumed that 47 offshore spills and fewer than 10 onshore spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action. Few of the offshore spills will contact the coastline. It is assumed that 2 spills greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action and that they will not contact the coastline. For the purpose of this analysis, it is assumed that spills less than 1,000 bbl will seldom contact and affect feeding, resting, or nesting habitats. The effect on Gulf coastal and marine birds is expected to be negligible.

Section IV.C.1. estimates the mean number of oil spills greater than or equal to 1,000 bbl resulting from the proposed action in the CPA. It is assumed that one crude oil spill greater than or equal to 1,000 bbl will occur from either a platform or pipeline in the Central Gulf during the 35-year life of the proposed action (median size is 6,500 bbl). Table IV-21 identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days feeding, resting, or nesting habitats within 10 days. The highest probability of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days a coastal bay in the Central Gulf is 2 percent (Timbalier Bay). The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days deltaic marshes is 2 percent. For the purpose of this analysis, it is assumed that an oil spill greater than 1,000 bbl will seldom contact and affect the feeding, resting, or nesting habitats in the CPA. The effect from oil spills greater than or equal to 1,000 bbl on Gulf coastal and marine birds is expected to be negligible.

The majority of coastal and marine bird feeding habitats occur nearshore. The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days nearshore areas (coastline) along the Central Gulf is 4 percent. For the purpose of this analysis, it is estimated that an oil spill greater than or equal to 1,000 bbl will seldom contact and affect nearshore areas (coastline) critical to the feeding of coastal and marine birds in the CPA. The effect on Gulf coastal and marine birds is expected to be negligible.

It is assumed that no spills greater than or equal to 1,000 bbl originating from OCS tankering will occur and contact within 10 days a Central Gulf bay, estuary, or nearshore area. For the purpose of this analysis, it is estimated that an oil spill from OCS tankering will not interact with Gulf coastal and marine birds.

Helicopter and service-vessel traffic related to OCS activities could disturb feeding, resting, or nesting behavior of birds or cause abandonment of preferred habitat. This impact-producing factor could contribute to population losses by displacement of birds to areas where they may experience increased environmental or physiological stress.

The FAA Advisory Circular 91-36C prohibits the use of fixed-wing aircraft lower than an elevation of 152 m and helicopters lower than 300 m during the period of October 15 through April 15 in the vicinity of numerous national wildlife refuges along the Gulf Coast to prevent disturbances to the birds (Biological Opinion Section 7 Consultation, Proposed Exploration Plans for OCS in the Gulf of Mexico; FWS/OES 375.0). The majority of these wildlife refuges provide important feeding, resting, and nesting areas for coastal and marine birds. Although an incident may occur and be disruptive, the effect is, at worst, of a temporary nature. It is assumed that helicopter traffic will not disturb Gulf coastal and marine birds because of special prohibitions and adherence to the general, FAA-recommended minimum ceiling of 300 m. For the purpose of this analysis, it is assumed that OCS-related flights at the appropriate altitude will seldom disturb Gulf coastal and marine birds. The effect on Gulf coastal and marine birds is expected to be negligible.

It is assumed that about 880 OCS-related oil and gas service-vessel trips will occur annually as a result of the proposed action and that 5 shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-2). For the purpose of this analysis, it is assumed that service-vessel traffic will seldom disturb Gulf coastal and marine birds. The effect on Gulf coastal and marine birds is expected to be negligible.

Disturbance of coastal and marine bird nesting and feeding habitats from pipeline landfalls and onshore construction could result in a reduction of or desertion by birds that use the habitats. It is assumed that no new OCS oil- and gas-related pipeline landfalls and one pipeyard will be constructed as a result of the proposed action in the CPA. For the purpose of this analysis, it is estimated that pipeline landfalls and onshore construction will not interact with feeding, resting, or nesting habitats of Gulf coastal and marine birds.

Coastal and marine birds can become entangled in or ingest trash and debris. Interaction with plastic materials can be especially injurious and cause mortalities. It is assumed that coastal and marine birds will seldom become entangled in or ingest OCS-related trash and debris. 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), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. For the purpose of this analysis, it is assumed that OCS oil- and gas-related plastic debris will seldom interact with seabirds. The effect on Gulf coastal and marine birds is expected to be negligible.

Activities resulting from the proposed action have the potential to affect Central Gulf coastal and marine birds detrimentally. It is expected that the effects from the major impact-producing factors on coastal and marine birds are negligible and of nominal occurrence. As a result, there will no discernible disturbance to Gulf coastal and marine birds.

*Conclusion*

The impact of the High Case scenario on coastal and marine birds within the potentially affected area is expected to result in no discernible decline in a population or species and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to predisturbance condition in less than one generation.

### *(b) Endangered and Threatened Species*

This section discusses the effects of the proposed action on endangered and threatened birds, including the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover. It summarizes and incorporates the discussion of the effects on the coastal and marine birds in Section IV.D.1.a.(7)(a) (nonendangered and nonthreatened birds) and additional information as cited. Oil spills, OCS service-vessel and helicopter traffic, onshore pipeline construction, and entanglement and ingestion of offshore oil- and gas-related plastic debris are sources of potential adverse impacts. The effects on birds from these impact-producing factors are discussed under nonendangered and nonthreatened birds (Section IV.D.1.a.(7)(a)). Any activity that is a result of the proposed action and that results in the mortality of an endangered or threatened bird represents a substantial impact on the species under discussion as above.

*Base Case Analysis*

It is assumed that helicopter traffic will occur on a regular basis, averaging 18,000 trips per year. The FAA Advisory Circular 91-36C prohibits the use of fixed-wing aircraft lower than an elevation of 152 m and helicopters lower than 300 m during the period of October 15 through April 15 in the vicinity of numerous national wildlife refuges in the Gulf of Mexico to prevent disturbances to the birds (Biological Opinion - Section 7 Consultation, Proposed Exploration Plans for OCS in the Gulf of Mexico; FWS/OES 375.0). The majority of these wildlife refuges provide important critical habitats (feeding, resting, or nesting areas) for endangered and threatened species. Although interactions may occur and be disruptive, effects are expected to be sublethal and, at worst, of a temporary nature. It is expected that helicopter traffic near critical feeding, resting, or nesting areas will seldom disturb the brown pelican, Arctic peregrine falcon, bald eagle, or piping plover because of special prohibitions and adherence to the general, FAA-recommended minimum ceiling of 300 m.

It is assumed that about 500 OCS-related oil and gas service-vessel trips will occur annually as a result of the proposed action and that 2 shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-2). Most of the OCS-related oil and gas traffic occurs in and out of areas that are well away from critical habitats for feeding, resting, or nesting areas of the Arctic peregrine falcon, bald eagle, or piping plover. Some OCS-related service vessel traffic occurs in the vicinity of Cameron, Intracoastal City, Morgan City, and Venice, Louisiana, within several miles of critical feeding, resting, or nesting habitats for the brown pelican (Table IV-15). Although incidents may occur and be disruptive, effects are expected to be sublethal and, at worst, of a temporary nature. It is expected that service-vessel traffic will seldom disturb the brown pelican.

Disturbance of brown pelican and piping plover critical feeding, resting, or nesting habitats from pipeline landfalls and onshore construction could result in a reduction or desertion of birds that use the habitats. It is assumed that no new OCS oil- and gas-related pipeline landfalls or coastal facilities will be constructed as a result of the proposed action in the CPA (Section IV.A.3.b.). It is estimated that pipeline landfalls and onshore construction will not interact with critical feeding, resting, or nesting habitats of the brown pelican, Arctic peregrine falcon, or piping plover.

The brown pelican, Arctic peregrine falcon, bald eagle, and piping plover can become entangled in or ingest trash and debris. Interaction with plastic materials can be especially injurious. 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), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. It is assumed that very little trash and debris will be lost into the Gulf of Mexico as a result of the proposed action. Although interactions may occur, effects are expected to be sublethal. It is expected that the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover will seldom become entangled in or ingest OCS-related trash and debris.

When an oil spill occurs, many factors interact to influence the severity of effects and the extent of damage to endangered and threatened birds. Important factors include geographic location, oil type, amount of oil, impact area, oceanographic conditions, meteorological conditions, and season (NRC, 1985; USDOI, MMS, 1987b). The direct effect of oiling on birds occurs through the matting of feathers and subsequent loss of body insulation and water-repellency, the ingestion of oil, the depression of egg-laying activity, and the reduction of hatching success (Holmes and Cronshaw, 1977; Ainley et al., 1981; Peakall et al., 1981). Transfer of oil from adults to eggs and young during nesting results in significant mortality for new eggs and deformities in hatchlings from eggs further along in incubation (Clapp et al., 1982a). Indirect effects of oil spills include contamination, displacement, and reduction of food sources. Food contamination may cause less severe, sublethal effects decreasing survival and fecundity, affecting behavior, and decreasing survival of young. Less severe, sublethal effects are defined as those that impair the ability of an organism to function effectively without causing direct mortality (NRC, 1985).

In the event that oiling of the brown pelican, Arctic peregrine falcon, bald eagle, or piping plover should occur from sale-related oil spills greater than or equal to 1,000 bbl (1 spill of 6,500 bbl is assumed), the effects would primarily be sublethal; few mortalities are expected. The effects of sale-related oil spills less than 1,000 bbl are expected to be solely sublethal due to the small area affected. In the event that sale-related oil spills of any size should occur in critical habitats for feeding, resting, or nesting, such as inshore, intertidal, and nearshore areas, sublethal effects are expected. It is expected that the extent and severity of effects from sale-related oil spills of any size will be lessened by improved coastal oil-spill contingency planning and response, deterrence of birds away from the immediate area of an oil spill, and increased percentage of survival from rehabilitation efforts (Section IV.C.5.).

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring from the proposed action in the CPA. It is assumed that 21 offshore spills and fewer than 10 onshore spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action. Few of the offshore spills will contact the coastline. It is assumed that 1 offshore spill greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action, and it is estimated that the spill will not contact the coastline. Although an interaction with spills less than 1,000 bbl may occur, only sublethal effects are expected. It is estimated that small spills less than 1,000 bbl will seldom contact and affect the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover.

Section IV.C.1. estimates the mean number of spills greater than or equal to 1,000 bbl resulting from the proposed action in the CPA. It is assumed that one crude oil spill greater than or equal to 1,000 bbl will occur from either a platform or pipeline in the Central Gulf during the 35-year life of the proposed action (median size is 6,500 bbl). Table IV-21 identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days critical habitats for feeding, resting, or nesting of the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover in the CPA. The highest probability of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days a coastal bay in the Central Gulf is 1 percent (Timbalier Bay). The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days deltaic marshes is 1 percent. Although an interaction with spills greater than or equal to 1,000 bbl may occur, infrequent mortalities are expected with primarily sublethal effects. It is expected that an oil spill greater than or equal to 1,000 bbl will seldom contact and affect the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover in the CPA.

Some critical feeding habitats of the brown pelican, Arctic peregrine falcon, and piping plover occur nearshore. The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days nearshore areas (coastline) along the Central Gulf is 2 percent. Although an incident may occur, sublethal effects are expected. It is estimated that an oil spill greater than or equal to 1,000 bbl will seldom contact and affect nearshore areas (coastline) critical to the feeding of the brown pelican, Arctic peregrine falcon, and piping plover.

*Summary*

The brown pelican, Arctic peregrine falcon, bald eagle, and piping plover may be impacted by helicopter and service-vessel traffic, onshore pipeline landfalls, entanglement in and ingestion of offshore oil- and gas-related plastic debris, and oil spills. The effects of these activities are expected to be sublethal. Lethal effects are expected only from oil spills greater than or equal to 1,000 bbl. Sale-related oil spills of any size are expected to seldom contact threatened and endangered birds or their critical feeding, resting, or nesting habitats.

*Conclusion*

The impact of the Base Case scenario on endangered and threatened birds within the potentially affected area is expected to result in no discernible decline in a population or species, and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to predisturbance condition in less than one generation.

*High Case Analysis*

It is assumed that helicopter traffic will occur on a regular basis, averaging about 31,000 trips per year. The FAA Advisory Circular 91-36C prohibits the use of fixed-wing aircraft lower than an elevation of 152 m and helicopters lower than 300 m during the period of October 15 through April 15 in the vicinity of numerous national wildlife refuges in the Gulf of Mexico to prevent disturbances to the birds (Biological Opinion - Section 7 Consultation, Proposed Exploration Plans for OCS in the Gulf of Mexico; FWS/OES 375.0). The majority of these wildlife refuges provide critical habitats (feeding, resting, or nesting areas) for endangered and threatened species. Although interactions may occur and be disruptive, effects are expected to be sublethal and at worst of a temporary nature. It is expected that helicopter traffic near critical feeding, resting, or nesting habitats will seldom disturb the brown pelican, Arctic peregrine falcon, bald eagle, or piping plover because of special prohibitions and adherence to the general FAA-recommended minimum ceiling of 300 m.

It is assumed that about 880 OCS-related oil and gas service-vessel trips will occur annually as a result of the proposed action and that during the 35-year life of the proposed action 5 shuttle tanker trips will occur (Table IV-2). These trips represent a meager amount of the total annual vessel traffic in the Gulf of Mexico. Most OCS-related oil and gas traffic occurs in and out of existing port areas that are well away from critical habitats for feeding, resting, or nesting areas of the Arctic peregrine falcon, bald eagle, or piping plover. Some OCS-related service vessel traffic occurs in the vicinity of Cameron, Intracoastal City, Morgan City, and Venice, Louisiana, within several miles of critical habitats (feeding, resting, or nesting areas) for the brown pelican. Although incidents may occur and be disruptive, effects are expected to be sublethal and, at worst, of a temporary nature. It is expected that service-vessel traffic will seldom disturb the brown pelican.

Disturbance of brown pelican and piping plover critical habitats (feeding, resting or nesting areas) from pipeline landfalls and onshore construction could result in a reduction or desertion of birds that use the habitats. It is assumed that no new OCS oil- and gas-related pipeline landfalls or coastal facilities will be constructed as a result of the proposed action in the CPA. It is estimated that pipeline landfalls and onshore construction will not interact with critical feeding, resting, or nesting habitats of the brown pelican, Arctic peregrine falcon, or piping plover.

The brown pelican, Arctic peregrine falcon, bald eagle, and piping plover can become entangled in or ingest trash and debris. Interaction with plastic materials can be especially injurious. 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), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. It is assumed that very little trash and debris will be lost into the Gulf of Mexico as a result of the proposed action. Although interactions may occur, effects are expected to be sublethal. It is expected that the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover will seldom become entangled in or ingest OCS-related trash and debris.

In the event that oiling of the brown pelican, Arctic peregrine falcon, bald eagle, or piping plover should occur from sale-related oil spills greater than or equal to 1,000 bbl, the effects would primarily be sublethal; few mortalities are expected. The effects of sale-related oil spills less than 1,000 bbl are expected to be sublethal. In the event that sale-related oil spills of any size should occur in critical feeding, resting, or nesting habitats, such as inshore, intertidal, and nearshore areas, of the brown pelican, Arctic peregrine falcon, and piping plover, sublethal effects are expected. The extent and severity of effects from sale-related oil spills will be lessened by improved coastal oil-spill contingency planning and response, deterrence of birds away from the oiled area, and increased percentage of survival from rehabilitation efforts (Section IV.C.5.).

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring from the proposed action in the CPA. It is assumed that 47 offshore spills and fewer than 10 onshore spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action. Few of the offshore spills will contact the coastline. It is assumed that 2 offshore spills greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action and that they will not contact the coastline. Although an interaction with chronic spills may occur, only sublethal effects are expected. It is estimated that small spills will seldom contact and affect the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover.

Section IV.C.1. estimates the mean number of oil spills greater than or equal to 1,000 bbl resulting from the proposed action in the CPA. It is assumed that one crude oil spill greater than or equal to 1,000 bbl will occur from either a platform or pipeline in the Central Gulf during the 35-year life of the proposed action (median size is 6,500 bbl). Table IV-21 identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days critical habitats for feeding, resting, or nesting of the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover in the CPA. The highest probability of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days a coastal bay in the Central Gulf is 2 percent (Timbalier Bay). The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days deltaic marshes is 2 percent. Although an interaction with spills greater than or equal to 1,000 bbl may occur, primarily sublethal effects are expected with infrequent mortalities. It is expected that an oil spill greater than or equal to 1,000 bbl will seldom contact and affect the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover in the CPA.

Some feeding habitats of the brown pelican, Arctic peregrine falcon, and piping plover occur nearshore. The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days nearshore areas (coastline) along the Central Gulf is 2 percent. Although an incident may occur, sublethal effects are expected. It is estimated that an oil spill greater than or equal to 1,000 bbl will seldom contact and affect nearshore areas (coastline) critical to the feeding of the brown pelican, Arctic peregrine falcon, and piping plover.

The brown pelican, Arctic peregrine falcon, bald eagle, and piping plover may be impacted by helicopter and service-vessel traffic, onshore pipeline landfalls, entanglement in and ingestion of offshore oil- and gas-related plastic debris, and oil spills. The effects of these activities are expected to be sublethal. Lethal effects are expected only from oil spills greater than or equal to 1,000 bbl. Sale-related oil spills of any size are expected to seldom contact threatened and endangered birds or their critical habitats for feeding, resting, or nesting habitats.

*Conclusion*

The impact of the High Case scenario on endangered and threatened birds within the potentially affected area is expected to result in no discernible decline in a population or species, and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to predisturbance condition in less than one generation.

### *(8) Impacts on the Gulf Sturgeon*

Oil can affect Gulf sturgeon by direct ingestion or ingestion of prey, by absorption through gills and epithelium, and by mortality of eggs and larvae (NRC, 1985). Linden et al. (1979) notes that life stages with limited mobility are most susceptible to oil. He also discusses how the stress of contacting oil, combined with other environmental factors, can impair the functioning and survival of fish. Oil spills are the only activity associated with the proposed action that are likely to impact the Gulf sturgeon. The analysis discusses oil spills of three different sizes because of the difference in their frequency and rate of dispersion.

*Base Case Analysis*

Contact with or ingestion/absorption of oil can result in mortality or sublethal effects. Section IV.C.1. estimates that 21 offshore spills and fewer than 10 onshore spills greater than 1 and less than or equal to 50 bbl will occur in the CPA. Few are assumed to occur from pipelines in the Louisiana coastal zone and several from shuttle tankers/barges near terminals in the coastal zone. The spills will originate from areas with the greatest density of platforms and largest volume of pipeline flow. Few of the 21 spills will contact the coast. Based on the number and rate of these spills and their rate of dispersion (Sections IV.C.1. and 2.), the assumption is that juvenile or adult Gulf sturgeon will contact or ingest hydrocarbons from these spills. Few mortalities are expected; primarily sublethal effects are expected. No eggs or larvae will be contacted because there is no spawning near OCS oil and gas activities.

It is assumed that one offshore spill greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action, but it will not contact the coastline. The occurrence of a single spill less than 1,000 bbl suggests that Gulf sturgeon will not be contacted.

Section IV.C.1. estimates that one oil spill greater than or equal to 1,000 bbl (median size of 6,500 bbl) will occur in the CPA during the 35-year life of the proposed action. There is a 1 percent probability that an oil spill greater than or equal to 1,000 bbl would occur and contact within 10 days coastal Plaquemines and Terrebonne Parishes in Louisiana. All other coastal areas have less than a 0.5 percent probability of an occurrence and contact. This analysis assumes that Gulf sturgeon will not ingest or contact hydrocarbons from a spill greater than or equal to 1,000 bbl.

*Summary*

The Gulf sturgeon can be impacted by oil spills resulting from the proposed action.

*Conclusion*

The impact of the Base Case scenario on the Gulf sturgeon within the potentially affected area is expected to result in sublethal effects and cause short-term physiological or behavioral changes.

*High Case Analysis*

Table IV-2 estimates that 47 offshore spills and fewer than 10 onshore spills greater than 1 and less than or equal to 50 bbl will occur in the CPA. A few are assumed to occur from pipelines in the Louisiana coastal zone and several from shuttle tankers/barges near terminals in the coastal zone. The small spills will originate from areas with the greatest density of platforms and largest volume of pipeline flow. Few of the 47 spills will contact the coast. Based on the number and rate of these spills and their rate of dispersion (Sections IV.C.1. and 2.), the assumption is that juvenile or adult Gulf sturgeon will contact or ingest hydrocarbons from these spills. Few mortalities are expected; primarily sublethal effects are expected. No eggs or larvae will be contacted because there is no spawning near OCS oil and gas activities.

It is assumed that two offshore spills greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action, but they will not contact the coastline. The occurrence of two spills suggests that Gulf sturgeon will not be contacted.

Section IV.C.1. estimates that one oil spill greater than or equal to 1,000 bbl (median size of 6,500 bbl) will occur in the CPA during the 35-year life of the proposed action. There is a 2 percent probability that one or more oil spills greater than or equal to 1,000 bbl would occur and contact within 10 days Gulf sturgeon habitat in coastal Plaquemines and Terrebonne Parishes and a 1 percent probability of occurrence and contact within 10 days in Barataria Bay, Louisiana. All other coastal areas have less than a 0.5 percent probability of an occurrence and contact within 10 days. This analysis assumes that Gulf sturgeon will not ingest or contact hydrocarbons from a spill greater than or equal to 1,000 bbl.

*Conclusion*

The impact of the High Case scenario on the Gulf sturgeon within the potentially affected area is expected to result in sublethal effects and cause short-term physiological or behavioral changes.

### *(9) Impacts on Commercial Fisheries*

Effects on commercial fisheries from activities associated with the proposed action could come from emplacement of production platforms, underwater OCS obstructions, production platform removals, seismic surveys, oil spills, subsurface blowouts, and OCS discharges of drilling muds and produced waters. Potential effects from these impact-producing factors are described below.

Sections providing supportive material for the commercial fisheries analysis include Sections III.B.6. (description of fish resources), III.C.3. (commercial fishing stocks and activities), IV.A.2.d.(3) (use conflicts), IV.A.2.b.(1) (pipelines), IV.A.2.a.(3) (structure removal), IV.A.2.a.(1) (seismic operations), IV.C.3. (oil spills), IV.A.2.d.(8) (subsurface blowouts), IV.A.2.d.(5) (offshore discharges), and IV.A.3.c.(5) (onshore discharges).

The emplacement of a production platform, with a surrounding 100-m navigational safety zone, results in the loss of approximately 6 ha of bottom trawling area to commercial fishermen and causes space-use conflicts. Gear conflicts from underwater OCS obstructions such as pipelines result in losses of trawls and shrimp catch, business downtime, and vessel damage. However, all pipelines in water depths less than 69 m (200 ft) will be buried, and their locations made public knowledged (Alpert, 1990). Although Gulf fishermen are experiencing some economic loss from gear conflicts, the economic loss for a fiscal year has historically been less than 1 percent of the value of that same fiscal year's commercial fisheries landings. In addition, most financial losses from gear conflicts are covered by the Fishermen's Contingency Fund (FCF).

Lessees are required to remove all structures and underwater obstructions from their leases in the Federal OCS within one year of the lease's relinquishment or termination of production. In 1990, MMS processed 97 structure removals. More platforms are removed by severing platform pilings with plastic explosives placed 5 m below the seafloor. The concussive force is lethal to fish that have internal air chambers (swim bladders), are demersal, or are in close association with the platform being removed (Caillouet and Landry, 1989). Within the past decade, stocks of demersal reef fish (snappers) have declined in the Gulf. There is concern over a possible connection between this decline and the explosive removal of platforms. To examine this issue of concern, MMS has funded a study, scheduled to begin in 1992, of fish mortality associated with structure removal. This study will further attempt to relate the role of fish mortalities from platform removals to the status of reef fish stocks in the Gulf of Mexico (USDOI, MMS, 1990a).

The sources of acoustical pulse used in seismic surveys are generated by airguns. Airguns have little effect on even the most sensitive fish eggs at distances of 5 m from the discharge (Falk and Lawrence, 1973). In general, the acoustical pulse from airguns has relatively little effect on marine invertebrates, presumably due to their lack of a swim bladder. Available scientific information concerning the effects of acoustic airgun sources on fish eggs and larvae indicates that commercial fishery resources are little disturbed by seismic surveys (Wingert, 1988).

When an oil spill occurs, many factors interact to limit the severity of effects and the extent of damage to commercially important fish populations. The direct effects of spilled oil on fish occur through the ingestion of oil or oiled prey, the uptake of dissolved petroleum products through the gills and epithelium by adults and juveniles, and through mortality of eggs and decreased survival of larvae (NRC, 1985). Adult finfish themselves may actively avoid an oil spill, thereby limiting the effects and lessening the extent of damage to their population. When contacted by spilled oil, floating eggs and larvae, with their limited mobility, and most juvenile fish are killed (Linden et al., 1979; Longwell, 1977). Ordinary environmental stresses may increase the sensitivity of fish to oil toxicity. These stresses may include changes in salinity, temperature, and food abundance (Evans and Rice, 1974; NRC, 1985).

The effects from oil spills less than 1,000 bbl differ in severity and kind from those of spills greater than or equal to 1,000 bbl. An OCS-related spill greater than or equal to 1,000 bbl certainly can be a long-term catastrophic event; however, such an event seldom occurs and the oil will eventually disappear due to physical-chemical processes and complex degradation (NRC, 1985). On a much smaller scale, oil spills less than 1,000 bbl may not have the same immediate effect that a spill greater than 1,000 bbl has on commercial fishery resources, but if such events are relatively common, spills less than 1,000 bbl may be a more serious problem, causing continued irritation and/or sublethal toxic effects. Less severe, sublethal effects are defined as those that impair the ability of an organism to function effectively without causing direct mortality (Linden et al., 1979).

The effects on and the extent of damage from an oil spill to Gulf commercial fisheries is restricted by time and location. Oil spills that contact coastal bays, estuaries, and waters of the OCS when high concentrations of pelagic eggs and larvae are present have the greatest potential to damage commercial fishery resources. Migratory species, such as mackerel, cobia, and crevalle could be impacted if oil spills contact nearshore open waters. The majority of the Gulf's fishes are estuary dependent. The effects from an oil spill contacting a large area of a Gulf estuary would be considerable on local populations of commercial fishery resources, such as menhaden, shrimp, and blue crabs, that use that area as a nursery and/or spawning ground. The effects from chronic oiling in Gulf coastal wetlands would be substantial on all life stages of a local population of a sessile fishery resource such as oysters.

For OCS-related oil spills to have a substantial effect on a commercial fishery resource, whether estuary dependent or not, a large number of eggs and larvae would have to be concentrated in the immediate spill area. Oil components also would have to be present in highly toxic concentrations when both eggs and larvae were in the pelagic stage (Longwell, 1977). There is no evidence at this time that commercially important Gulf fishery resources have been adversely affected on a regional population level by spills or chronic oiling (NRC, 1985). The effects may be masked by natural fluctuations in populations and our present crude stock assessment methods (NRC, 1985).

Subsurface oil-well blowouts resuspend sediments and release varying amounts of hydrocarbons into the water column (USDOI, MMS, 1987a). Both effects may be detrimental to commercial fishery resources. Resuspended sediments may clog gill epithelia of both finfish and shellfish with resultant smothering. Settlement of resuspended sediments may directly smother invertebrates or cover burrows of commercially important shellfish. Released aromatic hydrocarbons can have the same effects as spilled oil. Suspended sediments from blowouts are mostly redeposited within a few hundred meters from the blowout site. Released hydrocarbons are diluted to background levels within a few hundred meters of the blowout site and degrade quickly without major biological effect. Subsurface gas well blowouts are less of an environmental risk, resulting in resuspended sediments and short-term, increased levels of natural gas very near the source of the blowout. Natural gas consists mainly of nontoxic methane, which rapidly disperses upward into the air (Van Buuren, 1984).

Commercial fishery resources could also be adversely affected by the discharge of drilling muds and produced waters. Drilling muds contain materials 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 (NRC, 1983). Further dilution is extremely rapid in offshore waters to the extent that every substance measured in the water column is at background levels at a distance of 1,000 m of the discharge point (Ecomar, Inc., 1980).

In addition to toxic trace elements and hydrocarbons in produced waters, there are additional components and properties, such as hypersalinity, organic acids, and radionuclides, that have a potential to affect commercial fishery resources adversely. Produced waters that are discharged offshore are diluted, dispersed rapidly, and undetectable at a distance of 1,000 m from the discharge point, and detectable effects are limited to within 300 m of the source (Harper, 1986; Rabalais et al., 1991). There will be no onshore discharge of produced water from the proposed action. Produced water will be disposed of onshore by reinjection or discharge into the Mississippi River (Section IV.B.1.c.(3)(d.).

*Base Case Analysis*

The major impact-producing factors analyzed below are related to the proposed action and include underwater OCS obstructions, OCS drilling mud discharge, production platform removal, production platform emplacement, OCS produced-water discharge, seismic surveys, oil spills, and subsurface blowouts.

Gear conflicts are caused by underwater OCS obstructions such as pipelines. Section IV.A.2.b.(1) estimates the kilometers of offshore pipeline resulting from the proposed action in the CPA. It is expected that 240 km of pipeline will be installed in the CPA during the 35-year life of the proposed action (Table IV-2). In Subarea C-1, the area of concentrated bottom trawl fishing, only 20 percent, or 48 km, of pipeline will be installed during the 35-year life of the proposed action, with 8 km installed during the peak year. Gear conflicts are mitigated by the FCF. During FY 90, 198 claims were processed, with 77 percent being approved for a total of $836,798. This economic loss from gear conflicts for FY 90 was less than 0.1 percent of the value ($640 million) of Gulf commercial fisheries landings for 1990. For the purpose of this analysis, it is assumed that installed pipelines will seldom conflict with bottom trawl fishing and will have a negligible effect on Central Gulf fisheries.

Drilling mud discharges (Table IV-2) 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. Offshore discharges of drilling muds will rapidly dilute to background levels and have a negligible effect on Central Gulf fisheries.

Structure removal results in artificial habitat loss and causes fish kills when explosives are used. Section IV.A.4.b.(5) estimates that 20 structure removals using explosives will occur in the CPA during the 35-year life of the proposed action. It is assumed that these removals will occur during the last 12 years of the life of the proposed action and no more than 5 will occur in any single year (Table IV-2). For the purpose of this analysis, it is assumed that structure removals will have a negligible effect on Central Gulf fisheries because removals kill only those fish proximate to the removal site.

Thirty offshore platform complexes (Table IV-2) are expected to result from the proposed action, eliminating 120 ha (296 ac) of the trawling area during the peak year of activity of the proposed action in the CPA. In Subarea C-1, the area of concentrated bottom trawl fishing, only 6 platform complexes will be installed, eliminating 90 ha (223 ac). For the purpose of this analysis, it is assumed that space-use conflicts seldom occur. The effect of space loss to trawl fishing in the Gulf from the construction of platforms is negligible because the extent of the area lost to commercial trawling is less than 0.01 percent of the available trawl fishing area in either Subarea C-1 or in the CPA.

Seismic surveys will occur in both coastal and offshore areas of the CPA. For purposes of this analysis, it is assumed that seismic surveys will have a negligible effect on Gulf commercial fisheries because of the use of airguns.

In the event that sale-related oil spills should occur in coastal bays, estuaries, and waters of the OCS proximate to mobile adult finfish or shellfish, the effects and the extent of damage are expected to be limited and lessened due to some capability of adult fish to avoid an oil spill, to metabolize hydrocarbons, and to excrete both metabolites and parent compounds from their gills and liver. For floating eggs and larvae contacted by spilled oil, the effect is expected to be lethal. The effect of oil spills on commercial fishery resources is expected to result in a partial, long-term decrease in a commercial population, in an essential habitat, or in local fishing activity.

Section IV.C.1. estimates the mean number of oil spills less than 1,000 bbl resulting from the proposed action in the CPA. It is assumed that 21 spills greater than 1 and less than or equal to 50 bbl will occur offshore during the 35-year life of the proposed action. Few of the total spills will contact the coastline. It is assumed that 1 offshore spill greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action but it will not contact the coastline. For the purpose of this analysis, it is assumed that spills less than 1,000 bbl will seldom contact and affect the coastal bays and marshes critical to the well-being of commercial fisheries in the CPA.

Section IV.C.1. estimates the mean number of oil spills greater than or equal to 1,000 bbl resulting from the proposed action in the CPA. It is assumed that one crude oil spill greater than or equal to 1,000 bbl median size is 6,500 bbl will occur from either a platform or pipeline in the Central Gulf during the 35-year life of the proposed action. Table IV-21 identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days the coastal bays and marshes critical to the well-being of commercial fisheries in the CPA. The highest probability of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days a coastal bay in the Central Gulf is 1 percent (Timbalier Bay). The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days deltaic marshes is 1 percent. For the purpose of this analysis, it is estimated that an oil spill greater than or equal to 1,000 bbl will seldom contact and affect the coastal bays and marshes critical to the well-being of commercial fisheries in the CPA.

Although the quantity of commercial landings in the CPA of migratory species is comparatively small, these species are of high value. Migratory species could be affected by oil spills occurring in the coastal area. The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days nearshore and coastal areas along the Central Gulf is 2 percent. For the purpose of this analysis, it is estimated that an oil spill greater than or equal to 1,000 bbl will seldom contact and affect nearshore and coastal areas critical to migratory commercial fisheries in the CPA.

Oil spills greater than or equal to 1,000 bbl originating in port from OCS-related tankering include those that may occur and contact coastal bays, estuaries, and nearshore areas. It is assumed that no spills greater than or equal to 1,000 bbl from tankering will occur and contact within 10 days a Central Gulf bay, estuary, or nearshore area. For the purpose of this analysis, it is estimated that an oil spill greater than or equal to 1,000 bbl and that is OCS-related will not interact with Gulf commercial fisheries.

Subsurface blowouts of both oil and natural gas wells are detrimental to commercial fishery resources. Loss of well control and resultant blowouts seldom occur on the Gulf OCS (only 157 out of approximately 27,000 exploration and development wells since 1956, with 12 resulting in the release of more than one barrel of oil). It is assumed that there will be 4 blowouts in the CPA resulting from the proposed action during the 35-year life of the proposed action. For the purpose of this analysis, it is assumed that the infrequent subsurface blowout the may occur on the Gulf OCS will have a negligible effect on Gulf commercial fisheries.

*Summary*

Activities resulting from the proposed action have the potential to cause detrimental effects to Central Gulf commercial fisheries. It is expected that the effects from the major impact-producing factors on commercial fisheries in the CPA are inconsequential and of nominal occurrence. As a result, there will be little discernible disturbance to Gulf commercial fisheries.

*Conclusion*

The impact of the Base Case scenario on commercial fisheries within the potentially affected area is expected to result in a short-term decrease in a portion of a population of commercial importance, in an essential habitat, or in commercial fisheries on a local scale. Any affected population is expected to recover to predisturbance condition in one generation.

*High Case Analysis*

The High Case is an optimistic estimate of production and development of the proposed action. The major impact-producing factors analyzed in the High Case scenario are the same as for the Base Case and include underwater OCS obstructions, OCS drilling mud discharge, production platform removal, production platform emplacement, OCS produced water discharge, seismic surveys, oil spills, and subsurface blowouts.

Gear conflicts are caused by underwater OCS obstructions such as pipelines. Section IV.A.2.b. estimates the kilometers of offshore pipeline resulting from the proposed action in the CPA. It is expected that 400 km of pipeline will be installed in the CPA during the 35-year life of the proposed action. In Subarea C-1, the area of concentrated bottom trawl fishing, only 12 percent, or 48 km, of pipeline will be installed during the 35-year life of the proposed action, with 8 km installed during the peak year. Gear conflicts are mitigated by the FCF. During FY 90, 198 claims were processed with 77 percent being approved for a total of $836,798. This economic loss from gear conflicts for FY 90 was less than 0.1 percent of the value ($640 million) of Gulf commercial fisheries landings for 1990. For the purpose of this analysis, it is assumed that installed pipelines will seldom conflict with bottom trawl fishing and will have a negligible effect on Central Gulf fisheries.

Drilling mud discharges (Table IV-2) 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. Offshore discharges of drilling muds will rapidly dilute to background levels and have a negligible effect on Central Gulf fisheries.

Structure removal results in artificial habitat loss and causes fish kills when explosives are used. Section IV.A.2.a.(3) estimates that 24 structure removals using explosives will occur in the CPA during the 35-year life of the proposed action. It is assumed that these removals will occur during the last 12 years of the life of the proposed action and no more than 8 will occur in any single year (Table IV-2). For the purpose of this analysis, it is assumed that structure removals will have a negligible effect on Central Gulf fisheries because removals will kill only those fish proximate to the removal site.

Sixty offshore platform complexes and structures (Table IV-2) are expected to result from the proposed action, eliminating 900 ha of the trawling area during the 35-year life of the proposed action in the CPA. In Subarea C-1, the area of concentrated bottom trawl fishing, only 6 platform complexes will be installed, eliminating 90 ha (223 ac). For the purpose of this analysis, it is assumed that space-use conflicts seldom occur. The effect of space loss to trawl fishing in the Gulf from the construction of platforms is negligible because the extent of the area lost to commercial trawling is less than 0.01 percent of the available trawl fishing area in either Subarea C-1 or in the CPA.

Seismic surveys will occur in both coastal and offshore areas of the CPA. For purposes of this analysis, it is assumed that seismic surveys will have a negligible effect on Gulf commercial fisheries because of the use of airguns.

In the event that sale-related oil spills should occur in coastal bays, estuaries, and waters of the OCS proximate to mobile adult finfish or shellfish, the effects and the extent of damage are expected to be limited and lessened due to some capability of adult fish to avoid an oil spill and to metabolize hydrocarbons and to excrete both metabolites and parent compounds from their gills and liver. For floating eggs and larvae contacted by spilled oil, the effect is expected to be lethal. The effect of oil spills on commercial fishery resources is expected to result in a partial, long-term decrease in a commercial population, in an essential habitat, or in local fishing activity.

Section IV.C.1. estimates the mean number of oil spills less than 1,000 bbl resulting from the proposed action in the CPA. It is assumed that 47 spills greater than 1 and less than or equal to 50 bbl will occur offshore during the 35-year life of the proposed action. Few of the total spills will contact the coastline. It is assumed that 2 offshore spills greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action and that they will not contact the coastline. For the purpose of this analysis, it is assumed that spills less than 1,000 bbl will seldom contact and affect the coastal bays and marshes critical to the well-being of commercial fisheries in the CPA.

Section IV.C.1. estimates the mean number of oil spills greater than or equal to 1,000 bbl resulting from the proposed action in the CPA. It is assumed that one crude oil spill of 6,500 bbl will occur offshore from a pipeline in the Central Gulf during the 35-year life of the proposed action. Table IV-21 identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days the coastal bays and marshes critical to the well-being of commercial fisheries in the CPA. The highest probability of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days a coastal bay in the Central Gulf is 2 percent (Timbalier Bay). The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days deltaic marshes is 2 percent. For the purpose of this analysis, it is estimated that an oil spill greater than or equal to 1,000 bbl will seldom contact and affect the coastal bays and marshes critical to the well-being of commercial fisheries in the CPA.

Although the quantity of commercial landings in the CPA of migratory species is comparatively small, these species are of high value. Migratory species could be affected by oil spills occurring in the coastal area. The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days nearshore and coastal areas along the Central Gulf is 4 percent. For the purpose of this analysis, it is estimated that an oil spill greater than or equal to 1,000 bbl will seldom contact and affect nearshore and coastal areas critical to migratory commercial fisheries in the CPA.

Oil spills greater than or equal to 1,000 bbl originating in port from OCS-related tankering include those that may occur and contact coastal bays, estuaries, and nearshore areas. It is assumed that no spills greater than or equal to 1,000 bbl from tankering will occur and contact within 10 days a Central Gulf bay, estuary, or nearshore area. For the purpose of this analysis, it is estimated that an oil spill greater than or equal to 1,000 bbl and that is OCS-related will not interact with Gulf commercial fisheries.

Subsurface blowouts of both oil and natural gas wells are detrimental to commercial fishery resources. Loss of well control and resultant blowouts seldom occur on the Gulf OCS (only 157 out of approximately 27,000 exploration and development wells since 1956, with 12 resulting in the release of more than 1 bbl of oil). It is assumed that there will be 7 blowouts in the CPA resulting from the proposed action during the 35-year life of the proposed action. For the purpose of this analysis, it is assumed that the infrequent subsurface blowout on the Gulf OCS will have a negligible effect on Gulf commercial fisheries.

Activities resulting from the proposed action have the potential to cause detrimental effects to Central Gulf commercial fisheries. It is expected that the effects from the major impact-producing factors on commercial fisheries in the CPA are inconsequential and of nominal occurrence. As a result, there will be little discernible disturbance to Gulf commercial fisheries.

*Conclusion*

The impact of the High Case scenario on commercial fisheries within the potentially affected area is expected to result in a short-term decrease in a population of commercial importance, in an essential habitat, or in commercial fisheries on a local scale. Any affected population is expected to recover to predisturbance condition in one generation.

## *(10) Impacts on Recreational Resources and Activities*

### *(a) Beach Use*

Major recreational beaches are defined as those frequently visited sandy areas along the shoreline that are exposed to the Gulf of Mexico and that support a multiplicity of recreational activity, most of which is 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 general locations of these beaches are indicated on Visual No. 2.

The value of recreation and tourism in the Gulf of Mexico coastal zone from Texas through Florida is approaching $20 billion annually (USDOI, MMS, 1990a). A significant portion of these expenditures is made in coastal counties, where major shoreline beaches are primary recreational attractions. Almost 190,000 people, for example, visited the beaches and outer Mississippi islands of the Gulf Islands National Seashore during FY 1990, demonstrating the popularity of destination beach parks throughout the CPA as recreational resources.

The primary impact-producing factors associated with offshore oil and gas exploration and development, and most widely recognized as major threats to the enjoyment and use of recreational beaches, are trash and debris and oil spills. Additional factors such as the physical presence of platforms and drilling rigs can affect the aesthetics of beach appreciation (Section IV.A.2.d.(4)(c)), and noise from aircraft can disturb the ambience of a beach-related recreation experience (Section IV.A.3.a.(1)(b)). All these factors, either individually or collectively, may adversely affect the number and value of recreational beach visits.

Oil spills can be associated with either the exploration, production, or transportation phases of OCS operations. Major oil spills contacting recreational beaches can cause short-term displacement of recreational activity from the areas directly affected and will lead to closure of beaches directly impacted for periods of 2-6 weeks, or until the cleanup operations are complete. When an oil spill occurs, other factors such as season, publicity, extent of pollution, beach type and location, condition and type of oil washing ashore, tidal action, and cleanup methods, if any, can have a bearing on the severity of effects a spill may have on a recreational beach and its use.

Widely publicized and investigated oil spill events, such as the Santa Barbara spill of 1969, the *Ixtoc* spill in 1979 (Restrepo and Associates, 1982), the *Alvenus* tanker spill of 1984, and the 1989 *Exxon Valdez* tanker accident in Prince William Sound, Alaska, have demonstrated that oil spills greater than or equal to 1,000 bbl can severely impact beaches and their recreational use. However, findings from an indepth study of the *Ixtoc* oil-spill impact on three south Texas shoreline beach parks indicated no significant decrease in park visitations as a result of the oil spill (Freeman et al., 1985). Sorensen (1990) reviewed the socioeconomic effects of several historic major oil spills on beaches and concluded 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.

Section IV.C. presents available information on the historic oil spills from OCS operations in the Gulf, discusses the OSRA model developed for this EIS, and provides information on the extent and effectiveness of existing containment and cleanup capabilities. Most relevant to this impact analysis are the assumptions concerning the characteristics and fates of a Gulf of Mexico oil spill, indicating that the majority of oil spills occurring in the Gulf are estimated to dissipate rapidly, and that only relatively small fractions are subject to tarball formation because of the chemical properties of many northern Gulf light crude oils. (Tarballs are known to persist as long as 1-2 years in the marine environment.) The analysis of spills greater than or equal to 1,000 bbl assumes that an originating slick acutely threatens shoreline recreational resources for up to 10 days, after which natural processes significantly change the nature and form of the pollutant to the point that it is unlikely to be a major threat to beach recreational resources and activities.

Trash, debris, and tarballs from OCS operations can wash ashore on Gulf of Mexico recreational beaches and reduce their attractiveness as recreational resources (Section IV.A.2.d.(5)). Some trash items, such as glass, pieces of steel, and drums with chemical or chemical residues, can also be a health threat to users of recreational beaches. Cleanup of OCS trash and debris from coastal beaches adds to operation and maintenance costs for coastal beach and park administrators.

The physical presence of platforms and drilling rigs, when visible from shore (Section IV.A.2.d.(4)), and noise associated with vessels and aircraft (Section IV.A.3.a.(1)(b)) traveling between coastal shore bases and offshore operation sites can also adversely affect the natural ambience of primitive coastal beaches. Although these factors may affect the quality of recreational experiences, they are unlikely to reduce the number of recreation visits to coastal beaches in the CPA or WPA.

*Base Case Analysis*

Exploration and production on blocks leased in the Central Gulf of Mexico and transportation of produced oil and gas could lead to oil spills of 1,000 bbl or greater (16% probability) (Table IV-19) throughout the 35-year life of the proposed action (1993-2027). Wind, waves, and currents could result in spills reaching major shoreline recreational beaches throughout the CPA and WPA. As evident from the *Alvenus* tanker accident, oil spills greater than or equal to 1,000 bbl occurring in one region (CPA) can impact recreational resources and activities in another region (WPA).

Estimates based on OSRA (Table IV-21) indicate the proposed action has an estimated probability less than 0.5% chance to result in a 1,000 bbl or greater oil spill occurrence and contact (within 10 days) with any major recreational beach anywhere in the Gulf region. It is assumed, therefore, for purposes of this analysis that an oil spill of 1,000 bbl or greater will not impact recreational beaches in the CPA from operations resulting from proposed Sale 142.

As noted in Section IV.C.1., three small spills every five years in the size class greater than 1 and less than or equal to 50 bbl are assumed to occur during the 35-year project life. A few of these small spills are assumed to contact recreational beaches during this 35-year period. Such spills can be cleaned from recreational beaches with little disruption of normal recreational activities and with minimal effects on beach recreational resources.

Some litter from OCS accidents, carelessness, and noncompliance with OCS antipollution regulations and directives is likely to come ashore on recreational beaches. New industry waste management practices, in addition to training and awareness programs, focused on the beach litter problem are expected to minimize the level of indiscriminate and irresponsible trash disposal and accidental loss of solid wastes from OCS oil and gas operations.

Recreational beaches in Louisiana and Texas are most likely to be impacted from this waterborne trash. Incremental effects from the proposed action on litter are unlikely to be perceptible by beach users or administrators because the activity from the proposal will constitute only a very small percentage of the existing OCS activity in the CPA and is likely to be offset by the number of terminating leases in the next 35 years. Litter on recreational beaches from OCS operations will adversely affect the ambience of the beach environment, will detract from the enjoyment of beach activities, and can increase administrative costs on maintained beaches.

Drilling rigs and platforms may be placed within sight of shoreline recreational beaches of coastal Subareas C-1 and C-3. As most of the first three tiers of Federal lease blocks have already been leased off the coast of Louisiana and Baldwin County, Alabama, it is only in a few unleased blocks off Louisiana, Mississippi, and Alabama where new leases may bring OCS operations within sight of coastal recreational beaches (Visual No. 1). The Mississippi Sound buffers OCS exploration and development from Mississippi mainland recreational beaches; however, the first three tiers of Federal lease blocks off West Ship and Horn Islands are available for lease. Therefore, users of a large portion of the Gulf Islands National Seashore and Wilderness Area in Mississippi may be able to see OCS operations seaward from the south beaches on these islands. Assuming one jack-up type drilling rig and one production platform will operate within these nearshore tracts as a result of proposed Sale 142, they will be visible for an extended period of time (1-20 years) from portions of the seaward beaches and wilderness areas within 10 mi of the oil and gas exploratory and production operations. In areas where they do not already exist, these structures will introduce a new and unnatural contrast to the characteristic view of the seascape.

Proposed Sale 142 may also stimulate and redirect additional vessel and helicopter traffic. Over 6,000 vessel traffic trips and 123,000 helicopter trips are projected to result in coastal Subarea C-3 (Table IV-2). Although most of these trips are likely to use the busy navigation channels between the Mississippi and Atchafalaya Deltas, some new traffic around and above the Gulf Islands National Seashore is likely. Only 60 vessel trips are projected to use the Pascagoula/Bayou Casotte ship channel (Table IV-5) between Horn and Petit Bois Islands (Visual No. 2) as a result of the proposal. With no helicopter hubs in coastal Mississippi and only one in coastal Alabama, very little additional, if any, air traffic is expected over Gulf Islands National Seashore and Wilderness Area from proposed Sale 142. On the assumption that vessels use established nearshore traffic lanes and helicopters comply with areal clearance restrictions, boats and aircraft servicing offshore and nearshore oil and gas operations may still be seen and heard by some recreational and wilderness beach users, but the intermittent detection should not decrease the amount of recreational beach use.

*Summary*

A few oil spills greater than 1 and less than or equal to 50 bbl are assumed to affect portions of CPA beaches, with little disruption of recreational activities. Marine debris will be lost from time to time from OCS operations associated with drilling 590 new wells and producing oil and gas from 30 new production locations throughout the CPA over the next 35 years. However, the impact from the resulting intermittent pollution washup on Louisiana and Texas beaches should be very low. A drilling rig and production platform in the nearshore area off Louisiana and Mississippi could also impact the natural seascape from some wilderness beaches in coastal Subarea C-3. Helicopter and vessel traffic will add very little additional noise pollution likely to affect wilderness beach users.

*Conclusion*

The proposed action is expected to result in minor pollution events and nearshore operations that may adversely affect the enjoyment of some beach users on Texas and Louisiana beaches.

*High Case Analysis*

The causes and severity of impacts associated with the High Case scenario would be derived from the same impact-producing factors identified under the Base Case scenario, above. Included are oil spills, trash and debris, the physical presence of drilling rigs and platforms, and noise from vessels and helicopters.

The OSRA estimates (Table IV-21) indicate that, even with more optimistic oil and gas finds from this proposal, the estimated probability of an oil spill of 1,000 bbl or greater occurring and contacting a major recreational beach anywhere in the Gulf region within 10 days is estimated as less than 0.5% chance. With the number of wells drilled and the number of vessel traffic trips almost doubling, it is likely the level of accidental and irresponsible trash loss will also increase. Although the decibel level of noise impacting wilderness beach users from vessel and helicopter traffic will not increase, the frequency of these impacts is likely to increase; therefore, the number of visitors hearing and seeing vessels and helicopters while visiting Gulf Islands National Seashore and Wilderness Area or Breton Island National Wilderness Area will also increase. The number of platforms and drilling rigs operating within sight of wilderness beaches in coastal Subarea C-3 is unlikely to increase from the Base Case.

*Conclusion*

The impact on recreational beach use within the CPA as a result of the High Case is expected to be the same as the Base Case even though the number of minor pollution incidences adversely affecting the ambience of recreational beaches is likely to increase throughout the 35-year life of the proposed action.

## *(b) Marine Fishing*

Reports (USDOC, NMFS, 1990a) indicating declining trends in catch and effort for marine recreational fishing, along with recently imposed and proposed State and Federal regulations limiting the size, number and seasons on some popular sport fish (viz., snapper, red drum, speckled trout), have focused broad public concern on the prospects for marine recreational fishing throughout the Gulf region. As noted in Section III.C.4., studies, reports, and previous OCS sale analyses have shown that OCS platform development for oil and gas production has potential for causing a major change in the focus of offshore recreational fishing, both locally and regionally. That is not to say that oil spills, pipeline development, onshore support facilities, increased marine traffic, or other impacting factors likely to result from OCS operations will have no effect on recreational fishing. However, none of these impacting factors is likely to affect a major long-term change in the positive or negative aspects of offshore, nearshore, or inshore recreational fishing. Impacts to sports fishing caused by activities and pollution events associated with OCS oil and gas exploration and development will be localized, short-term, and minor when compared to the predictable long-term impacts resulting from the erection of major production platforms. An exception could result from the indirect effect on recreational fishing from a high regional impact affecting biological productivity. Major adverse consequences from 1993 sales to the life-support systems of primary sport fishing species may ultimately affect recreational fishing. Section IV.D.1.a.(9) (commercial fisheries) contains a discussion on the generic effects of oil on fish and fish-dependent ecosystems. Major research indicates (NRC, 1985) there is no evidence that oil spills greater than or equal to 1,000 bbl or chronic oiling have adversely affected important Gulf sport fishery resources on a regional population scale.

Oil and gas structures attract fish and, inevitably, recreational fishermen and divers. The structures also provide a convenient and productive fishing resource for many people who work offshore. The National Marine Fisheries Service, based on public hearing testimony, has informed MMS that some offshore oil and gas workers and support industry personnel may be engaging in illegal fishing activities at petroleum platforms while stationed offshore.

The OCS environmental reports on the artificial reef effects of petroleum platforms conclude that structures concentrate large numbers of epibiota and fishes that would not be as abundantly represented in the same area in the absence of structures (Gallaway et al., 1981). Gallaway and Lewbel (1982) estimated that the 3,500 petroleum structures in the CPA and WPA in 1981 provided 4,000 acres of artificial reef habitat on their vertical and horizontal supports. Because of the paucity of natural hard substrate in the Gulf, the more than 4,500 petroleum structures in the Gulf today provide larval settlement opportunities much greater than that naturally available. Gallaway has indicated some fish species may become permanently associated with petroleum structures while others are seasonal transients.

Many of the fish species congregating around petroleum structures are prime sport fishing targets (snapper, grouper, mackerels, cobia, etc.). The location and availability of desired sport fishing targets can be predicted fairly accurately by selecting platform locations in depth zones and seasons known to harbor the desired species (Reggio et al., 1983). Ditton and Graefe (1978), Dugas et al. (1979), and Witzig (1986) determined that oil and gas structures are the most popular offshore fishing locations for private and charter boat fishermen in portions of the Western and Central Gulf. As reported by Reggio and others at MMS Information Transfer Meetings (USDOI, MMS, 1982b, pp. 47-75; 1984b, pp. 102-163; 1985b, pp. 297-341; and 1986b, pp. 101-119), oil and gas structures are a major focus of all forms of offshore recreational fishing. Ditton and Auyong (1984) studied the spatial use patterns of offshore platform fishermen in the CPA and determined most private recreational fishing boats, scuba boats, and charter boats travel an average 12 to 47 mi offshore to catch and enjoy fish associated with oil and gas structures. Gordon (1987) verified the importance of oil and gas structures as recreational fishing attractions and determined some interesting facts from the 200 boating fishermen he interviewed. Almost all were itinerant Louisianians willing to travel 220 mi per day by car and boat for the opportunity to fish around offshore oil and gas structures. The typical fisherman trailered a 23-ft boat 80 mi to the launch site and traveled 60 mi by boat to fish around 6 or 7 production platforms. The offshore rig fisherman readily seeks out favorite platforms as far as 30 mi offshore and repeats this recreational activity as many as 22 times per year.

It is assumed that people fish offshore for one of three major reasons: to catch more fish, bigger fish, or fish not available inshore. Oil and gas structures are known to affect all these factors in a positive manner (Witzig, 1986). Furthermore, some species not formerly harvested in some areas by recreational fishermen have become regular fishing targets (pompano and cobia, for example, off the coast of Louisiana) since the advent of offshore petroleum platforms. Offshore recreational fishermen make much larger capital investments in boats and equipment and spend more on trip expenditures (gas, bait, groceries, etc.) than coastal and nearshore marine fishermen. We are unaware of any specific studies of the direct economic impact of rig fishing on the coastal area within the CPA and WPA, but believe it is significant. Roberts and Thompson (1983) did study the use of offshore petroleum structures by Louisiana scuba divers and determined each recreational diver was willing to pay on average more than $160 a year in 1981 to dive around oil and gas structures.

Fishermen who travel several miles offshore to fish around petroleum structures sometimes encounter problems brought on by imprudence, unexpected weather conditions, or mechanical problems. Ditton and Auyong (1984) reported workers on offshore platforms are called on to provide information and communication, supplies and services, and medical aid and emergency rescue to offshore fishermen and boaters seeking or desperately needing their assistance.

Some offshore sports fishing targets, such as snappers and groupers, are structure-faithful fish: i.e., they are recruited to an artificial structure at some point in their life cycle and will remain associated with that artificial habitat throughout part of their remaining lifetime (Gallaway et al., 1981; Gallaway and Lewbel, 1982). Even though MMS-supported studies on the effects of oil and gas platforms on natural reefs have been inconclusive (CSA, 1982), it is believed that new artificial reefs have little, if any, significant effect on the carrying capacity or size distribution of fish on natural reefs (Stone et al., 1979). If a constant demand for fish in space and time (fishing pressure) is assumed, the quantity and quality of offshore fishing will be enhanced in direct proportion to the number and extent of accessible fishing stations or reefs within the fishery.

The 3,422 oil and gas structures (Table IV-7) currently on the OCS in the CPA and WPA are *de facto* artificial reefs augmenting the permitted artificial fishing reefs off the coasts of Louisiana, Mississippi, and Alabama. Visual No. 1 charts the general location of these petroleum structures, and Visual No. 2 shows the location of permitted reefs and established artificial reef planning areas in the CPA.

Platform removals, especially when explosive detachments are used, are known to kill and adversely impact nearby sport fish. Artificial reef programs established by the Gulf states and the rigs-to-reefs projects they sponsor are helping to mitigate loss of fishing locations and fish affected by platform removals.

*Base Case Analysis*

The impacting factors considered in the Base Case analysis and discussed below include platform installations and removals and oil spills.

Table IV-2 projects the installation of 30 new platform complexes, most of which will be emplaced in the first 5-15 years of the 35-year life of the proposed action and will likely be removed in the last 12 years of the proposed action. Offshore Subareas C-2 and C-4 are projected to be the locations of 14 of the platform complexes resulting from the proposed sale. As these platforms will be located 45 or more miles from shore, they are expected to have very little effect on offshore recreational fishing. The 6 platform complexes installed in coastal Subarea C-1 will be located from 3 to 80 mi offshore and are likely to attract some recreational fishermen. Likewise, the 10 platform complexes expected from this proposal in coastal Subarea C-3 could be located within 30 mi of the Mississippi Delta area and attract some fishing use. Any platforms installed in the northeastern portion of coastal Subarea C-3 within 30 mi of shore would likely be a primary focus of offshore recreational fishermen from Mississippi and Alabama. There are about 3,000 production platforms off the coast of Louisiana, and additional installations are unlikely to influence seriously the scope of Louisiana offshore fishing. They could, however, influence individual fishermen who would visit these new platforms during the estimated 20-year platform life span. The 16 new platform complexes installed in coastal Subareas C-1 and C-3 would replace fishing opportunities being lost through platform removal over the next 5-10 years and would extend the time offshore platforms continue to be a principal focus of offshore recreational fishing in the CPA.

The 30 platforms resulting from this proposed sale will be removed towards the end of the project life. Therefore, those nearshore structures placed in coastal Subareas C-1 and C-3 will be lost as fish-attracting devices, thus negating their positive effects on recreational fishing. The removal of the platforms resulting from this proposal with the use of explosives will kill or adversely impact the sport fish directly associated with the structure at the time of removal, but will have no detectable effect on offshore fishing in general.

Even though there is an estimated 16 percent probability in the CPA for an oil spill of 1,000 bbl or greater to result from the proposed sale (Table IV-19), such a spill is assumed not to impact marine recreational fishing beyond the area of the oil slick and the short time it is detectable on the water.

*Summary*

The proposed action is expected to add, within 30 mi of shores, up to 16 new platform complexes that will function as high-profile artificial reefs and attract fish and fishermen from Louisiana, Mississippi, and Alabama. Although the number of offshore fishing trips is unlikely to increase as a result of the proposal, fishing success is likely to increase in offshore areas near oil and gas structures. Because of the increasing number and frequency of platform removals, this sale should help replace expected removals and extend the era of "big" fishing in the CPA.

*Conclusion*

Platforms installed within 30 mi of shore will attract fish and are likely to attract fishermen and improve fishing for a period of about 20 years, but are unlikely to affect offshore fishing patterns in general unless the platforms are installed in nearshore locations where no platforms currently exist.

*High Case Analysis*

Under the High Case scenario it is estimated 6 platform complexes will be installed in coastal Subarea C-1 and 18 platform complexes will be installed in coastal Subarea C-3 (Table IV-2). Some of these platform complexes are expected to be located within 30 miles of shore and are likely to attract offshore marine fishermen and improve fishing prospects in the immediate vicinity of each structure. However, the new platforms would have little incremental effect on offshore fishing in general, especially in areas offshore Louisiana, where many offshore platforms already exist. Should several structures be installed in the nearshore tracts off Mississippi and Alabama, they would augment the existing artificial reef system and diversify and increase the productive fishing locations available to offshore fishermen in that area. Installations would lead to eventual removals towards the latter years of the project life. Removals negate the effects of installations on fishing and, when explosives are used, lead to the demise of sport fish directly associated with the structure at the time of removal.

The estimated probability of an oil spill of 1,000 bbl or greater occurring increases from 16 to 32 percent (Table IV-19); however, the overall effect of one such spill on offshore recreational fishing is assumed not to extend beyond the immediate area and short-term life of its associated slick.

*Conclusion*

The High Case scenario will likely result in a few more platforms that will be productive sports fish areas accessible to and used by offshore recreational fishermen throughout the CPA, but the scenario is unlikely to have a detectable impact on the recreational fishing industry at the regional level. A few local fishing markets could suffer short-term (up to one month) loss of business from a major polllution event; however, these same markets should experience long-term (15-20 years) benefit from platform installations accessible to local fishermen.

### *(11) Impacts on Archaeological Resources*

Lease blocks with a high probability for the occurrence of prehistoric, prehistoric and historic, or historic archaeological resources may by found in the Central Gulf. Those blocks with a high probability for prehistoric archaeological resources may be found landward of a line that roughly follows the 45-m bathymetric contour. The areas of the northern Gulf of Mexico that are considered to have a high probability for historic period shipwrecks have recently been redefined as a result of an MMS-funded study (Garrison et al, 1989). The redefinition of the high probability areas has reduced the total number of lease blocks with a high probability for shipwrecks from 3,410 to 2,263.

The study expanded the shipwreck database in the Gulf of Mexico from 1,500 to over 4,000 wrecks. Statistical analysis of shipwreck location data identified two specific types of high probability areas; the first within 10 km of the shoreline, and the second proximal to historic ports, barrier islands, and other loss traps. High probability search polygons associated with individual shipwrecks were created to afford protection to wrecks located outside of the two aforementioned high probability areas. A new Notice to Lessees (NTL 91-02) has been issued concerning remote-sensing survey methodology and report writing requirements for archaeological resources in the Gulf of Mexico OCS. Briefly stated, the NTL increases remote-sensing survey linespacing density for historic shipwreck survey to 50 m from the previous 150 m. The NTL also requires submission of an increased amount of magnetometer data to facilitate in-house MMS analysis. Survey and report requirements for prehistoric site survey have not been changed. Since 1974, leases offered have contained an archaeological resource stipulation. Section II.A.1.c.(3) presents a proposed stipulation as a potential mitigating measure for leases resulting from the proposed action, the impact analysis for which, including the proposed Archaeological Resource Stipulation, is presented below. It should be noted that a rulemaking, which will incorporate the archaeological stipulation into regulation under 30 CFR 250.25, has been proposed. Presently, lessees or operators are required to comply with the remote-sensing survey and report requirements upon invocation of the stipulation by MMS. The proposed rulemaking will convert the stipulation into an operational regulation.

Sections that provide additional supportive material for the archaeological resources analysis include Sections III.C.5. (description of archaeological resources), IV.A.4.b. (offshore infrastructure), IV.A.5.a. (onshore infrastructure), and IV.C.3. (oil spills).

The OCS-related, impact-producing factors may cause adverse impacts to archaeological resources. Damage caused by the placement of drilling rigs, production platforms, pipelines, dredging, and anchoring could destroy artifacts or disrupt the provenience and stratigraphic context of artifacts, sediments, and paleoindicators from which the scientific value of the archaeological resource is derived. Oil spills could destroy the ability to date prehistoric sites by radiocarbon dating techniques. Ferromagnetic debris associated with OCS oil and gas activities would tend to mask magnetic signatures of significant historic archaeological resources.

Offshore development could result in a drilling rig, platform, pipeline, dredging activity or anchors having an impact on an historic shipwreck. This direct physical contact with a wreck site could destroy fragile ship 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, and the concomitant loss of information on maritime culture for the time period from which the ship dates.

The placement of drilling rigs and production platforms has the physical potential to cause an impact to prehistoric and/or historic archaeological resources. It may be assumed that the standard rig will directly disturb 1.5 ha of soft bottom, the average platform 2 ha. Pile driving associated with platform emplacement may also cause sediment liquefaction an unknown distance from the piling, disrupting stratigraphy in the area of liquefaction.

Pipeline placement has the physical potential to cause an impact to prehistoric and/or historic archaeological resources. Pipelines placed in water depths of less than 61 m (200 ft) must be buried. Burial depths of 1 m (3 ft) are required with the exception of shipping fairways and anchorage areas, where the requirements are 10 and 15 ft, respectively.

The dredging of new channels, as well as maintenance dredging of existing channels, has the physical potential to cause an impact to historic shipwrecks (Espey, Huston, & Associates, 1990). There are 23 navigation channels that provide OCS access to onshore facilities. It may be assumed that one channel in the Central Gulf will have to be deepened to provide access for larger offshore boats serving deeper waters.

Anchoring associated with platform and pipeline emplacement as well as service vessel and shuttle tanker activities, may also physically impact prehistoric and/or historic archaeological resources. It may be assumed that during pipeline emplacement, an array of eight 20,000-lb anchors is continuously repositioned.

Oil spills have the potential to affect both prehistoric and historic archaeological resources. Impacts to historic resources would be limited to visual impacts and, possibly, physical impacts associated with spill cleanup operations. Impacts to prehistoric archaeological sites would be the result of hydrocarbon contamination of organic materials, which have the potential to date site occupation through radiocarbon dating techniques, as well as possible physical disturbance associated with spill cleanup operations.

The OCS oil and gas activities will also generate tons of ferromagnetic structures and debris, which will tend to mask magnetic signatures of significant historic archaeological resources. The task of locating historic resources through an archaeological survey is, therefore, made more difficult as a result of leasing activity.

## *(a) Historic*

### *Base Case Analysis*

Since likely locations of archaeological sites cannot be delineated without first conducting a remote-sensing survey of the seabed and near-surface sediments, MMS, by virtue of the proposed Archaeological Resource Stipulation (Section II.A.1.c.(3)), requires that an archaeological survey be conducted prior to development of lease tracts within the high probability zones for historic and prehistoric archaeological resources. Generally, in the eastern part of the CPA, where unconsolidated sediments are thicker, it is likely that sidescan sonar will not detect shipwrecks buried beneath the mud. In this area, which begins nearshore around Vermilion Area (USDOI, MMS, 1984a) and extends eastward (Subareas C-1, C-2, and C-3), the effectiveness of the survey for detecting historic shipwrecks of composite and wooden construction would depend on the capability of a magnetometer towed at a 50-m line spacing (as specified in NTL 91-02) to detect ferromagnetic masses of the size characteristically associated with shipwrecks. Clausen and Arnold (1975) have concluded that magnetometer reliability for detecting ferrous objects at 150-m survey line spacing is 25-30 percent. It is assumed that an initial survey at a 50-m line spacing will be 90 percent effective at locating historic shipwrecks. The survey would therefore reduce the potential for an impact to occur by an estimated 90 percent.

According to estimates presented in Table IV-2, under the Base Case, 590 exploration, delineation, and development wells will be drilled, and 30 production platforms and 240 km of pipelines will be installed in the Central Gulf. Of this number, 410 exploration, delineation, and development wells will be drilled, and 16 platforms and 129 km of pipelines will be installed within Subareas C-1 and C-3, where the majority of lease blocks with a high probability for historic period shipwrecks are located. Under current survey requirements, as much as 10 percent of this activity would occur without accurate information about the proximity of the activity to an historic resource. The recent MMS study (Garrison et al., 1989) has refined the high probability area for the occurrence of historic period shipwrecks. The location of any proposed activity within a lease block that has a high probability for historic shipwrecks requires archaeological clearance prior to operations. Considering that the expanded database contains 273 shipwrecks in the entire Central Gulf OCS, the probability of an OCS activity contacting and damaging a shipwreck is very low. If an oil and gas structure contacted an historic resource, however, there could be a loss of significant or unique archaeological information.

In the western part of the CPA, where shipwrecks are more likely to be detected by sidescan sonar due to a thin Holocene sediment veneer overlying an indurated Pleistocene surface, the increased survey linespacing density (50 m) will reduce the potential for a direct physical contact between an impact-producing factor and a shipwreck by an estimated 95 percent. The effectiveness of the survey would reduce the potential impacts of OCS activities to historic shipwrecks in the western part of the CPA. There is a very small possibility that a historic shipwreck could be impacted by OCS activities. Should such an impact occur, however, significant or unique archaeological information could be lost.

Onshore historic properties include sites, structures, and objects such as historic buildings, forts, lighthouses, homesteads, cemeteries, and battlefields. Sites already listed on the National Register of Historic Places and those considered eligible for the Register have already been evaluated as being able to make a unique or significant contribution to science. At present, unidentified historic sites may contain unique historic information and would have to be assessed after discovery to determine the importance of the data.

Onshore development as a result of the proposed action could result in the direct physical contact between the construction of new onshore facilities or pipeline canals and previously unidentified historic sites. This direct physical contact with an historic site could cause physical damage to, or complete destruction of, information on the history of the region and the Nation. However, no new onshore pipelines or facilities are projected in the Base Case for proposed Sale 142. There is, therefore, no expected impact to onshore historic sites in the CPA from onshore development.

Maintenance dredging associated with the proposed action has the potential to impact an historic shipwreck. Maintenance dredging in the Port Mansfield Entrance Channel is believed to impact the *Santa Maria de Yciar*, which sank on April 29, 1554 (Espey, Huston & Associates, 1990). Table IV-6 indicates that, under the Base Case less than 0.1 percent of the ship traffic through the Port Mansfield Cut is related to OCS use. Therefore, the impact to the *Santa Maria de Yciar* directly attributable to OCS use as a result of the proposed action is extremely low. While the specific example falls within onshore Subarea W-1, an area unlikely to be affected by the CPA, it is reasonable to assume that the potential exists for historic shipwrecks to be impacted by dredging in the CPA. As this shipwreck is a unique historic archaeological resource, the impact level of maintenance dredging, in general, is considered to be very high. However, the portion of maintenance dredging attributable to the proposed action is, in the case of the Port Mansfield Entrance Channel, extremely low. According to Table IV-6, the percentage of OCS use under the Base Case among the 23 major navigation channels listed for the Central Gulf ranges from a low of less than 0.1 percent to a high of 2.2 percent.

Should an oil spill contact a coastal historic site, such as a fort or a lighthouse, the major impact would be visual because of oil contamination of the site and its environment. According to Table IV-21, the probability of a spill occurring and contacting within 10 days the coast of the CPA is 2 percent under the Base Case. This impact would is expected to be temporary and reversible.

Since all platform locations within the high probability areas for the occurrence of historic and prehistoric archaeological resources are given archaeological clearance prior to setting the structure, removal of the structure should not result in any adverse impact to archaeological resources. This is consistent with the findings of the *Programmatic Environmental Assessment: Structure Removal Activities, Central and Western Gulf of Mexico Planning Areas* (USDOI, MMS, 1987c).

*Summary*

The greatest potential impact to an historic archaeological resource as a result of the proposed action would result from a contact between an OCS offshore activity (platform installation, drilling rig emplacement, dredging or pipeline project) and an historic shipwreck. A recently completed, MMS-funded study (Garrison et al., 1989) has resulted in the refinement of the high probability areas for the location of historic period shipwrecks. A new NTL for archaeological resource surveys in the Gulf of Mexico Region (NTL 91-02) has increased the survey linespacing density for historic shipwreck surveys from 150 m to 50 m.

Most other activities associated with the proposed action are expected to have very low impacts on historic archaeological resources. No new onshore infrastructure construction or pipeline landfalls are expected as a result of the proposed action. Historic cultural resources, therefore, will not be affected by these activities. The chance of contact from an oil spill associated with the proposed action is very low. Furthermore, the major impact from an oil-spill contact on an historic coastal site, such as a fort or lighthouse, would be visual due to oil contamination. These impacts would be temporary and reversible. Impacts from dredging are expected to be low.

The OCS activity 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.

*Conclusion*

There is a very small possibility of an impact between OCS oil and gas activities and a historic shipwreck or site. Should such an impact occur, unique or significant historic archaeological information could be lost.

*Effects of the Base Case Without the Proposed Stipulation*

The greatest impact to an historic cultural resource as a result of the proposed action would result from a contact between an OCS offshore activity (platform installation, drilling rig emplacement, and pipeline projects) and an historic shipwreck. The Archaeological Resource Stipulation, which is currently in place, requires remote-sensing survey in areas designated to have a high probability for historic archaeological resources. It should also be noted that a proposed new regulation under 30 CFR 250.25 will incorporate the stipulation into operational regulations. The OCS Lands Act, as amended, states that a permit for geological exploration shall be issued only if such exploration does not disturb any site, structure, or object of historical or archaeological interest. As the only means to determine whether objects of historical or archaeological interest would be impacted by geological exploration, the archaeological surveys that are required under the current stipulation, would still be necessary to comply with the OCS Lands Act, as amended. The effects of the impact-producing factors on historic archaeological resources without the Archaeological Resource Stipulation would, therefore, remain the same as those when the stipulation is considered a part of the proposed action.

The archaeological surveys under NTL 91-02, conducted prior to initiating oil and gas activities within a lease block, are estimated to be 95 percent effective in locating historic shipwrecks in areas where sidescan sonar is effective in identifying shipwrecks. In areas where sidescan sonar is ineffective because of thick accumulations of sediment on the seafloor (these areas roughly account for 40% of the CPA), magnetometer data, which is estimated at being only 90 percent effective in locating ferrous objects at the 50-m survey line spacing required in NTL 91-02, will be the only means to detect shipwrecks. A recently completed, MMS-funded study (Garrison et al., 1989) has provided new data on shipwreck locations.

Most other activities associated with the proposed action are not expected to affect historic archaeological resources. No new onshore infrastructure construction or pipeline landfalls are expected as a result of the proposed action. Historic cultural resources, therefore, will not be affected by these activities. The chances of contact from an oil spill associated with the proposed action is very low. Furthermore, the impact from an oil-spill contact on an historic coastal site, such as a fort or a lighthouse, would be visible due to oil contamination and would be temporary and reversible. Impacts from dredging directly attributable to OCS activities are considered to be low.

To summarize, because of incomplete knowledge on the location of shipwrecks in the Gulf, an OCS activity could contact a shipwreck. 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.

*High Case Analysis*

Lease blocks with a high probability for the occurrence of prehistoric, prehistoric and historic, or historic archaeological resources may by found in the Central Gulf. Those blocks with a high probability for prehistoric archaeological resources may be found landward of a line that roughly follows the 45-m bathymetric contour. A Letter to Lessees (LTL) dated November 30, 1990, redefined the high probability areas for the presence of historic period shipwrecks. NTL 91-02, which changes survey methodology requirements for historic shipwreck surveys will become effective February 17, 1991. Section II.A.1.c.(3) presents a proposed stipulation as a potential mitigating measure for leases resulting from the proposed action, the impact analysis for which, including the Archaeological Resource Stipulation for analytical purposes, is presented below. It should also be noted that a proposed rulemaking creating an operational regulation to replace the archaeological stipulation has been issued.

Sections providing supportive material for the archaeological resources analysis include Sections III.C.5. (description of archaeological resources), IV.A.4.b. (offshore infrastructure), IV.A.5.a. (onshore infrastructure), and IV.C.3. (oil spills).

A number of OCS-related factors may cause adverse impacts to archaeological resources. Damage caused by the placement of drilling rigs, production platforms, pipelines, dredging, and anchoring could destroy artifacts or disrupt the provenience and stratigraphic context of artifacts, sediments, and paleoindicators from which the scientific value of the archaeological resource is derived. Oil spills could destroy the ability to date prehistoric sites by radiocarbon dating techniques. The dredging of new channels and maintaining current channels could impact a historic shipwreck (Espey, Huston, & Associates, 1990). Ferromagnetic debris associated with OCS oil and gas activities would tend to mask magnetic signatures of significant historic archaeological resources.

The placement of drilling rigs and production platforms has the physical potential to impact prehistoric and/or historic archaeological resources. Pile driving associated with platform emplacement may also cause sediment liquefaction an unknown distance from the piling. Pipeline placement has the physical potential to impact prehistoric and/or historic archaeological resources. Anchoring associated with platform and pipeline emplacement, as well as service vessel and shuttle tanker activities, may also physically impact prehistoric and/or historic archaeological resources.

Maintenance dredging associated with the proposed action has the potential to impact an historic shipwreck. As a shipwreck may represent a unique historic archaeological resource, dredging may result in the damage or loss of significant or unique archaeological information. However, the frequency of impact related to the proposed action is extremely low.

Oil spills have the potential to impact both prehistoric (by contamination of organic materials, which have the potential to date site occupation through radiocarbon dating techniques) and historic archaeological resources (limited to visual impacts and physical impacts associated with spill cleanup operations).

The OCS oil and gas activities will also generate tons of ferromagnetic structures and debris, which will tend to mask magnetic signatures of significant historic archaeological resources.

According to Table IV-2, under the High Case, 1,060 exploration, delineation, and development wells will be drilled, and 50 production platforms and 400 km of pipelines will be installed in the Central Gulf. Of this number, 445 exploration, delineation, and development wells will be drilled and 24 platforms and 128 km of pipelines will be installed within Subareas C-1 and C-3, where the majority of lease blocks with a high probability for historic period shipwrecks are located. The recent MMS study (Garrison et al., 1989) and concomitant LTL have redefined the high probability area for the occurrence of historic period shipwrecks. The location of any proposed activity within a lease block that has a high probability for historic shipwrecks requires archaeological clearance prior to operations. Considering that the expanded database contains 273 shipwrecks in the entire Central Gulf OCS, the probability of an OCS activity contacting and damaging a shipwreck is fairly low. If an oil and gas structure contacted an historic resource, there could be damage to or loss of significant or unique archaeological information. The greater effectiveness of the survey in the western part of the CPA would reduce the potential impact to historic shipwrecks.

Onshore historic properties include sites, structures, and objects such as historic buildings, forts, lighthouses, homesteads, cemeteries, and battlefields. Development as a result of the proposed action could result in the direct physical contact between the construction of new onshore facilities or pipeline canals and previously unidentified historic sites. No new onshore facilities are projected to be constructed under the High Case. Because no land is projected to be disturbed, impacts to coastal historic properties in the CPA are not expected to occur.

Should an oil spill contact a coastal historic site, such as a fort or a lighthouse, the major impact would be visual because of oil contamination of the site and its environment. This impact would is expected to be temporary and reversible.

Since all platform locations within the high probability areas for the occurrence of historic and prehistoric archaeological resources are given archaeological clearance prior to setting the structure, removal of the structure should not result in any adverse impact to archaeological resources. This is consistent with the findings of the *Programmatic Environmental Assessment: Structure Removal Activities, Central and Western Gulf of Mexico Planning Areas* (USDOI, MMS, 1987c).

*Conclusion*

Under the High Case scenario, there is a very small possibility of an impact between OCS oil and gas activities and a historic shipwreck or site. Should such an impact occur, unique or significant historic archaeological information could be lost.

## *(b) Prehistoric*

Offshore development as a result of the proposed action could result in an interaction between a drilling rig, a platform, a pipeline, dredging, or anchors and an inundated prehistoric site. This direct physical contact with a site could destroy fragile artifacts or site features and could disturb artifact provenience and site stratigraphy. The result would be the loss of archaeological data on prehistoric migrations, settlement patterns, subsistence strategies, and archaeological contacts for North America, Central America, South America, and the Caribbean.

*Base Case Analysis*

The archaeological surveys, coupled with archaeological analysis and clearance of proposed location of operations, are estimated to be 90 percent effective in allowing identification and avoidance of high probability areas for site occurrence. According to Table IV-2, under the Base Case, 590 exploration, delineation, and development wells will be drilled, and 30 production platforms and 240 km of pipelines will be installed in the Central Gulf. In-house analysis by MMS shows it likely that some of these potential impacts will occur within Subarea C-4, which has no potential for the occurrence of prehistoric archaeological sites. Removing Subarea C-4 from the projected impacts resulting from the proposed action leaves 355 exploration, delineation, and development wells; 21 production platforms; and 168 km of pipelines installed (Table IV-2). The limited amount of impact to the seafloor throughout the CPA, coupled with the effectiveness of the survey and resulting archaeological clearance, is sufficient to assume a low potential for interaction between an impact-producing factor and a prehistoric archaeological site. Should such an impact occur, damage to or loss of significant or unique prehistoric archaeological information could occur.

Onshore prehistoric archaeological resources include sites, structures, and objects such as shell middens, earth middens, campsites, kill sites, tool manufacturing areas, ceremonial complexes, and earthworks. Currently, unidentified onshore prehistoric sites would have to be assessed after discovery to determine the uniqueness or significance of the information that they contain. Sites already listed in the National Register of Historic Places and those considered eligible for the Register have already been evaluated as having the potential for making a unique or significant contribution to science. Of the unidentified coastal prehistoric sites that could be impacted by onshore development, some may contain unique information.

Onshore development as a result of the proposed action could result in direct physical contact between construction of new onshore facilities or a pipeline landfall and a previously unidentified prehistoric site. This direct physical contact with a prehistoric site could destroy fragile artifacts or site features and could disturb the site context. The result would be the loss of information on the prehistory of North America and the Gulf Coast Region. No new onshore facilities or pipeline landfalls, however, are projected for the Base Case as a result of proposed Sale 142. There should, therefore, be no impact to onshore CPA prehistoric sites from onshore development.

Should an oil spill contact a coastal prehistoric site, the potential for dating the site using C-14 could be destroyed. This loss of information might be ameliorated by ceramic or lithic seriation or other relative dating techniques. Previously unrecorded coastal sites could also experience an impact from oil-spill cleanup operations. Cleanup equipment could destroy fragile artifacts or site features and could disturb the site context. The result would be the loss of information on the prehistory of North America and the Gulf Coast Region. Some of the coastal prehistoric sites that might be impacted by beach cleanup operations may contain unique information. In coastal Louisiana, prehistoric sites occur frequently along the barrier islands and mainland coast and the margins of bays and bayous. Thus, any spill that contacts the land would involve a potential impact to a prehistoric site. The probability of a spill greater than or equal to 1,000 bbl occurring and contacting within 10 days the CPA coast within 10 days is 2 percent (Table IV-21). Based on this low probability, the assumption is that no spills greater than or equal to 1,000 bbl will affect prehistoric archaeological resources. Furthermore, it is assumed that no spill of greater than 50 and less than 1,000 bbl will occur and contact the coastline during the 35-year life of the proposed action. A few spills greater than 1 and less than or equal to 50 bbl are estimated to contact the coast during the lease life. By the time these spills contact the shore, however, there likely would not be enough oil to cover an exposed shell midden or other site to the extent that a large percentage of the organic remains in the site would be contaminated.

All platform locations within the high probability areas for the occurrence of historic and prehistoric archaeological resources are given archaeological clearance prior to setting the structure; removal of the structure should not result in any adverse impact to archaeological resources. This is consistent with finding of the *Programmatic Environmental Assessment: Structural Removal Activities, Central and Western Gulf of Mexico Planning Areas* (USDOI, MMS, 1987c).

*Summary*

Several impact-producing factors may threaten the prehistoric archaeological resources of the Central Gulf. An impact could result from a contact between an OCS activity (pipeline and platform installations, drilling rig emplacement and operation, dredging, and anchoring activities) and a prehistoric site located on the continental shelf. The archaeological surveys and archaeological clearance of sites that are required prior to an operator beginning oil and gas activities in a lease block are estimated to be 90 percent effective at identifying possible prehistoric sites. Since the survey and clearance provide a significant reduction in the potential for a damaging interaction between an impact-producing factor and a prehistoric site, there is a very small possibility of an OCS activity contacting a prehistoric site. Should such contact occur, there could be damage to or loss of significant or unique archaeological information.

Onshore development as a result of the proposed action could result in the direct physical contact from new facility construction, pipeline trenching, and new navigation canal dredging. None of these activities is expected to occur under the Base Case.

Should an oil spill contact a coastal prehistoric site, the potential for dating the site using radiocarbon methods could be destroyed. Oil-spill cleanup operations could physically impact coastal prehistoric sites. Previously unrecorded sites could also experience an impact from oil-spill cleanup operations on beaches. The probability of an spill greater than or equal to 1,000 bbl occurring and contacting within 10 days a coastal prehistoric site within 10 days is very low (2%), and it is assumed that no contact will occur. A few spills greater than 1 and less than or equal to 50 bbl are assumed to contact the coast, but these small spills would probably not cover an exposed site, such as a shell midden, with enough oil to contaminate all the datable organic remains.

*Conclusion*

There is a very small possibility of an impact between OCS oil and gas activities and a prehistoric archaeological site. Should such an impact occur, there could be damage to or loss of significant or unique prehistoric archaeological information.

*Effects of the Base Case Without the Proposed Stipulation*

Several impact-producing factors may threaten the prehistoric archaeological resources of the Central Gulf. An impact could result from a contact between an OCS activity (pipeline and platform installations, drilling rig emplacement and operation, and anchoring activities) and a prehistoric site located on the continental shelf. The Archaeological Resource Stipulation, which is considered part of the proposed action, requires remote-sensing surveys in areas designated to have a high probability for prehistoric archaeological resources. It should also be noted that a proposed new regulation under 30 CFR 250.25 will incorporate the stipulation into operational regulations. The OCS Lands Act, as amended, states that a permit for geological exploration shall be issued only if such exploration does not disturb any site, structure, or object of historical or archaeological interest. As the only means to determine whether objects of historical or archaeological interest would be impacted by geological exploration, the archaeological surveys that are required under the current stipulation would still be necessary to comply with the OCS Lands Act, as amended. The effects of the impact-producing factors on prehistoric archaeological resources without the Archaeological Resource Stipulation in place would, therefore, remain the same as those when the stipulation is considered part of the proposed action.

The archaeological surveys that are required prior to an operator beginning oil and gas activities in a lease block are estimated to be 90 percent effective in identifying possible prehistoric sites. The survey provides a significant reduction in the potential for a damaging interaction between an impact-producing factor and a prehistoric site.

Should such an impact occur, there could be damage to or loss of significant or unique prehistoric archaeological information.

Onshore development as a result of the proposed action could result in the direct physical contact between new facility construction, pipeline trenching, and navigation canal dredging. None of these activities are expected to occur under the Base Case.

Should an oil spill contact a coastal prehistoric site, the potential for dating the site using radiocarbon methods could be destroyed. Previously unrecorded sites could also experience an impact from oil-spill cleanup operations on beaches. The probability of a spill greater than or equal to 1,000 bbl occurring and contacting within 10 days a coastal prehistoric site is very low, and it is assumed that no contact will occur. A few spills greater than 1 and less than or equal to 50 bbl are assumed to contact the coast, but these small spills would not cover an exposed site, such as a shell midden, with enough oil to contaminate all the dateable organic remains.

*High Case Analysis*

The higher level of offshore development projected for the High Case would increase the potential for an interaction between an impact-producing factor and a prehistoric site. Should an interaction occur, the potential exists for the loss of significant or unique archaeological information.

Offshore development as a result of the proposed action could result in an interaction between a drilling rig, a platform, a pipeline, dredging, or anchors and an inundated prehistoric site. This direct physical contact with a site could destroy fragile artifacts or site features and could disturb artifact provenience and site stratigraphy. The result would be the loss of archaeological data on prehistoric migrations, settlement patterns, subsistence strategies, and archaeological contacts for North America, Central America, South America, and the Caribbean.

Likely locations for archaeological sites can be delineated with high-resolution seismic data. As the high probability zone for the occurrence of prehistoric sites on the OCS approximates the 45-m bathymetric contour, Subarea C-4, which is deeper than 45 m in its entirety, is assumed to have no potential for the occurrence of these sites.

The archaeological surveys, coupled with archaeological analysis and clearance of proposed location of operations, are estimated to be 90 percent effective in allowing identification and avoidance of high probability areas for site occurrence. According to Table IV-2, under the High Case, 1,060 exploration, delineation, and development wells will be drilled, and 50 production platforms and 400 km of pipelines will be installed in the Central Gulf. Removing Subarea C-4 from the projected impacts resulting from the High Case leaves 630 exploration, delineation, and development wells, 33 production platforms; and 264 km of pipelines installed (Table IV-2). The limited amount of impact to the seafloor throughout the CPA, coupled with the effectiveness of the survey and resulting archaeological clearance, is sufficient to assume a low potential for interaction between an impact-producing factor and a prehistoric archaeological site.

Onshore development is not expected as a result of the High Case scenario for proposed Sale 142. Because no land is projected to be disturbed, there are no expected impacts from onshore development as a result of the proposed action.

Should an oil spill contact a coastal prehistoric site, the potential for dating the site using C-14 could be destroyed. Previously unrecorded coastal sites could also experience an impact from oil-spill cleanup operations, which could destroy fragile artifacts or site features and disturb the site context. The result would be the loss of information on the prehistory of North America and the Gulf Coast Region. In coastal Louisiana, prehistoric sites occur frequently along the barrier islands and mainland coast and the margins of bays and bayous. Thus, any spill that contacts the land would involve a potential impact to a prehistoric site. The probability of a spill greater than or equal to 1,000 bbl occurring and contacting within 10 days the CPA coast within 10 days is 4 percent (Table IV-21). Based on this low probability, the assumption is that no spills greater than or equal to 1,000 bbl will affect prehistoric archaeological resources. Furthermore, it is estimated that no spill of greater than 50 and less than 1,000 bbl will occur and contact the coastline during the 35-year life of the proposed action. A few spills greater than 1 and less than or equal to 50 bbl are estimated to contact the coast during the lease life. By the time these spills contact the shore, however, there likely would not be enough oil to cover an exposed shell midden or other site to the extent that a large percentage of the organic remains in the site would be contaminated.

All platform locations within the high probability areas for the occurrence of historic and prehistoric archaeological resources are given archaeological clearance prior to setting the structure; removal of the structure should not result in any adverse impact to archaeological resources. This is consistent with finding of the *Programmatic Environmental Assessment: Structural Removal Activities, Central and Western Gulf of Mexico Planning Areas* (USDOI, MMS, 1987c).

*Conclusion*

Under the High Case scenario, there is a very small possibility of an impact between OCS oil and gas activities and a prehistoric archaeological site. Should such an impact occur, there could be damage to or loss of significant or unique prehistoric archaeological information.

## *(12) Impacts on Socioeconomic Conditions*

### *(a) Population, Labor, and Employment*

The importance of the oil and gas industry to the coastal communities of the Gulf of Mexico is significant, particularly in Louisiana and eastern Texas. Dramatic changes in the level of OCS oil and gas activity over recent years have brought forth similar fluctuations in population, labor, and employment in the Gulf of Mexico region. State government and citizen concern over the Gulf Coast's economic dependence on the oil and gas industry has made clear the need for an analysis of the impact of the OCS program on the social and economic well-being of affected communities.

This section focuses on an analysis of the direct, indirect, and induced impacts of the OCS oil and gas industry on the population, labor, and employment of the counties and parishes within the coastal impact area of the Central and Western Gulf Region caused by the proposed action in the Central Gulf. There would also be other economic impacts, both direct and indirect, associated with the proposed actions because of their effect on other industries, such as commercial fishing, tourism, and recreational fishing. The direct benefit or loss in these industries is addressed in the sections of this EIS related specifically to those topics. The OCS program's indirect and induced effect on these associated industries is much more difficult to quantify. Nevertheless, it will generally constitute a fraction of the magnitude of the direct impact.

Section III.C.1. provides an historical perspective of the oil and gas industry, as well as a brief description of recent events that have significantly affected the level of OCS activity in the Gulf of Mexico. A detailed discussion of historical trends in population, labor, and employment within the coastal impact area of the Central and Western Gulf can be found in Section III.C.2. Included in that section is a listing of counties and parishes in the Central and Western Gulf of Mexico coastal impact area, as well as current statistics and future projections of population, labor, and employment levels for coastal subareas in the region. These projections will serve as a baseline against which impacts will be measured.

The methodology developed to quantify these impacts on population, labor, and employment takes into account changes in OCS-related employment, along with population and labor impacts resulting from these employment changes within each individual coastal subarea. For analysis purposes, the projections of OCS-related employment are classified into three categories: direct, indirect, and induced employment.

Direct employment associated with the oil and gas industry consists of those workers involved in oil and gas exploration, development, and production operations, including geophysical and seismograph surveys, exploratory drilling, well operation, maintenance, and other contract support services. These activities are covered under the Standard Industrial Classification (SIC) Code 13--Oil and Gas Extraction. To facilitate the analysis, several assumptions were made regarding the employment associated with SIC 13 activity projected to result from the proposed action. These assumptions are estimates of typical levels of activity and employment based on historical observations:

| | |
|---|---|
| Exploration Activity - | One rig can drill an average of nine wells per year with approximately 133 workers. |
| Development Activity - | One platform rig can drill an average of six wells per year with a crew of approximately 115 workers. |
| Production Activity - | One offshore platform can operate with an average crew of 28 workers. |

A population and employment computer model developed at MMS uses these and other assumptions to translate estimates of exploration, development, and production activities associated with the proposed action into annual projections of direct employment for each planning area. Planning area level employment projections are apportioned to offshore subareas on the basis of each offshore subarea's hydrocarbon resource potential and projected share of the offshore infrastructure. Employment within each offshore subarea is then allocated to coastal subareas on the basis of an allocation matrix developed at MMS. This matrix allocates direct employment offshore to those coastal subareas where the onshore support facilities for that particular offshore site are expected to be located. The matrix was derived from an analysis of the historical and proposed location of onshore support facilities for the different actual or planned drilling sites offshore. The allocation matrix also accounts for the fact that employment impacts from offshore activity are not constrained by planning area or subarea boundaries. In other words, oil and gas development in the WPA can and does impact the coastal communities of the Central Gulf and vice versa.

Indirect employment resulting from activities in the primary oil and gas extraction industry occurs in secondary or supporting oil- and gas-related industries. Section III.C.2. provides a listing of those industries considered in the projection of indirect employment. Employment in the Sanitary Service Industry, which supports oil-spill clean-up activities (SIC 4959), was not included as part of indirect employment in the model because the manpower requirements for oil-spill clean-up activities are highly unpredictable. The level of employment involved in any given clean-up effort is influenced by a variety of factors, such as whether or not the oil comes ashore, the coastal formation, weather conditions at the time of the incident, type and quantity of oil spilled, as well as the extent and duration of the oiling. Nevertheless, employment in oil-spill clean-up activities has been included in the Base Case analysis as an external adjustment to the population and employment model, using assumptions regarding the size of potential oil spills presented in Section IV.C.

Based on an analysis of actual industry-specific employment levels in the counties and parishes of the coastal impact area, a multiplier was determined to estimate indirect employment from direct employment projections for the oil and gas extraction industry. The indirect employment multiplier determined for this analysis was 0.67.

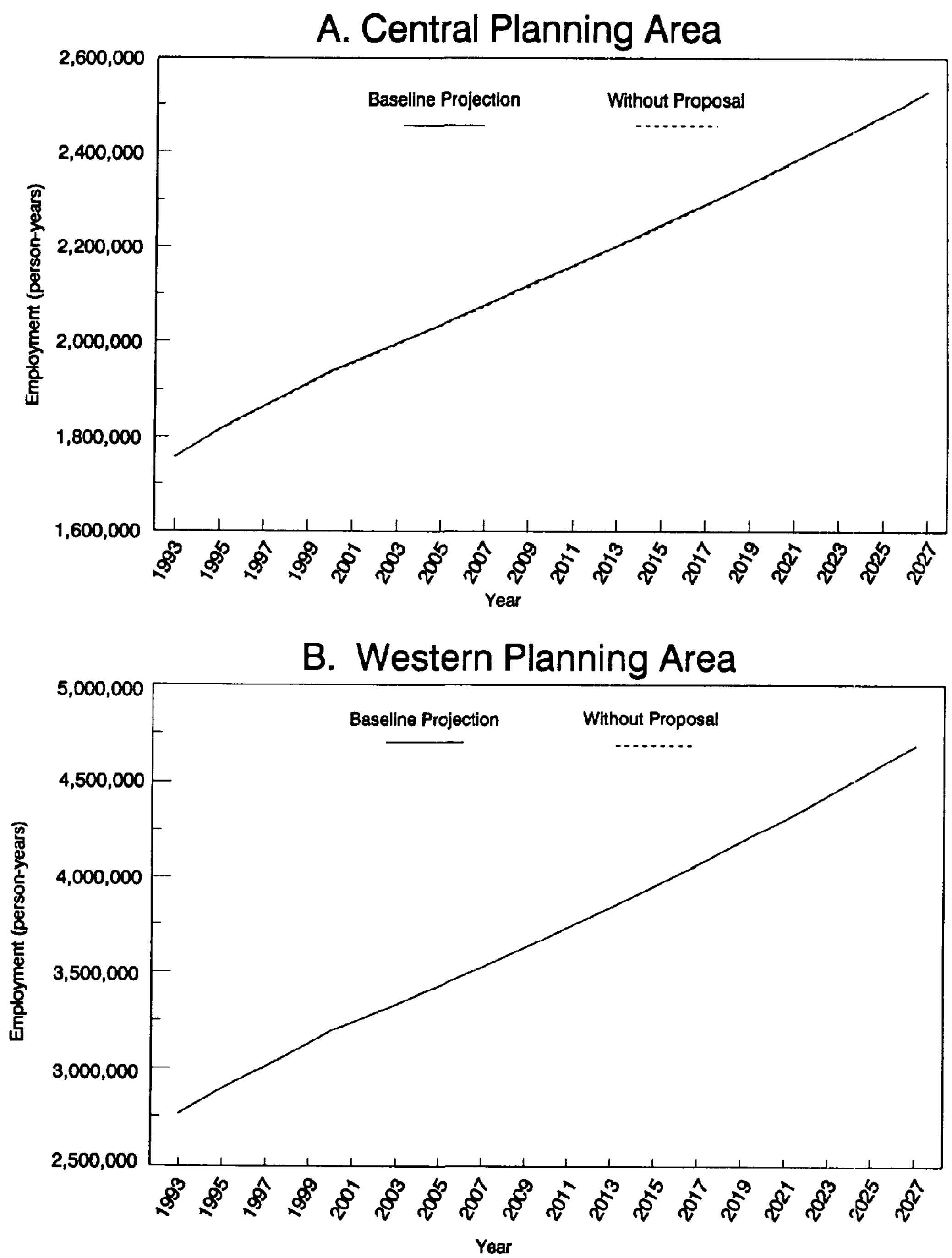
Induced employment in tertiary industries is generated from both direct and indirect employment and consists of jobs that are created or supported by the expenditures of employees in primary and secondary industries. Induced employment results from the demand for consumer goods and services such as food, clothing, housing, and entertainment. Based on a previous MMS analysis of employment impacts, the induced employment multiplier for this analysis was estimated to be 0.33.

The total employment impact to each coastal subarea because of the proposed action is the sum of its direct, indirect, and induced employment impact projections. The population dependent on the income from oil- and gas-related employment for their subsistence was derived from total employment estimates based on an analysis of the historic ratio of population to employment in the coastal subareas. Labor impacts were addressed using both population and employment data to assess the supply and demand for workers trained in oil- and gas-related trades.

To arrive at a bottom-line level of impact for population, labor, and employment, the population and employment model is used to convert the projections to a format that facilitates analysis and comparison. This conversion involves the estimation of annual changes in population, labor, and employment projections for the proposed action as a percent of the population, labor, and employment levels expected in absence of the proposal for each coastal subarea. To derive population and employment levels in absence of the proposal, the population and employment impacts estimated for the proposed actions were subtracted from a set of baseline projections that, inherently, included impacts from the proposal. The baseline projections of population and employment used in the analysis are described in Section III.C.2. Because these baseline projections assume the continuation of existing social, economic, and technological trends, they also include employment resulting from the continuation of current patterns in OCS leasing activity.

*Base Case Analysis*

Baseline employment projections for the coastal impact area of the Central and Western Gulf can be found in Figure IV-8. Displayed also on this figure are baseline employment projections excluding jobs generated by the proposed action in the Central Gulf. The methodology discussion preceding this Base Case analysis provides a description of these projections. A total of approximately 58,500 person-years of employment (direct, indirect, and induced) are required in the Central and Western Gulf coastal subareas in support of the proposed sale in the Central Gulf throughout its 35-year life. Less than 2 percent of the total employment




Due to the very low impact of the proposed action on employment, the projections graphed on the figure may appear to overlap.

Figure IV-8. Base Case Employment Impacts from Central Gulf Sale 142 (USDOI, MMS, Gulf of Mexico OCS Region estimates, 1991).

resulting from the proposed action is expected to affect the coastal subareas of the Western Gulf. Peak-year impacts occur in 1999, with a total of approximately 2,750 workers involved in primary, secondary, and tertiary industries. Direct employment in the primary oil and gas extraction industry (SIC 13) accounts for 45 percent of the total employment impact projected for the coastal subareas of the Central and Western Gulf over the life of the proposed action. Exploratory activities, which occur during the first 11 years of the life of the proposed action, are the main contributor to peak-year direct and total employment impacts. After their initial peak in 1999, total employment impacts begin to decline as oil and gas exploration is reduced in areas leased under the proposed action. Peak employment impacts resulting from development activities take place soon after exploratory activities reach their peak, but are much less intense. A second, smaller total employment peak impact is experienced in the years 2011 and 2012, as employment resulting from production activities offshore is reaching its peak. Even though exploratory activities drive peak-year employment impacts, the greatest contributor to overall employment impacts is production operations. Employment in oil and gas production activities accounts for approximately 60 percent of total direct employment impacts due to production in the Central Gulf. Indirect and induced employment impacts in secondary and tertiary industries amount to approximately 30 percent and 25 percent, respectively, of the total employment impacts over the life of the proposed action in the Central Gulf.

Table IV-27 displays the model projections of total OCS-related employment impacts (direct, indirect, and induced) from proposed Sale 142 in the Central Gulf to the coastal subareas of the CPA and WPA throughout the life of the proposed action. Table IV-28 provides estimates of annual impacts to the population and employment of each coastal subarea as a percent of levels expected in absence of the proposal. These impact estimates represent changes in the new share of the existing population and employment that will be dependent on the OCS oil and gas industry for support as a result of the proposed action. These impact estimates alone do not provide enough information to determine whether employment needs will be met with the population and labor force in the area or with immigrants and new labor force from other areas.

The greatest impact to employment is expected in coastal Subareas C-1 and C-2, with peak year impact estimates for 1998 of 0.24 percent and 0.23 percent, respectively. Coastal Subareas C-1 and C-2 collectively provide over 67 percent of the total employment required in support of the proposed action in the Central Gulf. Coastal Subarea C-3 contributes approximately 27 percent of the employment. The least impacted coastal subarea in the CPA is C-4, accounting for only 4 percent of the employment projected for the proposal in the coastal impact area. Only coastal Subarea W-2 in the Western Gulf is affected by the proposed action in the CPA. The Western Gulf is expected to provide under 2 percent of total employment for proposed Sale 142 in the Central Gulf.

Employment impacts resulting from oil-spill clean-up activities, because of their highly unpredictable nature, were handled apart from the population and employment model. The level of employment associated with any given clean-up operation is dependent on numerous variables which, in themselves, are also difficult to predict. Nevertheless, the most labor-intensive clean-up operations are those from spills that contact the coastline, particularly recreational beaches. For the purpose of this analysis, it is assumed that only those spills contacting land will involve significant manpower requirements in their clean-up efforts. Based on employment statistics from recent spill clean-up operations along the coast, the assumption is that, for every kilometer of coastline subjected to heavy oiling, approximately 100 temporary workers will be employed for a maximum of 6 weeks.

Section IV.C. presents estimates of the mean number of offshore spills assumed to result from the proposed action in the CPA. The probability that one or more offshore spills greater than or equal to 1,000 bbl will occur and contact land within 10 days of the accident is 2 percent (Table IV-21). Based on the low probability of an offshore spill this size occurring and contacting land, the assumption is that no significant employment requirements will result from the clean-up of offshore spills of this size category in the Base Case. One spill of the size category greater than 50 bbl and less than 1,000 bbl is assumed to occur (Table IV-2); however, it is not assumed to contact the coastline (Section IV.C.1.). Twenty-one small spills of the size category greater than 1 bbl and less than or equal to 50 bbl are assumed to occur in the CPA over the life of the proposed action. Of these 21 spills, only a few are estimated to contact land. Furthermore, employment impacts resulting from the clean-up of spills this small would be negligible.

Table IV-27

Base Case OCS-Related Employment Projections (Direct+Indirect+Induced)
Central Gulf Sale 142
(person-years)

| YEAR | W1 | W2 | C1 | C2 | C3 | C4 | WGOM* | CGOM** |
|---|---|---|---|---|---|---|---|---|
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 2 | 37 | 72 | 46 | 7 | 2 | 162 |
| 1995 | 0 | 10 | 178 | 336 | 212 | 32 | 10 | 757 |
| 1996 | 0 | 21 | 382 | 721 | 457 | 69 | 21 | 1629 |
| 1997 | 0 | 26 | 456 | 864 | 549 | 83 | 26 | 1953 |
| 1998 | 0 | 35 | 613 | 1154 | 732 | 111 | 35 | 2609 |
| 1999 | 0 | 37 | 645 | 1205 | 765 | 116 | 37 | 2731 |
| 2000 | 0 | 35 | 611 | 1132 | 713 | 108 | 35 | 2564 |
| 2001 | 0 | 33 | 568 | 1040 | 655 | 99 | 33 | 2362 |
| 2002 | 0 | 33 | 542 | 974 | 613 | 92 | 33 | 2221 |
| 2003 | 0 | 33 | 536 | 954 | 601 | 90 | 33 | 2181 |
| 2004 | 0 | 31 | 493 | 862 | 542 | 81 | 31 | 1979 |
| 2005 | 0 | 33 | 504 | 868 | 546 | 82 | 33 | 2000 |
| 2006 | 0 | 28 | 421 | 705 | 448 | 67 | 28 | 1641 |
| 2007 | 0 | 31 | 453 | 757 | 481 | 72 | 31 | 1763 |
| 2008 | 0 | 32 | 469 | 783 | 498 | 75 | 32 | 1824 |
| 2009 | 0 | 34 | 501 | 835 | 531 | 80 | 34 | 1947 |
| 2010 | 0 | 35 | 517 | 861 | 548 | 82 | 35 | 2008 |
| 2011 | 0 | 37 | 549 | 912 | 581 | 87 | 37 | 2130 |
| 2012 | 0 | 37 | 549 | 912 | 581 | 87 | 37 | 2130 |
| 2013 | 0 | 36 | 516 | 844 | 540 | 81 | 36 | 1981 |
| 2014 | 0 | 36 | 516 | 844 | 540 | 81 | 36 | 1981 |
| 2015 | 0 | 37 | 532 | 870 | 557 | 83 | 37 | 2042 |
| 2016 | 0 | 36 | 516 | 844 | 540 | 81 | 36 | 1981 |
| 2017 | 0 | 35 | 500 | 818 | 524 | 78 | 35 | 1920 |
| 2018 | 0 | 31 | 434 | 698 | 449 | 67 | 31 | 1648 |
| 2019 | 0 | 30 | 418 | 672 | 433 | 65 | 30 | 1587 |
| 2020 | 0 | 29 | 402 | 646 | 416 | 62 | 29 | 1526 |
| 2021 | 0 | 27 | 386 | 620 | 400 | 60 | 27 | 1465 |
| 2022 | 0 | 26 | 370 | 595 | 383 | 57 | 26 | 1404 |
| 2023 | 0 | 24 | 337 | 543 | 350 | 52 | 24 | 1282 |
| 2024 | 0 | 19 | 273 | 439 | 283 | 42 | 19 | 1038 |
| 2025 | 0 | 14 | 193 | 310 | 200 | 30 | 14 | 733 |
| 2026 | 0 | 7 | 96 | 155 | 100 | 15 | 7 | 366 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 948 | 14512 | 24846 | 15814 | 2375 | 948 | 57547 |

* Western Gulf of Mexico.
** Central Gulf of Mexico.

Source: USDOI, MMS, Gulf of Mexico OCS Region estimates, 1991.

Table IV-28

Population and Employment Impact Levels for the Base Case Scenario
Central Gulf Sale 142
(percent*)

EMPLOYMENT IMPACT LEVELS:

| YEAR | W1 | W2 | C1 | C2 | C3 | C4 |
|---|---|---|---|---|---|---|
| 1993 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 1994 | 0.00% | 0.00% | 0.01% | 0.01% | 0.01% | 0.00% |
| 1995 | 0.00% | 0.00% | 0.07% | 0.07% | 0.03% | 0.01% |
| 1996 | 0.00% | 0.00% | 0.15% | 0.15% | 0.07% | 0.02% |
| 1997 | 0.00% | 0.00% | 0.17% | 0.17% | 0.08% | 0.02% |
| 1998 | 0.00% | 0.00% | 0.23% | 0.23% | 0.11% | 0.03% |
| 1999 | 0.00% | 0.00% | 0.24% | 0.23% | 0.11% | 0.03% |
| 2000 | 0.00% | 0.00% | 0.22% | 0.22% | 0.10% | 0.02% |
| 2001 | 0.00% | 0.00% | 0.21% | 0.20% | 0.09% | 0.02% |
| 2002 | 0.00% | 0.00% | 0.19% | 0.18% | 0.09% | 0.02% |
| 2003 | 0.00% | 0.00% | 0.19% | 0.18% | 0.08% | 0.02% |
| 2004 | 0.00% | 0.00% | 0.17% | 0.16% | 0.07% | 0.02% |
| 2005 | 0.00% | 0.00% | 0.18% | 0.16% | 0.07% | 0.02% |
| 2006 | 0.00% | 0.00% | 0.14% | 0.13% | 0.06% | 0.01% |
| 2007 | 0.00% | 0.00% | 0.15% | 0.13% | 0.06% | 0.02% |
| 2008 | 0.00% | 0.00% | 0.16% | 0.14% | 0.07% | 0.02% |
| 2009 | 0.00% | 0.00% | 0.17% | 0.14% | 0.07% | 0.02% |
| 2010 | 0.00% | 0.00% | 0.17% | 0.15% | 0.07% | 0.02% |
| 2011 | 0.00% | 0.00% | 0.18% | 0.16% | 0.07% | 0.02% |
| 2012 | 0.00% | 0.00% | 0.18% | 0.15% | 0.07% | 0.02% |
| 2013 | 0.00% | 0.00% | 0.17% | 0.14% | 0.07% | 0.02% |
| 2014 | 0.00% | 0.00% | 0.16% | 0.14% | 0.07% | 0.02% |
| 2015 | 0.00% | 0.00% | 0.17% | 0.14% | 0.07% | 0.02% |
| 2016 | 0.00% | 0.00% | 0.16% | 0.14% | 0.06% | 0.02% |
| 2017 | 0.00% | 0.00% | 0.15% | 0.13% | 0.06% | 0.02% |
| 2018 | 0.00% | 0.00% | 0.13% | 0.11% | 0.05% | 0.01% |
| 2019 | 0.00% | 0.00% | 0.13% | 0.11% | 0.05% | 0.01% |
| 2020 | 0.00% | 0.00% | 0.12% | 0.10% | 0.05% | 0.01% |
| 2021 | 0.00% | 0.00% | 0.11% | 0.10% | 0.05% | 0.01% |
| 2022 | 0.00% | 0.00% | 0.11% | 0.09% | 0.04% | 0.01% |
| 2023 | 0.00% | 0.00% | 0.10% | 0.08% | 0.04% | 0.01% |
| 2024 | 0.00% | 0.00% | 0.08% | 0.07% | 0.03% | 0.01% |
| 2025 | 0.00% | 0.00% | 0.06% | 0.05% | 0.02% | 0.01% |
| 2026 | 0.00% | 0.00% | 0.03% | 0.02% | 0.01% | 0.00% |
| 2027 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

POPULATION IMPACT LEVELS:

| YEAR | W1 | W2 | C1 | C2 | C3 | C4 |
|---|---|---|---|---|---|---|
| 1993 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 1994 | 0.00% | 0.00% | 0.02% | 0.02% | 0.01% | 0.00% |
| 1995 | 0.00% | 0.00% | 0.07% | 0.07% | 0.03% | 0.01% |
| 1996 | 0.00% | 0.00% | 0.15% | 0.15% | 0.07% | 0.02% |
| 1997 | 0.00% | 0.00% | 0.18% | 0.18% | 0.08% | 0.02% |
| 1998 | 0.00% | 0.00% | 0.24% | 0.23% | 0.11% | 0.03% |
| 1999 | 0.00% | 0.00% | 0.25% | 0.24% | 0.12% | 0.03% |
| 2000 | 0.00% | 0.00% | 0.24% | 0.23% | 0.11% | 0.03% |
| 2001 | 0.00% | 0.00% | 0.22% | 0.21% | 0.10% | 0.02% |
| 2002 | 0.00% | 0.00% | 0.21% | 0.19% | 0.09% | 0.02% |
| 2003 | 0.00% | 0.00% | 0.21% | 0.19% | 0.09% | 0.02% |
| 2004 | 0.00% | 0.00% | 0.19% | 0.17% | 0.08% | 0.02% |
| 2005 | 0.00% | 0.00% | 0.19% | 0.17% | 0.08% | 0.02% |
| 2006 | 0.00% | 0.00% | 0.16% | 0.13% | 0.07% | 0.02% |
| 2007 | 0.00% | 0.00% | 0.17% | 0.14% | 0.07% | 0.02% |
| 2008 | 0.00% | 0.00% | 0.17% | 0.15% | 0.07% | 0.02% |
| 2009 | 0.00% | 0.00% | 0.19% | 0.16% | 0.08% | 0.02% |
| 2010 | 0.00% | 0.00% | 0.19% | 0.16% | 0.08% | 0.02% |
| 2011 | 0.00% | 0.00% | 0.20% | 0.17% | 0.08% | 0.02% |
| 2012 | 0.00% | 0.00% | 0.20% | 0.17% | 0.08% | 0.02% |
| 2013 | 0.00% | 0.00% | 0.19% | 0.15% | 0.08% | 0.02% |
| 2014 | 0.00% | 0.00% | 0.19% | 0.15% | 0.08% | 0.02% |
| 2015 | 0.00% | 0.00% | 0.19% | 0.15% | 0.08% | 0.02% |
| 2016 | 0.00% | 0.00% | 0.18% | 0.15% | 0.08% | 0.02% |
| 2017 | 0.00% | 0.00% | 0.18% | 0.14% | 0.07% | 0.02% |
| 2018 | 0.00% | 0.00% | 0.15% | 0.12% | 0.06% | 0.01% |
| 2019 | 0.00% | 0.00% | 0.15% | 0.12% | 0.06% | 0.01% |
| 2020 | 0.00% | 0.00% | 0.14% | 0.11% | 0.06% | 0.01% |
| 2021 | 0.00% | 0.00% | 0.13% | 0.11% | 0.05% | 0.01% |
| 2022 | 0.00% | 0.00% | 0.13% | 0.10% | 0.05% | 0.01% |
| 2023 | 0.00% | 0.00% | 0.12% | 0.09% | 0.05% | 0.01% |
| 2024 | 0.00% | 0.00% | 0.09% | 0.07% | 0.04% | 0.01% |
| 2025 | 0.00% | 0.00% | 0.07% | 0.05% | 0.03% | 0.01% |
| 2026 | 0.00% | 0.00% | 0.03% | 0.03% | 0.01% | 0.00% |
| 2027 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

* Note: Impact levels represent the percent change in population or employment due to the proposal with respect to total levels expected in absence of the proposal.

Source: USDOI, MMS, Gulf of Mexico OCS Region estimates, 1991.

In addition to the offshore spills referenced above, a number of small onshore spills are expected to occur (Table IV-4). The level of cleanup action associated with spills this size will be minimal.

The greatest impact on population from activities associated with Sale 142 is expected in coastal Subareas C-1 and C-2 with peak-year estimates for 1999 of 0.25 and 0.24 percent, respectively (Table IV-28). The coastal communities of the Western Gulf have no noticeable peak population impacts.

The level of OCS-related employment expected to result from the proposed action in the Central Gulf is not significant enough to attract new residents and labor force to the area. Analysis of historical trends has shown that only population impacts greater than 1 percent typically involve positive net migration to any given area. None of the coastal subareas is projected to experience population impacts greater than 1 percent because of the proposed action. Labor force impacts will parallel population and employment impacts. Jobs are expected to be filled by currently unemployed or underemployed workers or by future entrants into the labor force already living in the area. Therefore, employment demands in support of the proposed action will be met with the existing population and available labor force.

*Summary*

Peak annual changes in the population, labor, and employment of all coastal subareas in the Central and Western Gulf resulting from the proposed action in the Central Gulf represent less than 1 percent of the levels expected in absence of the proposal in the Central Gulf. Only 2 percent of the total employment resulting from the proposed action is expected to affect the coastal subareas of the Western Gulf. Employment resulting from oil-spill clean-up activities due to the proposed action is negligible. It is expected that employment demands in support of the proposed action will be met with the existing population and available labor force.

*Conclusion*

The Base Case impact of the proposed action in the Central Gulf on the population, labor, and employment of the counties and parishes of the Central and Western Gulf coastal impact area is expected to be less than 1 percent of the levels expected in the absence of the proposal.

*High Case Analysis*

Population, labor, and employment impacts resulting from the proposed action in the High Case are less than twice as high as those expected in the Base Case. A total of approximately 101,100 person-years of employment (direct, indirect, and induced) are required in the Central and Western Gulf coastal subareas in support of the proposed action for the High Case. Peak-year impacts occur in 1999 with approximately 4,350 workers involved in primary, secondary, and tertiary industries. Direct employment in the primary oil and gas extraction industry (SIC 13) accounts for 45 percent of the total employment impact projected for the coastal subareas of the Central and Western Gulf over the life of the proposed action. Exploratory activities, which occur during the first 12 years of the life of the proposed action, are the main contributor to peak-year direct and total employment impacts. After their initial peak in 1999, total employment impacts begin to decline as oil and gas exploration is reduced in areas leased under the proposed action. Peak employment impacts resulting from development activities take place soon after exploratory activities reach their peak, but are much less intense. A second, smaller total employment peak impact is experienced in the year 2015, when employment resulting from production activities offshore reaches its peak. Even though exploratory activities drive peak-year employment impacts, the greatest contributor to overall employment impacts for the High Case is production operations. Employment in oil and gas production activities accounts for approximately 57 percent of total direct employment impacts resulting from production in the Central Gulf. Indirect and induced employment impacts in secondary and tertiary industries amount to approximately 30 and 25 percent, respectively, of the total employment impacts over the life of the proposed action in the Central Gulf.

Table IV-29 displays the model projections of total OCS-related employment impacts (direct, indirect, and induced) from Sale 142 in the Central Gulf to the coastal subareas of the CPA and WPA throughout the life of the proposed action in the High Case. Table IV-30 provides estimates of annual impacts to the population

Table IV-29

High Case OCS-Related Employment Projections (Direct+Indirect+Induced)
Central Gulf Sale 142
(person-years)

| YEAR | W1 | W2 | C1 | C2 | C3 | C4 | WGOM* | CGOM** |
|---|---|---|---|---|---|---|---|---|
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 4 | 76 | 146 | 89 | 13 | 4 | 324 |
| 1995 | 0 | 19 | 355 | 677 | 420 | 64 | 19 | 1515 |
| 1996 | 0 | 33 | 612 | 1166 | 723 | 109 | 33 | 2610 |
| 1997 | 0 | 47 | 862 | 1645 | 1018 | 154 | 47 | 3679 |
| 1998 | 0 | 54 | 982 | 1869 | 1160 | 176 | 54 | 4187 |
| 1999 | 0 | 56 | 1014 | 1922 | 1201 | 182 | 56 | 4318 |
| 2000 | 0 | 56 | 1002 | 1896 | 1188 | 180 | 56 | 4265 |
| 2001 | 0 | 51 | 909 | 1709 | 1080 | 164 | 51 | 3862 |
| 2002 | 0 | 52 | 906 | 1694 | 1080 | 163 | 52 | 3844 |
| 2003 | 0 | 44 | 749 | 1388 | 897 | 136 | 44 | 3169 |
| 2004 | 0 | 43 | 717 | 1320 | 861 | 130 | 43 | 3029 |
| 2005 | 0 | 43 | 715 | 1305 | 861 | 130 | 43 | 3011 |
| 2006 | 0 | 44 | 729 | 1331 | 879 | 133 | 44 | 3072 |
| 2007 | 0 | 47 | 773 | 1410 | 932 | 141 | 47 | 3256 |
| 2008 | 0 | 48 | 788 | 1436 | 950 | 144 | 48 | 3318 |
| 2009 | 0 | 52 | 847 | 1540 | 1021 | 154 | 52 | 3563 |
| 2010 | 0 | 51 | 827 | 1498 | 999 | 151 | 51 | 3475 |
| 2011 | 0 | 54 | 886 | 1603 | 1070 | 162 | 54 | 3720 |
| 2012 | 0 | 54 | 886 | 1603 | 1070 | 162 | 54 | 3720 |
| 2013 | 0 | 56 | 915 | 1655 | 1105 | 167 | 56 | 3842 |
| 2014 | 0 | 56 | 915 | 1655 | 1105 | 167 | 56 | 3842 |
| 2015 | 0 | 57 | 930 | 1681 | 1123 | 170 | 57 | 3904 |
| 2016 | 0 | 56 | 915 | 1655 | 1105 | 167 | 56 | 3842 |
| 2017 | 0 | 54 | 886 | 1603 | 1070 | 162 | 54 | 3720 |
| 2018 | 0 | 47 | 758 | 1363 | 918 | 139 | 47 | 3177 |
| 2019 | 0 | 40 | 631 | 1123 | 765 | 116 | 40 | 2634 |
| 2020 | 0 | 38 | 601 | 1070 | 730 | 110 | 38 | 2512 |
| 2021 | 0 | 36 | 572 | 1018 | 694 | 105 | 36 | 2389 |
| 2022 | 0 | 35 | 543 | 966 | 659 | 99 | 35 | 2267 |
| 2023 | 0 | 32 | 499 | 888 | 605 | 91 | 32 | 2083 |
| 2024 | 0 | 26 | 411 | 731 | 498 | 75 | 26 | 1715 |
| 2025 | 0 | 19 | 293 | 522 | 356 | 54 | 19 | 1225 |
| 2026 | 0 | 9 | 147 | 261 | 178 | 27 | 9 | 613 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 1415 | 23648 | 43349 | 28412 | 4295 | 1415 | 99704 |

* Western Gulf of Mexico.
** Central Gulf of Mexico.

Source: USDOI, MMS, Gulf of Mexico OCS Region estimates, 1991.

Table IV-30

Population and Employment Impact Levels for the High Case Scenario
Central Gulf Sale 142
(percent*)

EMPLOYMENT IMPACT LEVELS:

| YEAR | W1 | W2 | C1 | C2 | C3 | C4 |
|---|---|---|---|---|---|---|
| 1993 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 1994 | 0.00% | 0.00% | 0.03% | 0.03% | 0.01% | 0.00% |
| 1995 | 0.00% | 0.00% | 0.14% | 0.14% | 0.06% | 0.02% |
| 1996 | 0.00% | 0.00% | 0.24% | 0.24% | 0.11% | 0.03% |
| 1997 | 0.00% | 0.00% | 0.33% | 0.33% | 0.15% | 0.04% |
| 1998 | 0.00% | 0.00% | 0.37% | 0.37% | 0.17% | 0.04% |
| 1999 | 0.00% | 0.00% | 0.38% | 0.37% | 0.17% | 0.04% |
| 2000 | 0.00% | 0.00% | 0.37% | 0.36% | 0.17% | 0.04% |
| 2001 | 0.00% | 0.00% | 0.33% | 0.32% | 0.15% | 0.04% |
| 2002 | 0.00% | 0.00% | 0.32% | 0.32% | 0.15% | 0.04% |
| 2003 | 0.00% | 0.00% | 0.27% | 0.26% | 0.12% | 0.03% |
| 2004 | 0.00% | 0.00% | 0.25% | 0.24% | 0.12% | 0.03% |
| 2005 | 0.00% | 0.00% | 0.25% | 0.24% | 0.12% | 0.03% |
| 2006 | 0.00% | 0.00% | 0.25% | 0.24% | 0.12% | 0.03% |
| 2007 | 0.00% | 0.00% | 0.26% | 0.25% | 0.12% | 0.03% |
| 2008 | 0.00% | 0.00% | 0.27% | 0.25% | 0.12% | 0.03% |
| 2009 | 0.00% | 0.00% | 0.28% | 0.27% | 0.13% | 0.03% |
| 2010 | 0.00% | 0.00% | 0.27% | 0.26% | 0.13% | 0.03% |
| 2011 | 0.00% | 0.00% | 0.29% | 0.27% | 0.14% | 0.03% |
| 2012 | 0.00% | 0.00% | 0.29% | 0.27% | 0.13% | 0.03% |
| 2013 | 0.00% | 0.00% | 0.29% | 0.28% | 0.14% | 0.03% |
| 2014 | 0.00% | 0.00% | 0.29% | 0.27% | 0.14% | 0.03% |
| 2015 | 0.00% | 0.00% | 0.29% | 0.27% | 0.14% | 0.03% |
| 2016 | 0.00% | 0.00% | 0.29% | 0.27% | 0.13% | 0.03% |
| 2017 | 0.00% | 0.00% | 0.27% | 0.26% | 0.13% | 0.03% |
| 2018 | 0.00% | 0.00% | 0.23% | 0.22% | 0.11% | 0.03% |
| 2019 | 0.00% | 0.00% | 0.19% | 0.18% | 0.09% | 0.02% |
| 2020 | 0.00% | 0.00% | 0.18% | 0.17% | 0.08% | 0.02% |
| 2021 | 0.00% | 0.00% | 0.17% | 0.16% | 0.08% | 0.02% |
| 2022 | 0.00% | 0.00% | 0.16% | 0.15% | 0.07% | 0.02% |
| 2023 | 0.00% | 0.00% | 0.15% | 0.13% | 0.07% | 0.02% |
| 2024 | 0.00% | 0.00% | 0.12% | 0.11% | 0.06% | 0.01% |
| 2025 | 0.00% | 0.00% | 0.08% | 0.08% | 0.04% | 0.01% |
| 2026 | 0.00% | 0.00% | 0.04% | 0.04% | 0.02% | 0.00% |
| 2027 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

POPULATION IMPACT LEVELS:

| YEAR | W1 | W2 | C1 | C2 | C3 | C4 |
|---|---|---|---|---|---|---|
| 1993 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 1994 | 0.00% | 0.00% | 0.03% | 0.03% | 0.01% | 0.00% |
| 1995 | 0.00% | 0.00% | 0.14% | 0.14% | 0.06% | 0.02% |
| 1996 | 0.00% | 0.00% | 0.24% | 0.24% | 0.11% | 0.03% |
| 1997 | 0.00% | 0.00% | 0.34% | 0.34% | 0.16% | 0.04% |
| 1998 | 0.00% | 0.00% | 0.39% | 0.38% | 0.18% | 0.04% |
| 1999 | 0.00% | 0.00% | 0.40% | 0.39% | 0.18% | 0.04% |
| 2000 | 0.00% | 0.00% | 0.39% | 0.38% | 0.18% | 0.04% |
| 2001 | 0.00% | 0.00% | 0.35% | 0.34% | 0.16% | 0.04% |
| 2002 | 0.00% | 0.00% | 0.35% | 0.33% | 0.16% | 0.04% |
| 2003 | 0.00% | 0.00% | 0.29% | 0.27% | 0.13% | 0.03% |
| 2004 | 0.00% | 0.00% | 0.27% | 0.25% | 0.13% | 0.03% |
| 2005 | 0.00% | 0.00% | 0.27% | 0.25% | 0.13% | 0.03% |
| 2006 | 0.00% | 0.00% | 0.28% | 0.25% | 0.13% | 0.03% |
| 2007 | 0.00% | 0.00% | 0.29% | 0.27% | 0.14% | 0.03% |
| 2008 | 0.00% | 0.00% | 0.29% | 0.27% | 0.14% | 0.03% |
| 2009 | 0.00% | 0.00% | 0.31% | 0.29% | 0.15% | 0.04% |
| 2010 | 0.00% | 0.00% | 0.31% | 0.28% | 0.14% | 0.03% |
| 2011 | 0.00% | 0.00% | 0.33% | 0.29% | 0.15% | 0.04% |
| 2012 | 0.00% | 0.00% | 0.32% | 0.29% | 0.15% | 0.04% |
| 2013 | 0.00% | 0.00% | 0.33% | 0.30% | 0.16% | 0.04% |
| 2014 | 0.00% | 0.00% | 0.33% | 0.30% | 0.16% | 0.04% |
| 2015 | 0.00% | 0.00% | 0.33% | 0.30% | 0.16% | 0.04% |
| 2016 | 0.00% | 0.00% | 0.33% | 0.29% | 0.15% | 0.04% |
| 2017 | 0.00% | 0.00% | 0.32% | 0.28% | 0.15% | 0.04% |
| 2018 | 0.00% | 0.00% | 0.27% | 0.24% | 0.13% | 0.03% |
| 2019 | 0.00% | 0.00% | 0.22% | 0.19% | 0.11% | 0.03% |
| 2020 | 0.00% | 0.00% | 0.21% | 0.18% | 0.10% | 0.02% |
| 2021 | 0.00% | 0.00% | 0.20% | 0.17% | 0.09% | 0.02% |
| 2022 | 0.00% | 0.00% | 0.19% | 0.16% | 0.09% | 0.02% |
| 2023 | 0.00% | 0.00% | 0.17% | 0.15% | 0.08% | 0.02% |
| 2024 | 0.00% | 0.00% | 0.14% | 0.12% | 0.07% | 0.02% |
| 2025 | 0.00% | 0.00% | 0.10% | 0.09% | 0.05% | 0.01% |
| 2026 | 0.00% | 0.00% | 0.05% | 0.04% | 0.02% | 0.01% |
| 2027 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

* Note: Impact levels represent the percent change in population or employment due to the proposal with respect to total levels expected in absence of the proposal.

Source: USDOI, MMS, Gulf of Mexico OCS Region estimates, 1991.

and employment of each coastal subarea as a percent of levels expected in absence of the proposal. These impact estimates represent changes in the new share of the existing population and employment that will be dependent on the OCS oil and gas industry for support as a result of the proposed action. These impact estimates alone do not provide enough information to determine whether employment needs will be met with the existing population and labor force in the area or with immigrants and new labor force from other areas.

The greatest impact to employment in the High Case is expected in coastal Subareas C-1 and C-2, with peak year impact estimates for 1999 of 0.38 percent and 0.37 percent, respectively. Coastal Subareas C-1 and C-2 collectively provide over 66 percent of the total employment required in support of the proposed action in the Central Gulf. Coastal Subarea C-3 contributes approximately 28 percent of the total employment impacts to the Central and Western Gulf coastal impact area. The least impacted coastal subarea in the CPA is C-4, accounting for only 4 percent of the total employment impact from Sale 142. Only coastal Subarea W-2 in the Western Gulf is affected by the proposed action in the CPA. The Western Gulf is expected to provide slightly under 2 percent of total employment for Sale 142 in the Central Gulf.

Employment impacts resulting from oil-spill clean-up activities, because of their highly unpredictable nature, were handled apart from the population and employment model. The level of employment associated with any given clean-up operation is dependent on numerous variables which, in themselves, are also difficult to predict. Nevertheless, the most labor-intensive clean-up operations are those from spills that contact the coastline, particularly recreational beaches. For the purpose of this analysis, it is assumed that only those spills contacting land will involve significant manpower requirements in their clean-up efforts. Based on employment statistics from recent spill clean-up operations along the coast, the assumption is that, for every kilometer of coastline subjected to heavy oiling, approximately 100 temporary workers will be employed for a maximum of 6 weeks.

Section IV.C. presents estimates of the mean number of offshore spills assumed to result from the proposed action for the High Case in the CPA. The probability that one or more offshore spills of 1,000 bbl or greater will occur and contact land within 10 days of the accident is 4 percent (Table IV-21). In addition to the offshore spills referenced above, a number of small onshore spills are expected to occur. The level of clean-up action associated with spills this size will be minimal (Table IV-4). Based on the low probability of a spill this size occurring and contacting land, the assumption is that no significant employment requirements will result from the clean-up of offshore spills of this size category in the High Case. Two spills of the size category greater than 50 bbl and less than 1,000 bbl are assumed to occur (Table IV-2); however, it is not expected that they will contact the coastline (Section IV.C.1.). Forty-seven spills of the size category greater than 1 bbl and less than or equal to 50 bbl are assumed to occur in the CPA over the life of the proposed action. Of these 47 spills, only a few are estimated to contact land (Section IV.C.1.). Furthermore, employment impacts resulting from the clean-up of spills this small are expected to be negligible.

In addition to the offshore spills referenced above, a number of small onshore spills are expected to occur (Table IV-4). The level of cleanup action associated with spills this size will be minimal.

The greatest impact on population from activities associated with Sale 142 in the High Case is expected in coastal Subareas C-1 and C-2 with peak-year impact estimates for 1999 of 0.40 and 0.39 percent, respectively (Table IV-30). The coastal communities of the Western Gulf have no noticeable peak population impacts.

The level of OCS-related employment expected to result from the proposed action for the High Case in the Central Gulf is less than twice as large as that estimated for the Base Case. However, it is still not significant enough to attract new residents and labor force to the area. Analysis of historical trends has shown that only population impacts greater than 1 percent typically involve positive net migration to any given area. None of the coastal subareas is projected to experience population impacts greater than 1 percent as a result of the proposed action in the High Case. Labor force impacts will parallel population and employment impacts. Jobs are expected to be filled by currently unemployed or underemployed workers or by future entrants into the labor force already living in the area. Therefore, employment demands in support of the proposed action for the High Case in the Central Gulf will be met with the existing population and available labor force.

*Summary*

Peak annual changes in the population, labor, and employment of all coastal subareas in the Central and Western Gulf resulting from the proposed action in the Central Gulf for the High Case represent less than 1 percent of the levels expected in absence of the proposal. The coastal communities of the Western Gulf are expected to support slightly over 1 percent of the total employment generated by the Central Gulf Sale. Employment resulting from oil spill clean-up activities due to the proposed action is negligible. It is expected that employment demands in support of the proposed action will be met with the existing population and available labor force.

*Conclusion*

The High Case impact of the proposed action in the Central Gulf on the population, labor, and employment of the counties and parishes of the Central and Western Gulf coastal impact area is expected to be less than 1 percent of the levels expected in the absence of the proposal.

## *(b) Public Services and Infrastructure*

Public services and infrastructure, as used in this analysis, include commonly provided public, semipublic, and private services and facilities, such as education, police and fire protection, sewage treatment, solid-waste disposal, water supply, recreation, transportation, health care, other utilities, and housing. Changes in demands for and usage of public services and infrastructure could result from OCS activities. Adverse effects could arise if the amount or rate of increase or decrease in the usage significantly exceeded or fell far below the capability of a local area to provide a satisfactory level of service.

Sections providing supportive material for this analysis include Sections III.C.2. (description of socioeconomic issues), IV.A.2. (offshore infrastructure), IV.A.3. (onshore infrastructure), IV.C.1. and IV.C.3. (oil spills), and IV.D.1.a.(12)(a) (impacts on population, labor, and employment).

For the purpose of this analysis, OCS-related, impact-producing factors to public services and community infrastructure will include work force fluctuations, migration (both in-migration and out-migration), and the effect of relative income. These impact-producing factors are interrelated and derive from or result in increased population. It should be noted that these impact-producing factors also pertain to social patterns and will be analyzed in Section IV.D.1.a.(12)(c).

*Base Case Analysis*

Baseline employment projections and information relating to the model analysis used to arrive at these projections are presented in Section IV.D.1.a.(12)(a). This information is incorporated by reference. Unexpected events (such as the 1973 Arab Oil Embargo) may influence oil and gas activity within the Gulf of Mexico Region. These events cannot be projected and cannot be presumed for this analysis.

Approximately 58,495 person-years of employment (direct, indirect, and induced) are required to sustain the proposed action throughout its 35-year life (Table IV-27). Less than 2 percent of total employment in support of the proposed action is expected to affect the Western Gulf coastal subareas (Subarea W-2). The remaining employment is expected to lie within coastal Subareas C-1 (25%), C-2 (42%), C-3 (27%), and C-4 (4%). In the peak year of 1999, approximately 2,768 person-years of total employment will be required to support the proposed action. The greatest amount of this employment is expected to lie within Subarea C-2. A comparison between the expected population and employment impacts for the coastal subareas as a result of the proposed action compared to expected population and employment without the proposal is shown in Table IV-30. The greatest impact to employment is expected to occur in coastal Subareas C-1 and C-2, with peak-year impact estimates in 1999 of 0.24 and 0.23 percent, respectively.

A major impact of OCS-generated activities, new population associated with increased service demands, will be significantly mitigated by planning and other measures undertaken at the Federal, State, regional, and local levels. All the potential onshore development areas either have or participate in local and/or regional planning programs. The objectives of these programs include orderly and efficient growth management that minimizes fiscal, social, and environmental impacts. This analysis assumes that future Federal, State, and local management efforts will be effective at avoiding or mitigating many potential adverse effects on the quality of public services and infrastructure that might occur as a result of the kinds of planned, long-term economic growth and development anticipated by the local and regional planning community.

Short-term fluctuations in the work force as a result of changing levels of OCS-related oil and gas activity could impact social services and community infrastructure in several ways. Large, short-term layoffs of oil and gas industry personnel could stress the abilities (both in terms of work load and available funding) of public and private agencies whose mission is to aid persons with severe financial difficulties. The need for public or private assistance could force the diversion of funds needed for the maintenance of community infrastructure, such as schools and roads. Large, short-term increases in the work force could result in net positive migration and cause a scarcity of housing, a shortage of municipal personnel (i.e., policemen, firemen, engineers, etc.), and an increase in the cost of living. A comparison with Table IV-28 reveals that there are no significant differences expected in population and employment between the proposed action and the levels expected without the proposal in coastal Subareas W-1 and W-2. None of the CPA coastal subareas is expected to experience population impacts greater than 0.25 percent (1999-peak year) as a result of the proposed action. It is expected that employment related to the proposed action will not require importation of labor and that the existing labor pool will be adequate to supply labor needs (Section IV.D.1.a.(12)(a)). The proposed action is expected to provide jobs for unemployed, underemployed, and new employees already living in the area. Excess labor capacity of the coastal subareas is expected to provide sufficient human resources to maintain adequate levels of public services and infrastructure.

Migration into a coastal subarea (in-migration) as a response to increased levels of OCS-related oil and gas activity could result in increased stress on both public and private agencies in assisting newly relocated persons and in providing basic services to an expanding population. In addition, not all persons who migrate to an area seeking employment will find it. This failure causes additional stress on social service agencies. In-migration into an area may result in dramatic population increases, stressing on community schools, roads, law enforcement agencies, and other community infrastructure. Migration out of a coastal subarea (out-migration) in response to lowered levels of OCS-related oil and gas activity could jeopardize secondary and tertiary jobs that were created during periods of increased population, stressing social service agencies. Community infrastructure created in response to a larger population could become a redundant expense as a result of out-migration. An analysis of historical trends indicates that population impacts of greater than 1 percent involve positive net migration into a given area. Table IV-28 indicates that population impacts are not expected to exceed this figure under the Base Case. Therefore, it is expected that the proposed action will not produce in-migration into the coastal subareas of the Gulf of Mexico. The proposed action will result in the need for approximately 58,495 person-years of total employment throughout its 35-year life. These jobs are expected to be filled by unemployed, underemployed, and newly employed persons already living in the area. By providing these jobs, the proposed action will reduce the amount of out-migration comparative to that which might occur without the proposal.

The relatively high wages paid to OCS-related oil and gas industry personnel could result in an increase in population from in-migration and a concomitant increase in the local cost of living. Impacts to social services could come from the need for assistance of those living on fixed incomes, as well as those unemployed as a result of the decline of businesses unable to operate in an environment of high wage scale. Impacts to community infrastructure could come from the defection of community workers from infrastructure-related activities to higher paying jobs in the oil and gas industry. The employment needs of the proposed action are not expected to exceed the labor capacity of the Gulf coastal subareas. As mentioned above, an analysis of historical trends indicates that in-migration should not be expected as a result of the proposed action. In addition, jobs created by the proposal would likely reduce the amount of migration out of the coastal subareas when compared to scenarios without the proposal. It is expected that employees leaving public service and infrastructure-based jobs could be replaced by the existing labor pool and area residents entering the job market. Revenues generated by Federal, State, and local taxes from employment related to the proposed action are expected to mitigate increased needs for public services generated by the proposed action.

*Summary*

Impacts to public services and infrastructure would be related to dramatic, short-term population increases or decreases, which are not projected as a result of the proposed action. Specific impact-producing factors examined in this analysis include work force fluctuations, migration into or out of the coastal subareas, and the relatively high wages made by personnel involved in the oil and gas industry. An analysis of historical trends indicates that population impacts of greater than 1 percent involve positive net migration into a given area. Under the Base Case, population impacts are not expected to exceed the peak year impacts of 0.25 percent. No positive net migration into the coastal subareas of the Central and Western Gulf is expected to occur as a result of the proposed action. It is expected that employment needs will be met by those currently employed in the oil and gas industry as well as the unemployed and underemployed, and new employees already living in the area. In addition, jobs created by the proposal would likely reduce the amount of migration out of the coastal subareas when compared to scenarios without the proposal. It is expected that employees leaving public service and infrastructure-related jobs could be replaced from the existing labor pool.

*Conclusion*

Population and employment impacts that result from the proposed action under the Base Case scenario will not result in disruptions to community infrastructure and public services beyond what is anticipated by in-place planning and development agencies.

*High Case Analysis*

Baseline employment projections and information relating to the model analysis used to arrive at these projections are presented in Section IV.D.1.a.(12)(a). This information is incorporated by reference. Unexpected events (such as the 1973 Arab Oil Embargo) may influence oil and gas activity within the Gulf of Mexico Region. These events cannot be projected and cannot be presumed for this analysis.

Approximately 101,119 person-years of employment (direct, indirect, and induced) are required to sustain the proposed action in the High Case throughout its 35-year life (Table IV-29). Less than 2 percent of total employment in support of the High Case is expected to affect the Western Gulf coastal subareas (Subarea W-2). The remaining employment is expected to lie within coastal Subareas C-1 (23%), C-2 (43%), C-3 (28%), and C-4 (4%). In the peak year of 1999, approximately 4,374 person-years of total employment are required to support the High Case. The greatest amount of this employment is expected to lie within Subarea C-2. A comparison between the expected population and employment impacts for the coastal subareas as a result of the High Case and the expected population and employment without the proposal may be seen in Table IV-30. The greatest impact to employment is expected to occur in coastal Subareas C-1 and C-2 with peak-year impact estimates in 1999 of 0.38 and 0.37 percent, respectively.

A major impact of OCS-generated activities, new population associated with increased service demands, will be significantly mitigated by planning and other measures undertaken at the Federal, State, regional, and local levels. All of the potential onshore development areas either have or participate in local and/or regional planning programs, which have objectives that include orderly and efficient growth management that minimizes fiscal, social, and environmental impacts. This analysis assumes that future Federal, State, and local management efforts will be effective at avoiding or mitigating many potential adverse effects on the quality of public services and infrastructure, effects that might occur as a result of the kinds of planned, long-term economic growth and development anticipated by the local and regional planning community.

Short-term fluctuations in the work force as a result of changing levels of OCS-related oil and gas activity could impact social services and community infrastructure in several ways. Large, short-term layoffs of oil and gas industry personnel could stress the abilities (both in terms of work load and available funding) of public and private agencies whose mission is to aid persons with severe financial difficulties. The need for public or private assistance could force the diversion of funds needed for the maintenance of community infrastructure, such as schools and roads. Large, short-term increases in the work force could result in net positive migration and cause a scarcity of housing, a shortage of municipal personnel (i.e., policemen, firemen, engineers, etc.), and an increase in the cost of living. A comparison with Table IV-30 reveals that there are no significant differences in population and employment between the proposed action and the levels expected without the proposal in coastal Subareas W-1 and W-2. None of the CPA coastal subareas is expected to experience population impacts greater than 0.40 percent (1999-peak year) as a result of the High Case. It is expected that employment related to the High Case will not require importation of labor and that the existing labor pool will be adequate to supply labor needs. The proposal under the High Case is expected to provide jobs for the unemployed and the underemployed, and new employees already living in the area. Excess labor capacity of the coastal subareas is expected to provide sufficient human resources to maintain adequate levels of public services and infrastructure (Section IV.D.1.a.(12)(a)).

Migration into a coastal subarea (in-migration) as a response to increased levels of OCS-related oil and gas activity could result in increased stress on both public and private agencies in assisting newly relocated persons and in providing basic services to an expanding population. In addition, not all persons who migrate to an area seeking employment will find it, causing additional stress on social service agencies. In-migration may result in dramatic increases in population, producing stress on community schools, roads, law enforcement agencies, and other community infrastructure. Migration out of a coastal subarea (out-migration) in response to lowered levels of OCS-related oil and gas activity could jeopardize secondary and tertiary jobs that were created during periods of increased population, stressing social service agencies. Community infrastructure created in response to a larger population could become a redundant expense as a result of out-migration. An analysis of historical trends indicates that population impacts of greater than 1 percent involve positive net migration into a given area. Table IV-30 indicates that population impacts are not expected to exceed this figure under the High Case. It is therefore expected that the proposal under the High Case will not produce in-migration into the coastal subareas of the Gulf of Mexico. The High Case will result in the need for approximately 101,119 person-years of total employment throughout the 35-year life of the proposed action. These jobs are expected to be filled by the unemployed and the underemployed, and newly employed persons already living in the area. By providing these jobs, the High Case will reduce the amount of out-migration compared to that which might occur without the proposal.

The relatively high wages paid to OCS-related oil and gas industry personnel could result in a population increase from in-migration and a concomitant increase in the local cost of living. Impacts to social services could come from the need for assistance of those living on fixed incomes, as well as those unemployed as a result of the decline of businesses unable to operate in an environment of high wage scale. Impacts to community infrastructure could come from the defection of community workers from infrastructure-related activities to higher paying jobs in the oil and gas industry. The employment needs of the High Case are not expected to exceed the labor capacity of the Gulf coastal subareas. As mentioned above, an analysis of historical trends indicates that in-migration should not be expected as a result of the High Case. In addition, jobs created by the proposal would likely reduce the amount of migration out of the coastal subareas when compared to scenarios without the proposal. It is expected that employees leaving public service and infrastructure-based jobs could be replaced by the existing labor pool and area residents entering the job market. Revenues generated by Federal, State, and local taxes from employment related to the High Case are expected to mitigate any increased needs for public services generated by the proposal.

Impacts to public services and infrastructure would be related to dramatic short-term population increases or decreases, which are not projected as a result of the proposed action. Specific impact-producing factors examined in this analysis include work force fluctuations, migration into or out of the coastal subareas, and the relatively high wages made by personnel involved in the oil and gas industry. An analysis of historical trends indicates that population impacts of greater than 1 percent involve positive net migration into a given area. Under the High Case, population impacts are not expected to exceed the peak-year impacts of 0.40 percent. No positive net migration into the coastal subareas of the Central and Western Gulf is expected to occur as a result of the proposal. It is expected that employment needs will be met by those currently employed in the oil and gas industry as well as the unemployed and the underemployed, and new employees already living in the area. In addition, jobs created by the proposal would likely reduce the amount of migration out of the coastal subareas when compared with scenarios without the proposal. It is expected that employees leaving public service and infrastructure-related jobs could be replaced from the existing labor pool.

*Conclusion*

Population and employment impacts that result from the proposed action under the High Case scenario will not result in disruptions to community infrastructure and public services beyond what is anticipated by in-place planning and development agencies.

## (c) Social Patterns

This impact analysis includes the coastal parishes and counties of the Central and Western Gulf of Mexico (Section III.C.2.(a)). Social patterns, as used in this analysis, include traditional occupations, folkways, social structure, language, family life, and other forms of cultural adaptation to the natural and human environment. It should be noted that impacts unrelated to OCS oil and gas activity (such as technological improvements in communications and transportation) have caused, and will continue to cause, changes within the analysis area. However, the present analysis will consider only the effects of OCS-related oil and gas activity on the social patterns of the Central and Western Gulf coastal subareas.

Sections providing supportive material for this analysis include Sections III.C.3. (description of socioeconomic issues), IV.A.2. (offshore infrastructure), IV.C.1. and IV.C.3. (oil spills), IV.D.1.a.(1)(b) (impacts on sensitive coastal environments), IV.D.1.a.(9) (impacts on commercial fisheries), IV.D.1.a.(12)(a) (impacts on population, labor, and employment), and IV.D.1.a.(12)(b) (impacts on public services and infrastructure).

For the purpose of this analysis, OCS-related impact-producing factors to social patterns will include work force fluctuations, net migration (both in-migration and out-migration), work scheduling, displacement from traditional occupations, and relative income. Many of these impact-producing factors result in or derive from population growth. Adverse effects to social patterns could arise if disruption of social patterns occurred and resulted in changes in traditional occupations, disruption in the viability of extant subcultures, and detrimental effects on family life. As mentioned in Section III.C.2.c., it may be argued that employment in the oil and gas industry could be perceived as a traditional occupation; however, for the purpose of this analysis, employment in OCS-related oil and gas activity will not be considered a traditional occupation.

*Base Case Analysis*

Baseline employment projections and information relating to the model analysis used to arrive at these projections are presented in Section IV.D.1.a.(12)(a). This information is incorporated by reference. Unexpected events (such as the 1973 Arab Oil Embargo) may influence oil and gas activity on the OCS within the Gulf of Mexico Region. These events cannot be projected and cannot be presumed for this analysis.

The proposed action will result in approximately 58,500 person-years of employment (direct, indirect, and induced) throughout its 35-year life (Table IV-27). Less than 2 percent of total employment in support of the proposed action is expected to affect the Western Gulf coastal subareas (Subarea W-2). The remaining employment is expected to lie within coastal Subareas C-1 (25%), C-2 (42%), C-3 (27%), and C-4 (4%). In the peak year of 1999, approximately 2,768 person-years of total employment are required to support the proposed action. The greatest amount is expected to lie within Subarea C-2. A comparison between the expected population and employment impacts for the coastal subareas as a result of the proposed action and the expected population and employment without the proposal is shown in Figure IV-10 and in Table IV-30. The greatest impact to employment is expected to occur in coastal Subareas C-1 and C-2, with peak-year impact estimates in 1999 of 0.24 and 0.23 percent, respectively.

Short-term fluctuations in the work force as a result of changing levels of activities could affect social patterns in several ways. Large amounts of short-term layoffs in oil and gas industry personnel could result in large numbers of persons returning to traditional ways of employment (i.e., fishing, trapping, farming, etc.), stressing the various resources that would be exploited. A large increase in the hiring of oil and gas industry personnel could attract persons engaged in traditional occupations, leaving fewer persons in them in the coastal subareas and, perhaps, resulting in the loss of traditional knowledge associated with these occupations.

The potential effects of work force fluctuations on extant subcultures in the coastal subareas are expected to be greatest when large changes in OCS-related activity result in net positive or negative migration. The quality of family life, in pertinent individual cases, could be adversely affected from the decrease of family income and loss of security resulting from layoffs in the OCS oil and gas industry. The expected impacts on family life, in pertinent individual cases, from increased hiring in the OCS-related oil and gas industry would be decreased monetary stress and an increased financial security. Problems related to work scheduling may arise and are discussed below. As mentioned above, employment impacts under the proposed action are not expected to exceed 0.24 percent in the peak year of 1999. Projected employment associated with the proposed action is expected to come from those already employed in OCS-related activities and from the unemployed and underemployed, and new employees already living in the coastal subareas. It is expected that the proposed action will not result in large increases or decreases in OCS-related employment within the Central and Western Gulf coastal subareas.

Both in-migration and out-migration could adversely effect social patterns in the Central and Western Gulf coastal subareas. Expected adverse effects of in-migration include the loss of cultural homogeneity, the loss of community cohesion, and changes in the quality of life with possible associated stresses to social patterns. Expected adverse effects of out-migration include stress placed on family life by the departure of extended family members; the departure of persons who are engaged, part-time, in traditional occupations; and impacts to community cohesion by the departure of long-time residents. Projected population impacts in the Central and Western Gulf coastal subareas are not expected to exceed 0.25 percent (1999-peak year). An analysis of historical trends indicates that only population impacts greater than 1 percent typically involve positive net migration into a given area. None of the coastal subareas is projected to experience population impacts greater than 1 percent as a result of the proposed action. Employment in support of the proposed action is expected to come from those currently employed in OCS-related oil and gas activities as well as the unemployed and underemployed, and new employees already living in the area. It is assumed that employment as a result of the proposal will decrease the amount of out-migration compared to that which would occur without the proposal.

Distance to site and type of transportation needed for personnel in OCS-related oil and gas activities results in the normal work schedule occurring as a large block of time on duty (or at site) followed by a large block of time off duty. The schedules may range from 7 days on followed by 7 days off to a 30 day-on/30-day off schedule. It has been argued that this type of schedule has allowed for the participation in, and continuance of, traditional occupations (Hallowell, 1979; Laska, personal comm., 1991). It is expected that stress will be placed on family life in response to the regular absences of a parent (usually the father). In some cases, it is expected that adaptation to changing family roles will occur. In other cases, however, it is expected that adaptation will not occur and that deleterious impacts to family life, in pertinent individual cases, will occur. In the peak-year of 1999, approximately 2,768 person-years of total employment are required to support the proposed action. Many of those employed will be working in secondary and tertiary jobs and will not encounter the extended work schedule mentioned above. Impacts to family life are expected to be serious in some individual cases.

Displacement from traditional occupations could originate from destruction of a resource base, space-use conflict, and voluntary shifts from traditional occupations to employment in OCS-related activities. Adverse effects resulting from displacement from traditional occupations could include a diminishment in the number of participants in traditional occupations, the loss of traditional knowledge and cultural heritage, and deleterious impacts to family life. Space-use conflicts have been discussed in Section IV.D.1.a.(9). The existence of the Fisherman's Contingency Fund mitigates, to some extent, space-use conflicts associated with commercial fishing. A total of 239 claims was filed in 1990 and $212,453.24 were paid to persons attributing damage to OCS-related debris. According to Sections IV.D.1.a.(1)(b) and IV.D.2.a.(1)(b), the proposed action is expected to have a very low impact on coastal wetlands in both the CPA and WPA. It is therefore assumed that very little displacement from traditional occupations will occur as a result of OCS-related destruction of wetlands. As mentioned above, the extended work schedule associated with many OCS-related jobs may allow for continued participation in traditional occupations. It is expected that relatively few persons will be displaced from traditional occupations as a result of the proposed action.

The relatively high wages paid to OCS-related oil and gas industry personnel can result in the voluntary shift of persons engaged in traditional occupations to more lucrative positions within the oil and gas industry. Dependency on these relatively high wages may have deleterious impacts on family life, particularly if layoffs occur and the wage-earner cannot find work at comparable pay. It is assumed that some persons engaged in lower-paying traditional occupations will seek employment in OCS-related oil and gas activities. Those engaged in extended work schedules will retain the ability to participate in traditional occupations on a part-time basis. Employment projections for the life of the proposed action indicate that peak year employment (1999) will total approximately 2,768 persons throughout the Central and Western Gulf coastal subareas. It is expected that employment will come from persons already working in OCS-related oil and gas activities as well as the unemployed and underemployed, and new employees already living in the area. The relatively small amount of employment associated with the proposed action, in comparison with total employment in the Central and Western Gulf, lessens the potential impact of relative wages on social patterns.

*Summary*

Impacts to social patterns would be related to dramatic changes in population and the disruption of environmental resources, as well as conditions inherent to OCS-related employment (i.e., work scheduling and rate of pay). Specific impact-producing factors examined in this analysis include work force fluctuations, migration into or out of the coastal subareas, work scheduling, displacement from traditional occupations, and relative income. An analysis of historical trends indicates that population impacts of greater than 1 percent typically involve positive net migration into a given area. Under the Base Case, population impacts are not expected to exceed the peak-year impact of 0.25 percent. No positive net migration into Central and Western Gulf coastal subareas is expected to occur as a result of the proposal. It is expected that employment will occur from those currently employed in the oil and gas industry, as well as the unemployed and underemployed, and new employees already living in the area. It is expected that jobs created by the proposal would likely reduce the amount of out-migration when compared to scenarios without the proposal and that minor displacement from traditional occupations will occur as a result of the proposed action. This displacement will be mitigated, to some extent, by the extended work schedule associated with OCS-related employment. However, the extended work schedule is expected to have some deleterious effects on family life in some individual cases. Impacts caused by the displacement of traditional occupations and relative wages are expected to occur to a minimal extent.

*Conclusion*

It is expected that no net migration will occur as a result of the proposed action. Deleterious impacts to social patterns are expected to occur in some individual cases as a result of extended work schedules, displacement from traditional occupations, and relative wages.

*High Case Analysis*

Baseline employment projections and information relating to the model analysis used to arrive at these projections are presented in Section IV.D.1.a.(12)(a). This information is incorporated by reference. Unexpected events (such as the 1973 Arab Oil Embargo) may influence oil and gas activity on the OCS within the Gulf of Mexico Region. These events cannot be projected and cannot be presumed for in this analysis.

Approximately 101,100 person-years of employment (direct, indirect, and induced) are required to sustain the proposed action in the High Case throughout its 35-year life (Table IV-29). Less than 2 percent of total employment in support of the proposed action is expected to affect the Western Gulf coastal subareas (Subarea W-2). The remaining employment is expected to lie within coastal Subareas C-1 (23%), C-2 (43%), C-3 (28%), and C-4 (4%). In the peak year of 1999, approximately 4,374 person-years of total employment are required to support the High Case. The greatest amount of this employment is expected to lie within Subarea C-2. A comparison between the expected population and employment impacts for the coastal subareas as a result of the High Case and the expected population and employment without the proposal is shown in Table IV-30.

The greatest impact on employment is expected to occur in coastal Subareas C-1 and C-2, with peak-year impact estimates in 1999 of 0.38 and 0.37 percent, respectively.

Short-term fluctuations in the work force as a result of changing levels of activities could affect social patterns in several ways. Large amounts of short-term layoffs in oil and gas industry personnel could result in large numbers of persons returning to traditional ways of employment (i.e., fishing, trapping, farming, etc.), thereby stressing the various resources that would be exploited. A large increase in the hiring of oil and gas industry personnel could attract persons engaged in traditional occupations, leaving fewer persons in them in the coastal subareas and, perhaps, resulting in the loss of traditional knowledge associated with these occupations.

The potential effects of work force fluctuations on extant subcultures in the coastal subareas are expected to be greatest when large changes in OCS-related activity result in net positive or negative migration. The quality of family life, in pertinent individual cases, could be adversely affected from the stress of decreased family income and loss of security resulting from layoffs in the OCS oil and gas industry. The expected impact on family life, in pertinent individual cases, from increased hiring in the OCS-related oil and gas industry would be decreased monetary stress and an increased financial security. Problems related to work scheduling may arise and are discussed below. As mentioned above, employment impacts under the High Case are not expected to exceed 0.38 percent in the peak year of 1999. Projected employment associated with the proposal is expected to come from those already employed in OCS-related activities and from the unemployed and underemployed, and new employees already living in the coastal subareas (Section IV.D.1.a.(12)(a)). It is expected that the High Case will not result in large increases or decreases in OCS-related employment within the Central and Western Gulf coastal subareas.

Both in-migration and out-migration could have an adverse effect on social patterns in the Central and Western Gulf coastal subareas. Expected adverse effects of in-migration could include the loss of cultural homogeneity, the loss of community cohesion, and changes in the quality of life with possible associated stresses to social patterns. Expected adverse effects of out-migration could include stress placed on family life by the departure of extended family members; the departure of persons engaged, part-time, in traditional occupations; and impacts to community cohesion by the departure of long-time residents. Projected population impacts in the Central and Western Gulf coastal subareas are not expected to exceed 0.40 percent (1999-peak year). An analysis of historical trends indicates that only population impacts greater than 1 percent typically involve positive net migration into a given area. None of the coastal subareas is projected to experience population impacts greater than 1 percent as a result of the High Case. Employment in support of the proposal is expected to come from those currently employed in OCS-related oil and gas activities as well as the unemployed and underemployed, and new employees already living in the area. It is assumed that employment as a result of the proposal will decrease the amount of out-migration, compared to that which would occur without the proposal.

Distance to the site and the type of transportation needed for personnel in OCS-related oil and gas activities results in the normal work schedule occurring as a large block of time on duty (or at site) followed by a large block of time off duty. The schedules may range from 7 days on followed by 7 days off to a 30 day-on/30 day-off schedule. It has been argued that this type of schedule has allowed for the participation in, and continuance of, traditional occupations (Hallowell, 1979; Laska, personal comm., 1991), thereby assisting in the maintenance of cultural viability. It is expected that stress will be placed on family life in response to the regular absences of a parent (usually the father). In some cases, it is expected that adaptation to changing family roles will occur. In other cases, it is expected that adaptation will not occur and that deleterious impacts to family life, in pertinent individual cases, will occur. In the peak year of 1999, approximately 4,374 person-years of total employment are required to support the proposed action. Many of those employed will be working in secondary and tertiary jobs and will not encounter the extended work schedule mentioned above. Of those persons employed in OCS-related oil and gas activity and working the extended schedule, it is expected that some families will not adapt to these conditions and that deleterious impacts to family life will occur.

Displacement from traditional occupations could originate from destruction of a resource base, space-use conflict, and voluntary shifts from traditional occupations to employment in OCS-related activities. Adverse effects resulting from displacement from traditional occupations could include a diminishment in the number of participants in traditional occupations, the loss of traditional knowledge and cultural heritage, and deleterious impacts to family life as a result of the displacement. Space-use conflicts have been discussed in Section IV.D.1.a.(9). The existence of the Fisherman's Contingency Fund mitigates, to some extent, space-use conflicts associated with commercial fishing. A total of 239 claims was filed in 1990 and $212,453.24 were paid to persons attributing damage to OCS-related debris. According to Sections IV.D.1.a.(1)(b) and IV.D.2.a.(1)(b), the High Case is expected to have a very low impact on coastal wetlands in both the CPA and WPA. It is therefore assumed that very little displacement from traditional occupations will occur as a result of OCS-related destruction of wetlands. As mentioned above, the extended work schedule associated with many OCS-related jobs may allow for continued participation in traditional occupations. It is expected that relatively few persons will be displaced from traditional occupations as a result of the High Case.

The relatively high wages paid to OCS-related oil and gas industry personnel can result in the voluntary shift of persons engaged in traditional occupations to more lucrative positions within the oil and gas industry. Dependency on these relatively high wages may have deleterious impact on family life, particularly if layoffs occur and the wage-earner cannot find work at comparable pay. It is assumed that some persons engaged in lower-paying traditional occupations will seek employment in OCS-related oil and gas activities. Those engaged in extended work schedules will retain the ability to participate in traditional occupations on a part-time basis. Employment projections for the life of the proposed action under the High Case indicate that peak-year employment (1999) will total approximately 4,374 persons throughout the Central and Western Gulf coastal subareas. It is expected that employment will come from persons already working in OCS-related oil and gas activities as well as the unemployed and underemployed, and new employees already living in the area. The relatively small amount of employment associated with the High Case, in comparison with total employment in the Central and Western Gulf, lessens the impact of relatively high wages paid to OCS-related oil and gas industry personnel on social patterns.

Impacts on social patterns would be related to dramatic changes in population and the disruption of environmental resources, as well as conditions inherent to OCS-related employment (i.e., work scheduling and rate of pay). Specific impact-producing factors examined in this analysis include work force fluctuations, migration into or out of the coastal subareas, work scheduling, displacement from traditional occupations, and relative income. An analysis of historical trends indicates that population impacts of greater than 1 percent typically involve positive net migration into a given area. Population impacts under the High Case are not expected to exceed the peak-year impact of 0.40 percent. No positive net migration into the Central and Western Gulf coastal subareas is expected to occur as a result of the proposal. It is expected that employment will occur from those currently employed in the oil and gas industry, as well as the unemployed and underemployed, and new employees already living in the area. It is expected that jobs created by the proposal would likely reduce the amount of out-migration when compared to scenarios without the proposal. It is expected that minor displacement from traditional occupations will occur as a result of the proposed action. This displacement will be mitigated, to some extent, by the extended work schedule associated with OCS-related employment. However, the extended work schedule is expected to have some deleterious effects on family life in some individual cases. Impacts caused by the displacement of traditional occupations and relative wages are expected to occur to a minimal extent.

*Conclusion*

It is expected that no net migration will occur as a result of the High Case scenario. Deleterious impacts on social patterns are expected to occur in some individual cases as a result of extended work schedules, displacement from traditional occupations, and relative wages.

## b. Alternative B - The Proposed Action Excluding the Blocks Near Biologically Sensitive Topographic Features

Alternative B would offer approximately 5,194 unleased blocks in the CPA for leasing; it differs from Alternative A (the proposed action) only by not offering the 62 unleased blocks of the 167 total blocks that are possibly affected by the proposed Topographic Features Stipulation (Section II.A.1.c.(1)). All the assumptions and estimates are the same as in the Base Case of Alternative A. Details are presented in Sections I.A. and II.A.2.

The analyses of impacts are based on the Base Case scenario of Alternative A. These scenarios were formulated to provide sets of assumptions and estimates on the amounts, locations, and timing for OCS exploration, development, and production operations and facilities, both offshore and onshore. These are estimates only and not predictions of what will happen as a result of holding this proposed sale. A detailed discussion of the development scenarios and major, related impact-producing factors is included in Sections IV.A. and B.

It should be emphasized that the analyses of impacts to the various resources under Alternative B are very similar to those for Alternative A. The reader should refer to the appropriate discussions under Alternative A for additional and more detailed information regarding impact-producing factors and their expected effects on the various resources.

To facilitate the analysis, the Federal offshore area is divided into subareas. The CPA comprises four subareas (C-1, C-2, C-3, and C-4), and the coastal region is divided into four coastal subareas (C-1, C-2, C-3, and C-4). These subareas are delineated on Figure IV-1.

### *(1) Impacts on Sensitive Coastal Environments*

#### *(a) Coastal Barrier Beaches*

The activities that could affect barrier beaches under Alternative B include oil spills, pipeline emplacements, dredging of new navigation channels, deepening of existing channels, maintenance dredging and vessel usage of existing navigation channels, and the construction of onshore facilities on barrier features.

As in the Base Case, there is a less than a 1 percent chance of occurrence and contact from a spill greater than or equal to 1,000 bbl. Because of this very low probability, no contact from a spill greater than or equal to 1,000 bbl is assumed to occur. No spills greater than 50 and less than or equal to 1,000 bbl are assumed to contact barrier features. One or two spills greater than 1 and less than or equal to 50 bbl will occur inshore and contact the landward side of barrier beaches. These spills will contact about 2 km of coast, and will be cleaned without the removal of sand. No oil will contact sand dune areas. The barrier features will not be affected by contact from these spills.

No pipeline landfalls, navigation channels, or new infrastructure construction projects are expected as a result of Alternative B. Some maintenance dredging of existing channels will occur under Alternative B. Only a small percentage of the usage of these channels, however, can be attributed to OCS support activities under Alternative B. Consequently, although maintenance dredging of channels that cut across barrier landforms could result in some localized beach erosion downdrift from the mouth of the channel, only a small percentage of these impacts can be attributed to OCS activities. One navigation channel is expected to be deepened to provide access for deeper draft service vessels used for deepwater operations. Dredged material from this project will be disposed of in the coastal littoral zone to enhance coastal stabilization.

*Conclusion*

Alternative B is not expected to result in permanent alterations of barrier beach configurations, except in localized areas downdrift from navigation channels that have been dredged and deepened. The contribution to this localized erosion is expected to be less than 1 percent.

#### *(b) Wetlands*

The activities that could affect wetlands under Alternative B include oil spills, pipeline emplacements, dredging of new navigation channels, maintenance dredging and vessel usage of existing navigation channels, and the construction of onshore facilities on barrier features. The impacts expected from Alternative B do not greatly differ from those associated with OCS development under the Base Case scenario because the deleted offshore blocks are located at a distance from coastal wetland habitats.

As in the Base Case, there is a less than 1 percent chance of occurrence and contact from a spill greater than or equal to 1,000 bbl. Because of this low probability, it is assumed that no contact from a spill of 1,000 bbl or greater will occur. No spills greater than 50 and less than or equal to 1,000 bbl are assumed to contact wetlands. Several spills greater than 1 and less than or equal to 50 bbl will occur from both offshore and inshore sources and contact the coast. In Louisiana, where most CPA oil and gas activity occurs, several spills greater than 1 and less than or equal to 50 bbl could result in short-term (up to four years) dieback effects on 10-15 ha of wetlands and the permanent conversion of 2 ha of wetlands into open water and mudflats over the 35-year life of the proposed action.

Produced waters transported to shore will be either reinjected or disposed of in offshore state waters or the Mississippi River and its passes. No impacts to wetlands under these conditions are anticipated, based on an analysis of the results of field and remote sensing investigations in coastal Louisiana (Boesch and Rabalais, 1989b).

No pipeline landfalls, navigation channels, or new infrastructure construction projects are expected as a result of Alternative B. Although no new waste sites will be constructed for OCS-generated waste disposal, seepage from existing sites could affect nearby wetlands. Some maintenance dredging of existing channels will occur under Alternative B. Only a small percentage of the usage of these channels, however, can be attributed to OCS support activities under Alternative B. Consequently, although maintenance dredging of channels that cut through wetlands could result in burial of wetlands with dredge spoil and the reinforcement of secondary impacts associated with canal-induced hydrologic changes, only a small percentage of these impacts can be attributed to OCS activities. The deepening of one navigation channel for deeper draft service vessels is projected under Alternative B. This analysis assumes that the dredged material will be disposed of to enhance wetland growth and create new wetlands. The creation of several hectares of new wetlands is anticipated as a result of channel deepening. Alternative B will result in a reduction in resource development, compared with the Base Case scenario. The amount of vessel traffic required under Alternative B for supply vessels, barges, and shuttle tankers will be less than or equal to that required under the Base Case. Up to several hectares of wetlands along channel banks could be eroded by waves generated by vessel traffic associated with Alternative B.

*Conclusion*

Alternative B is expected to result in dieback and mortality of 10-15 ha of wetlands vegetation as a result of contacts from onshore oil spills. All but 2 ha of these wetlands will recover within 10 years; the remaining 2 ha will be converted to open water. About 5.5 ha of wetlands are projected to be eroded along channel margins as a result of OCS vessel wake erosion, and 3.5 ha of wetlands are projected to be created as a result of beneficial disposal of dredged material from channel deepening projects.

## *(2) Impacts on Sensitive Offshore Resources*

### *(a) Live Bottoms (Pinnacle Trend)*

The live bottoms of the pinnacle trend region are located in the northeastern portion of the Central Gulf and adjacent areas of the Eastern Gulf between 73- and 101-m (240- and 330-ft) water depth in the Main Pass and Viosca Knoll lease areas. The pinnacles are scattered in this area and include recently documented live-bottom areas that may be sensitive to oil and gas activities. Leases in past sales have contained a live-bottom stipulation for protection of such areas, and a proposed stipulation is presented in Section II.A.1.c.(2) as a possible mitigating measure for leases resulting from the proposed action.

A number of OCS-related factors may cause adverse impacts to the pinnacle trend communities and features. Damage caused by oil spills (which have the potential to foul benthic communities and cause the death or disruption of organisms), blowouts (which have the potential of resuspending considerable amounts of sediment and releasing hydrocarbons into the water column), anchoring (which may damage lush biological communities or the structure of the pinnacles themselves), structure emplacement (which will crush the organisms directly beneath the legs or mat used to support the structure) and removal (which can suspend sediments throughout the water column to the surface), drilling discharges (that can smother organisms through deposition of sediments), and pipeline emplacement (through burial and disruption of the benthos) can cause the immediate death of numerous organisms or the alteration of sediments to the point that recolonization of the affected areas may be delayed or impossible.

Estimates presented in Table IV-2 project the level of impact-producing factors that may result from the proposed action. Approximately 1,430,000 bbl of drilling muds and 344,000 bbl of drill cuttings will be discharged from 290 exploration or delineation and production wells over the 35-year life of the proposed action in offshore Subarea C-3. Approximately 80 km of pipeline will be installed to transport production from the eight platforms projected to be emplaced.

Activities resulting from the proposed action are not expected to have a high level of impact on the pinnacle trend environment, because the activities for this analysis are restrained by the implementation of the proposed Live Bottom Stipulation. The impact to the pinnacle trend area as a whole is expected to be slight because no community-wide impacts are expected. The implementation of the proposed Live Bottom Stipulation would preclude the occurrence of the most potentially damaging of these activities associated with mechanical damages. Impacts are expected to be infrequent because of the limited operations in the vicinity of the pinnacles and the small size of many of the features. Potential impact levels from oil spills greater than or equal to 1,000 bbl, blowouts, pipeline emplacement, muds and cuttings discharges, and structure removals are very low because the analysis includes the proposed Live Bottom Stipulation. The frequency of impacts to the pinnacles is low, and the severity is judged to be slight because of the widespread nature of the features.

*Conclusion*

The impact of Alternative B on the pinnacle trend region in the Gulf of Mexico is expected to be such that any changes in the regional physical integrity, species diversity, or biological productivity of the pinnacle trend region would recover to pre-impact conditions in less than 2 years, more probably on the order of 2-4 months.

### *(b) Deep-water Benthic Communities*

The sources and severity of impacts associated with this alternative are those sale-related activities discussed for the Base Case. As noted in Section IV.D.1.a.(2)(b) for the Base Case, the impact-producing factors threatening these communities result from those activities that would physically disturb the bottom, such as the routine operations of anchoring, drilling, and pipeline installation, and the infrequent seafloor blowout accident. A more detailed examination of this potential impact-producing factor is presented in that section.

As noted in Section IV.D.1.a.(2)(b) above, high-density chemosynthetic communities are found only in water depths greater than 400 m (1,312 ft). Thus, they will not be found in Subarea C-1; they will be found only in the southeast third of Subarea C-2 and the southern two-thirds of C-3; they may be found throughout C-4. Thus, these communities will not be exposed to the full level of the projected impact-producing factors of Table IV-2. None of the excluded blocks are in areas in which chemosynthetic communities may be expected, because the excluded blocks are in much shallower water near the topographic features.

The majority of these deep-water communities are of low density and are widespread throughout the deep-water areas of the Gulf, and disturbance to a small area would not result in a major impact to the ecosystem. For purposes of this analysis, the frequency of such impact is expected to be once every six months to two years, and the severity of such an impact is judged to result in few losses of ecological elements with no alteration of general relationships.

High-density communities are largely protected by the provisions of NTL 88-11. For purposes of this analysis, the frequency of some small percentage of impact is expected to be once every six months to two years, but the severity of such an impact is such that there may be some loss of ecological elements and/or some alteration of general relationships.

*Conclusion*

Aternative B is expected to cause little damage to the physical integrity, species diversity, or biological productivity of either the widespread, low-diversity chemosynthetic communities or the rare, widely scattered, high-density Bush-Hill type chemosynthetic communities. Recovery from any damage is expected to take less than 2 years.

## (c) *Topographic Features*

The sources and severity of impacts associated with this alternative are those sale-related activities discussed for the Base Case. As noted in Section IV.D.1.a.(2)(c) for the Base Case, the potential impact-producing factors to the topographic features of the Central Gulf are anchoring and structure emplacement, effluent discharge, blowouts, oil spills, and structure removal. A more detailed examination of these potential impact-producing factors is presented in that section.

Fifteen of the 16 topographic features of the CPA are located in Subarea C-2; 1 is in C-3 (in both cases they occupy a very small portion of the entire area). Thus, these communities will not be exposed to the full level of the projected impact-producing factors of Table IV-2. This alternative differs from Alternative A by excluding the 61 unleased blocks near the topographic features in C-2 and the 1 unleased block near the bank in C-3. (These excluded blocks are the blocks that would be subject to the proposed Topographic Features Stipulation under Alternative A. It should be noted that 105 of the total of 167 blocks subject to the proposed stipulation are currently leased.) The amounts of wastes discharged in the vicinity of a bank will be some very small fraction of those shown in Table IV-2.

Of the potential impact-producing factors to the topographic features, anchoring, structure emplacement, and structure removal will be eliminated by the adoption of this alternative. Effluent discharge and blowouts will not be a threat because blocks near enough to the banks for these events to have an impact on the biota of the banks will have been excluded from leasing. Thus, the only impact-producing factor remaining, from operations in blocks included in this alternative (i.e., those blocks not excluded by this alternative), is an oil spill.

There is an estimated 16 percent chance of an oil spill greater than or equal to 1,000 bbl occurring in the Central Gulf as a result of this alternative (it will be the same as the Base Case of Alternative A) (Table IV-19). It is assumed that 21 spills of greater than 1 and less than or equal to 50 bbl will occur each year and that 1 spill of greater than 50 and less than 1,000 bbl and 1 spill of 6,500 bbl is assumed to occur during the 35-year life of the proposed action (Section IV.C.1.). In addition, it is assumed there will be 4 spills of diesel oil and other pollutants, the average size of which will be only 34 bbl (Table IV-2). In the Central Gulf, Sonnier Bank crests the shallowest at 18 m. Therefore, a surface oil spill would likely have no impact on the biota of Sonnier Bank or the other topographic features because any oil that might be driven to 18 m or deeper would be well below the concentrations needed to cause an impact. However, spills resulting from this proposal are assumed to be subsurface; such spills are likely to rise to the surface, and any oil remaining at depth will be swept clear of the banks by currents moving around the banks (Rezak et al., 1983). A seafloor oil spill would have to come into contact with a biologically sensitive feature to have an impact. The fact that the topographic features are widely dispersed in the Central Gulf, combined with the probable random nature of spill locations, would serve to limit the extent of damage from any given spill to only one of the sensitive areas. The currents that move around the banks will steer any spilled oil around the banks rather than directly upon them, lessening the severity of impacts.

*Conclusion*

Alternative B is expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 $m^2$ would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than

2 years, probably on the order of 2-4 weeks. Selection of Alternative B would preclude oil and gas operations in the unleased blocks affected by the proposed Topographic Features Stipulation.

### *(3) Impacts on Water Quality*

All existing onshore infrastructure and associated coastal activities occurring in support of the proposed action will contribute to the degradation of regional coastal and nearshore water quality to a minor extent because each provides a low measure of continuous contamination and because discharge locations are widespread. The effect of chronic contamination on the Gulf's coastal waters due to the proposed action is considered negligible, with water characteristics rapidly returning to background levels. The OCS-related vessel traffic is likely to impact water quality through routine releases of bilge and ballast waters, chronic fuel and tank spills, trash, and low-level releases of the contaminants in antifouling paints. Given the small concentrations of the releases anticipated, and their continuous and widespread nature, it is expected that there will be some localized, short-term change (up to several weeks) in water quality characteristics from background levels, depending on the length of the affected channel, flushing rates, and other factors. The OCS produced-water discharges are not assumed to degrade coastal and nearshore waters because of the new State regulations phasing out the discharge of these waters into Louisiana's State waters. The improper storage and disposal of oil-field wastes and NORM-contaminated oil-field equipment would adversely impact surface and ground waters in proximity to disposal facilities, cleaning sites, and scrap yards. Surface and groundwater in proximity to improperly designed and maintained disposal sites and facilities could be adversely impacted with elevated concentrations of arsenic, chromium, zinc, cadmium, mercury, lead, barium, penta-chlorophenol, naphthalene, benzene, toluene, and radium.

Immediate effects would be brought about by increased drilling, construction, and pipelaying activities, causing an increase in water column turbidities (lasting for several hours for mud discharges to several weeks for pipelaying and dredging activities) to the affected offshore waters. The magnitude and extent of turbidity increases would depend on the hydrographic parameters of the area, nature and duration of the activity, and bottom-material size and composition. Offshore Subarea C-1 would receive the greatest portion of program-related pipeline burial activities, whereas offshore Subareas C-2 and C-3 would receive the largest amounts of program-related operational discharges. Because of the continuous nature of oil and gas activities in the northwestern and north-central Gulf of Mexico, discharges of drilling mud and cuttings and produced water are judged to be of nearly continuous frequency throughout these areas. Proposed produced-water discharges will be rapidly diluted within the immediate vicinity of the discharge source. Significant increases in water concentrations of dissolved and particulate hydrocarbons and trace metals are not expected outside the initial mixing zone or immediate vicinity of the discharge source. Higher concentrations of trace metals, salinity, temperature, organic compounds, and radionuclides, and lower dissolved oxygen may be present near the discharge source. Long-term effects to water column processes, consisting of localized increases in particulate metal and soluble lower molecular weight hydrocarbon (e.g., benzene, toluene, and xylenes) concentrations, may be implicated within the mixing zone of the discharge. Trace metals and hydrocarbons associated with the discharge may be deposited within sediments near the discharge point. The proposed discharge of drilling fluids and cuttings would rapidly disperse in marine waters. Discharge plumes will be diluted to background levels within a period of several hours and/or within several hundred meters of the discharge source. The accumulation of toxic trace metals and hydrocarbons in exposed shelf waters, due to periodic releases of water-based generic muds and cuttings, is unlikely, and the long-term degradation of the water column from such discharges is not a major concerns.

One oil spill greater than or equal to 1,000 bbl and one oil spill greater than 50 and less than 1,000 bbl are assumed to occur, but not assumed to contact coastal and nearshore waters. An additional 31 spills greater than 1 but less than or equal to 50 bbl are assumed from OCS sale-related activities both in the coastal zone and offshore. Of these, fewer than 10, associated with onshore support and vessel activities, are assumed to occur in coastal waters. Program-related spills will introduce oil into nearshore waters, creating elevated hydrocarbon levels (up to 100+ $\mu$g/l) within affected waters. Much of the oil will be dispersed throughout the water column over several days to weeks. In shallow areas, oil may become entrained in suspended particles and bottom sediments. Water uses would be affected for up to several weeks from proposed spills and then only near the source of slick.

*Conclusion*

An identifiable change to the ambient concentration of one or more water quality parameters will be evident up to several hundred to 1,000 m from the source and for a period lasting up to several weeks in duration in marine and coastal waters. Chronic, low-level pollution related to the proposal will occur throughout the 35-year life of the proposed action.

### *(4) Impacts on Air Quality*

Alternative B will offer for lease all unleased blocks in the proposed action, excluding the 62 unleased blocks near biologically sensitive topographic features in the CPA.

A description of CPA air quality is provided in Section III.A.3., and descriptions of the potential impact-producing factors are provided in Section IV.A. An analysis of the impacts of Alternative A is presented in Section IV.D.1.a.(4).

The size of the area and the number of blocks available for lease under Alternative A is large. Because only 62 blocks would be withheld from proposed Sale 142 if Alternative B were adopted, it is expected that activities, infrastructure, and other factors described in that analysis will not change appreciably. The reader may consult Table IV-2 for the number of wells and platform complexes related to Alternative A. It is conceivable, given the small size of the changes produced by Alternative B, that the analyses described in Alternative A will not changed.

It is assumed under the proposed action that 340 exploration and delineation wells and 250 development wells will be drilled, and 30 platform complexes will be emplaced. The information presented below displays emissions for each subarea during the life of the proposed action.

Total Emissions in CPA Subareas
(tons over 35-year life of the proposed action)

| Pollutant | C-1 | C-2 | C-3 | C-4 |
|---|---|---|---|---|
| $NO_x$ | 12,979.9 | 10,816.6 | 21,633.1 | 19,469.8 |
| CO | 1,875.5 | 1,562.9 | 3,125.8 | 2,813.2 |
| $SO_x$ | 169.3 | 141.1 | 282.2 | 254.0 |
| THC | 4,046.1 | 3,372.1 | 6,744.3 | 6,069.8 |
| TSP | 261.1 | 217.6 | 435.2 | 391.7 |

The discussion of the meteorology and pollutant dispersion presented under Alternative A indicates that the release of pollutants over the Gulf waters occurs relatively close to the surface (30 m) and that prevailing atmospheric conditions will promote vertical and horizontal mixing of the plume. During night and morning hours and in the winter, even though turbulence is available, the mixing height would be low, so that little dilution would occur. During the summer, the available turbulent energy and the greater mixing heights will allow greater dispersion and dilution of pollutants. During high-wind conditions, the dispersion will be much larger, reducing the concentrations to even lower levels. The only pollutant that may remain in large concentrations is $NO_X$.

More important are the potential impacts of these emissions on inshore air quality. It is reasonable to expect that emissions reaching land will be minimal from Subareas C-2 and C-4, and the southern portions of C-3. Emissions from subareas close to land, C-1 and the northern portions of C-3, will be carried mostly offshore in winter. In summer, mixing over the Gulf waters is intensive and the arriving concentrations will be diminished. At the coastline, the effects will depend on the level of concentration of arriving pollutants. For

$NO_x$, however, the concentrations may not be low. Numerical modeling by MMS of pollutant transport to inshore areas reveals that inert pollutants have very low concentrations when they reach the onshore.

Oil spills of all categories have temporal effects on offshore air quality and are limited to the immediate vicinity of the spill.

Offloading of crude oil from surface vessels at ports is estimated to be near 4 percent of the OCS production. The emission rates of these unintentional emissions are small, and it is estimated that they produce negligible effects on CPA inshore air quality. Tugboat emissions in these operations are expected to produce negligible effects on air quality.

Suspended particulate matter is important because of its potential in degrading the visibility in national wildlife parks or recreational parks, designated as Type I areas. Particles larger than 10 microns will have small concentrations because they settle very fast. Particles of 10 microns or smaller remain floating in the air for long periods, but their low concentrations generally will have little effect on the visibility of these areas. The selection of Alternative B can diminish effects on the air quality from the above impact producing factors, but not enough to change the impacts expected under Alternative A.

*Conclusion*

Emissions of pollutants into the atmosphere from activities assumed for Alternative B are expected to have concentrations that would not change onshore air quality classifications. Increases in onshore concentrations of air pollutants from Alternative B are estimated to be about 1 $\mu m^3$ (box model steady concentrations). This concentration will have minimal impact during winter because onshore winds occur only 37 percent of the time and maximum impacts in summer when onshore winds occur 61 percent of the time.

## *(5) Impacts on Coastal and Marine Mammals*

### *(a) Marine Mammals*

*Nonendangered and Nonthreatened Species*

This section discusses the impact of the adoption of Alternative B, which excludes biologically sensitive offshore habitats, on nonendangered and nonthreatened cetaceans (including whales and dolphins). The level of activity associated with the alternative is the same as the summary of infrastructure and activity described for the Base Case in Table IV-2. The sources and severity of impacts for nonendangered and nonthreatened species in Alternative B are the same as those discussed for the Base Case (Section IV.D.1.a.(5)). The impacts include operational discharges, helicopter and vessel traffic, drilling operations, explosive platform removals, seismic surveys, oil spills, and oil-spill response activities. The effects of these activities are expected to be primarily nonlethal and the probability of an interaction is unlikely. Lethal effects are expected only from oil spills greater than or equal to 1,000 bbl.

*Conclusion*

The impact of Alternative B on nonendangered and nonthreatened marine mammals is expected to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes, as well as some degree of avoidance of the impacted area(s).

*Endangered and Threatened Species*

This section discusses the impact of the adoption of Alternative B, which excludes biologically sensitive offshore habitats, on endangered and threatened cetaceans. The level of activity associated with the alternative is the same as the summary of infrastructure and activity described for the Base Case in Table IV-2. The sources and severity of impacts for endangered and threatened species in Alternative B are the same as those discussed for the Base Case (Section IV.D.1.a.(5)). The impacts include operational discharges, helicopter and vessel traffic, drilling operations, explosive platform removals, seismic surveys, oil spills, and oil-spill response activities. The effects of these activities are expected to be primarily nonlethal and the probability of an interaction is unlikely. Lethal effects are expected only from oil spills greater than or equal to 1,000 bbl.

*Conclusion*

The impact of Alternative B on endangered and threatened marine mammals is expected to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes, as well as some degree of avoidance of the affected area(s).

### *(b) Alabama, Choctawhatchee, and Perdido Key Beach Mice*

This section discusses the impact of the adoption of Alternative B, which excludes biologically sensitive offshore habitats, on the Alabama, Choctawhatchee, and Perdido Key beach mice. The level of activity associated with the alternative is the same as the summary of infrastructure and activity described for the Base Case in Table IV-2. The sources and severity of impacts for beach mice in Alternative B are the same as those discussed for the Base Case (Section IV.D.1.a.(5)). The impacts include habitat alteration and physical contact with oil and oil-spill response activities. The effects of these activities are expected to be primarily nonlethal and the probability of an interaction is unlikely. Lethal effects are expected only from oil spills greater than or equal to 1,000 bbl.

*Conclusion*

The impact of Alternative B on the Alabama, Choctawhatchee, and Perdido Key beach mice within the potentially affected area is expected to result in sublethal effects that seldom occur and may cause short-term physiological or behavioral changes.

### *(6) Impacts on Marine Turtles*

This section discusses the impact of the adoption of Alternative B, which excludes biologically sensitive offshore habitats, on marine turtles. The level of activity associated with the alternative is the same as the summary of infrastructure and activity described for the Base Case in Table IV-2. The sources and severity of impacts for marine turtles in Alternative B are the same as those discussed for the Base Case (Section IV.D.1.a.(6)). The impacts include habitat alteration by physical disturbance and chemical discharges, and direct impacts by trash and debris, vessel traffic, explosive structure removals, and oil or oil-spill response activities. The effects of these activities are expected to be primarily nonlethal and the probability of an interaction is unlikely. Lethal effects are expected only from oil spills greater than or equal to 1,000 bbl.

*Conclusion*

The impact of Alternative B on marine turtles within the potentially affected area is expected to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes.

### *(7) Impacts on Coastal and Marine Birds*

### *(a) Nonendangered and Nonthreatened Species*

The Gulf of Mexico is populated by migrant and nonmigrant species of coastal and marine birds. This broad category consists of four main groups: seabirds, waterfowl, wading birds, and shorebirds.

The sources and severity of impacts associated with this alternative to coastal and marine birds are those sale-related activities discussed for the Base Case (Table IV-2). As noted in Section IV.D.1.a.(7) for the Base Case, effects that may result from this alternative include oil spills, disturbance from OCS service-vessel and helicopter traffic near coastal areas, displacement from onshore pipeline landfalls and facility construction near coastal areas, and entanglement and ingestion of offshore oil- and gas-related plastic debris.

It is expected that the effects from the major impact-producing factors on coastal and marine birds are negligible and of nominal occurrence. As a result, there will no discernible disturbance to Gulf coastal and marine birds.

*Conclusion*

The impact of Alternative B on nonendangered and nonthreatened coastal and marine birds is expected to result in no discernible decline in a population or species, and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to predisturbance condition in less than one generation.

### *(b) Endangered and Threatened Species*

This section discusses the impact of Alternative B, which excludes biologically sensitive offshore habitats, on endangered and threatened coastal and marine birds. The sources and severity of impacts associated with this alternative to endangered and threatened species of coastal and marine birds are those sale-related activities discussed for the Base Case. The endangered and threatened birds include the piping plover, brown pelican, bald eagle, and Arctic peregrine falcon. The level of activity associated with the alternative is the same as the summary of infrastructure and activity described for the Base Case in Table IV-2. The sources and severity of impacts in Alternative B for endangered and threatened coastal and marine birds are the same as those discussed for the Base Case (Section IV.D.1.a.(7)). The impacts include habitat alteration by physical disturbance and chemical discharges, and direct impacts by trash and debris, vessel traffic, explosive structure removals, and oil or oil-spill response activities. The effects of these activities are expected to be primarily nonlethal and the probability of an interaction is unlikely. Lethal effects are expected only from oil spills greater than or equal to 1,000 bbl.

*Conclusion*

The impact of Alternative B on endangered and threatened coastal and marine birds is expected to result in no discernible decline in a population or species and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to predisturbance condition in less than one generation.

### ***(8) Impacts on the Gulf Sturgeon***

This section discusses the impact of the adoption of Alternative B, which excludes biologically sensitive offshore habitats, on the Gulf sturgeon. The level of activity associated with the alternative is the same as the summary of infrastructure and activity described for the Base Case in Table IV-2. The sources and severity of impacts in Alternative B for the Gulf sturgeon are the same as those discussed for the Base Case (Section IV.D.1.a.(8)). The impacts include oil spills. The effects of these activities are expected to be primarily nonlethal and the probability of an interaction is unlikely. Lethal effects are expected only from oil spills greater than or equal to 1,000 bbl. Effects from oil spills of less than 1,000 bbl are expected to be sublethal.

*Conclusion*

The impact of Alternative B on the Gulf sturgeon is expected to result in sublethal effects that cause short-term physiological or behavioral changes.

### *(9) Impacts on Commercial Fisheries*

The sources and severity of impacts to commercial fisheries are the same in this alternative as those sale-related activities discussed for the Base Case (Table IV-2). As noted in Section IV.D.1.a.(9) for the Base Case, effects that may result from this alternative include emplacement of production platforms, underwater OCS obstructions, production platform removals, seismic surveys, oil spills, subsurface blowouts, and OCS discharges of drilling muds and produced waters.

It is expected that the effects from the major impact-producing factors on commercial fisheries in the CPA will be inconsequential and of nominal occurrence. As a result, there will be little discernible disturbance to Gulf commercial fisheries.

*Conclusion*

The impact of Alternative B on commercial fisheries is expected to result in short-term decrease in a portion of a population of commercial importance, in an essential habitat, or in commercial fisheries on a local scale. Any affected population is expected to recover to predisturbance condition in one generation.

### *(10) Impacts on Recreational Resources and Activities*

### *(a) Beach Use*

The sources and severity of beach use impacts associated with the offering of Alternative B are the same as the sale-related activities discussed for the Base Case. As noted in Section IV.D.1.a.(10)(a) for the Base Case, effects that may result on beach uses from this alternative include oil spills, trash and debris, and the physical presence of drilling rigs and platforms within sight of coastal beaches. The potential effects from these impact-producing factors are described in the discussion in Section IV.D.1.a.(10)(a).

No oil spills of 1,000 bbl or greater and a few spills greater than 1 and less than or equal to 50 bbl are assumed to occur and contact a major recreational beach in the CPA. There will also be the minor, intermittent effect of litter or trash associated with sale-related OCS operations. Removing tracts associated with the protected biological features noted (far offshore on Visual No. 2) will have no effect on the possibility of a drilling rig or platform being placed in nearshore tracts, within sight of intensively used or wilderness beaches.

*Conclusion*

Alternative B is expected to result in minor pollution events and nearshore operations that may adversely affect the enjoyment of some beach users on Texas and Louisiana beaches.

### *(b) Marine Fishing*

The sources and severity of marine fishing impacts associated with the offering of Alternative B are the same as the sale-related activities discussed for the Base Case. As noted in Section IV.D.1.a.(10)(b) for the Base Case, effects that may result on marine fishing from this alternative include platform installations and removals and oil spills. Offshore platforms attract fish and fishermen; explosive removal of platforms will kill or critically injure sport fish directly associated with the structure at the time of detonation; and oil spills will tend to discourage fishing.

The 16 platform complexes expected to be installed and ultimately removed in coastal Subareas C-1 and C-3 will most likely be unaffected by this alternative, as all of the tract deletions associated with this alternative, except one, are in offshore Subarea C-2. A few oil spills greater than 1 and less than or equal to 50 bbl are being assumed. The impact on marine recreational fishing from this pollution will be short term and minor.

*Conclusion*

Platforms installed within 30 mi of shore will attract fish and are likely to attract fishermen and improve fishing for a period of about 20 years, but are unlikely to affect offshore fishing patterns in general unless the platforms are installed in nearshore locations where no platforms currently exist.

## *(11) Impacts on Archaeological Resources*

A number of OCS-related factors may cause adverse impacts to archaeological resources. Damage to both historic and prehistoric archaeological resources could be caused by the placement of drilling rigs, production platforms, and pipelines; dredging; and anchoring. These activities could destroy artifacts or disrupt the provenience and stratigraphic context of artifacts, sediments, and paleoindicators, from which the scientific value of the archaeological resource is derived. Oil spills could contaminate site organics and destroy the ability to date prehistoric sites by radiocarbon dating techniques. Ferromagnetic debris associated with OCS oil and gas activities would tend to mask magnetic signatures of significant historic archaeological resources.

### *(a) Historic*

The offering for lease of all CPA lease blocks, with the exception of the lease blocks near biologically sensitive topographic features, would not result in the deletion of any blocks considered to have a high probability for the occurrence of historic and/or prehistoric archaeological resources. Adoption of the alternative will not change expected impacts from those discussed under the Base Case scenario (Section IV.D.1.a.(11)).

Offshore development could result in an interaction between a drilling rig, a platform, a pipeline, dredging activity, or anchors and an historic shipwreck. The result would be the loss of archaeological data on ship construction, cargo, the social organization of the vessel's crew, and the concomitant loss of information on maritime culture for the time period from which the ship dates.

Likely locations of archaeological sites on the OCS cannot be delineated without first conducting a remote-sensing survey of the seabed and near-surface sediments. The location of any proposed activity within a lease block that has a high probability for historic shipwrecks requires archaeological clearance prior to operations. If the expanded database containing the 273 shipwrecks in the entire Central Gulf OCS is considered, the probability of an OCS activity contacting and damaging a shipwreck is fairly low. However, if an oil and gas structure contacted an historic resource, significant or unique archaeological information could be lost. The frequency of such an occurrence, however, is expected to be low. The deletion of blocks near biologically sensitive topographic features will not result in the deletion of any blocks considered to have a high probability for historic archaeological resources. Expected impacts under the alternative are not expected to change from the Base Case.

The greatest impact to an historic archaeological resource as a result of the proposed action would result from a contact between an OCS offshore activity (platform installation, drilling rig emplacement, dredging and ipeline projects) and an historic shipwreck. Deletion of the blocks near biologically sensitive topographic features would not result in the deletion of any block considered to have a high probability for historic and/or prehistoric archaeological resources.

Because of incomplete knowledge on the location of shipwrecks in the Gulf, an OCS activity could contact a shipwreck. Although this occurrence is not probable, such an event would result in the disturbance or destruction of significant or unique historic archaeological information. Other factors associated with the proposed action are not expected to affect historic archaeological resources.

*Conclusion*

There is a very small possibility of an impact between OCS oil and gas activities and an historic shipwreck or site. Should such an impact occur, significant or unique archaeological information could be lost.

## *(b) Prehistoric*

Prehistoric sites anticipated to occur in CPA waters offshore include all the types that occur onshore. The baseline study for the Gulf of Mexico (CEI, 1977) identified distinct, high-probability geomorphic features for the occurrence of prehistoric archaeological sites. Two possible prehistoric sites have been located in the western portion of the Central Planning Area as a result of an MMS-funded study (CEI, 1986). These possible sites occurred in association with the ancient Sabine River valley and were identified by coring within Sabine Area, Block 6.

Offshore development as a result of the proposed action could result in an interaction that could destroy fragile artifacts or site features and could disturb artifact provenience and site stratigraphy. The limited amount of impact to the seafloor throughout the CPA, coupled with the effectiveness of the archaeological survey and resulting archaeological clearance, is sufficient to assume a low potential for interaction between an impact-producing factor and a prehistoric archaeological site. The adoption of Alternative B will not change expected impacts from those expected under the Base Case.

The survey and clearance provide a significant reduction in the potential for a damaging interaction between an impact-producing factor and a prehistoric site.

*Conclusion*

There is a very small possibility of an impact between OCS oil and gas activities and a prehistoric archaeological site. Should such an impact occur, there could be damage to or loss of significant or unique archaeological information.

## *(12) Impacts on Socioeconomic Conditions*

### *(a) Population, Labor, and Employment*

Resource estimates and associated infrastructure for the proposed action in the Central Gulf, excluding blocks near biologically sensitive topographic features, are not significantly different from those estimated for the proposed action in the Base Case. Estimates include the drilling of 340 exploration and delineation wells, the emplacement of 30 platform complexes, and the drilling of 250 development wells (Table IV-2). The sources and severity of impacts to population, labor, and employment are, therefore, the same as those assessed for Central Gulf Sale 142 in the Base Case. A total of approximately 58,500 person-years of employment (direct, indirect, and induced) is required in the Central and Western Gulf coastal subareas in support of Alternative B throughout its 35-year life. Peak annual changes in the population, labor, and employment of all coastal subareas in the Central and Western Gulf resulting from Alternative B represent less than 1 percent of the levels expected in absence of the proposal. The coastal communities of the Western Gulf are expected to support under 2 percent of the total employment generated by the Central Gulf sale under this alternative. Employment resulting from oil-spill clean-up activities is negligible. It is expected that employment demands in support of this alternative will be met with the existing population and available labor force.

*Conclusion*

The impact of Alternative B on the population, labor, and employment of the counties and parishes of the Central and Western Gulf coastal impact area is expected to be less than 1 percent of the levels expected in the absence of the proposal.

### *(b) Public Services and Infrastructure*

Impacts on public services and infrastructure would be related to dramatic increases or decreases in population. No positive net migration into the coastal subareas of the Central and Western Gulf is expected to occur as a result of Alternative B. It is expected that employment needs will be filled from the existing oil and gas labor pool, as well as the unemployed and underemployed, and new employees already living in the area. In addition, jobs created by the proposal would likely reduce the amount of migration out of the coastal subareas when compared with scenarios without the proposal. It is expected that employees leaving public service and infrastructure-related jobs could be replaced from the existing labor pool.

*Conclusion*

Population and employment impacts that result from the proposed action under Alternative B will not result in disruptions to community infrastructure and public services beyond what is anticipated by in-place planning and development agencies.

### *(c) Social Patterns*

Impacts on social patterns would be related to dramatic changes in population and the disruption of environmental resources, as well as conditions inherent to OCS-related employment (i.e., work scheduling and rate of pay). No positive net migration into coastal subareas of the Central and Western Gulf is expected to occur as a result of the proposal. It is expected that employment will occur from those currently employed in the oil and gas industry, as well as the unemployed and underemployed, and new employees already living in the area. It is expected that jobs created by the proposal would likely reduce the amount of out-migration when compared to scenarios without the proposal. It is expected that minor displacement from traditional occupations will occur as a result of Alternative B. This displacement will be mitigated, to some extent, by the extended work schedule associated with OCS-related employment. The extended work schedule is expected to have some deleterious effects on family life in pertinent, individual cases. Impacts caused by the displacement of traditional occupations and relative wages are expected to occur to a minimal extent.

*Conclusion*

Deleterious impacts to social patterns are expected to occur in some individual cases as a result of extended work schedules, displacement from traditional occupations, and relative wages.

## c. Impacts from Alternative C - No Action

*Description of the Alternative*

Alternative C is equivalent to cancellation of a sale scheduled for a specific time period on the approved 5-year OCS Oil and Gas Leasing Schedule. Sales in the Central Gulf are scheduled on an annual basis. By canceling the proposed sale, the opportunity is postponed or foregone for development of the estimated 0.14 BBO and 1.40 tcf of gas that could have resulted from proposed Sale 142 in the Central Gulf.

*Effects of the Alternative*

If Alternative C is selected, all impacts, positive and negative, associated with the proposed action would be canceled. This alternative would therefore result in no effect on the sensitive resources and activities discussed in Section IV.D.1.a. The incremental contribution of the proposed action to cumulative effects (Section IV.D.1.d.) would also be foregone, but such effects from other activities, including other OCS sales, would remain. One contribution to cumulative effects that could increase oil-spill risk due to the importation of foreign oil to replace the resources lost through cancellation of the proposed action.

Alternative energy strategies that could provide replacement resources for lost domestic OCS oil and gas production include energy conservation; conventional oil and gas supplies; coal; nuclear power; oil shale; tar sands; hydroelectric power; solar and geothermal energy; and imports of oil, natural gas, and liquefied natural gas (LNG). These are discussed in some detail in Appendix D. A National Energy Strategy is under development by the U.S. Department of Energy (DOE), and the interim report was published April 2, 1990. The energy equivalents that may be required from several alternative energy sources, should this lease sale be permanently cancelled, are shown on Table D-8 and are based on the resources estimated by MMS to be produced as a result of the proposed action. For the purpose of clarity, this table has separately identified each potential alternative source of energy regarding substitution requirements. It is unlikely, however, that there would be a single choice between these alternatives sources, but instead, some combined effort to explore and develop further many or all of these forms as a substitute for OCS oil and gas production.

## d. Impacts of Cumulative Actions

This section analyzes "cumulative" actions, defined as other past, present, and reasonably foreseeable future actions, both Federal and nonfederal (40 CFR 1508.7), that when added with actions resulting from the proposed actions result in an incremental impact to the proposed actions (1993-2027), and the resources analyzed are those identified as potentially being impacted from the proposed action. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. See Section IV.B. for details regarding the cumulative scenario and assumptions on which the following analyses are based.

### *(1) Impacts on Sensitive Coastal Environments*

### *(a) Coastal Barrier Beaches*

This Cumulative Analysis considers the effects of impact-producing factors related to the proposed action, plus those related to the Western Gulf proposed action, prior and future OCS sales, State oil and gas activities, other governmental and private projects and activities, and pertinent natural processes that may affect barrier features.

Specific impact-producing factors considered in the Cumulative Analysis include sediment reduction, oil spills, pipeline landfalls, onshore infrastructure facilities construction, navigation canals, beach protection and stabilization projects, and recreational activities.

As discussed in Section III.B.1.a., under natural conditions, the erosional condition of barrier islands in coastal Louisiana and easternmost Texas is related to the constructional versus the destructional stage of the nearby deltaic landmass. The Mississippi River has been the direct source of sand-size sediment to coastal landforms in Louisiana, and the location of the mouth of the river has determined which areas of the Deltaic Plain were aggrading and which were eroding. The suspended sediment load of the Mississippi River, however, has decreased over 50 percent since the 1950's, largely as a result of dam and reservoir construction upstream within the drainage basin (Turner and Cahoon, 1987). The reduction in sediment supply to barrier beaches in coastal Subareas C-1, C-2, and C-3 has resulted in marine erosion forces dominating the construction processes that tend to build barrier beaches. Sediment deprivation in these subareas will continue to have very high impacts on barrier features during the life of the proposed action.

The barrier landforms to the east of the Mississippi River delta (coastal Subarea C-4) are not dependent on a fluvial source of sand. Rather, these islands appear to be nourished by the sandy barrier platforms beneath them (Otvos, 1980). Reduced discharges of fluvial sediment into the coastal zone will not affect these barriers.

Oil spill contacts to barrier landforms can occur from a number of sources. This analysis considers spills in three size categories: greater than 1 and less than or equal to 50 bbl; greater than 50 and less than 1,000 bbl; and greater than or equal to 1,000 bbl. Spills from offshore and onshore sources will be considered.

A few spills greater than 1 and less than or equal to 50 bbl are assumed to occur offshore and contact barrier features as a result of OCS Program activities. As discussed in Section IV.D.1.a.(1)(a), as much as 35 bbl of oil from such a spill could contact a coastal barrier along a 2-km stretch of beach. Cleanup crews are expected to remove the oil from the beach manually with no resulting removal of sand from the littoral environment. No spill greater than 50 and less than 1,000 bbl is assumed to occur and contact barriers. The offshore occurrence of seven spills greater than or equal to 1,000 bbl is assumed to occur as a result of OCS Program activities. According to Table IV-21, the probability of occurrence and contact within 10 days from one or more spills grater than or equal to 1,000 bb ranges from 52 percent along the West Plaquemines Parish coastal barriers to less than 0.5 percent for Gulf Shores barrier islands. Based on the probabilities in these tables, this analysis assumes one contact will occur along the Plaquemines Parish coast, one along the Grand Isle/Grand Terre barrier coast, and one along the Chenier Plain coast. The spill in Plaquemines Parish will contact the coast within 3 days; the other spills will contact within 10 days. The median size of these spills is 6,500 bbl.

Assuming a 70 percent loss from weathering and offshore cleanup efforts for spills making contact within 10 days, 1,950 bbl of oil will contact the coast. Assuming that the percent of this oil along the coast that contacts a barrier feature is proportional to the ratio of barrier beach to barrier passes along the coast, about two-thirds of the oil will contact a beach. It is assumed that about 50 km of beach will be contacted with 1,300 bbl of oil. For the spill that contacts within three days, assuming a 40 percent loss of oil from weathering and offshore cleanup, as much as 2,600 bbl of oil could contact the beach. As discussed in Section IV.D.1.a.(1)(a), the probability that tide levels could reach or exceed the elevations of sand dune vegetation on barrier beaches ranges from 0 to 16 percent, depending on the particular coastal setting and the elevation of the vegetation. The combined probabilities of occurrence and contact from a spill and contact to sand dune vegetation at the spill sites being considered range from 2 to 8 percent. This analysis assumes that no sand dune vegetation will be contacted by spilled oil in any the three spills being considered. Furthermore, the strong onshore winds that would be needed to produce unusually high tide levels would disperse and spread the slick over a larger area than is being considered in the current analysis. The spreading would reduce the oil concentration along the coast and the unit area impacts to vegetation, assuming a direct relationship between oil concentration and effects on vegetation.

Impacts to contacted beaches from these spills could occur if sand were removed during cleanup operations. Removing sand from the coastal littoral environment, particularly in the sand-starved transgressive setting of coastal Louisiana, could result in accelerated coastal erosion. Cleaning these spills would be difficult in the inaccessible setting of coastal Louisiana. This analysis assumes that the State would require, however, that the responsible party clean the beach without removing the contacted sand, or by replacing whatever sand was removed, regardless of the specialized equipment and crews that would be needed to accomplish the task.

It is assumed that the cleanup operations would be accomplished with no permanent effects on the stability of the coastal landform. Some short-term (up to a few months) adjustments in beach configuration may result from the disturbance and movement of sand during cleanup. Some of the oil that penetrated to depths beneath the reach of the cleanup methods would persist in the beach sands, and periodically be released when storms and high tides flushed through the beach sediments.

Onshore spills could also occur from OCS operations and contact coastal barriers. These spills could occur as a result of pipeline accidents and barge or shuttle tanker accidents during transit or offloading. Most oil terminals are located inland from barrier islands, so an accident there would not likely result in contact to a barrier feature. A barge or shuttle tanker accident in transit could occur as the vessel approached or was traveling through a barrier pass, or while the vessel was travelling through the Intracoastal Waterway after entering coastal waters and making the final approach to the terminal. Under this scenario, it is more likely that a spill will contact the lagoonal, rather than the ocean side, of a barrier beach.

This analysis assumes that about 35 spills greater than 1 and less than or equal to 50 bbl, 5 spills greater than 50 and less than 1,000 bbl, and one spill greater than or equal to 1,000 bbl will occur onshore as a result of OCS Program activities. The assumption, based on an analysis of historic spill locations, which have been concentrated in the Mississippi River area, is that only a few contacts to barrier landforms will occur, resulting in 10 to 50 km of back barrier coast contacted. Because of the low energy environment of this setting, cleanup will be accomplished without erosion or alteration of the island configuration.

Non-OCS spills can occur as a result of import tankers, tidelands oil activities, and petroleum product spills. It is assumed that numerous spills greater than 1 and less than or equal to 50 bbl and greater than 50 and less than 1,000 bbl will occur and contact the ocean and land sides of barrier islands. Most of these spills will result in only small amounts of oiling that may not be noticed in more remote and inaccessible settings. One hundred and ten crude oil and product spills greater than or equal to 1,000 bbl, averaging 7,000 bbl each, are assumed to occur during the life of the proposed action from offshore and onshore sources. Numerous contacts to barrier beaches are expected. The same assumptions about impacts to beaches from cleanup operations that were used for OCS spills apply here. Because of the heavier and more frequent oilings of beaches in this scenario, compared to OCS spills, it is likely that cleanup operations will disturb and remove some sand, which could result in short-term (up to two years) adjustments in beach configuration if the sand is not replaced and regraded as a mitigation measure. Given the higher frequency of spill occurrence, and the heavier oilings from onshore spills greater than or equal to 1,000 bbl, it is more likely that the lower elevations of some sand dune vegetation will be contacted. An investigation of the effects of the disposal of oiled sand on dune vegetation in Texas showed no deleterious impacts on existing vegetation or colonization of the sand by new vegetation (Webb, 1988). On this basis, it is assumed that contacts to small areas of lower elevated sand dunes will not result in destabilization of the sand dune area or the barrier landform.

Of the 235 pipeline landfalls that have originated in Federal OCS and State waters in the area (Visual No. 1), many have occurred on barrier landforms. A recently completed MMS study has investigated the geologic, hydrologic, and botanical impacts of pipeline emplacement on barrier landforms in the Gulf (Wicker et al., 1989). In general, the impacts of pipeline landfalls were minor to nonexistent. In most cases, there was no evidence of accelerated erosion in the vicinity of the canal crossings. Wicker et al. (1989) warn, however, that the potential for future breaching of the shoreline remains at the site of the flotation canal crossings because the width is small, the sediments beneath the sand-shell beach plugs are unconsolidated and susceptible to erosion and, in most cases, the width of the marshland and beach beside the canals is diminishing because of Gulf and bay erosion. No pipelines cross barrier features along Mississippi Sound.

The addition of up to three new pipeline landfalls in the area is assumed to result from prior OCS sales. These landfalls are expected to occur in the Mobile, Alabama, area. The State of Alabama has formulated a plan for the transportation of oil and gas in its coastal area; the plan identifies barrier islands as unsuitable areas for pipeline crossings (Marine Environmental Sciences Consortium, 1981). These new projected landfalls will therefore not cross barriers. If, because of unanticipated discoveries, new landfall events occur elsewhere, current environmental regulations and pipeline emplacement techniques are sufficient for minimizing pipeline project impacts (LeBlanc, 1985).

The construction and maintenance of navigation canals through barrier island passes can impact the surrounding landscape. Stabilization of these channels with jetties can interfere with longshore sediment transport, resulting in the accumulation of sediments on the updrift side of the jetty and erosion on the downdrift side. Penland and Boyd (1982) have documented shoreline accretion updrift from jetties constructed in the Belle Pass area, but accelerated erosion downdrift from the jetties. Wicker et al. (1989) have also investigated navigation canal impacts, concluding that channels have affected coastal physiography mainly through the action of jetties, which block the downdrift movement of sediment. At Belle Pass, however, they noted that the downdrift erosional effects of the jetty disappeared when maintenance-dredged material was discharged into the littoral zone downdrift from the jetty. During the life of the proposed action, it is assumed that beneficial use of dredged material will increase, thereby reducing the ongoing impacts of navigation channels. Impacts from existing channels are expected to result in some accelerated erosion immediately downdrift of the channel.

No new navigation canals are expected to be installed during the next 35 years. The basis of this assumption is the large number of existing navigation channels that can accommodate further navigation needs.

Section IV.A.3.c.(3)(c) states that the channel leading to Port Fourchon, Louisiana (Belle Pass), will be deepened to 6.7 m (22 ft) to provide access for larger service vessels used for deep-water operations. It is assumed that 90 percent of the impacts of this project can be attributed to OCS Program scenario activities. Wicker et al. (1989), as discussed above, have studied the effects of navigation channel dredging and maintenance operations on coastal processes, and at Belle Pass in particular. Prior to the dredging of the channel to Port Fourchon, and the construction of jetties at the channel entrance, the coast east (updrift) of the channel was retreating at a rate of 40 m/yr, compared to 31 m/yr west (downdrift) of the channel. The difference in retreat rates (30 percent higher to the west) can perhaps be attributed to the channel's acting as a sediment sink in this predominantly east-to-west littoral drift environment. After dredging and jetty construction, the difference between the east and west erosion rates increased to 50 percent, although the magnitude of the retreat rate decreased by nearly one-half. In 1974, the Corps of Engineers (COE) began to use material from maintenance dredging operations in Belle Pass to nourish the beach areas west of the channel. Since then, no significant difference between east and west erosion rates has been observed, and the absolute erosion rate has decreased by about another one-half. The COE's feasibility report for the Belle Pass deepening project indicates that some of the dredged material can be used for beach nourishment (U.S. Dept. of the Army, COE, 1991). Therefore, no increase in ongoing erosion rates of barrier islands and beaches is expected as a result of channel deepening.

Efforts to stabilize the Gulf shoreline have impacted barrier landscapes. Stabilization projects in the cumulative impact area have been mainly along the Louisiana coast. Structures constructed to stabilize the beach by fixing its location expose the landform to the erosive effects of a rising relative sea level. The impacts of beach stabilization projects are difficult to quantify in coastal Louisiana. The negative impacts of fixed structures are being offset to some extent by nonstructural approaches such as sand dune stabilization and beach nourishment projects. Furthermore, coastal barriers are eroding so rapidly in Louisiana as a result of alterations of the sedimentary dynamics of the Mississippi River deltaic system and the high coastal subsidence rates that it is difficult to isolate the impacts of coastal structures.

Most barrier beaches in Louisiana and Mississippi are relatively inaccessible for recreational users either because they are located at a substantial distance offshore, as in Mississippi, or in coastal areas with limited road access, as in Louisiana. Few beaches have been, or are likely to be, substantially altered for construction projects to accommodate recreational users. Further, damage to dune vegetation and other sensitive beach areas from recreational users, such as dune buggy operators or hikers, has not been, and will not likely be, significant in most cases.

*Summary*

Sediment reduction and rapid submergence have resulted in rapid erosion of most of the barrier landforms along the Louisiana coast. The impact level from these factors is expected to be very high in Louisiana. In Mississippi and Alabama, most of the barrier islands are supplied with an offshore source of sand and are not affected by sediment deprivation.

Several spills greater than or equal to 1,000 bbl from both onshore and offshore sources and several smaller spills are assumed to contact coastal barriers. The impacts of these spills along the sand-starved Louisiana coast would not result in long-term erosion of the landform if the beaches are cleaned using techniques that do not remove sand from the beach. Some contact to lower areas of sand dunes are assumed. These contacts will not result in destabilization of the dunes.

Pipeline landfalls have been examined as possible sites of accelerated shore erosion and island breaching. A recently completed, MMS-funded study of pipeline landfall impacts (Wicker et al., 1989), however, documented little to no impacts of pipeline landfalls. The study did note, however, that pipeline landfalls could be future sites of island breaching.

Three new pipeline landfalls are projected under the Cumulative scenario: one in Pascagoula, Mississippi; and two in Mobile, Alabama. In addition, new pipeline landfalls may be installed to transport production from State waters to land. Modern pipeline installation techniques that do not result in noticeable impacts to coastal habitats will be used. Furthermore, the States of Alabama and Mississippi have established management plans for oil and gas development that do not allow pipeline landfalls across barrier islands.

Wicker et al. (1989) have documented localized, accelerated erosion updrift from jetties installed to stabilize navigation channels. The impact level from this factor is expected to be reduced as a result of beneficial use of dredged material.

Beach stabilization projects, such as groins, jetties, and seawalls, are considered to cause accelerated coastal erosion. Although the impacts of fixed structures on the erosion of the Louisiana barrier coast have not been precisely quantified, coastal researchers have observed localized erosion near various kinds of coastal structures.

Recreational usage of beaches in the Central Gulf is not expected to result in impacts because of the inaccessibility of the barrier coast to humans.

Between 1880 and 1980 the total coastal barrier area in Louisiana decreased by over 40 percent, or 0.4 percent per year (Penland and Boyd, 1982). Recent estimates of loss rates vary from about 3 percent per year for the Isles Dernieres to under 0.5 percent per year for the Chandeleur Islands (Penland and Suter, 1988). Impacts on barriers should continue because most of the impacting factors have not been effectively mitigated. Although public concern over barrier erosion in Louisiana has increased in recent years, a program to significantly reduce cumulative impacts during the next few decades has not been formulated. Impacts on the barrier islands offshore Mississippi and Alabama are expected to be insignificant except for the eastern side of Dauphin Island, which is experiencing rapid erosion.

The contribution of OCS activities associated with the Cumulative scenario to coastal barrier beach impacts is expected to be very low because oil-spill cleanup operations, pipeline landfalls, and navigation channel deepening and maintenance projects will not result in large amounts of barrier beach changes.

*Conclusion*

Under the Cumulative scenario, the observed erosional trend of barrier features is expected to continue in onshore Subareas C-1, C-2, and C-3. The major causes of these impacts are sediment deficits and rapid rates of relative sea-level rise.

### *(b) Wetlands*

This Cumulative Analysis considers the effects of impact-producing factors related to the proposed action, plus those related to the Western Gulf proposed action, prior and future OCS sales, tideland oil and gas activities, other governmental and private projects and activities, and pertinent natural processes and events that may occur and adversely affect wetlands. As a result of these activities and processes, several impact-producing factors, discussed below, will contribute to impacts on wetlands during the life of the proposed action.

The effects of oil spills, produced-water discharges, canal dredging, navigation activities, and onshore infrastructure on wetlands have been described in the Base Case Analysis (Section IV.D.1.a.(1)(b)). Other impact-producing factors relevant to the Cumulative Analysis are discussed below.

In a coastal setting experiencing submergence, the wetland surface must accrete vertically to keep pace with the ongoing rate of relative sea-level rise. Mineral sedimentation is needed to encourage this vertical accretion. In coastal Louisiana, the Mississippi River and its distributaries are the primary sources of alluvial sediments for coastal wetlands. The suspended sediment load of the Mississippi River has decreased over 50 percent since the 1950's, largely as a result of dam and reservoir construction upstream (Turner and Cahoon, 1987). Furthermore, channelization of the lower Mississippi for navigation and flood control has prevented floodwaters from depositing sediment on adjoining wetlands.

The channelization of the Mississippi River also affects seagrass beds in Mississippi and Chandeleur Sounds. During high water stages of the river, the Bonnet Carre spillway is sometimes opened to divert floodwaters of the Mississippi River into Lake Pontchartrain. This freshwater eventually flows into Mississippi and Chandeleur Sounds. In the past, spillway openings have been associated with as much as a 16 percent loss in seagrass acreage (Eleuterius, 1987).

The negative impacts of sediment deprivation on coastal wetlands are compounded by rapid submergence rates that characterize much of the area, and coastal Louisiana in particular, where the coastal submergence rate ranges from 3 to 10 mm/yr.

Additional impacts to wetlands occur from activities associated with State onshore oil and gas activities and from land development for agricultural, urban, and commercial projects

Sediment deprivation, combined with rapid coastal submergence, will continue as a major impact-producing factor during the life of the proposed action, and in coastal Louisiana in particular. Expert consensus is that sediment deprivation and submergence are the major factors that have caused up to 130 $km^2$ year of land loss in coastal Louisiana. Current estimates of land loss in coastal Louisiana are 60 $km^2$/yr on the Deltaic Plain (Britsch and Kemp, 1990) and 21 $km^2$/yr on the Chenier Plain (Dunbar et al., 1990).

Oil spill contacts to wetlands can occur from a number of sources. This analysis considers spills in three size categories: greater than 1 and less than or equal to 50 bbl; greater than 50 and less than 1,000 bbl; and greater than or equal to 1,000 bbl. The effects of oil spills on wetlands under the Cumulative scenario will be evaluated for OCS Program spills and for imported/onshore crude and petroleum products spills. Spills from offshore and onshore sources will be considered.

A few spills greater than 1 and less than or equal to 50 bbl are assumed to occur offshore and contact wetlands as a result of OCS Program activities. Because of evaporation losses, spreading considerations, and the fact that much of the remaining oil will wash onto barrier beaches that front the coast, contact from these spills is not expected to result in high-enough concentrations of oil (greater than 0.1 $l/m^2$) on wetland surfaces to affect wetland vegetation adversely. None of the oil is expected to contact seagrass beds located behind barrier islands. No spill greater than 50 and less than 1,000 is assumed to occur and contact barriers. The offshore occurrence of seven spills greater than or equal to 1,000 bbl is assumed to occur as a result of OCS Program activities. According to Table IV-21, the probability of occurrence and contact within 10 days from one or more spills greater than or equal to 1,000 bbl is a maximum (49%) along the East Deltaic Plain marshes. Given the probabilities in these tables, this analysis assumes two contacts will occur along the East Deltaic Plain, and one along the Chenier Plain coast. The spills along the East Deltaic Plain will contact the coast within 3 days; the other spill will contact the Chenier Plain within 10 days. The median size of these spills is 6,500 bbl.

Assuming a 70 percent loss from weathering and offshore cleanup efforts for spills making contact within 10 days, 1,950 bbl of oil will contact the coast. Assuming that one-third of the oil that reaches the coast will move through barrier passes and estuaries and contact wetlands, approximately 650 bbl of oil will be spread across 25 km of shoreline and penetrate 20 m into the wetlands.

The resulting average oil concentration will be 0.20 $l/m^2$ contacting the wetlands within a 50 ha contact area. For the spills that contact within three days, assuming a 40 percent loss of oil from weathering and offshore cleanup, as much as 1,300 bbl of oil could contact wetlands. These spills will result in higher concentrations of oil on the vegetation and a larger area of contact than in the above case. Given the assumptions described in Section IV.D.1.a.(1)(b), the approximately 150 ha (60 ac) contacted by the three spills will result in up to 50 or more hectares of wetland vegetation experiencing above-ground dieback or mortality. As much as 20 ha will recover within four years, with an eventual permanent loss of 15 ha of wetlands as a result of conversion to open water. Some additional permanent wetlands loss may occur along the shoreline as a result of accelerated erosion induced by weakening of the vegetation that binds the soil.

Onshore spills could also occur from OCS operations and contact coastal wetlands. These spills could occur as a result of pipeline accidents and barge or shuttle tanker accidents during transit or offloading. This analysis assumes that about 35 spills greater than 1 and less than or equal to 50 bbl, 5 spills greater than 50 and less than 1,000 bbl, and 1 spill greater than or equal to 1,000 bbl will occur onshore as a result of OCS Program activities. Because these spills are assumed to occur close to or within wetland areas a proportionately larger percentage of oil could contact wetlands than was the case for offshore spills. Spill occurrences that will most likely result in a high percentage of the oil's contacting wetlands will be pipeline accidents within wetlands and in-transit barge/shuttle tanker accidents within navigation channels that do not have prominent spoil banks to confine the oil within the channel. It is assumed that a few of these spills of varying size will contact wetlands, resulting in up to 50 ha of wetland vegetation being affected as described in the previous paragraph, and up to 5 ha of permanent wetland loss.

Non-OCS spills can occur as a result of import tankers, tidelands oil activities, and petroleum product spills. It is assumed that numerous spills greater than 1 and less than or equal to 50 bbl and greater than 50 and less than 1,000 bbl will occur and contact wetlands during the life of the proposed action. Most of these spills will result in only small amounts of oiling that may not be noticed in more remote and inaccessible settings. One hundred and ten crude oil and product spills greater than or equal to 1,000 bbl, averaging 7,000 bbl each, are assumed to occur during the life of the proposed action from offshore and onshore sources. Many of these spills are assumed to occur within the Mississippi River. These spills will be confined within the channel and diluted by the discharge of the river. Still, several contacts to wetlands are expected. Because these spills will be larger on average than coastal OCS-related spills, and will result in heavier oiling than was the case for contact from offshore OCS spills, it is assumed that as much as 500 ha of wetlands could be affected over the life of the proposed action, and up to 50 ha of wetlands could be permanently converted to open water.

Under the Cumulative scenario, spills that occur in or near Chandeleur or Mississippi Sounds could potentially contact seagrass beds. Spills in these areas could result from accidents involving import tankers and barges travelling to refineries and oil storage facilities in coastal Subarea C-4 and from pipeline spills. A large-diameter oil pipeline traverses Chandeleur and Mississippi Sounds. Small spills could occur as a result of tanker, barge, and pipeline accidents, as in September 1989, when about 100 bbl of oil spilled from a pipeline in Mississippi Sound.

As discussed in the Base Case analysis (Section IV.D.1.a.(1)(b)), oil-spill impacts to seagrasses are usually buffered by the subtidal position of seagrasses, resulting in the absence of direct contact to the seagrass vegetation in subtidal beds. Furthermore, because so much of the seagrass biomass is contained in roots and rhizomes, which are buried in sediment, seagrasses have a high regenerative capacity when their vegetative parts are contacted by oil. Seagrass beds, however, occur at shallow depths, generally less than 50 cm, creating some vulnerability to contact from oil mixed into shallow estuarine waters. Given the large number of potential spills from pipeline and barge accidents in and near Chandeleur and Mississippi Sounds, it is assumed that several contacts to seagrass beds will occur and will result in dieback to the grass vegetation, which will be replaced for the most part within one growing season. Although no to little direct permanent mortality of grass beds is expected as a result of oil-spill occurrences, contact of seagrasses with crude and refined oil has been implicated as a causative factor in the decline of seagrass beds and the observed changes in species composition within them (Eleuterius, 1987).

Another effect of the occurrence of spills in Mississippi Sound is possible contacts to wetlands on barrier islands within the Gulf National Seashore. These wetlands occur within embayments and ponds that contact Mississippi Sound. Because of their natural history, these areas are considered areas of special importance, and they support endangered and threatened species. Although the wetland acreage on these islands is small, these wetlands make up an important element in the habitat of the islands. Because the inlets that connect Mississippi Sound with the marsh-fringed estuaries and lagoons within the islands are narrow, only a small percentage of the oil that contacts the Sound side of the islands will be carried by the tides into interior lagoons. Because only spills less than 1,000 bbl are assumed to occur in these locations, the amount of oil that would finally contact wetlands would be relatively small and would not result in high-enough concentrations to affect wetlands deleteriously except in small isolated areas where oil tended to become concentrated, and in isolated locations.

According to Table IV-10, over 2.4 Bbbl of produced waters will be disposed of in coastal Louisiana. These produced waters will either be reinjected or discharged into offshore State waters or into the Mississippi River and its passes. Field studies have documented no impacts to wetland vegetation under these disposal conditions (Boesch and Rabalais, 1989b). It is therefore assumed that produced-water discharges will not affect wetland vegetation.

The dredging of pipeline and navigation canals for oil and gas operations has had impacts on wetlands in coastal Louisiana. Although no dredging activity for new navigation channels is anticipated under the Cumulative scenario (Table IV-9) and only a small amount of dredging for new pipeline landfalls is expected, the lingering indirect impacts of existing channels have to be considered.

Indirect impacts from canals associated with the OCS program have been estimated as accounting for 4 to 13 percent of the total amount of wetland loss that occurred in coastal Louisiana between 1955-1956 and 1978 (Turner and Cahoon, 1987). Turner and Cahoon calculated this range by dividing the length of OCS canal spoil banks by the length of all canal spoil banks (OCS, State onshore oil and gas, general navigation, and drainage canals), and then multiplying this proportion by the range of estimates of the contribution of indirect impacts to wetlands loss. They assumed that the proportion of OCS spoil banks could be used as a direct surrogate of the proportion of indirect impacts.

The MMS does not consider this method of indirect impact determination acceptable for use as a basis for the Cumulative Analysis. This conclusion is based on two considerations. First, the calculation of the proportion of indirect impacts was based on untested and inaccurate assumptions and, second, their method did not incorporate the data that had been collected and analyzed in the body of the study, even though the data were relevant to the issue.

Concerning the first point, MMS questions the numbers as they were derived by Turner and Cahoon (1987). As stated by the authors, OCS spoil banks may have been overestimated in their calculations because OCS canals and spoil banks tend to be large and thus more visible on remote-sensing imagery. Further, the Turner and Cahoon study only produces a number for the length of OCS canals. The length of all spoil banks (the number in the denominator of their proportion) is not revealed within the study, nor is the methodology that was used to calculate the length of all spoil banks indicated. Furthermore, the study defined indirect losses as all wetland losses occurring in the State minus the direct losses attributable to canal dredging and urban/residential/agriculturaldevelopment. The contribution of sediment deprivation and subsidence were not accounted for in either of these categories, even though many researchers believe these factors to be the most important cause of wetlands loss in the area. Turner and Cahoon (1987), in essence, inappropriately allocated a proportion of the impacts of sediment deprivation on wetland loss to the indirect impacts of OCS canals. Consequently, MMS cannot validate the accuracy of the study's apportionment of indirect impacts to OCS canals.

In addition, the data that had been generated from field, laboratory, modeling, and remote-sensing analysis efforts in the study were not used in developing the indirect impact proportion number, even though much of the data were relevant to the issue. For example, the study hypothesized that the indirect impacts of canals could affect wetlands through the influence of canals on saltwater intrusion and through the influence of associated spoil banks on sedimentation and drainage patterns. The study data, however, did not confirm this hypothesis. The data, for example, did not document a relationship between saltwater intrusion and marsh loss and did not show a statistically valid correlation between proximity to spoil banks and vertical rates of marsh accretion. The computer analyses of remote-sensing imagery did not establish a statistically valid relationship between either canal density or proximity to a canal and marsh loss. Rather, the study documented a greater than 50 percent reduction in the suspended sediment discharge of the Mississippi River since the 1950's and a widespread accretionary deficit within the wetlands of coastal Louisiana. These results, which did not confirm the hypothesized mechanisms of indirect wetland loss but suggested an emphasis on sedimentary deficits and subsidence as mechanisms for marsh loss, were not brought into the methodology for assessing OCS indirect impacts.

To conclude, the OCS canal indirect impact numbers derived in the study were not based on the body of data generated by the study, but were instead developed using an indirect and incomplete approach that could have been done even in the absence of the study. The MMS considers the Turner and Cahoon estimates to be no more reliable or better supported by field data than any of the other attempts in the past to estimate the role of indirect impacts.

One consideration in assessing indirect impacts of the OCS program is that 77 percent of all OCS-related pipeline canals have been backfilled (Turner and Cahoon, 1987). Backfilling, by partially filling in the canal cut and by levelling spoil banks, should greatly reduce indirect impacts. Furthermore, OCS-related vessel traffic accounts for only a small percentage of the commercial usage of major navigation routes through coastal Louisiana. Of 7,866 km (4,886 mi) of coastal navigation routes, only 330 km (205 mi), or 4 percent, are allocated to OCS traffic.

Most of the canalization that has occurred in coastal Louisiana has occurred as a result of onshore oil and gas activities. An indication of the extent of this activity is provided by well completion data: approximately 41,190 wells had been completed in coastal Louisiana as of 1984 (USDOI, GS, 1984). Access canals and pipelines to service onshore development are pervasive throughout the coastal area: 15,285 km (9,498 mi) of pipeline canals have been installed there to carry onshore production. According to the U.S. Army Corps of Engineers, in 1988 that agency received applications for the installation of 123 km (76 mi) of pipelines through wetland areas. The average direct impacts from backfilled pipeline canals in coastal Louisiana are 0.91 ha/km. If 123 km of pipelines are installed each year during the 35 years of the proposed action, the direct impacts from pipeline projects would be approximately 4,000 ha. This estimate, however, is probably high because tidelands oil and gas activities are expected to decline during the life of the proposed action.

Drilling and production activity at coastal well sites requires rig access canals. Typical dimensions of an access canal, as indicated on permits, are 366 m long by 20 m wide with a 0.5 ha drill slip at the end. In 1988, the COE received applications for the dredging of over 11 km of access canals. Assuming this level of activity persists over the life of the proposed action, the direct impacts from the permitted dredging will be the conversion over 750 ha of wetlands to open water, with additional wetland acreage buried by spoil banks along the channel margins. In addition to these direct impacts, the ongoing indirect impacts from this pervasive and growing network of pipeline and navigation canals will continue to produce impacts on wetlands in coastal Louisiana (coastal Subareas C-1, C-2, and C-3).

Under the Cumulative scenario, there will be three new pipeline landfalls in coastal Subarea C-4, which includes Mississippi and Alabama (Table IV-10). One of these landfalls is assumed to occur in coastal Mississippi and two in coastal Alabama. Assuming that these pipeline canals will be backfilled, that proper precautions will be taken to reduce environmental impacts, and that there will be a 16-km length per pipeline landfall, impacts to surrounding wetlands, if the pipelines traverse wetland areas, would be about 33 ha, using the impact rate of 0.68 ha/km in Mississippi/Alabama (Turner and Cahoon, 1987). No new dredging of navigation channels in the area is projected.

As discussed in Section IV.A.3.c.(3)(c), OCS activities in deep water are requiring larger service vessels for efficient operations. Currently, service bases in Galveston, Texas, and Berwick, Louisiana, are accessible to the larger vessels; and Empire and Cameron, Louisiana, are considered marginally useable. This document assumes that the channel through Belle Pass, Louisiana, to Port Fourchon will be deepened to 6.7 m (22 ft). The Corps of Engineers has completed a feasibility report for the project (U.S. Dept. of the Army, COE, 1991). According to the report, dredged material from the channel will be disposed of in wetland areas to enhance marsh creation. The COE projects that 192 ha (479 ac) of saline marsh will be created. Assuming that 90 percent of the justification of the project is for OCS activities, 173 ha (431 ac) of wetlands will be created as a result of OCS Program activities. The COE does not anticipate saltwater intrusion effects on wetlands as a result of the deepening project, probably because the project will be done in a saline environment where the existing vegetation is salt-tolerant.

Vessel usage of existing navigation channels creates wakes that can cause erosion of the wetlands along channel margins. According to Johnson and Gosselink (1982), channels with high navigational usage in coastal Louisiana widen about 1.5 m/yr more rapidly than channels that have little navigational usage (2.58 m/yr versus 0.95 m/yr). Based on these results, this analysis assumes that navigational usage is responsible for 1.5 m/yr of accelerated wetland erosion per meter of channel where wetlands fringe waterway. An idea of the contribution of OCS oil and gas activities to accelerated channel bank erosion is provided in Table IV-12, which projects that over 700,000 service vessel and 6,800 barge trips will take place under the Cumulative scenario during the life of the proposed action. Under the Cumulative scenario, it is assumed OCS activities account for 12 percent of all vessel usage within the major navigation channels in the CPA. The 21 channels associated with OCS activities in the CPA are listed in Table IV-2. Assuming that the average OCS facility is located 24 km from the coastline and that 50 percent of the channel length is fringed with wetlands, the amount of wetland erosion that could occur from OCS traffic under the Cumulative scenario is 2.25 ha/yr, or nearly 80 ha over the life of the proposed action.

The erosion effects of all other (non-OCS) traffic in these channels are difficult to calculate because the OCS figure is based on the first 24 km of the channel. The total navigable length of these channels for general navigation purposes has not been calculated. Given, however, that OCS traffic accounts for only 12 percent of the traffic, erosion caused by general navigation will be at least eight times greater, or 640 ha over the life of the project.

In addition to the widening of the major navigation channels at the expense of wetlands, widening of rig access canals for State onshore oil and gas activities causes considerable impacts each year. Because of the smaller amount of vessel usage of these single purpose channels, it is assumed that the lower widening rate of 0.95 m/yr occurs in these channels (Johnson and Gosselink, 1982). As mentioned above, in 1988 applications for dredging 11 km of these access canals in coastal Louisiana were submitted to the U.S. Army Corps of Engineers. Assuming that this number applies to each of the 35 years of the life of the proposed action, and that the canals widen at the same rate each year, over the life of the proposed action nearly 700 ha of wetlands will be eroded.

Maintenance dredging of existing channels can also contribute to wetland problems. In 1988, the U.S. Army Corps of Engineers received applications for permits for maintenance dredging along 130 km of existing rig access channels and drill slips for State onshore oil and gas activities in Louisiana. These activities generated approximately 4,500,000 $m^3$ of dredged material, 82 percent of which was disposed of onto existing spoil banks.

Data on maintenance dredging in major Gulf waterways for OCS and general navigation are being compiled, but are not available for this EIS. In general, it is assumed that major Gulf waterways will be maintenance-dredged every one or two years. This analysis assumes that, during the life of the proposed action, dredged material will be increasingly used to enhance marsh growth in deteriorating wetland areas. This policy will reduce the damaging effects of maintenance dredging.

No new onshore infrastructure is projected to be constructed in support of the OCS program in coastal Subareas C-1,C-2, and C-3 under the Cumulative scenario (Table IV-10). In C-4, two gas processing plants, two separation facilities, and one oil terminal are projected to be constructed. The gas processing plant and separation facilities are assumed to be constructed in a upland area of coastal Alabama. The oil terminal is assumed to be constructed in Jackson County, Mississippi, and will occupy about 15 ha. Some filling of wetlands may occur at the terminal site. It is assumed that an acre-for-acre replacement of the affected wetland will be required as a mitigation condition of the project.

Miscellaneous factors that impact coastal wetlands include marsh burning, marsh buggy traffic, onshore oil and gas activities, and well-site construction. Bahr and Wascom (1984) report major marsh burns that have resulted in permanent wetland loss. Sikora et al. (1983) reported that in one 16 $km^2$ wetland area in coastal Louisiana, 18.5 percent of the area was covered with marsh buggy tracks. Well-site construction activities include board roads and ring levees. Ring levees are approximately 1.6-ha impoundments constructed around a well site. With 41,000 onshore coastal wells drilled in Louisiana as of 1984, the total acreage of impounded wetlands is substantial. Further, onshore oil and gas waste disposal practices can cause localized impacts in wetlands (Sections IV.A.4.e.(8)(b) and IV.B.2.b.). This analysis assumes that current landfill and waste site capacities can accommodate the onshore disposal of offshore wastes and that no new disposal sites will be constructed. Some damage to adjacent wetlands, however, is possible as a result of seepage from the waste sites.

Development of wetlands for agricultural, residential, and commercial uses affects wetlands in the area. During the period 1952-1974 in the Chenier Plain area of southwestern Louisiana, an estimated 1,233 ha of wetlands were converted to urban use (Gosselink et al., 1979). During the period 1956-1978, an estimated 21,642 ha of urban or industrial development occurred in the Mississippi Deltaic Plain region of southern Louisiana (Bahr and Wascom, 1984).

The land use impacts on wetlands in coastal Alabama have been very high in recent decades. Major causes of estuarine wetland loss in Alabama include industrial and residential-commercial development. Loss of fresh coastal marsh was mainly attributable to commercial-residential development and silviculture (Roach et al., 1987). Between 1955 and 1979, fresh and estuarine marshes declined by 69 and 29 percent, respectively.

*Summary*

The decrease in the amount of sediment being transported by the Mississippi River to coastal Louisiana will continue as a major factor causing wetland loss. Sediment deprivation is compounded by rapid submergence occurring along the coast. Flood control and channelization of the river will also result in freshwater diversions during flood stages into areas of seagrass beds. These diversions will result in very high impacts to seagrass beds.

Oil spills are expected to affect as much as 600 ha of wetlands during the life of the proposed action. The effects will be manifested as accelerated erosion of wetland shorelines and permanent loss of up to 70 ha of wetlands and as temporary (up to four growing seasons) dieback and reduced vigor of wetland vegetation.

No impacts to wetlands from produced-water discharges into coastal water bodies are expected to be occur.

Indirect impacts from new canal dredging for State onshore oil and gas development and from the continuing indirect impacts of the existing canal network are expected to continue. Furthermore, the disappearance of wetlands along navigation channels as a result of vessel wake erosion is expected to result in several hundred hectares of wetlands loss.

Only minor amounts of new onshore infrastructure construction are projected under the Cumulative scenario. These facilities are projected for coastal Subarea C-4 and will likely be constructed on coastal uplands, given the ample amounts of such land near the coast in Subarea C-4 and the regulatory difficulties involved in construction projects on wetlands.

Impacts from State onshore oil and gas activities include new and maintenance dredging, existing rig access canals, drill slips, and well-site preparation. Impacts from residential, commercial, and agricultural and silvicultural developments are expected to continue in coastal Louisiana and Alabama.

The contribution of OCS activities associated with the Cumulative scenario to wetland impacts is expected to be very low because of the small portion of the total impacts to wetlands that can be attributed to OCS related spills, the small percentage of the vessel usage of navigation channels that can be attributed to OCS activities, the small amount of expected new infrastructure construction in wetland areas, and the dominating importance of sediment deprivation and submergence to the wetlands loss problem.

*Conclusion*

Under the Cumulative scenario, large losses of wetlands are expected to continue to occur. The main cause of these losses, particularly in coastal Louisiana, where the largest amount of wetlands will be lost, is sediment deprivation and rapid coastal submergence. Other contributing factors include tideland oil and gas development, the erosion of navigation channel margins and, to a lesser extent, impacts from oil spills.

### (2) Impacts on Sensitive Offshore Resources

### (a) Live Bottoms (Pinnacle Trend)

This Cumulative Analysis considers the effects of impact-producing factors related to the proposed action plus those related to prior and future OCS sales and tanker and other shipping operations that may occur and adversely affect live bottoms associated with the pinnacle-trend area. Specific types of impact-producing factors considered in the analysis include drilling rig, platform, and pipeline emplacement; well drilling (discharges); hydrocarbon production (produced waters); blowouts; oil spillage; anchoring; and operational discharges by tank ships. Non-OCS-related impacts, including fishing pressure, natural events, increased anchoring from pleasure boats, and spillage from import tankering, have the potential to impact the pinnacle communities.

Biological stipulations or comparable mitigation will be made a part of appropriate leases resulting from this proposal. The stipulations force the operators to locate the individual pinnacles and associated communities that may be present in the block. This procedure will help to protect those regions that may be potentially impacted by OCS activities and, if so, require any appropriate mitigative measures. The biological stipulations do not affect or protect the resources from activities over which the MMS has no authority (i.e., commercial fishing, tanker and shipping operations, or recreational activities).

Non-OCS activities have the greatest potential to affect the hard-bottom communities of the region. Recreational boating and fishing, import tankering, and natural events (such as storm and hypoxic conditions) may lead to damage and are a serious threat to the hard-bottom communities. The area of the pinnacle trend is located near a major shipping fairway, and ships using this fairway into Mobile, Alabama, can be expected to anchor in this area on occasion. Numerous fishermen also take advantage of the relatively shallow and easily accessible resources of the region and are expected to anchor in these areas to fish. It is expected that several instances of severe and permanent mechanical damage to the pinnacles and the low-relief live bottoms are likely to occur as the result of the Cumulative scenario. It is projected that this damage to one or more components of a few regionally common habitats or communities results in changes to physical integrity, species diversity, or biological productivity that exceeds natural variability observed prior to the damage, and recovery to pre-impact conditions takes longer than 10 years.

The placement of drilling rigs and platforms on the seafloor crushes the organisms directly beneath the legs or mat used to support the structure; anchoring has the same effects. The areas affected by the placement of the platforms and rigs will predominantly be soft-bottom regions where the infaunal and epifaunal communities are not unique. The presence of a conventional structure (some 117 platforms are assumed to be constructed in offshore Subarea C-3) can cause scouring of the surficial sediments (Caillouet et al., 1981). Additionally, it has been assumed that between 0.4 and 1.6 ha (1 and 4 ac) of bottom may be disturbed by platform emplacement activities alone. Structure placement and anchor damage from support boats and ships, floating drilling units, and pipeline-laying vessels disturb areas of the seafloor and are the most serious threats to live-bottom areas at these depths. The size of the areas affected by chains will depend on depth of water, length of chain, size of anchor and chain, method of placement, wind, and current. The biological stipulations limit the proximity of new activities in the hard-bottom region. For this reason, the damage from support boats and ships would be minimal. The impact from rigs and associated anchors on the hard-bottom communities of the region as a result of the proposed action would be such that any changes in the regional physical integrity, species diversity, or biological productivity of the hard-bottom region would recover to pre-impact conditions in less than two years, more probably on the order of 2-8 weeks.

Both explosive and nonexplosive structure-removal operations disturb the seafloor and can potentially affect nearby hard-bottom communities. Structure removal using explosives (the most common removal method) can suspend sediments, which settle much in the same manner as discussed for muds and cuttings discharges. Charges used in OCS structure removals are typically 50 lb or less, and detonated five meters below the mudline, thus restricting impacts to very close to the structure being removed (USDOI, MMS, 1987a). As previously discussed, the platforms will not be constructed directly on the hard-bottoms because of the biological stipulation. Impacts to the hard-bottom area from structure removal are expected to be minimal because of the restricted regions affected by the shock from explosives and the low number of structures likely to be placed (and subsequently removed) in such regions. The impact of a structure removal would be such that it would not result in any changes in the regional physical integrity, species diversity, or biological productivity, and hard-bottom region would recover to pre-impact conditions in less than two years, more probably on the order of 4-8 weeks.

Drilling discharges affect biological communities and organisms through a variety of mechanisms. Smothering of organisms through deposition of these sediments may occur, or less obvious sublethal effects may take place. Oil and gas operations will routinely discharge drilling muds and cuttings. (Some 26 MMbbl of drilling muds and 6 MMbbl of drill cuttings are assumed to be discharged as a result of all OCS activities in offshore Subarea C-3.) Deposition of drilling muds and cuttings on the hard-bottom communities would not significantly impact the biota of the hard-bottoms or the habitat itself. The biota of the seafloor surrounding the hard-bottoms are adapted to life in turbid conditions, and existing currents in the regions would prevent the adverse accumulation of large amounts of muds and cuttings. The depth of water would dilute the effluent to a significant degree, and the hard-bottoms themselves are coated with a veneer of sediment. Additional deposition and turbidity caused by a nearby well are not expected to affect the hard-bottom environment significantly, because since such fluids are discharged into very large volumes of water (the open Gulf of Mexico) and rapidly disperse, can be measured above background at only very short distances from the discharge point, and have little biological effect except very close to the discharge point. Such an event would rarely impact the resource because of the depth of the communities. The impact from muds and cuttings discharged as a result of the proposed action would be such that any changes in the regional physical integrity, species diversity, or biological productivity of the hard-bottom region would recover to pre-impact conditions in less than two years, more probably on the order of 2-8 weeks.

Pipeline emplacement will resuspend sediments and may clog filter-feeding mechanisms and gills of fishes and sedentary invertebrates. The stipulation, or some similar protective measure, will severely limit oil and gas activities in the immediate vicinity of the hard-bottom communities. For the purposes of this analysis, it is presumed that pipeline-laying activities would be prohibited in the proximity of live-bottom communities. The effect of pipeline-laying activities on the biota of the hard-bottom communities would be restricted to the resuspension of sediments. It is likely that pipelines up to 2,125 km of pipelines are expected to be installed under the Cumulative scenario in offshore Subarea C-3. Enforcement of the biological stipulations minimize pipeline-laying activities through the hard-bottom region. The severity of these actions has been judged, at the community level, to be such that any changes in the regional physical integrity, species diversity, or biological productivity of the hard-bottom region would recover to pre-impact conditions in less than two years, more probably on the order of 2-8 weeks.

Oil spills resulting from the OCS program and import tankering have been described earlier under Gulf of Mexico Marine Mammals (Section IV.D.1.c.(3)(a)). That description includes assumptions of oil-spill occurrence, spill sizes, and estimated contacts with shoreline and wetlands areas.

Oil spills have the potential to be driven into the water column, with measurable amounts documented at depths approximating 10 m. At this depth, the oil is only found at concentrations several orders of magnitude lower than the amount shown to have an effect on marine organisms (Lange, 1985; McAuliffe et al., 1975 and 1981). In spite of the large number of surface spills, for the purpose of this analysis, it is projected that no surface spills, regardless of size, would have an impact on the biota of the hard-bottoms, largely because these features occur at depths greater than 10 m. No impact from surface oil spills on the communities is expected.

It is assumed that four pipeline spills greater than or equal to 1,000 bbl will occur in the northeastern Gulf of Mexico. One of these pipeline spills is assumed to occur in the general vicinity of the hard-bottom region. This subsurface spill would have to come into contact with a pinnacle feature or low-relief live bottom for an impact to be observed. Few pipelines exist within these regions from which a spill would occur, and the biological stipulations would prevent the construction of pipelines immediately adjacent to these features.

There have been only 31 oil spills from pipelines on the OCS, 23 of which were between 50 and 1,000 bbl and only 8 were more than 1,000 bbl (USDOI, MMS, 1988c). Any spilled oil would have to impinge directly upon the features to be detrimental to the communities; impacts, including uptake of hydrocarbons or reduced visibility, may then be serious to the local biota, or even fatal. However, most of the region is washed in strong currents, and exposure to such an event would be short-term (3-96 hours). The biota would survive and recover once the features were clear of the oil.

There is a likelihood of the assumed pipeline spill contacting a hard-bottom community. However, for the purpose of this analysis, it is assumed that a spill greater than or equal to 1,000 bbl (regardless of the source) would contact one community. The above-listed factors would serve to limit the extent of damage from the spill. The severity of the contact would be such that any changes in the regional physical integrity, species diversity, or biological productivity of the pinnacle region would recover to pre-impact conditions in less than two years, more probably on the order of 2-8 weeks. The widespread nature of the resource, the strong dominant currents of the region, and the probable random occurrence of the pipeline spill will serve to limit the effect of any pipeline spill on the hard-bottom communities.

Blowouts have the potential of resuspending sediments and releasing hydrocarbons into the water column, which may affect benthic communities. Subsurface blowouts can pose a threat to the biota of these communities if a blowout were to occur near one of these habitats. From 1956 to 1989, 157 blowouts occurred on the OCS, only 28 of which resulted in the release of oil into the environment. Of these, 16 involved less than 1 bbl of oil spilled; only 2 blowouts resulted in the spillage of more than 6,000 bbl (USDOI, MMS, 1988c). It is assumed that 7 blowouts will occur for every 1,000 wells drilled, or approximately 30 blowouts across the northcentral region as a result of the Cumulative scenario. Blowouts are not expected to be a significant threat to these communities because of the protective distances imposed by the biological stipulations. The frequency of subsurface blowouts impacting the resource is judged to be rare, and it is expected that any effects would be small in area. The biological stipulations prevent the drilling of wells close to biologically lush communities, thus preventing most adverse impacts from this factor. Blowouts outside this zone are expected not to have an impact on the biota of the region because of the distances and strong currents. The severity of the contact would be such that any changes in the regional physical integrity, species diversity, or biological productivity of the pinnacle region would recover to pre-impact conditions in less than two years, more probably on the order of 2-4 months.

The impact analysis presented above presumes implementation of a biological stipulation, or some comparable mitigation, in the vicinity of the biologically productive hard-bottom communities. Should that protection not be provided, adverse impacts resulting from the proposed action, particularly anchor damage to localized hard-bottom areas, are expected to have adverse impacts on some individuals at portions of the hard-bottom trend environment, because these activities have the potential to destroy some of the biological communities and damage one or several individual hard-bottoms. The most potentially damaging of these are the impacts associated with mechanical damages that may result from anchors. However, the action is judged to be infrequent because of the limited operations in the vicinity of the hard-bottoms and the small size of many of the features. Potential impacts from oil spills greater than or equal to 1,000 bbl, blowouts, pipeline emplacement, mud and cutting discharges, and structure removals exist. The proposed action, without the benefit of the biological stipulation, is expected to have an adverse impact on the hard-bottom region.

In summary, non-OCS activities in the vicinity of the hard-bottom communities include recreational boating and fishing, import tankering, and natural events (such as storm and hypoxic conditions). These may lead to serious damage, and represent serious threats to the hard-bottom communities. Ships using the fairway into Mobile, Alabama, can be expected to anchor in this area on occasion, and the numerous fishermen take advantage of the relatively shallow and easily accessible resources of the region. These activities are expected to lead to several instances of severe and permanent mechanical damage. It is projected that this damage to one or more components of a few regionally common habitats or communities would result in changes to physical integrity, species diversity, or biological productivity that exceeds natural variability observed prior to the damage, and recovery to pre-impact conditions would take longer than 10 years.

Impact-producing factors resulting from routine activities of oil and gas operations include mechanical damage caused by underwater oil spills, blowouts, anchoring, structure emplacement and removal, drilling discharges, and pipeline emplacement. These activities may threaten the sessile and pelagic communities associated with the crest and flanks of the hard-bottom and low-relief features of the hard-bottom region. Because protection similar to that of the biological stipulations is assumed to be attached to leases issued as a result of this proposal, the effects from these factors will have been mitigated on the biota of the banks. The potential impacts from spilled oil include uptake of hydrocarbons and reduced visibility; these impacts may be serious or fatal to the local biota. A blowout within 100 m of a hard-bottom community could result in the smothering of the biota within a very limited area of a hard-bottom due to sedimentation. The placement of drilling rigs and platforms on the seafloor will crush the organisms directly beneath the legs or mat used to support the structure, as will anchoring. Structure placement and anchor damage from support boats and ships, floating drilling units, and pipeline-laying vessels disturb areas of the seafloor and are the most serious threat to live-bottom areas at these depths. Structure removal using explosives (the most common removal method) could suspend sediments throughout the water column to the surface and may cause substantial impacts to nearby habitats. Deposition of these sediments would occur largely within the first 100 m of the site. Explosive structure removals create shock waves, which could also harm resident biota in the immediate vicinity. Smothering of organisms through deposition of drilling discharges (drill muds and cuttings) may occur; less obvious sublethal effects may also take place. Pipeline emplacement directly affects the benthic communities through burial and disruption of the benthos, and through resuspension of sediments. These resuspended sediments may clog filter-feeding mechanisms and gills of fishes and sedentary invertebrates. The majority of these impacts are mitigated through implementation of the biological stipulations or comparable measures. Because protection similar to that of the biological stipulations will be attached to leases issued as a result of this proposal, the effects from these factors will have been mitigated on the biota of the banks.

*Conclusion*

The impact under the Cumulative scenario on the pinnacle trend communities of the northern Gulf region is expected to be such that this damage to one or more components of a few regionally common habitats or communities results in changes to physical integrity, species diversity, or biological productivity that exceeds natural variability (observed prior to the damage); recovery to pre-impact conditions is expected to take longer than 10 years.

### *(b) Deep-water Benthic Communities*

Cumulative factors considered to impact the deep-water benthic communities of the Central Gulf include both oil- and gas-related and non-oil- and gas-related activities. The latter type of impacts includes activities such as fishing, trawling, and anchoring. However, fishing and trawling in the deeper waters of the Central and Western Gulf are minimal and impacts are minimal. Oil- and gas-related activities include pipeline and platform emplacement activities and anchoring, instances of which are expected to be higher than under the

Base Case (Section IV.D.1.a.(2)(b)). This analysis considers the effects of these factors related to the proposed action, and to prior and future OCS sales.

The greatest potential for adverse impacts to occur to the deep-water benthos stems from pipeline and platform emplacement and associated anchoring activities. The impacts to benthos from these activities are discussed above. As exploration and development continue on the Federal OCS, activities in the Central and Western Gulf regions have moved into the deeper water areas of the Gulf of Mexico. With this trend comes the certainty that increased development will occur in these areas, accompanied by stress to the deep-water benthos from bottom disturbances and disruption of the seafloor from associated activities. The extent of this disturbance shall be determined by the intensity of development in these deep-water regions, as well as the types of structures and mooring systems utilized. For instance, Table IV-7 indicates that in offshore Subareas C-2, C-3, and C-4 (where these communities would be found) an estimated 5,140 exploration and delineation wells and 4,345 development wells will be drilled and 288 platforms and 4,525 km (2,810 mi) of pipelines will be installed. However, as noted in Section IV.D.1.a.(2)(b) above, NTL 88-11 operates to protect high-density chemosynthetic communities in a high percentage of the cases (but not 100% of the time); for purposes of this analysis, the frequency of impact from bottom disturbance is considered to be once every six months to two years, but the severity of impact is such that the loss of elements and/or relationships will not occur.

*Summary*

The only impact-producing factor threatening the chemosynthetic communities is physical disturbance of the bottom, which would destroy the organisms comprising these communities. Only structure emplacement is considered to be a threat, and then only to the high-density (Bush Hill-type) communities; the widely distributed low-density communities would not be at risk. The provisions of NTL 88-11 (currently in effect), requiring surveys and avoidance prior to drilling, will reduce, but not completely eliminate, the risk.

Activities not related to the OCS oil and gas program include fishing, trawling, and anchoring. Because of the water depths in these areas, these activities are not expected to have any impact on the chemosynthetic communities.

The cumulative impacts are expected to be due entirely to the activities of the proposed action (as analyzed in Section IV.D.1.a.(2)(b)) because activities unrelated to the OCS oil and gas program, such as fishing, trawling, and anchoring, are not expected to have any impact on these chemosynthetic communities.

*Conclusion*

The activities associated with the Cumulative scenario are expected to cause little damage to the physical integrity, species diversity, or biological productivity of either the widespread, low-density chemosynthetic communities or the rarer, widely scattered, high-density Bush Hill-type chemosynthetic communities. Recovery from any damage is expected to take less than 2 years.

### *(c) Topographic Features*

Oil and gas leasing has been increasing around the topographic features of the Central Gulf, and this trend is expected to continue in the future. Of the 167 blocks in the CPA near the topographic features, 105 are under active lease (Appendix A). Many oil and gas operations on the previously leased blocks are subject to the provisions of a biological stipulation. For purposes of this analysis, the Topographic Features Stipulation is included in the analysis below. For this reason, these operations are not expected to have an adverse impact on the biota of the topographic features. Thus, the impact from cumulative oil and gas routine operations would be limited to those from the operations conducted as a result of any future OCS sales held without benefit of the proposed stipulation. The impacts, without benefit of the proposed stipulation, are expected to be very destructive of the reefal communities of the banks (Section II.A.1.c.(1). The impact from cumulative oil and gas routine operations includes those from the operations conducted as a result of the proposed action (as explained in Section IV.D.1.a.(2)(c)). These operations include anchoring and structure emplacement, effluent discharge, blowouts, oil spills, and structure removal, future OCS sales, past sales (which include the proposed biological stipulation of Section II.A.1.c.(1) for analysis purposes), hurricanes, the activities of scuba divers, the collapse of the tops of the features due to dissolution of the underlying salt structure, ocean dumping, and the tankering of imported oil.

Anchor damage and damage from structure emplacement are considered to be the most serious threats to coral and coral-community areas (Bright and Rezak, 1978; Rezak and Bright, 1981). The biological stipulation on the existing leases and proposed for leases resulting from this proposed action prohibits the anchoring of industry-related vessels and the emplacement of structures by the industry in the No Activity Zones; the potential stipulation does not affect other activities such as anchoring, fishing, or recreational scuba diving. No data are available on the extent to which such anchoring may take place; however, all three activities are known to occur in proximity to the topographic features. Nearly all the banks are near established shipping fairways. The banks are apparently well-known fishing areas. Several of the shallower cresting banks are scuba trip destinations. Anchoring at a topographic feature by a vessel involved in any of these activities would cause significant damage to the biota, and although the degree of damage would depend on the size of the anchor and chain, there is the potential for serious anchor damage to the biota of the topographic features.

Treasure hunters have destroyed large areas of Bright Bank by using explosives to blast through the coral reef. The impact has been high to Bright Bank as a result of this blasting activity; however, such blasting is not a common event. All of the impacts described above for the Base Case would also pertain in this case. Thus, for the purpose of this analysis, the frequency of these events is judged to be once or twice each year, and the severity of the impact is considered to be such that there is no loss of elements and/or relationships; and such perturbations would last for periods from 6 months to 2 years at the regional scale and for periods of 2-5 years at the local scale. Recovery of the system to pre-interference conditions is probable.

The routine discharge of drilling muds and cuttings will greatly increase under this scenario. As noted above under the Base Case, most water-based fluids are relatively nontoxic (the more toxic effluents are not allowed to be discharged under the NPDES permit), and their effects are limited to the immediate vicinity of the discharge (NRC, 1983). No effects to the biota of the topographic features are expected due to toxicity. Small amounts of drilling effluent may reach a bank from wells drilled more than 1,000 m away; however, these amounts from single wells, where measurable, would be extremely small and would have no effect on the biota. Effluents discharged at the water's surface within 1,000 m of a bank could impact the biota of the bank, although the currents at the banks would tend to keep the bank swept clean of fine sediments and would prevent the accumulation of drilling muds at the bank. The muds and cuttings can smother the sessile benthic invertebrates; turbidity from the discharge can reduce light levels to benthic organisms and clog the feeding mechanisms of sessile invertebrates. These conditions can lead to reduced productivity, susceptibility to infection, and mortality. The MMS, as a condition of the operational plan approval, can require the operator of a lease to perform certain measures, such as shunting, that would reduce the impacts to the biota of the banks to very low. The USEPA, through its NPDES permitting procedures, may also require mitigative measures. Current leases and leases resulting from this proposed action near topographic features may contain, at the option of the Secretary, a biological stipulation that protects the biota of the bank from most impacts from oil and gas operations, but leases resulting from future lease sales may not contain this restriction. For purposes of this analysis, it is assumed that such impacts will occur once each year and that the severity of the impacts is judged to be such that there is no loss of elements and/or relationships. Such perturbations would last for short periods at both the regional and local scales. Recovery of the system to pre-interference conditions would be rapid.

There is an estimated 99+ percent chance of an oil spill greater than or equal to 1,000 bbl occurring in the Central Gulf as a result of the OCS Program (Table IV-19). It is also assumed that 830 spills of greater than 1 and less than 50 bbl will occur each year and that 33 spills of greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action (Section IV.C.3.a.). It is assumed that 7 oil spills of 1,000 bbl or greater will occur on the OCS from OCS oil and gas operations, with an additional 37 spills resulting from import tankering (Section IV.C.1). Because of the water depths in which topographic features are found, no oil will reach the biota of concern. As discussed for the Base Case, blowouts seldom occur in the Gulf and, even if one occurred, it is expected that any oil spilled into the water column from a blowout would not reach the biota of a topographic feature. Therefore, it is assumed that no spills of any size would contact the biota of the topographic features.

Many platforms could be removed during the life of this proposed action; some may be near topographic features. However, the proposed Topographic Features Stipulation (Section II.A.1.c.(1)), which has been applied in the past to all leases on or near such features and which may be applied to leases resulting from this proposed action, prevents the installation of platforms in the near vicinity of the biota of concern, thus reducing the potential for impact from this factor. Therefore, the impact from this factor is negligible. See Section IV.A.2.a.(3) for more information regarding structure removals.

Impacts to the topographic features could occur as a result of operational discharges from import and shuttle tankers. Due to the dilution factor and the depths of the banks, this activity is expected to have a very low level of impact on the topographic features. This is also true for the very low level of ocean dumping that occurs in the Gulf (and which is being phased out).

Impacts from natural occurrences such as hurricanes are not expected to result in damage to the biota of the banks. Collapse of the crest of the banks from dissolution of the underlying salt structure is possible, but unlikely and certainly uncontrollable by human activity.

Scuba divers may visit the shallow banks, and their collecting activities may have an adverse impact on the biota of those banks. Other than anchor damage, however, such activities are not expected to have major impacts on the banks.

The other impacts to the biota of the topographic feature described above for the Base Case would also obtain here, but at a greatly increased level.

*Summary*

Those activities causing physical disturbance to the bottom of the topographic features and presenting the greatest threat to the biotic communities of the banks would be prevented by the imposition of the proposed Topographic Features Stipulation. Those OCS oil and gas program-related activities include anchoring of vessels and structure emplacement, operational discharges (drilling muds and cuttings, produced waters), blowouts, oil spills, and structure removal.

Non-OCS oil and gas activities are judged to have little, if any, impact on the biota of the topographic features (except for anchoring, described in detail above). These activities include hurricanes, activities of scuba divers, the collapse of the tops of the banks, ocean dumping, and the tankering of imported oil.

Activities resulting from this proposed action, especially bottom-disturbing activities, have a potential for causing low impacts to the biota of the topographic features. While some of the activities are expected to result in lower impacts, those having the greatest impacts are also those most likely to occur.

The cumulative impact to topographic features is expected to be low. The incremental contribution of the proposed action (as analyzed in Section IV.D.1.a.(2)(c)) to the cumulative impact level is very low because of the implementation of the Topographic Features Stipulation, which would limit operational discharges, and to the low probability (and thus risks) of accidental OCS-related events such as blowouts and oil spills.

*Conclusion*

The activities assumed for the Cumulative scenario are expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 $m^2$ would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks.

### *(3) Impacts on Water Quality*

*Coastal and Estuarine Waters*

The Cumulative Analysis considers the effects of low-level routine point and nonpoint source discharges, such as industry effluents, both chronic low-level and large accidental hydrocarbon and chemical discharges, and natural seepage entering the coastal or nearshore waters of the northern Gulf of Mexico. These discharges occur from urban and agricultural expansion, municipal and industrial wastes, recreational and commercial boating, maritime commerce, dredging activities, natural events, State oil and gas development activities, and the proposed action plus other OCS oil and gas development activities due to past and future sales. Section IV.B. presents information on major activities occurring in the Gulf and its coastal areas.

The major causes of nonpoint source contamination in Louisiana are listed in the Section 319 State of Louisiana Nonpoint Source Pollution Assessment Report (Louisiana Dept. of Environmental Quality, 1988). The report identifies agriculture, general construction in the coastal zone, hydromodification, silviculture, septic tank leakage, and urban runoff (Louisiana Dept. of Environmental Quality, 1988). This report shows a substantial percentage of the coastal area to be significantly affected by nonpoint source pollution so that identified areas do not support fully designated uses of surrounding water. Given the expected continuous nature of these discharges, but accounting for the filtering and assimilative capacity of wetlands (Kennedy, 1984) and the improved environmental regulatory programs adopted by the Gulf coastal States (such as tougher water quality standards), chronic point and nonpoint source discharges are expected to cause localized and short-term (up to several weeks) degradation of coastal waters throughout the Gulf region.

Section IV.B.6. presents an overview of the major sources of oil contamination in the Gulf. This overview shows that these larger oil spill incidents and chronic small inputs impact water quality but are overshadowed by the input of the Mississippi River. Clearly, the major source of oil contamination of Gulf waters is the contaminated waters coming down the Mississippi River (78%), a conclusion supported by a number of major studies conducted in the Gulf of Mexico, including the MAFLA study, the Buccaneer Oil Field Study (Bedinger, 1981), and the Southwest Research Institute Platform Study (Middleditch, 1981). The Mississippi River also carries both nonpoint source runoff and point source discharges from industrial, municipal, and agricultural industries along or near its levees. The plume contains high amounts of sediments and organic chemicals, trace metals, and pesticides, which interact with the coastal and nearshore waters of Louisiana and Texas. Hydrocarbons were the most significant of the pollutants found in the sediments of Mississippi Sound (Delfino et al., 1984). Analyses revealed three principal sources of pollutant hydrocarbons: petroleum associated with the Pascagoula refinery, fuel oil, and sewage. Land runoff apparently contributed some of the contamination.

Vessel traffic associated with both State and international oil and gas industry activities is expected to be extensive in the Louisiana coastal areas, especially within the Mississippi Delta area. Discharges from service boats and barges, although diluted and discharged slowly over large lengths of channel, will be great enough to result in some degradation of water quality in the navigation channels traversed. Besides impacts to water quality from operational discharges of oil and gas industry vessel traffic, impacts will occur along the Gulf's coastal waterways, the GIWW, and within bays and coastal rivers from discharges from other types of vessel traffic. These include maritime commerce, private recreational boats, and commercial and recreational fishing activities. The combined vessel traffic associated with these activities will be extensive and is expected to impact nearshore and coastal waters within the entire coastal zone through bilge and ballast water discharges, sanitary and domestic waste discharges, releases of antifouling paint compounds, and spills less than 1,000 bbl and spills greater than or equal to 1,000 bbl events. Impacts from such sources are substantial enough to cause low-level effects when discharged into confined waters over a long period. Impacts to open waters are expected to be negligible, not causing changes in water quality characteristics.

The discharge of sewage and wastes from boats and vessels in coastal waters may impact water quality by increasing BOD locally and introducing pathogens into the water column. The Federal Water Pollution Control Act requires recreational boats to be equipped with approved marine sanitation devices; however, boats still legally discharge treated and illegally discharged untreated waste into coastal water bodies. Although the wastewater generated by recreational boats is small, the organics are concentrated and, therefore, the BOD levels are much higher than that of raw or treated municipal sewage. When this occurs in poorly flushed waters, the DO concentrations of the water may decrease. In more temperate regions, these effects are exacerbated due to increased boat traffic, higher water temperatures, and higher metabolism rates for marine organisms. The addition of disease-carrying pathogens from fecal matter in boat sewage poses a potential problem with regard to human health impacts. Humans are put at risk from either contacting contaminated waters through swimming or eating shell fish taken from such waters. Bacteria, viruses, and other water-borne diseases can be attributed to sewage pollution.

Antifouling paints and coatings containing copper and organotin biocides are used to prevent the buildup of barnacles and other encrusting organisms on vessels and docks. Other toxic compounds such as mercury, arsenic, and PCB's are no longer used due to their extreme toxicity. By 1985, up to 30 percent of the vessels worldwide used tributyltin-containing antifouling paints. A 1987 survey found that 97 percent of the tributyltin use was on vessels or boats less than 65 ft, and that 93 percent of this was on recreational boats. Tributyltins are a class of organic tins used in antifouling paints. There are two classes of these paints--conventional, or those that leach continuously, and copolymer, which are released to the aquatic environment at much slower rates. Due to the rapid leaching of these compounds, elevated levels of tributyltin and its breakdown products have been found in the water, sediments and organisms where there are high concentrations of vessels and, more specifically, recreational boats.

Studies indicate organotin is highly toxic at very low levels to marine and freshwater organisms. Tributyltins have been reported to cause acute and chronic toxicity to marine organisms, especially in small crustaceans (zooplankton) and bivalves. Bacteria and phytoplankton bioaccumulate tributyltin at concentrations of 600 to 30,000 times the exposure concentration, while bioaccumulation in bivalves has been reported up to 4,000 times the exposure concentration. Bivalves are extremely susceptible because of their ability to metabolize these compounds, which are found in nearly anoxic sediments that lack the bacterial species necessary to degrade these compounds.

Unlike copper, tributyltin in seawater degrades rapidly, with a half-life of 3-15 days (seawater). Within the water column, the primary means of degradation in the presence of light appears to be debutylation by planktonic algae, especially diatoms. In the absence of light, degradation is primarily by bacteria. Tributyltins tend to concentrate in the surface microlayer and are found at higher levels than found in the subsurface. Once these compounds adsorb to particulate matter and sink into the sediments, they tend to concentrate and slowly degrade.

Tributyltin paints are now regulated in the United States by the Organotin Antifouling Paint Control Act of 1988. The Act prohibits the use of certain antifouling paints containing organotin and the use of organotin compounds, purchased at retail, to make paints. The Act prohibits the application of antifouling paints to vessels less than 25 m in length, with the following exceptions: the aluminum hull of a vessel less 25 m in length or the outboard motor or lower drive unit of a vessel less than 25 m in length. All antifouling paints must be certified by the Administrator of USEPA not to have a release rate of more than 4.0 micrograms per square centimeter per day.

Dredging activities (Section IV.B.) associated with maintenance dredging and deepening of channels, and the creation of ports, marinas, and private docks, will continue to impact the Gulf's coastal waters. A number of maintenance dredging projects are ongoing, especially in the Mississippi River passes area, other navigation channels, and along the GIWW. Dredging activities are expected to result in localized impacts (primarily elevated water column turbidities) occurring over the duration of the activity (up to several months). Such activities would preclude some recreational and commercial water uses within the immediate area of this activity. The periods between expected dredging operations will generally allow for the recovery of affected areas between such activities. Impacts are expected to be somewhat higher in the Mississippi Delta area because of higher sediment inputs.

Continued offshore and onshore oil and gas activities will contribute to the cumulative impacts on coastal and nearshore water quality. An unknown number of additional structures and facilities may be constructed as a result of resource development in State waters and coastal areas. The construction and operation of onshore facilities supporting domestic and international oil and gas activities may impact coastal and nearshore water quality by routine point and nonpoint source pollution. Increased effluent discharges from support facilities may contribute to point source pollution within coastal areas. These effluents are commonly discharged into surface waters after treatment. Surface runoff from existing refining and processing facilities is extensive and can adversely impact the surrounding area. Runoff from these facilities is likely to contain oil, brine, particulate matter, heavy metals, petroleum products, process chemicals, and soluble inorganic and organic compounds leached from the soil surface. Aside from adding contaminants to coastal waters, runoff from such facilities may alter circulation in wetland areas and affect flushing rates and salinity gradients. Because the majority of the facilities expected to support oil and gas refining and processing activities are located primarily in coastal Texas and Louisiana, impacts of chronic discharges from these sources are expected to be focused there.

Oil-field wastes generated from coastal and offshore oil and gas development activities and disposed of in the Louisiana coastal area have contaminated groundwater and coastal water quality. As of November 1989, the State of Louisiana's Department of Natural Resources (DNR), Conservation Division, has identified 13,000 oil-field pits that contain a variety of oil-field waste chemicals (McCarthy, personal comm., 1989). Interagency projections estimate the total number of pits to be higher, closer to 20,000 dug in the last 10 years. Until recently, these pits were unlined and resulted in degradation of usable groundwater through seepage of their constituents (USEPA, 1988). The USEPA documented a number of cases of damage caused by these reserve pits, both those illegal and those legal under Louisiana law. According to USEPA, these documented damages suggest that all major types of oil-field waste and waste management practices have been associated to some degree with endangerment of human health and damage to the environment. The principal types of wastes responsible for damage cases include general reserve pit wastes (drilling fluids and cuttings, pipe dope, rigwash, diesel fuel, and crude oil), fracturing fluids, production chemicals, waste crude oil, produced waters, and miscellaneous wastes associated with oil-field exploration, development,and production (USEPA, 1988). Until March 1991, the State of Louisiana allowed for the direct discharge of waste drilling mud and produced water into its bays and estuaries. There are documented cases of environmental damage to oyster beds and, thereby, water quality from this practice (USEPA, 1988). The OCS oil industry has contributed to this problem because of its practice of coastal disposal of some produced waters (discussed below) and certain types of oil-field waste, such as oil-based drilling fluids.

In the past, produced waters discharged from State oil and gas activities have been substantial and have had adverse effects at many of the discharge sites. In 1986, 1,524,962 BPD of produced water were discharged from 682 separation facilities associated with the Louisiana State oil and gas industry (Boesch and Rabalais, 1989a). In this report, it was estimated that another 823,575 bbl of produced waters from Texas State oil and gas activities were discharged daily into Texas State waters. In March 1991, the Louisiana State Legislature approved regulations banning the discharge, into State waters, of all oil and gas activity-derived wastewaters (primarily produced waters). The State's effluent guideline standards have been revised such that there shall be no discharge of produced waters into State waters after January 1, 1995, unless the discharge(s) are authorized in an approved elimination schedule or are in effluent limitation compliance. Given this legislation, it is difficult to project the extent of impact, if any, of these future discharges. At sites continuing the practice of coastal discharge, it is anticipated that elevated levels of salinity (50-150 ppt), dissolved and dispersed petroleum hydrocarbons (10-50 ppm), organic acids, radionuclides, and trace metals may result around discharge sites. Concentrations of the organic constituents will depend on the separation and treatment technologies employed. Substantial hydrocarbon contamination of fine-grained sediments may extend out from several hundred meters to over one kilometer from the point of discharge. Concentrations of aromatic hydrocarbons in sediments may exceed background levels by over an order of magnitude.

It is assumed that 37 oil spills greater than or equal to 1,000 bbl will occur from import tankering in the Gulf of Mexico during the life of the proposal. The average size of an import tanker spill is estimated at 30,000 bbl. Eight import spills (approximate size of 7,665 bbl) are assumed to occur in nearshore waters and in port areas. Those port areas expected to receive the greatest number of these spills include the Louisiana Offshore Oil Port (LOOP) and Mississippi River ports. Another 60 spills (average size of 10,000 bbl) are estimated to occur in the CPA's coastal zone (primarily in coastal Louisiana) from coastwise movement of petroleum products. Most of these spills are assumed to occur in the GIWW. Petroleum hydrocarbons introduced into marine and coastal waters may have varied effects depending on the resource impacted, stage of weathering, and local physical and meteorological conditions. Some crude oil components are highly toxic and may cause damage to marine organisms due to the crude's aromatic content. It is expected that encountered, normal weathering processes will detoxify the oil by breaking down its toxic components. Background levels in the Gulf of Mexico were reported at $\mu$g/l. In shallow areas, oil may become entrained in suspended particles and bottom sediments and subsequently be reintroduced into the water column. The assumption, based on these estimates and the frequent nature of spills over the life of the proposal, is that the effect of hydrocarbon contamination on the Gulf's coastal waters due to the proposed action is considered negligible, with water characteristics rapidly returning to background levels within several days to weeks.

Within the Gulf's coastal zone, much of the existing infrastructure supporting offshore OCS oil and gas activities is distributed throughout coastal Texas and Louisiana. About 90 percent of the existing capacity or frequency usage of the oil industry infrastructure will support OCS operations in the future. The addition of two new gas processing plants, up to three new pipeline landfalls, 48 km of onshore pipelines, one new terminal, and two new separation facilities is estimated to result from the cumulative OCS activities in the CPA. All these activities are assumed to occur in coastal Subarea C-4. Both the use of new oil and gas facilities once constructed and the use of the existing facility network would contribute to the number of effluents expected to be discharged into coastal waters from petroleum activities primarily in the Louisiana coastal zone. The construction and operation of onshore facilities supporting OCS activities may impact coastal and nearshore water quality by routine point and nonpoint source pollution. Increased effluent discharges from support facilities may contribute to point source pollution within coastal areas. These effluents are commonly discharged into surface waters after treatment. Surface runoff from existing OCS facilities is extensive and can adversely impact the surrounding area. Runoff from these facilities is likely to contain oil, brine, particulate matter, heavy metals, petroleum products, process chemicals, and soluble inorganic and organic compounds leached from the soil surface. Aside from adding contaminants to coastal waters, runoff from such facilities may alter circulation in wetland areas and affect flushing rates and salinity gradients. Because the majority of the facilities expected to support offshore oil and gas activities are located in Texas and Louisiana, impacts of chronic discharges from these sources are expected to be focused there.

Vessel traffic associated with OCS oil and gas industry activities is expected to be extensive in the Texas and Louisiana coastal areas, especially within the Mississippi Delta area. Approximately 701,200 service vessel trips are estimated to support cumulative OCS activities in the CPA. Waterways along the Louisiana coast where projected service vessel traffic will be the greatest include the Calcasieu River, Freshwater Bayou, the Atchafalaya River, and within the Mississippi River passes. The other navigation channels will have significant but lesser OCS vessel traffic. Import tankering and barge trips (6,828 barge vessel trips related to OCS production activities) carrying both domestic and imported crude oil and products between terminals and refineries along the Gulf Intracoastal Waterway (GIWW), adjoining navigation channels, and along coastal nearshore fairways will add to this traffic. Shuttle tankering associated with OCS production in the CPA will result in 575 trips, most of which will result from activities in the Eastern Gulf, offshore Florida. While inshore, service vessels are estimated to discharge approximately 3,000 liters of bilge water per trip in support of OCS-related activities. An estimated four trillion liters (300 MM liters/day) will be discharged into coastal waters of the CPA from vessels supporting OCS activities. Discharges from service boats and barges, although diluted and discharged slowly over large lengths of channel, will be great enough to result in some water quality degradation in the traversed navigation channels and GIWW. As noted in Alternative A, antifouling paints used on boats and tankers have been shown to have toxic effects on some marine biota. Increased loadings within coastal waters of tributyltin and copper compounds contained in antifouling paints are expected. Ballast and bilge waters from shuttle tankers are assumed to be discharged at onshore reception facilities and are not expected to impact coastal water quality. Operational discharges from shuttle tankering offshore are expected to add to the overall hydrocarbon contamination of nearshore open waters. Tarballs formed from these service vessel discharges will impact the Gulf's coastal beaches. Because no new service base locations are projected for OCS activities, and none is likely for State activities, operational discharges associated with OCS service vessel traffic will not impact coastal water quality. Impacts from such sources are substantial enough to cause low-level effects when discharged into confined waters over a long time period. Impacts to open waters are expected to be negligible.

No new navigation channels are expected to be dredged; however, maintenance dredging of major navigation channels and deepening of some channels to support service vessel traffic are expected. Dredging activities are expected to result in localized impacts (primarily elevated water column turbidities) occurring over the duration of the activities (up to several months). Such activities would preclude some recreational and commercial uses within the immediate area. The periods for expected dredging operations will generally allow for the recovery of affected areas between such activities. Impacts from dredging are expected to be somewhat higher near the mouths of major rivers, where sediment inputs are greater. Approximately 48 km of new pipelines are projected to be constructed in association with OCS activities; 98 percent of the oil and all of the gas produced will be transported ashore via the existing pipeline network. Pipelines reduce the need for barge and truck transport of petroleum and the potential for transfer spills. The environmental effects associated with chronic pipeline leakage and malfunction are generally considered small (USDOC, NOAA, 1985). Given this and the small percentage use of the existing pipeline network in support of the proposed action, impacts from leakage and hydrologic alterations associated with pipelines are considered negligible.

Onshore produced-water discharges originating from OCS oil and gas activities could have detrimental effects at the discharge sites. In MMS funded studies completed by LUMCON (Boesch and Rabalais, 1989a and b; and Rabalais et al., 1991), elevated concentrations of polynuclear hydrocarbons were found in sediments within a kilometer of the discharge sites. Total amounts of OCS produced waters expected to be piped ashore for separation, treatment, and disposal are 2.4 Bbbl. Because of the recent Louisiana Legislation concerning produced-water discharges, most of these waters will be piped ashore for separation and treatment then reinjection onshore, or be piped offshore and discharged into marine waters. Most of the 11 sites produced-water discharged sites discussed in the Boesch and Rabalais study are either discontinuing their operations or modifying their sites for reinjection or transmission of these waters back offshore. At sites continuing the practice of coastal discharge up to January 1, 1995, it is anticipated that elevated levels of salinity (50-150 ppt), dissolved and dispersed petroleum hydrocarbons (10-50 ppm), organic acids, radionuclides, and trace metals may result around discharge sites. Concentrations of the organic constituents will depend on the separation and treatment technologies employed. Substantial hydrocarbon contamination of fine-grained sediments may extend out from several hundred meters to over one kilometer from the point of discharge. Concentrations of aromatic hydrocarbons in sediments may exceed background levels by over an order of magnitude.

It is assumed that 18 percent of the drilling muds (13.87 MMbbl) associated with sale-related drilling activities and 2.44 MMbbl of produced sand will be brought ashore for disposal. The improper storage and disposal of such oil-field wastes and contaminated oil-field equipment could result in adverse impacts to surface and ground waters in proximity to disposal facilities, cleaning sites, and scrap yards. Many of these wastes may be contaminated by NORM. Improper design and maintenance of such facilities could result in adverse impacts to these waters. The quantities of many wastes attributable to OCS activities, and more specifically the proposed action, are largely unknown, as are the associated environmental consequences and health risks.

Under the Cumulative scenario, 7 oil spills greater than or equal to 1,000 bbl would occur in the north-central Gulf offshore Louisiana-Mississippi-Alabama. Four of these oil spills would occur from pipeline sources, whereas 3 could originate from platform sources. The average size of these spills is 6,500 bbl. It is assumed that as much as 75 percent of the original volume of oil from the spill source will be lost as a result of weathering processes by the time the slick contacts the coast. It should be noted that there could be some effects from residual weathered oil that could reach coastal waters following a spill event, primarily in the form of tar material. Impacts from low-level contamination were discussed earlier. It is further assumed that 33 oil spills greater than 50 and less than 1,000 bbl and 830 oil spills greater than 1 and less than or equal to 50 bbl could occur from OCS pipeline, platform, and transportation sources within the CPA. Of these, it is assumed that few would contact coastal and estuarine waters. An additional 399 oil spills (less than 50 bbl--average size of 34 bbl) are assumed to occur in the CPA from spills related to the use of diesel and other potential pollutants. The effects of oil spills on coastal and marine waters were discussed previously under import spills.

Petroleum product spills are of great concern because the refined products of crude oil are often more toxic than crude itself. In general, refined oils is considered more toxic than crude due to the higher concentration of aromatic hydrocarbons and their greater ability to dissolve and disperse into the water column as a result of their less viscous nature. Refined oil, such as gasoline and kerosene, is likely to cause biological damage due to its toxicity over a relatively short period of time. Up to 60 petroleum product spills (average size 10,000 bbl) and another 670 smaller spills (most are less than 1 bbl) will occur in the CPA. Of these, most will occur in Louisiana port areas, along the GIWW, and near the Gulf coastline.

*Summary*

Routine point and nonpoint source discharges from non-OCS activities, such as agriculture, general construction projects, hydromodification, silviculture, septic tank leakage, urban runoff, and especially oil and gas activities will degrade coastal and estuarine waters within the Gulf of Mexico's coastal zone. In addition, maritime activities are expected to contribute to the degradation of waters near ports and major navigation channels. Total hydrocarbon concentrations measured in Gulf of Mexico oyster and sediment samples from the NOAA Status and Trends Program were generally lower than hydrocarbon concentrations at east and west U.S. coast locations, probably because the sites in the Gulf are farther removed from point sources. The following conclusions about hydrocarbon contamination can be made from the study: (a) chronic petroleum contamination is taking place, possibly from oil and gas operations along the Gulf of Mexico coastline, but also due to contamination of the discharge from the Mississippi River; and (b) water quality degradation is not taking place to such an extent to show marked increases over U.S. coastal areas that do not have as many oil operations.

All existing onshore infrastructure and associated coastal activities occurring in support of the proposed action will contribute to the degradation of regional coastal and nearshore water quality to a minor extent because each provides a low measure of continuous contamination and because discharge locations are widespread throughout the Gulf Region. The effect of chronic contamination on the Gulf's coastal waters due to the proposed action is considered negligible, with water characteristics rapidly returning to background levels. The OCS-related vessel traffic is likely to impact water quality through routine releases of bilge and ballast waters, chronic fuel and tank spills, trash, and low-level releases of the contaminants in antifouling paints. Depending on the length of the affected channel, flushing rates, etc., it is expected that there will be some localized short-term change (up to several weeks) in water quality characteristics from background levels. The OCS produced-water discharges will have localized impacts at those sites that continue their coastal discharge practice up to January 1, 1995. The Mississippi River Delta area will receive the greatest amount of these discharges. It is anticipated that elevated levels of salinity (50-150 ppt), dissolved and dispersed petroleum hydrocarbons (10-50 ppm), organic acids, radionuclides, and trace metals may result around produced-water discharge sites. Substantial hydrocarbon contamination of fine-grained sediments may extend out from several hundred meters to over one kilometer from the point of discharge. The improper storage and disposal of oil-field wastes and contaminated oil-field equipment would adversely impact surface and ground waters in proximity to disposal facilities, cleaning sites, and scrap yards. Surface and groundwater in proximity to improperly designed and maintained disposal sites and facilities could be adversely impacted with elevated concentrations of arsenic, chromium, zinc, cadmium, mercury, lead, barium, penta-chlorophenol, naphthalene, benzene, toluene, and radium.

Accidental spills will introduce oil into nearshore waters, creating elevated hydrocarbon levels (up to 100+ $\mu$g/l) within affected waters. Much of the oil would be dispersed throughout the water column over several days to weeks. In shallow areas, oil may become entrained in suspended particles and bottom sediments. Water uses would be affected for up to several weeks from proposed spills and then only near the source of slick. Other spills will occur from import tankering, transporting oil products throughout the Gulf, barging crude oil, etc. Refined oils are considered more toxic than crude due to the higher concentration of aromatic hydrocarbons and their greater ability to dissolve and disperse into the water column as a result of their less viscous nature. Products such as gasoline and kerosene are likely to cause biological damage due to their toxicity over a relatively short period of time.

*Marine Waters*

This Cumulative Analysis considers the effects of impact-producing factors related to the proposed action, plus those related to tankering and other vessel traffic, the Strategic Petroleum Reserve Program (SPRP), and industrial waste disposal activities that may occur and adversely affect the offshore water quality in the northern Gulf of Mexico. Specific types of impact-producing factors considered in the analysis include well-drilling discharges, pipeline emplacement, hydrocarbon production formation waters, dredging, accidental oil spillage, routine operational discharges, ocean disposal of hazardous material, and industrial waste discharges.

Vessels vary in size and design as much as in function, ranging from small recreational craft used primarily in coastal waters to defense-related naval vessels and ships of the merchant marine fleet up to several hundred thousand tons in size. With respect to ships that maintain sizable crews, the pollutants are the large amounts of domestic waste products such as sewage, food waste, and trash from the human activities on board. For recreational vessels, sewage disposal from marine sanitation devices in highly populated, confined harbors and anchorages is the primary pollution concern. Other problems are related to the movement of crude oil and concern offshore unloading terminals (deep-water ports) and the identification of systems most reliable for transfer of oil from OCS production areas to shoreside facilities. Perhaps the most publicized source of pollution is the operational discharge of oil by tankers in the merchant marine fleet. In 1979 alone, an estimated 2.5 million gallons of petroleum hydrocarbons were discharged from ships operating within the Gulf under normal operating conditions (USDC, NOAA, 1985). Regulations, coupled with the increased value of oil, have led to development of new and better techniques, such as segregated ballast, crude-oil washing systems, and oil-water separation systems for minimizing contamination of ballast water. Nevertheless, enforcement of regulations and standards is still a problem.

Between 1946 and 1970 the Atomic Energy Commission (AEC) licensed the dumping of more than 86,000 containers of low-level radioactive wastes at 28 recorded dumpsites in the Atlantic and Pacific Oceans and the Gulf of Mexico. Of these, only 2 dumps were made in the Gulf of Mexico (USEPA, 1980). Ocean dumping was discontinued in June 1970 following a policy recommendation by the President's Council on Environmental Quality (CEQ) in its 1970 report to the President. The United States has never disposed of its high-level wastes in the oceans, and in 1972 two major legislative initiatives were enacted prohibiting future disposal of high-level wastes into coastal waters and rivers. The Ocean Dumping Act, in addition to regulating ocean disposal of low-level waste, prohibits the dumping of high-level waste and radiological warfare agents in ocean waters. Soon after the Ocean Dumping Act was enacted, the Clean Water Act was amended to extend the prohibition to all navigable waters.

The development and operation of salt-dome storage cavities associated with the Strategic Petroleum Reserve Program, which is mandated by the Energy Policy and Conservation Act of 1975 (42 U.S.C. §6201 et seq.), results in a concentrated brine solution that must be disposed of. The brines are normally discharged into the Gulf of Mexico through diffusers to promote rapid dilution to background salt concentrations. However, the brines are denser than seawater and tend to flow along the seafloor, affecting bottom-dwelling-organisms until sufficient dilution has been achieved. In addition, hydrocarbons and other harmful constituents may be dissolved in or entrained with the brine discharge. Brine discharges are regulated by USEPA under NPDES.

Offshore sulphur operations off Louisiana have been ongoing since 1954. As with oil and gas activities, potential wastewater degradation resulting from sulphur mining operations will be governed by numerous factors. Bleedwater is by far the largest quantity of waste discharged during normal operations. Bleedwater is typically discharged directly into surface waters, and the dissolved solids in these streams closely approximate those of seawater. Sulfide in bleedwater will have a brief presence once discharged. Data from years of testing by Freeport McMoran at its Grand Isle Mine indicate that bleedwater is not measurable at 300+ feet from the source. Accidental spills of molten sulphur would have a minimal impact on nearshore or offshore water quality. Impacts to water quality within the Gulf are expected to be negligible.

Spills from import tankering (average spill size 30,000 bbl) and Gulfwide OCS activities may affect offshore water quality as indicated (see previous discussion under Coastal and Estuarine Waters). It is assumed that 37 oil spills greater than or equal to 1,000 bbl will occur from import tankering in the Gulf of Mexico during the life of the proposal.

As indicated in the Base Case Analysis, immediate effects would be brought about by increased drilling, construction, and pipelaying activities, causing an increase in water column turbidities to the affected offshore waters. Pipeline construction activities may result in the resuspension of some 8.4 million $yd^3$ of sediment. Offshore Subarea C-2 will support the greatest portion of program-related pipeline burial activities and associated sediment resuspension, with 2.5 million $yd^3$. Pipeline construction activities may result in the resuspension of settled pollutants, toxic heavy metals, and pesticides, if present. Impacts resulting from resuspension of bottom sediments following an explosive structure removal include increased water turbidity and mobilization of sediments containing hydrocarbon extraction waste (drill mud, cuttings, etc.) in the water column. The discharge of 102 MMm³ of NPDES-regulated, treated sanitary and domestic wastes from the various rigs and platforms will increase levels of suspended solids, nutrients, chlorine and BOD near the point of discharge. These are considered minor discharges and are quickly diluted. Treated deck drainage and domestic wastes are most often taken ashore for proper disposal at an approved site. Up to 12.3 Bbbl of produced waters are estimated to result from cumulative OCS activities in the CPA. Of this, 2.4 Bbbl will be transported onshore for separation, treatment, and disposal. Offshore Subareas C-2 and C-3 will receive the greatest number of these discharges with 3.67 Bbbl and 4.44 Bbbl, respectively. From the findings of investigators, MMS anticipates the effects of these discharges on offshore water quality to be limited to an area in proximity to the discharge source.

Some 76.6 MMbbl of drilling muds and 18.25 million yd³ of drill cuttings are estimated to result from drilling activities associated with the cumulative OCS activities in the CPA. As indicated in the Base Case Analysis, it is assumed that 18 percent of all muds used (13.8 MMbbl) will be brought ashore for disposal Drilling muds and cuttings are routinely discharged into offshore waters and are regulated by NPDES permits. As with produced-water discharges, offshore Subareas C-2 and C-3 would receive the greatest percentage of these potential discharges. An estimated 32.65 MMbbl of drilling muds and 4.4 million yd³ of cuttings could be potentially discharged in offshore Subarea C-2, whereas in offshore Subarea C-3 an estimated 26.14 MMbbl drilling muds and 6.21 million yd³ of cuttings could be discharged. When discharged into the surrounding offshore waters, drilling muds may create turbidity plumes several hundred meters in length. Studies indicate that these impacts are restricted to an area within 300 to 500 m of the discharge site. Dilution is extremely rapid in offshore waters. A 1983 NRC study suggests that, for routine oil and gas discharges, the various components measured, including turbidity, are at background levels by a distance of 1,000-2,000 m. As in the Alternative A analysis, the natural processes of dispersion, degradation, and sedimentation will result in immeasurably low concentrations of these materials within a few meters to a few kilometers of the discharge site.

It has been recognized that spills of hazardous materials may, in many cases, pose a more serious threat to marine ecosystems than oil spills. Substantial amounts of oil and hazardous materials enter the marine environment as a result of accidental spills. Alternative I analyzes the severity of oil spills to water quality in general. Program-related spills are discussed in the previous section under Coastal and Estuarine Waters. It is assumed that 60 petroleum product spills (10,000 bbl in size) will occur in the CPA from OCS-related activities. As previously noted, refined oils are considered more toxic than crude due to the higher concentration of aromatic hydrocarbons and their greater ability to dissolve and disperse into the water column as a result of their less viscous nature. Products such as gasoline and kerosene are likely to cause biological damage due to their toxicity over a relatively short period of time. Although the focus in the past has been on the cleanup and mitigation of spilled oil, national attention has been shifting toward hazardous materials as the cause for most immediate concern. Much has been learned in the past 10 years about how to respond to oil spills; far less is known for spills of hazardous material. Unlike oil, whose properties are fairly uniform, hazardous materials have a wide variety of physical and chemical forms, complicating and making the response necessary for their cleanup and disposal much more difficult. Methods for the cleanup and mitigation of hazardous materials are not well established.

*Summary*

Those activities that would impact the Gulf's marine waters include marine transportation and OCS oil and gas activities. Vessels range from small recreational craft used primarily in coastal waters to defense-related naval vessels and ships of the merchant marine fleet up to several hundred thousand tons in size. Pollutants from vessel traffic include large amounts of domestic waste products such as sewage, food waste, and trash from the human activities on board. Other problems are related to the movement of crude oil and concern offshore unloading terminals (deep-water ports).

With regard to OCS activities, immediate effects would be brought about by increased drilling, construction, and pipelaying activities, causing an increase in water column turbidities (lasting for several weeks) to the affected offshore waters. The magnitude and extent of turbidity increases would depend on the hydrographic parameters of the area, nature and duration of the activity, and bottom-material size and composition.

Offshore Texas would receive the greatest portion of program-related pipeline burial activities, whereas offshore Louisiana would receive the largest amounts of program-related operational discharges. Because of the continuous nature of oil and gas activities in the northwestern and north-central Gulf of Mexico, the frequency of drilling mud and cutting and produced-water discharges is judged to occur nearly continuously throughout these areas. Proposed produced-water discharges will be rapidly diluted within the immediate vicinity of the discharge source. Significant increases in water concentrations of dissolved and particulate hydrocarbons and trace metals are not expected outside the initial mixing zone or the immediate vicinity of the discharge source. Higher concentrations of trace metals, salinity, temperature, organic compounds, and radionuclides, and lower dissolved oxygen may be present near the discharge source. Within the mixing zone of the discharge, long-term effects to water column processes, consisting of localized increases in particulate metal and soluble lower molecular weight hydrocarbon (e.g., benzene, toluene, and xylenes) concentrations, may be implicated. Trace metals and hydrocarbons associated with the discharge may be deposited within sediments near the discharge point. The proposed discharge of drilling fluids and cuttings would encounter rapid dispersion in marine waters. Discharge plumes will be diluted to background levels within a period of several hours and/or within several hundred meters of the discharge source. The accumulation of toxic trace metals and hydrocarbons in exposed shelf waters, due to periodic releases of water-based generic muds and cuttings, is unlikely, and the long-term degradation of the water column from such discharges is not a major concern. No effects to water uses from routine activities and discharges are expected.

Program-related and nonrelated crude oil spills will introduce oil into offshore waters and create elevated hydrocarbon levels (up to 100+ $\mu$gl) within affected waters. Much of the oil will be dispersed throughout the water column over several days to weeks. Little effect to water use is expected from these spills, and then only in an area near the source and slick. Other spills will occur from import tankering (including oil from the TransAlaskan Pipeline), transporting oil products throughout the Gulf, barging crude oil, etc. Refined oils are considered more toxic than crude due to the higher concentration of aromatic hydrocarbons and their greater ability to dissolve and disperse into the water column as a result of their less viscous nature. Products such as gasoline and kerosene are likely to cause biological damage due to their toxicity over a relatively short period of time.

*Conclusion*

Cumulative demands resulting from the proposal are expected to result in significant changes to the ambient concentration of one or more water quality parameters, up to several hundred to 1,000 m from the source of activities and for a period lasting up to several weeks or months in duration. Chronic, low-level pollution related to the proposal will occur throughout the life of the proposed action. Overall cumulative impacts, which include the effects of non-OCS-related factors and OCS activities will significantly degrade water quality, primarily within the Gulf of Mexico's coastal zone in highly urbanized and industrialized coastal areas. Maritime activities are expected to contribute to water quality degradation near ports and major navigation channels. In restricted or poorly flushed coastal water bodies, localized increases in pollutant concentrations may be severe and persist for months or longer. Chronic low-level pollution will continue to persist in marine and coastal waters.

### *(4) Impacts on Air Quality*

The Cumulative Analysis considers the impacts from the following factors and/or activities: the proposed action, past and future OCS sales, power generation, industrial activities, and transport in the CPA.

The scenario discussed in Section IV.A. (Table IV-7) for the Cumulative Case establishes that 5,890 exploration and delineation wells and 5,130 development wells would be drilled, and 340 platforms would be emplaced. The sale area has been subdivided into four offshore Subareas: C-1, C-2, C-3, and C-4 (Figure IV-1). This discussion analyzes the potential degrading effects of OCS-related activities on air quality in each subarea. Table IV-7 presents for the Cumulative scenario the numbers of exploration, delineation, and development wells; platforms installed; and service vessel trips for each subarea. The following table shows total emissions from wells, platform complexes, and vessels in the CPA for the Cumulative Case. Observe that $NO_x$ is the most emitted pollutant, while $SO_x$ is the least emitted. More important is that this information shows that wells and vessels contribute mostly $NO_x$; while platforms contribute mostly $NO_x$, CO, and VOC. These emissions were calculated by adding the emissions of wells and platforms over time. Vessel emissions were calculated using the total number of service-vessel trips presented in Table IV-7.

Total OCS Emissions in the CPA
(tons over the 35-year life of the proposed action-Cumulative Case)

| Activity | $NO_x$ | CO | $SO_x$ | THC | TSP |
|---|---|---|---|---|---|
| Service Vessels | 362,270.0 | 42,440.3 | 5,723.7 | 18,435.0 | 5,017.1 |
| LTO Helicopters | 3,690.8 | 2,981.0 | 567.8 | 154.3 | 19.7 |
| Cruise Helicopters | 11,924.2 | 34,069.0 | 2,555.2 | 2,777.4 | 473.4 |
| Blowouts without Fire | 0.0 | 0.0 | 0.0 | 41.3 | 0.0 |
| Spills without Fire | 0.0 | 0.0 | 0.0 | 1,785.0 | 0.0 |
| Barge Loading | 0.0 | 0.0 | 0.0 | 4,059.0 | 0.0 |
| Tanker Loading | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Transit Loss | 0.0 | 0.0 | 0.0 | 7,739.5 | 0.0 |
| Tanker Exhaust | 102.8 | 11.2 | 127.7 | 0.2 | 788.2 |
| Tug Exhaust | 12,342.2 | 1,229.7 | 159.2 | 556.3 | 82.3 |
| Exploratory Wells | 56,956.3 | 15,196.2 | 6,655.7 | 1,471.4 | 5,097.3 |
| Development Wells | 36,730.8 | 9,798.3 | 4,309.2 | 430.5 | 1,476.0 |
| Platforms | 1,572,684.4 | 20,486.1 | 2,751.1 | 80,635.2 | 521.0 |
| Totals | 2,056,701.5 | 126,211.8 | 22,849.6 | 118,845.1 | 13,475.0 |

Total emissions for each subarea in the CPA during the Cumulative Case are presented below. Observe that Subarea C-1, which is the closest to land, generates the greatest emissions of all pollutants, while Subarea C-4, the farthest from land, generates the smallest amounts of emissions.

Total Emissions in CPA Subareas
(tons over the 35-year life of the proposed action--Cumulative)

| Pollutant | C-1 | C-2 | C-3 | C-4 |
|---|---|---|---|---|
| $NO_x$ | 888,425.2 | 589,374.4 | 533,520.6 | 45,381.2 |
| CO | 54,519.2 | 36,167.6 | 32,740.1 | 2,784.9 |
| $SO_x$ | 9,870.3 | 6,547.8 | 5,927.3 | 504.2 |
| THC | 51,088.8 | 33,838.8 | 30,632.0 | 2,605.6 |
| TSP | 5,820.7 | 3,861.4 | 3,495.5 | 297.3 |

The total pollutant emissions per year are not uniform. During the early years of the OCS program activities, emissions would be large and would decrease over time as reserves and production decrease. After a maximum, emissions would decrease rapidly as platforms, wells, and service vessel trips decrease to minimum.

The following table presents peak emissions of primary pollutants from OCS program activities in tons per year. It is very important to note that well drilling activities and platform peak emissions are not necessarily simultaneous; so, the combined maximum emissions are not a simple addition of the individual peak emissions. However, it is assumed that peak emissions from service vessel and other OCS-related activities, and combined well and platform peak emissions, occur simultaneously. In this analysis the aggregate peak emissions, which are 1.5 to 8.7 times the average emissions, will be employed. Use of peak emissions results in conservative impact level estimates from the OCS program activities.

Mean and Peak Emissions in the CPA
(tons over the 35-year life of the proposed action--Cumulative)

| Pollutant | Wells | Platforms | Vessels | Others | Mean | Aggregate |
|---|---|---|---|---|---|---|
| $NO_x$ | 6,087.60 | 76,704.75 | 11,152.29 | 0.00 | 58,762.90 | 91,527.19 |
| CO | 1,624.10 | 9,991.74 | 2,306.61 | 0.00 | 3,606.05 | 13,277.41 |
| $SO_x$ | 712.40 | 134.18 | 260.96 | 0.00 | 652.85 | 998.46 |
| THC | 177.10 | 29,071.77 | 626.38 | 467.99 | 3,452.57 | 30,273.26 |
| TSP | 611.20 | 187.85 | 182.31 | 0.00 | 385.00 | 872.01 |

The mean emissions were computed by dividing the total emissions by the 35-year life of the proposed action. Peak emissions from platforms are obtained from their temporal distribution. Platforms and wells have the greatest peak emissions, while vessels and other activities have smaller emissions in general. This phenomenon is contrary to the emission rates, where wells have greater rates than platforms.

The effects of the pollutants considered in this analysis were described in the Base Case analysis and will not be repeated here. The reader may consult that section.

Because the meteorological conditions described in the Base Case will not change for this analysis, neither will they be repeated. The only changes that occur in the Cumulative Case are those related to infrastructures and resources. These changes are reflected in an increase of emissions for all analyzed pollutants. A comparison of cumulative emissions per year with those of the Base Case shows that cumulative emissions would increase by four to five times.

To estimate the potential impact of offshore emissions on offshore and onshore air quality, a steady state box model (Lyons and Scott, 1990) was employed. The model is an expression of mass conservation and assumes that pollutants are vertically dispersed and sources uniformly distributed. For the purpose of these air quality analyses, an assumption of uniform distribution of average sources throughout the planning areas at this early stage is a reasonable approach. Predominance of unstable atmospheric conditions over the sea, as discussed in Section III.A.2., ensures that pollutants are dispersed homogeneously. The model was applied to $NO_x$ emissions because these are the largest emissions. Because VOC emissions are not inert, the box model cannot be used to assess their impacts on air quality. Concentrations for other pollutants can be estimated by multiplying the $NO_x$ concentrations by the ratio of the pollutant emissions over the $NO_x$ emissions. Concentrations of primary pollutants other than $NO_x$ would be smaller by more than 65 percent. Impacts from VOC and CO will be estimated by comparing the offshore and onshore emission rates.

The box model was applied to the following conditions: onshore and offshore winds with speeds ranging from 1 to 7 $ms^{-1}$, a mean mixing height of 900 m, and a low mixing height of 300 m. During periods of winds blowing offshore, concentrations reaching onshore from offshore CPA emissions are low. Conditions of onshore winds indicate that concentrations reaching land from Subarea C-3 varied between 3.86 and 0.32 $\mu gm^{-3}$ for speeds from 1 to 7 $ms^{-1}$ and a mixing height of 900 m; for a 300-m mixing height, concentrations varied from 11.57 to 1.65 $\mu gm^{-3}$ under the same wind speeds. For Subarea C-1 the concentrations varied from 4.76 to 0.62 $\mu gm^{-3}$ with a 900-m mixing height across the entire wind speed range; concentrations varied from 14.28 to 1.87 $\mu gm^{-3}$ with a 300-m mixing height across the entire wind speed range.

Concentrations for pollutants other than VOC would be smaller, as indicated above. Impacts to air quality for $NO_x$, $SO_x$, and TSP are moderate because the concentrations arriving onshore are enough to cause some areas to become border cases. However, under low wind speeds and low mixing heights impacts could be high, according to results from the box model. The MMS regulations (30 CFR 250.44) do not establish annual significance levels for CO and VOC. For these pollutants, a comparison of emission rates will be used to assess impacts. Formulas to compute the emission rates in tons/yr for CO are $3,400 \cdot D^{2/3}$ and $33.3 \cdot D$ for VOC. In these formulas, D represents distance in statute miles from the shoreline to the source. The CO exempt emission level in Subarea C-1 is 7,072.8 tons/yr, which is greater than peak emissions from the whole CPA.

The exemption emission level of THC in Subarea C-1 is 100 tons/yr, while platform emission level is estimated as 204.0 tons/yr.

Transport of pollutants toward onshore areas has a frequency maximum of 61 percent during summer and only 37 percent during winter. Thus, the box model results are very conservative estimates of concentrations arriving onshore from the OCS. The modeling effort does not consider removal processes such as rain, which in the CPA has a high frequency (Section III.A.2.) and would reduce impact levels to onshore air quality. Further, it is very important to note that OCS activity emissions will decrease over the 35-year life of the proposed action. Thus, these estimated emission peaks will reach land during one year only.

The MMS has also studied the impacts of offshore emissions using the OCD Model (USDOI, MMS, 1986a). Eight offshore areas off Grand Isle, Louisiana, containing from 19 to 85 production complexes and 19 to 195 point sources, were used in the study. Source distance from the coastline ranged from 5.6 to 45 km (3.5 to 28 mi). The study employed a 300-m mixing height, which coincides with the lower mixing height employed in the box model. Because the last model run in the study represents an aggregation of all sources and covers the entire distance range, this discussion emphasizes those results. The annual arithmetic mean varied between 0.82 and 1.83 $\mu gm^{-3}$, which is below the national standard of 100 $\mu gm^{-3}$.

All other inert pollutants would have lower concentrations. This modeling effort represents the combined effect of 85 production complexes close to onshore areas. Therefore, it is reasonable to assume that mean hourly concentrations derived from emissions associated with OCS program activities (0.17 $\mu gm^{-3}$) and spread over 193.4 billion square meters would have a moderate effect.

Oil-spill effects on air quality are examined below. It is assumed that oil spills in the category greater than 1 and less than or equal to 50 bbl, as well as greater than 50 and less than 1,000 bbl, would have low impacts on air quality because their input of pollutants (it is assumed that 30% of the spill evaporates in three days) would be very small. Information from OCS accidents indicates emissions of fewer than 100 tons/hour by the second hour. For spills greater than or equal to 1,000 bbl, emissions are about 285 tons/hour or smaller. If the dispersion of emissions is taken into account, effects on offshore air quality would be temporary.

Nearly 3 percent of OCS crude-oil production is offloaded from surface vessels at ports. The unintentional emissions from these offloading operations are estimated as 4,059 tons of THC over the 35-year life of the proposed action. This represents about 3.4 percent of the total VOC emissions in the CPA. Safeguards to ensure minimum emissions from the offloading and loading operations have been adopted by the State of Louisiana (The Marine Vapor Recovery Act, 1989: LAC: III.2108).

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 used in this analysis represents the equivalent diameter, which is the diameter of a sphere that will 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 $\mu m$ and a third peak with a diameter larger than 2 $\mu m$. Particles with diameters of 2 $\mu m$ or larger settle very close to the source (residence time of approximately ½ day, Lyons and Scott, 1990). For particles smaller than 2 $\mu m$, which do not settle fast, wind transport determines their impacts. Results from the box model indicate that the largest concentration for TSP will be 0.14 $\mu gm^{-3}$, which is less than the allowable annual increase level of 5 $\mu gm^{-3}$. Therefore, suspended matter would have little effect on the visibility of PSD Class I areas.

Ozone is of great concern because of its environmental considerations. In the CPA six parishes have nonattainment status for this pollutant (Section III.A.3.). Ozone measurements between 1989 (La. Dept. of Environmental Quality, 1989) and 1990 were examined from Morgan City in St. Martin Parish, Thibodaux in Lafourche Parish, and Westlake in Calcasieu Parish. These measurements show that in Morgan City and Thibodaux the ozone concentration never exceeded the national standard. Concentrations were between 15 and 25 $\mu gm^{-3}$, below the national standard during episodes of highest ozone concentrations. At other times concentrations were 45 to 50 units below the national standard. At Westlake in Calcasieu Parish, which is north of Cameron Parish, the ozone concentrations exceeded the national standards at least twice during 1989 and once during the first eight months of 1990. Since Cameron Parish, a coastal parish, is attainment for all pollutants, an argument could be made that OCS emissions are not the cause of Calcasieu Parish ozone problems. Another area with ozone problems is Baton Rouge. Recent air modeling there (Haney et al., 1990) indicates that ozone concentrations peak near 1600-1700 hours. The modeling effort, which included anthropogenic and biogenic sources, showed that some events could result from atmospheric overturning. During overturning episodes ozone from previous days is mixed downward and, coupled with local and imported input of ozone, causes the concentrations to exceed the national standards.

A recent report from the Lake Charles Ozone Task Force shows that out of 12 ozone exceedances in Calcasieu Parish, 3 cases show significant ozone contributions by transport from Texas. Another 3 cases with demonstrable transport ozone input occur, but the source areas are to the south or northwest. The report cites the Lake Charles industrial area to the south and the Beaumont and Orange, Texas, areas as the possible source areas in these cases. There were 5 other cases that showed local sources as the cause for the ozone exceedance episode. One episode cannot be studied with the methods employed by the Task Force for this analysis. Thus, there are 3 out of 12 cases where the ozone transport is correlated with southerly winds and that can point to some inputs from OCS offshore sources. However, the report never indicates this as a possibility or even speculates about the OCS role. Ozone measurements made between 1989 and 1990 in Alabama show only one ozone exceedance episode near the Chickasaw station. Another station located on Highway 43 shows no episodes of ozone exceedance over the same period. Both stations showed that ozone is seasonal with a maximum during August and a decrease during the fall and winter, when ozone levels are about 50 percent below the national standard of 235 $\mu gm^{-3}$.

The amount of power generation is very difficult to predict because it depends on many nonquantifiable factors. Therefore, different sets of assumptions result in different estimates. The envelope of predictions shows that energy consumption should increase up to the year 2010; after this, predictions show more variation but generally indicate an increase of energy consumption. Because energy production is the largest single pollutant generator, it is safe to assume that emissions must also increase (USDOE, 1990). However, advances in control technology and use of alternative energy sources can change the correlation between energy production and emissions. The available information (USDOE, 1990) indicates that $SO_x$ emissions from energy generation decreased 16.4 percent between 1970 and 1987. Other pollutants that showed a decrease over the 1970-1987 period are particulate matter and $NO_x$. Although CO and VOC increased over the same period, the overall amount of emitted pollutants decreased.

Emissions of the primary pollutants related to industrial activities decreased over the 1970-1987 period. The reduction in the total amount of pollutants was 51 percent (Godish, 1991). The projected increase in employment (Section III.C.2.) can be interpreted as an increase of industrial activities. However, if the decreasing trend of emissions holds during the next 35 years, it is safe to assume that industrial emissions would not increase; at worst they would remain at present levels.

Transportation-related emissions are an important consideration in regard to inshore air quality, because vehicles constitute the second largest emitters of $SO_2$ and $NO_x$ and the largest source of carbon monoxide (USDOE, 1990). Emissions of particulate matter and $SO_x$ increased, while $NO_x$ emissions remained the same over the 1970-1987 period. Emissions of CO and hydrocarbons decreased over the same period. The overall emissions showed a reduction of almost 44 percent during the 1970-1987 period (Godish, 1991). Vehicular use is population-dependent, and the demographic trends through most of the 1980's have shown a population decrease in most Gulf Coast States. A recent projection for MMS (Section III.C.2.) indicates that this trend will be reversed, and population will increase. Thus, vehicular use will increase, but as the consequences of advances in fuel efficiency, alternative gasoline developments, and better emission controls, emissions will probably decrease or, at worse, remain at the same level.

Blowouts are accidents related to OCS activities and are defined as an uncontrolled flow of fluids from a wellhead or wellbore. In the Gulf of Mexico OCS there have been 157 blowouts over a period of 33 years (1956-1989) (Section IV.A.4.b.(4)). This represents an average of about 5 blowouts per year, but the number of wells drilled is a better indicator. The estimated number of blowouts at a rate of 7 blowouts per 1,000 wells drilled, is 130 blowouts during the Cumulative scenario in the CPA. 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.

Because of technological advances the duration of blowouts has decreased, and about 61 percent of the recent blowouts last 1 day or less, 19 percent last between 2 and 3 days, 7 percent last between 4 and 7 days, and 13 percent last more than 7 days (Fleury, 1983). Further, most blowouts occurred without fire (MMS Database). The amount of oil released during these accidents has been small. The total emission of THC is

2,796 tons during the Cumulative scenario. It must be remembered that these are conservative estimates and that the total amount of THC may be less; the VOC will also be less because it is a fraction of the THC.

Even though oil production in State waters is known to be taking place, the State of Louisiana cannot provide information regarding the actual number of production facilities in State water; thus, it is impossible to estimate their emissions.

*Summary*

The scenario discussed in Section IV.A. (Table IV-12) for the Cumulative Case establishes that 5,890 exploration and delineation wells and 5,130 development wells would be drilled and that 340 platforms would be emplaced. This is in addition to the 1,106 platforms that were considered as sources in this analysis. These latter sources exist as a result of past sales. It is also assumed that power generation, transportation, and industry will cause enough emissions to keep the present impacts at their actual levels. Maintenance of the present impacts is due to the continuation of actual trends in energy consumption or technological developments in fuel and motor efficiency.

The incremental contribution of the proposed action (as analyzed in Section IV.D.1.a.(4)) to the cumulative impacts is low because of the prevailing atmospheric conditions and mixing heights affecting the transport and dispersion of emissions, and the concentrations of pollutants reaching the onshore areas.

*Conclusion*

Emissions of pollutants into the atmosphere from the activities assumed for the OCS program are expected to have concentrations that may not change onshore air quality classifications. Increases in onshore concentrations of air pollutants are estimated to be between 1 and 14.5 $\mu gm^{-3}$ (box model steady concentrations). This concentration will have minimal impact during winter because onshore winds occur only 37 percent of the time, and a maximum impact in summer, when onshore winds occur 61 percent of the time.

## *(5) Impacts on Coastal and Marine Mammals*

## *(a) Marine Mammals*

*Nonendangered and Nonthreatened Species*

This Cumulative Analysis considers the effects of impact-producing factors related to the Central Gulf proposed action, prior and future OCS sales, State oil and gas activity, commercial fishing, removal of live specimens for public display, and pathogens that may occur and adversely affect nonendangered and nonthreatened cetaceans (cetaceans include whales and dolphins) in the same general area that may be affected by OCS oil and gas activity located in the CPA.

Sections providing supportive material for the nonendangered and nonthreatened cetacean analysis include Sections III.B.3. (description of cetaceans), IV.A.2.a.(1) (seismic operations), IV.A.2.a.(3) (structure removal), IV.A.2.c. (support activities), IV.A.2.d.(5) (offshore discharges), IV.C.3. (oil spills), and IV.C.5. (oil-spill response activities).

An estimated 76.6 MMbbl of drilling muds, 182 MMbbl of drill cuttings, and 12.2 Bbbl of produced waters are assumed to be generated as a result of the proposed action plus prior and future OCS sales (Table IV-7). These effluents are routinely discharged into offshore marine waters and are regulated by the U.S. Environmental Protection Agency's NPDES permits. An unknown but expected substantial amount would also be discharged into nearshore waters from State oil and gas activities. It is expected that nonendangered cetaceans will periodically interact with these discharges. Direct effects to cetaceans are expected to be sublethal, and effects to cetacean food sources are not expected due to the rapid offshore dilution and dispersion of operational discharges. It is expected that operational discharges will periodically contact and affect nonendangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis, averaging about a million trips per year. The FAA Advisory Circular 91-36C encourages the use of fixed-wing aircraft above an elevation of 152 m and helicopters above 300 m. It is expected that at these elevations no cetaceans will be affected by OCS helicopter traffic. It is expected that helicopter traffic will rarely disturb and affect nonendangered cetaceans because of special prohibitions and adherence to the general, FAA-recommended minimum ceiling of 300 m.

It is assumed that, during the peak year, 36,000 OCS-related oil/gas service-vessel trips, 2 shuttle tanker trips, and 299 barge traffic trips will occur as a result of the proposed action, plus prior and future OCS sales in the CPA (Table IV-7). Noise from service-vessel traffic may elicit a startle reaction from cetaceans or mask their sound reception. This effect is sublethal and, at worst, of a short-term, temporary nature. Service vessels could collide with and directly impact cetaceans, but due to dolphin maneuverability and echo-location, encounters of this type seldom occur. Cetaceans can avoid service vessels, and operators can avoid cetaceans. It is expected that service-vessel traffic will rarely contact and affect nonendangered cetaceans.

It is assumed that, during the peak year, 400 exploration and delineation wells and 235 development wells will be drilled as a result of the proposed action, plus prior and future OCS sales in the CPA (Table IV-7), and will produce sounds at intensities and frequencies that could be heard by cetaceans. It is estimated that noise from drilling activities will last no longer than two months at each location. However, the decibel level of these sounds dissipates to the tolerance of most cetaceans within 15 m of the source. Odontocetes (toothed whales) communicate at higher frequencies than the dominant sounds generated by drilling platforms. Sound levels in this range are not likely to be generated by drilling operations (Gales, 1982). The effects on cetaceans from platform noise are expected to be sublethal. It is expected that drilling noise will rarely disturb and affect nonendangered cetaceans.

Explosive platform removals can interfere with communication, disturb behavior, reduce hearing sensitivity, or cause hemorrhaging in cetaceans. It is estimated that, during the peak year, 94 structures will be removed by explosives from the CPA as a result of the proposed action, plus prior and future OCS sales. It is expected that structure removals will cause sublethal effects on cetaceans. No mortalities are expected because of the MMS guidelines for explosive removals (USDOI, MMS, 1990a, Appendix B). It is expected that structure removals will periodically disturb and affect nonendangered cetaceans.

Seismic surveys use airguns to generate pulses. It is assumed that only this method will be used in seismic surveys as a result of the proposed action, plus prior and future OCS sales (Section IV.A.2.). It is expected that effects on cetaceans from seismic surveys are primarily sublethal, constituting short-term avoidance behavior.

Oil spills can adversely affect cetaceans, causing skin and eye irritation, asphyxiation from inhalation of toxic fumes, food reduction or contamination, oil ingestion, and displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from oil spills greater than or equal to 1,000 bbl, the effects would primarily be sublethal; few mortalities are expected. The effects of oil spills less than 1,000 bbl are expected to be solely sublethal due to the small area affected and their rapid dispersion. It is expected that the extent and severity of effects from oil spills of any size will be lessened by improved coastal oil spill contingency planning (Section IV.C.5.) and by active avoidance of oil spills by cetaceans.

Section IV.C.3. estimates the mean number of spills less than 1,000 bbl occurring as a result of the proposed action, plus prior and future OCS sales in the CPA. It is assumed that 24 spills greater than 1 and less than or equal to 50 bbl will occur offshore each year, that a few will occur in each offshore Subarea, and that a few will contact land. It is assumed that one spill greater than 50 and less than 1,000 bbl will occur each year and that it will disperse rapidly. No spills greater than 50 and less than 1,000 bbl are assumed to occur and contact nearshore areas. Although an interaction with spills less than 1,000 bbl is expected, primarily sublethal effects are expected. It is expected that spills greater than 50 and less than 1,000 bbl will periodically contact and affect nonendangered cetaceans.

It is assumed that 44 crude oil spills greater than or equal to 1,000 bbl will occur as a result of import tankering and the proposed action, plus prior and future OCS sales in the Gulf of Mexico (Table IV-7). Table IV-21 identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days areas where cetaceans have been surveyed. There is a 59 percent probability that an oil spill greater than or equal to 1,000 bbl will occur and contact within 10 days cetacean habitats at or beyond the shelf break of the CPA. There is a 28 percent probability that an oil spill greater than or equal to

1,000 bbl will occur and contact within 10 days areas of the Mississippi Delta where cetaceans have been sighted. Although an interaction with spills greater than or equal to 1,000 bbl is expected, infrequent mortalities are expected with primarily sublethal effects. It is assumed that an oil spill greater than or equal to 1,000 bbl will occur and contact within 10 days periodically and affect nonendangered cetaceans in the CPA.

Commercial fishing equipment entangles and drowns cetaceans during routine activities or during accidental "ghost" fishing by lost or discarded gear (Tucker and Associates, Inc., 1990). Although the extent of incidental take and death during "ghost" fishing is largely undocumented, it has been noted as an activity of concern by the NMFS and the Marine Mammal Commission. It is expected that both routine commercial and accidental "ghost" fishing will cause few mortalities of cetaceans. It is expected that commercial fishing equipment will periodically contact and affect nonendangered cetaceans in the CPA.

Nonendangered and nonthreatened cetaceans are captured and removed for public display and research. These activities are concentrated on bottlenose dolphins and not all endeavors are successful. Dolphins occasionally elude capture or escape during acquisition. Catch quotas are set by the NMFS to ensure a sustainable yield, and capture is occasionally banned if populations are considered depleted. It is assumed that bottlenose dolphins will be captured and removed from the CPA. The effects on those dolphins that elude or escape capture are expected to be sublethal. It is expected that live capture and removal will rarely contact and affect nonendangered cetaceans in the CPA.

Epidemic die-offs or mass strandings occur in several species of nonendangered cetaceans. The causes are difficult to diagnose, as has been the case with abnormal bottlenose dolphin mortality in the Gulf in 1989-1990 and along the Atlantic Seaboard in 1988 (USDOC, NMFS, 1990b). Naturally occurring and anthropogenic toxins have been the hypothesized cause. Sources include algal blooms, oil spills, ocean dumping, industrial and municipal effluents, and agricultural runoff. These concentrations are not widespread, and mortalities occur in localized populations. It is expected that toxins will periodically contact and affect nonendangered cetaceans in the CPA.

*Summary*

Activities resulting from the Cumulative scenario have a potential to affect nonendangered cetaceans detrimentally. These cetaceans could be impacted by operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills, commercial fishing, capture and removal, and pathogens. The effects of the majority of these activities are expected to be sublethal. Lethal effects are expected only from oil spills greater than or equal to 1,000 bbl, commercial fishing, and pathogens. Oil spills of any size as a result of import tankering, the proposed action, and prior and future OCS sales are estimated to be infrequent events that will periodically contact nonendangered and nonthreatened cetaceans.

The incremental contribution of the proposed action (as analyzed in Section IV.D.1.a.(5)(a)) to the cumulative impact is inconsequential because the effects of sale-specific operational discharges, helicopter and service-vessel traffic, and seismic activity are expected to be sublethal. No mortalities are expected from explosive platform removal because of MMS guidelines. Lethal effects are expected only from oil spills greater than or equal to 1,000 bbl that will seldom contact nonendangered and nonthreatened cetaceans.

*Conclusion*

The impact of the Cumulative Case scenario on nonendangered and nonthreatened cetaceans within the potentially affected area is expected to result in a decline in species numbers or temporary displacement from their current distribution, a decline or displacement that will last more than one generation.

*Endangered and Threatened Species*

This Cumulative Analysis considers the effects of activities related to the Central Gulf proposed action, prior and future OCS sales, State oil and gas operations, migration, and recreational whale-watching on the blue, sei, humpback, fin, and sperm whale. The sperm whale is the species most seen in the Gulf of Mexico.

The major impact-producing factors are described in the preceding section (Section IV.D.1.d.(5)(a), nonendangered and nonthreatened species). Sections providing supportive material for the endangered cetacean analysis include III.B.3. (description of cetaceans), IV.A.2.a.(1) (seismic operations), IV.A.2.a.(3) (structure removal), IV.A.2.c. (support activities), IV.A.2.d.(5) (offshore discharges), IV.C.3. (oil spills), and IV.C.5. (oil-spill response activities).

An estimated 76.6 MMbbl of drilling muds, 18.2 MMbbl of drill cuttings, and 12.2 Bbbl of produced waters are assumed to be discharged annually as a result of the proposed action, plus prior and future OCS sales (Table IV-7). These effluents are routinely discharged into offshore marine waters and are regulated by the U.S. Environmental Protection Agency's NPDES permits. An unknown but expected substantial amount would also be discharged into nearshore waters from State oil and gas activities. It is expected that endangered cetaceans will periodically interact with these discharges. Direct effects to cetaceans are expected to be sublethal and effects to cetacean food sources are not expected due to the rapid offshore dilution and dispersion of operational discharges. It is expected that operational discharges will periodically contact and affect endangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis, averaging about a million trips a year. The FAA Advisory Circular 91-36C encourages the use of fixed-wing aircraft above an elevation of 152 m and helicopters above 300 m. It is expected that at these elevations no cetaceans will be affected by OCS helicopter traffic. It is expected that helicopter traffic will rarely disturb and affect endangered cetaceans because of special prohibitions and adherence to the general, FAA-recommended minimum ceiling of 300 m.

It is assumed that, during the peak year, 36,000 OCS-related oil/gas service-vessel trips, 2 shuttle tanker trips, and 299 barge traffic trips will occur as a result of the proposed action, plus prior and future OCS sales in the CPA (Table IV-7). Noise from service-vessel traffic may elicit a startle reaction from cetaceans or mask their sound reception. This effect is sublethal, and at worst, of a short-term, temporary nature. Service vessels could collide with and directly impact cetaceans, but due to dolphin maneuverability and echo-location, encounters of this type seldom occur. Cetaceans can avoid service vessels and operators can avoid cetaceans. It is expected that service-vessel traffic will rarely contact and affect endangered cetaceans.

It is assumed that, during the peak year 400, exploration and delineation wells and 235 development wells will be drilled as a result of the proposed action, plus prior and future OCS sales in the CPA (Table IV-7), and will produce sounds at intensities and frequencies that could be heard by cetaceans. It is estimated that noise from drilling activities will last no longer than two months at each location. However, the decibel level of these sounds dissipates to the tolerance of most cetaceans within 15 m of the source. Odontocetes communicate at higher frequencies than the dominant sounds generated by drilling platforms. Sound levels in this range are not likely to be generated by drilling operations (Gales, 1982). The effects on cetaceans from platform noise are expected to be sublethal. It is expected that drilling noise will rarely disturb and affect endangered cetaceans.

Explosive platform removals can interfere with communication, disturb behavior, reduce hearing sensitivity, or cause hemorrhaging in cetaceans. It is estimated, that during the peak year, 94 structures will be removed by explosives from the CPA as a result of the proposed action, plus prior and future OCS sales. It is expected that structure removals will cause sublethal effects on cetaceans. No mortalities are expected because of the MMS guidelines for explosive removals (USDOI, MMS, 1990a, Appendix B). It is expected that structure removals will periodically disturb and affect endangered cetaceans.

Seismic surveys use airguns to generate pulses. It is assumed that only these methods will be used in seismic surveys as a result of the proposed action, plus prior and future OCS sales (Section IV.A.2.). It is expected that effects on cetaceans from seismic surveys are primarily sublethal, constituting short-term avoidance behavior.

Oil spills can adversely affect cetaceans, causing skin and eye irritation, asphyxiation from inhalation of toxic fumes, food reduction or contamination, oil ingestion, and displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from oil spills greater than or equal to 1,000 bbl, the effects would primarily be sublethal; few mortalities are expected. The effects of oil spills less than 1,000 bbl are expected to be solely sublethal due to the small area affected and their rapid dispersion. It is expected that the extent and severity of effects from oil spills of any size will be lessened by improved coastal oil-spill contingency planning (Section IV.C.5.) and by active avoidance of oil spills by cetaceans.

Section IV.C.3. estimates the mean number of spills less than 1,000 bbl occurring as a result of the proposed action, plus prior and future OCS sales in the CPA. It is assumed that 24 spills greater than 1 and less than or equal to 50 bbl will occur each year, that a few will occur in each offshore subarea, and that a few will contact land. It is assumed that one spill greater than 50 and less than 1,000 bbl will occur each year and that it will not occur in each subarea, that it will not contact land, and that it will disperse rapidly. No spills greater than 50 and less than 1,000 bbl are assumed to occur and contact nearshore areas. Although an interaction with spills less than 1,000 bbl is estimated, only sublethal effects are expected. It is expected that spills less than 1,000 bbl will periodically contact and affect endangered cetaceans.

It is assumed that 44 crude oil spills greater than or equal to 1,000 bbl will occur as a result of import tankering and the proposed action, plus prior and future OCS sales in the Gulf of Mexico (Table IV-19). Table IV-21 identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bb occurring and contacting within 10 days areas where cetaceans have been surveyed. There is a 59 percent probability that an oil spill greater than or equal to 1,000 bbl will occur and contact within 10 days cetacean habitats at or beyond the shelf break of the CPA. There is a 28 percent probability that an oil spill greater than or equal to 1,000 bbl will occur and contact within 10 days areas of the Mississippi Delta where cetaceans have been sighted. Although an interaction with spills greater than or equal to 1,000 bbl is estimated, primarily sublethal effects are expected with infrequent mortalities. It is assumed that an oil spill greater than or equal to 1,000 bbl will periodically contact and affect endangered cetaceans in the CPA.

It is assumed that the migratory behavior of the great whales exposes them to potential adverse impacts generated from all Gulf of Mexico and Atlantic OCS planning areas, as well as routine activities and accidental events originating from Central America, North America, Europe, and the Caribbean. The incremental contribution of each impact cannot be determined nor its effect estimated because of the multitude of sources.

Recreational whale-watching is an applicable impact-producing factor only to large cetaceans and great whales. Although whale-watching vessels have the potential to displace or collide with whales, no incidents of this nature have been reported. These activities are not popular in the Gulf; however, it is assumed that they regularly occur on the Eastern Seaboard (Freeman, 1991). It is expected that these activities cause sublethal effects. It is estimated that recreational whale-watching activities rarely contact and affect great whales that migrate to the CPA.

*Summary*

Activities resulting from the Cumulative scenario have a potential to affect endangered and threatened cetaceans detrimentally. These cetaceans could be impacted by operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills, oil-spill response operations, natural and anthropogenic activities contacted during migration, and recreational whale-watching. The effects of the majority of these activities are expected to be sublethal. Lethal effects are expected only from oil spills greater than or equal to 1,000 bbl. Oil spills of any size as a result of import tankering, the proposed action, and prior and future OCS sales are estimated to be infrequent events that will periodically contact endangered cetaceans.

The incremental contribution of the proposed action (as analyzed in Section IV.D.1.a.(5)(a)) to the cumulative impact is inconsequential because the effects of sale-specific operational discharges, helicopter and service-vessel traffic, and seismic activity are expected to be sublethal. No mortalities are expected from explosive platform removal because of MMS guidelines. Lethal effects are expected only from oil spills greater than or equal to 1,000 bbl that will rarely contact endangered and threatened cetaceans.

*Conclusion*

The impact of the Cumulative Case scenario on endangered and threatened cetaceans within the potentially affected area is expected to result in a decline in species numbers or temporary displacement from their current distribution, a decline or displacement that will last more than one generation.

### *(b) Alabama, Choctawhatchee, and Perdido Key Beach Mice*

This Cumulative Analysis considers the effects of impact-producing factors related to the Central Gulf proposed action, prior and future OCS sales, State oil and gas activity, alteration and destruction of habitat, competition, predation, and natural catastrophe on the Alabama, Choctawhatchee, and Perdido Key beach mice.

The effects from the major impact-producing factors are discussed in detail in Section IV.D.1.a.(5)(b) and are described below. Sections providing supportive material for the Alabama, Choctawhatchee, and Perdido Key beach mice analysis include III.A.2. (meteorological conditions), III.B.3.(b) (description of Alabama, Choctawhatchee, and Perdido Key beach mice), IV.B.1.C. (other major coastal/onshore activities), IV.C.3. (oil spills), and IV.C.5. (oil-spill response activities).

Direct contact with spilled oil can cause skin and eye irritation, asphyxiation from inhalation of toxic fumes, food reduction, food contamination, oil ingestion, and displacement from preferred habitat, which is not on the beach, but behind the barrier dunes. An oil spill would have to breach the dunes to reach either the mice or their preferred habitat. This could occur only if an oil spill coincided with a storm surge.

Section IV.C.3. estimates the mean number of coastal spills less than 1,000 bbl occurring as a result of the proposed action, plus prior and future OCS sales in the CPA. It is assumed that one spill greater than one and less than or equal to 50 bbl will occur onshore each year. It is assumed that one spill greater than 50 and less than 1,000 bbl will occur onshore every 10 years. Although an interaction with spills less than 1,000 bbl may occur, only sublethal effects are expected. It is expected that spills will seldom breach barrier dunes and contact or affect beach mice or their habitats.

It is assumed that 44 crude oil spills greater than or equal to 1,000 bbl will occur as a result of import tankering and the proposed action, plus prior and future OCS sales in the Gulf of Mexico (Table IV-20). It is expected that an oil spill greater than or equal to 1,000 bbl could breach beach barriers only if the spill coincided with a storm surge strong enough to lift oil over the foredunes. Table IV-21 identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days coastal areas near beach mice habitats. The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days nearshore areas (coastline) along the Central Gulf is 85 percent. There is a 3 percent probability of an oil spill greater than or equal to 1,000 bbl occurring and contacting within 10 days the coastal areas of the Alabama, Choctawhatchee, and Perdido Key beach mice (Mobile Bay, Perdido Bay seagrass beds, and Escambia County). Although an interaction with spills greater than or equal to 1,000 bbl is estimated, primarily sublethal effects are expected with infrequent mortalities. It is expected that oil spills greater than or equal to 1,000 bbl will rarely contact or affect beach mice or their habitats.

Vehicular traffic associated with oil-spill cleanup activities can degrade preferred habitat and cause displacement from these areas. The home range of the beach mice is within Perdido Key State Preserve (Florida), Grayton Beach State Recreational Area (Florida), St. Andrews State Recreation Area (Florida), Gulf Islands National Seashore (Alabama), and Gulf State Park (Alabama), which receive particular consideration during oil-spill cleanups. Because of the critical designation and general status of those areas, oil-spill contingency plans include special notices to minimize adverse effects from vehicular traffic during cleanup activities and to maximize the protection efforts to prevent contact of these areas with spilled oil (Section IV.C.5.). Vehicular traffic associated with oil-spill cleanup activities is assumed to contact beach mouse habitat in the event of a spill greater than or equal to 1,000 bbl breaching barrier dunes. Table IV-21 indicates that there is a 3 percent probability of an oil spill greater than or equal to 1,000 bbl occurring and contacting within 10 days the coastal areas of Alabama, Choctawhatchee, and Perdido Key beach mice (Mobile Bay, Perdido Bay seagrass beds, and Escambia County). It is expected that vehicular traffic associated with oil-spill cleanup activities rarely contacts or affects beach mice or their habitats.

Non-OCS operations, such as dredge-and-fill activities and natural catastrophes, can cause the loss of Alabama, Choctawhatchee, and Perdido Key beach mice habitats, e.g., barrier islands and nearshore wetland areas. Non-OCS activities, such as predation from both feral and nonferal domestic cats and dogs, and competition by common house mice, directly impact the Alabama, Choctawhatchee, and Perdido Key beach mice.

Dredge-and-fill activities occur throughout the nearshore areas of the United States. They range in scope from propeller dredging by recreational boats to large-scale navigation dredging and fill for land reclamation. Natural catastrophes, including storms, floods, droughts, and hurricanes, can result in substantial damage to Alabama, Choctawhatchee, and Perdido Key beach mice habitats. Sublethal effects on beach mice are expected from these activities. It is expected that dredge-and-fill activities and natural catastrophes will periodically contact and affect beach mice habitats.

Predation by dogs and cats and competition by house mice have a substantial effect on the Alabama, Choctawhatchee, and Perdido Key beach mice. The number of mortalities is unknown, and the nature of the activities causes unreliable estimates. However, these activities are considered the most damaging to Alabama, Choctawhatchee, and Perdido Key beach mice populations in the Gulf of Mexico (USDOI, FWS, 1987). Both mortalities and sublethal effects are expected from these activities. It is expected that predation and competition will periodically contact and affect Alabama, Choctawhatchee, Perdido Key beach mice.

*Summary*

Activities resulting from the Cumulative scenario have a potential to affect Alabama, Choctawhatchee, and Perdido Key beach mice detrimentally. Those activities include oil spills, oil-spill response activities, alteration and destruction of habitat, natural catastrophes, predation, and competition. The effects of the majority of these activities are expected to be sublethal. Lethal effects are expected from oil spills greater than or equal to 1,000 bbl, predation, and competition. Oil spills of any size as a result of import tankering, the proposed action, and prior and future lease sales are expected to be periodic events that will rarely contact beach mice or their habitats. The incremental contribution of the proposed action (as analyzed in Section IV.D.1.a.(5)(b)) to the cumulative impact level is negligible because it is expected that there will be no interaction between oil spills and oil-spill response activities and endangered and threatened Alabama, Choctawhatchee, and Perdido Key beach mice.

*Conclusion*

The impact of the Cumulative Case scenario on Alabama, Choctawhatchee, and Perdido Key beach mice within the potentially affected area is expected to result in a decline in species numbers or temporary displacement from their current distribution, a decline or displacement that will last more than one generation.

### *(6) Impacts on Marine Turtles*

This Cumulative Analysis considers the effects of impact-producing factors related to the Central Gulf proposed action, prior and future OCS sales, State oil and gas activity, migration, dredge-and-fill operations, natural catastrophe, pollution, commercial fishing, hopper dredge operation, recreational boat traffic, and human consumption on the loggerhead, Kemp's ridley, hawksbill, green, and leatherback marine turtles.

The effects from the major impact-producing factors are discussed in detail in Section IV.D.1.a.(6) and are described below. Sections providing supportive material for the marine turtle analysis include III.A.2. (meteorological conditions), III.B.4. (description of marine turtles), IV.A.2.a.(3) (structure removal), IV.A.2.c. (support activities), IV.A.2.d.(5) (offshore discharges), IV.B.1.c. (other major coastal/onshore activities), IV.C.3. (oil spills), and IV.C.5. (oil-spill response activities).

Anchoring, structure installation, pipeline placement, dredging, and operational discharges as a result of the proposed action, plus prior and future OCS sales, may adversely affect marine turtle habitat through destruction of nearshore wetland areas and live-bottom communities. The impact under the Cumulative case scenario from these activities is analyzed in detail in Sections IV.D.1.c.(1)(b) and IV.D.1.c.(2)(a). Sublethal effects on marine turtles or their habitats are expected from these impact-producing factors.

To summarize the effects on wetlands and estuaries, it is expected that 500 ha of coastal areas will be affected by oil spills as a result of the proposed action, prior and future OCS sales, and State oil and gas activities. An estimated dieback of up to 50 ha of wetlands, mainly along the Texas and Louisiana coasts, will occur from contact with spilled oil. Up to 80 ha of wetlands could be eroded as a result of maintenance dredging and deepening of navigation channels in coastal Louisiana. Three new pipeline landfalls will affect a total of 16 ha of wetlands in Jackson County, Mississippi (Pascagoula), and 32 ha of wetlands in the Mobile, Alabama, area. The main cause of wetland and estuary loss within the Gulf of Mexico are sediment deprivation and rapid coastal submergence.

To summarize the effects on nesting beaches, it is expected that minor changes in beach profiles will occur as a result of oil-spill cleanup operations that remove some sand from the littoral zone. Prespill configurations are expected to be reestablished within 2-4 months. Recreational usage of accessible beaches near large population centers, such as in Texas, will result in damage to beach features. The main causes of nesting beach loss within the Gulf of Mexico are the reduction in sediment being delivered to the coastal littoral system, rapid rate of relative sea level rise, and continued coastal urbanization. To summarize the effects on seafloor habitats, little or no damage is expected to the physical integrity, species, diversity, or biological productivity of topographic features. Small areas of 5-10 $m^2$ would be affected for less than two years, probably on the order of four weeks. However, damage is expected to one or more components of physical integrity, species diversity, or biological productivity in the regionally common habitats or the communities of live-bottom areas. Fewer han five live-bottom areas of 5-10 $m^2$ would be affected for 10 years. Offshore operational discharges are not lethal to marine turtles and are diluted and dispersed rapidly within 1 km of the discharge point to the extent that adverse effects to marine turtle food sources do not occur (API, 1989; NRC, 1983). It is expected that effects on marine turtles from anchoring, structure installation, pipeline emplacement, and dredging will be indistinguishable from the long-term (25-50 years) natural variability within populations of marine turtles. It is expected that marine turtles will avoid 5-10 $m^2$ of topographic feature areas for up to a month and that this avoidance of impoverished foraging areas will have no effect on marine turtles. It is expected that marine turtles will avoid 5-10 $m^2$ of live-bottom areas for up to 10 years and that this avoidance of impoverished foraging areas will have no effect on marine turtles. The suspended particulate matter in operational discharges offshore is expected to cause sublethal effects by inhibition of the ability of marine turtles to locate their prey visually within 1 km of the discharge point for the short time period (less than one hour) spent traversing the plume. Based on the aforementioned analyses, the estimate is that anchoring, structure installation, pipeline placement, dredging, and operational discharges will periodically contact marine turtles or their habitats.

Marine turtles can become entangled in or ingest trash and debris, which may result in injury or mortality. It is assumed that some OCS-related trash and debris will be accidentally lost into the Gulf and available for interaction with marine turtles. Although mortalities could occur, primarily sublethal effects are expected. It is further expected that OCS oil- and gas-related trash and debris will rarely interact with and affect marine turtles.

Explosive platform removals can cause capillary damage, disorientation, and loss of motor control, and fatal injuries in marine turtles. It is estimated that, during the peak year, 94 structures will be removed by using explosives from the CPA as a result of the proposed action, plus prior and future OCS sales (Table IV-7). It is assumed that some of the platform removals will occur beyond the continental shelf. As benthic feeders, Gulf of Mexico hard-shell marine turtles do not use habitats beyond the shelf break. Although the pelagic life stages of all marine turtles use these habitats, there is no correlation between marine turtles and the presence of offshore structures beyond the shelf break. It is expected that structure removals will cause sublethal effects on marine turtles. No mortalities are expected because of the MMS guidelines for explosive removals (USDOI, MMS, 1990a, Appendix B) and because removals occur away from preferred offshore habitats. It is expected that structure removals will rarely disturb and affect marine turtles.

It is assumed that, during the peak year of the proposed action, 36,000 OCS-related oil and gas service-vessel trips, 2 shuttle tanker trips, and 299 barge trips will occur in the CPA as a result of the proposed action, plus prior and future OCS sales (Table IV-7). Noise from service-vessel traffic may elicit a startle reaction from marine turtles. This effect is sublethal and, at worst, of a short-term, temporary nature (NRC, 1990). Collision between service vessels and surfaced marine turtles would likely cause fatal injuries. It is assumed that service-vessel traffic and marine turtles will infrequently be in close proximity. Although a low percentage of stranded marine turtles have shown indications of vessel collision, it cannot be determined what types of vessel were involved and whether these injuries occurred before or after death. Marine turtles are known to spend less than 5 percent of their time at the surface and to sound when large vessels approach. In addition, marine vessel operators can avoid marine turtles. It is expected that service-vessel traffic will rarely contact and affect marine turtles.

Oil spills and oil-spill response activities can adversely affect marine turtles by toxic external contact, toxic ingestion or blockage of the digestive tract, asphyxiation, entrapment in tar or oil slicks, habitat destruction, and displacement from preferred habitats. Oil-spill response activities, such as vehicular and vessel traffic, are assumed to contact marine turtle habitat, such as shallow areas of turtle grass beds and live-bottom communities, in the event of contact with an oil spill greater than or equal to 1,000 bbl. Sublethal effects are expected due to the particular consideration these areas receive during oil-spill cleanup to minimize adverse effects from traffic during cleanup activities and to maximize protection efforts to prevent contact of these areas with spilled oil. It is expected that oil-spill response activities will rarely contact and affect marine turtle habitat.

In the event that oiling of marine turtles should occur from oil spills greater than or equal to 1,000 bbl, the effects would primarily be sublethal; few mortalities are expected. The effects of oil spills less than 1,000 bbl are expected to be solely sublethal due to the small area affected and their rapid dispersion. It is expected that the extent and severity of effects from oil spills of any size will be lessened by improved coastal oil-spill contingency planning (Section IV.C.5.).

Section IV.C.3. estimates the mean number of spills less than 1,000 bbl occurring as a result of the proposed action, plus prior and future OCS sales in the CPA. It is assumed that 24 spills greater than 1 and less than or equal to 50 bbl will occur offshore each year, that a few will occur in each offshore subarea, and that a few will contact land. It is assumed that 1 spill greater than 50 and less than 1,000 bbl will occur each year, that they will not occur in each subarea, that they will not contact land, and that they will disperse rapidly. Although an interaction with small spills is estimated, only sublethal effects are expected. It is assumed that small spills will periodically contact and affect marine turtles.

It is assumed that 44 crude oil spills greater than or equal to 1,000 bbl will occur as a result of import tankering and the proposed action, plus prior and future OCS sales in the Gulf of Mexico (Table IV-19). Section IV.C.3. identifies the estimated risk of one or more oil spills greater than 1,000 bbl occurring and contacting marine turtle habitat. There is a 54 percent probability that an oil spill greater than or equal to 1,000 bbl will occur and contact within 10 days marine turtle habitats in nearshore areas of the CPA (Plaquemines Parish). There is a 96 percent probability that an oil spill greater than or equal to 1,000 bbl will occur and contact within 10 days pelagic turtle habitat beyond the shelf break of the CPA. Although an interaction with spills greater than or equal to 1,000 bbl is estimated, primarily sublethal effects are expected with infrequent mortalities. It is expected that an oil spill greater than or equal to 1,000 bbl will occur and contact periodically and affect nonendangered cetaceans in the CPA.

Non-OCS operations, such as dredge-and-fill activities, pollution, and natural catastrophes, can cause the loss of marine turtle habitats, e.g., nesting beaches, nearshore wetland areas, and live-bottom communities. Non-OCS operations such as commercial fishing, hopper dredge activities, nearshore boat traffic, human consumption, and loss of anthropogenic debris directly impact marine turtles. Dredge-and-fill activities occur throughout the nearshore areas of the United States and range in scope from propeller dredging by recreational boats to large-scale navigation dredging and fill for land reclamation. Pollution resulting in loss of turtle grass beds includes the alteration of salinity, as in Florida Bay, as well as man-induced increases in turbidity, witnessed in Tampa Bay. Disturbances to nesting beaches occur from a variety of sources, including construction, vehicle traffic, and deprivation of sand. Natural catastrophes, including storms, floods, droughts, and hurricanes, can result in substantial damage to sea turtle habitat. Sublethal effects on marine turtles are expected from these activities. It is expected that dredge-and-fill activities, pollution, and natural catastrophes will periodically contact and affect marine turtle habitats.

Drowning that results from forced submergence in commercial fish trawls has a substantial effect on marine turtle populations in the Gulf of Mexico. Shrimp trawling in the southeastern United States has received extensive scrutiny because of its incidental turtle catch. The National Research Council (1990) has identified shrimp trawling as the greatest cause of human-induced mortality in marine turtles. The use of turtle excluder devices is legislatively mandated in order to decrease losses. Dismemberment of turtles by hopper dredging has resulted in turtle mortalities. Specific dredging projects include the Canaveral Ship Channel in Florida, the King's Bay Submarine Channel in Georgia, and channel dredging of ports throughout the Gulf. Data from the Sea Turtle Stranding Network indicate a large number of marine turtles are hit by boats. In the Eastern Gulf, the incidence of stranded marine turtles exhibiting indications of vessel collision has been related to the volume of recreational boat traffic. However, the number of mortalities caused by collisions is unknown. The human consumption of turtle eggs, meat, or by-products occurs worldwide (Mack and Duplaix, 1979; Cato et al., 1978). Human use is probably substantial, but the frequently illegal nature of the activity suggests unreliable estimates of mortality. In addition to the incremental amount of trash and debris generated by the proposed action, plus prior and future OCS sales, trash and debris that could affect marine turtles find their way into the Gulf of Mexico from both commercial and recreational water traffic in the Gulf of Mexico, South and Central America, and North Africa. The volume of marine debris from these sources is unknown (USDOC, NMFS, 1989b; Heneman and the Center for Environmental Education, 1988). Both mortalities and sublethal effects on marine turtles are expected from these activities. It is expected that hopper dredge activities, nearshore boat traffic, human consumption, and loss of anthropogenic debris will periodically contact and affect marine turtles.

It is assumed that the migratory behavior of marine turtles exposes them to potential adverse impacts generated from all Gulf of Mexico and Atlantic OCS planning areas, as well as routine and accidental events originating from Central America, North America, Europe, and the Caribbean. The incremental contribution of each impact cannot be determined, nor its effect estimated, because of the multitude of sources.

*Summary*

Activities resulting from the Cumulative scenario have a potential to affect marine turtles detrimentally. Those activities include anchoring, structure installation, pipeline placement, dredging, operational discharges, vessel traffic, explosive platform removals, oil-spill response operations, oil spills, dredge-and-fill operations, natural catastrophes, pollution, hopper dredge operation, recreational boat traffic, commercial fishing, human consumption, and natural and anthropogenic activities contacted during migration. The effects of the majority of these activities are expected to be sublethal. Lethal effects are expected from oil spills greater than or equal to 1,000 bbl, hopper dredge operation, commercial fishing, and human consumption. Oil spills of any size as a result of import tankering, the proposed action, and prior and future OCS sales are estimated to be infrequent events that will periodically contact endangered cetaceans.

The incremental contribution of the proposed action (as analyzed in Section IV.D.1.a.(6)) to the cumulative impact is inconsequential because the effects of sale-specific anchoring, structure installation, pipeline placement, dredging, operational discharges, service-vessel traffic, and trash and debris are expected to be sublethal. No mortalities are expected from explosive platform removal because of MMS guidelines. Lethal effects are expected only from oil spills greater than or equal to 1,000 bbl and that will rarely contact endangered and threatened turtles.

*Conclusion*

The impact of the Cumulative Case scenario on marine turtles within the potentially affected area is expected to result in a decline in species numbers or a temporary displacement from their current distribution, a decline or displacement that will last more than one generation.

### *(7) Impacts on Coastal and Marine Birds*

### *(a) Nonendangered and Nonthreatened Species*

The Gulf of Mexico is populated by migrant and nonmigrant species of coastal and marine birds. This broad category consists of four main groups: seabirds, waterfowl, wading birds, and shorebirds.

This Cumulative Analysis considers the status of populations and migratory habits of coastal and marine birds, and the effects of impact-producing factors related to the proposed action; plus those related to prior and future OCS sales; State oil and gas activity; crude oil imports by tanker; and other commercial, military, recreational offshore, and coastal activities that may occur and adversely affect those populations. Specific types of impact-producing factors considered in the analysis include habitat loss and degradation, oil spills, vessel traffic, pipeline landfalls and coastal construction, fishing gear, and plastic debris.

See Section III.B.5.a. for a detailed discussion of coastal and marine birds in the Gulf of Mexico. The four major types of coastal and marine birds have experienced decreases in population (National Geographic Society, 1983a; Spendelow and Patton, 1988).

Nonmigrant populations of coastal birds that nest in the CPA are believed to be in decline due to habitat loss from channelization, river control, and subsidence of wetlands (Section III.B.1.b.) (National Geographic Society, 1983a; Turner and Cahoon, 1987; Spendelow and Patton, 1988). Overwintering migrant waterfowl in the CPA are believed to be in decline due to loss and degradation of their nesting habitat in the north-central United States and south-central Canada from encroaching agriculture and drought (Ducks Unlimited, 1989). Should habitat loss cease, the population will return to its pre-impact level within one to two generations. However, the assumed continual loss of crucial habitat will have a deleterious impact on coastal and marine birds during several or all lifestages of migratory and resident species, respectively.

Many coastal and marine bird populations in the Gulf of Mexico are overwintering migrants or migrants passing through to wintering grounds outside the country. Waterfowl journey to Gulf feeding grounds using specific flight corridors that run the length of the continental U.S. These corridors terminate in distinct localities along the Gulf Coast. Some waterfowl exhibit a limited degree of coastal movement within their terminal locality, but do not cross planning areas (Bellrose, 1968).

Resident wading bird populations are augmented during the winter by migrants from as far away as southern Canada. The Mississippi Delta divides migrating wading birds into distinct east-west groups in the Gulf. Migrating adults of each group terminate and remain in distinct localities along the Gulf Coast, while juveniles usually continue migration outside the country. Migration by Eastern Gulf juveniles begins in southern Florida and terminates in the Caribbean or on the Yucatan Peninsula. Juvenile migration in the Western Gulf begins and continues southwestward along the Gulf Coast, terminating in Mexico and Central America (Byrd, 1978; Ogden, 1978; Ryder, 1978).

Resident shorebird and seabird populations are augmented during the winter by migrants from as far away as the North American Arctic Circle. Some species overwinter in discrete localities within a single planning area of the Gulf of Mexico Region, while other species are split into distinct groups east or west of the Mississippi Delta. A few species of shorebirds and seabirds may continue migration. Those in the Western Gulf continue along the coast into Mexico and Central America. Those in the Eastern Gulf continue to the Caribbean. Those that remain on the Western or Eastern Gulf Coast exhibit a limited degree of coastal movement within their terminal locality, but do not cross planning areas (Clapp, 1982a and b; Fritts et al., 1983).

Discernible effects to regional populations or subpopulations of these migrating coastal and marine birds as a result of OCS oil and gas activities are not expected because these species have a large areal distribution and do not migrate through more than one planning area.

Section IV.C.3. estimates the mean number of offshore spills less than 1,000 bbl occurring as a result of the proposed action, plus prior and future OCS sales in the CPA. Twenty-four offshore spills and 1 onshore spill greater than 1 and less than 50 bbl are assumed to occur each year; a few offshore spills will contact the coastline. It is assumed that 1 offshore spill per year and 1 onshore spill every 5 years greater than 50 and less than 1,000 bbl will occur; none of the offshore spills will contact the coastline. For the purpose of this analysis, it is estimated that spills greater than 50 and less than 1,000 bbl will seldom contact and affect coastal and marine birds.

It is assumed that 44 crude oil spills greater than or equal to 1,000 bbl will occur in the CPA for the Cumulative scenario (Section IV.C.3.)--3 from platforms, 4 from pipelines, and 37 from foreign oil imports. Section IV.C.3. identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl resulting from the proposed action, prior and future OCS leasing, and import and OCS shuttle tankering occurring and contacting, within 10 days, the Gulf of Mexico coastline at 73 percent for imports and 85 percent for the OCS.

In the CPA, OCS spills have the highest probability of occurring and contacting within 10 days Plaquemines and Terrebonne Parishes, Louisiana (Table IV-21). Imported oil in the CPA has the highest probability of contacting the coast in Plaquemines Parish.

For purposes of this analysis, it is estimated that oil spills greater than or equal to 1,000 bbl will often contact and affect Central Gulf inshore habitats or the coastline. Therefore, this analysis estimates noticeable interaction between coastal and marine birds and oil spills.

The OCS-related helicopter traffic could disturb feeding, resting, or breeding/nesting behavior of birds, or cause abandonment of preferred habitat. This impact-producing factor could contribute to population losses by displacement of birds to areas where they may experience increased environmental or physiological stress. It is assumed that air traffic will adhere to the FAA Advisory Circular 91-36C, which prohibits flights below 300 m over national wildlife refuges and national park lands. At this elevation, birds will not be disturbed.

Disturbance from vessel traffic in the vicinity of bird feeding and breeding habitats in the CPA will increase very little above current levels as a result of OCS-related oil and gas activities. Table IV-7 describes the total and peak-year traffic for service vessels, shuttle tankers, and barges. For the purpose of this analysis, it is expected that OCS oil and gas traffic will seldom affect coastal and marine bird feeding and breeding habitats.

The frequency and severity of cumulative impacts will moderately increase as a result of OCS-related onshore construction of 3 pipeline landfalls, 48 km of onshore pipeline, 1 marine terminal, and 2 gas processing plants (Table IV-12). An unknown but substantial amount of coastal construction is possible due to further urbanization. Coastal development falls under the jurisdiction of individual states.

Entanglement in commercial and recreational fishing gear and plastic debris causes injuries and death of birds. Coastal storms and hurricanes cause flooding and destruction of nesting areas, resulting in coastal and marine bird losses. High levels of oil and organic chemical contamination in the river runoff into the northern Gulf of Mexico could cause direct mortality or indirect food loss to avian species. Collision with power lines and supporting towers causes additional bird mortality (Avery et al., 1980).

*Summary*

Habitat loss results in the decline of populations of coastal and marine birds. In the Central Gulf coastal zone, habitat loss of nonmigrating birds occurs from channelization, river control, and subsidence of wetlands. In the north-central United States and south-central Canada, habitat loss of migrating birds occurs from encroaching agriculture and drought.

The OCS-related helicopter and service-vessel traffic results in displacement of birds from feeding and breeding habitats. At worst, the effect of vessel or air traffic during any time of year is of a very short-term nature. The FAA Advisory Circular 91-36C regulates flight elevation to no lower than 300 m during the time of year of greatest concentration of coastal and marine birds (mid-October to mid-April).

Pipeline landfalls and coastal facility construction possibly result in desertion of birds from feeding and breeding habitats. Entanglement or ingestion of commercial and recreational fishing plastic debris may injure or kill coastal and marine birds.

Oil spills pose the greatest threat to coastal and marine birds by direct oiling, food source contamination, or breeding habitat pollution. It is assumed that 44 oil spills greater than or equal to 1,000 bbl will occur as a result of the OCS program and import tankering. The highest estimated probability of oiling, contamination, or pollution involving coastal and marine birds is 98 percent.

The incremental contribution of the proposed action (as analyzed in Section IV.D.1.a.(7)(a)) to the cumulative impact is negligible because the effects of sale-specific helicopter and service-vessel traffic and trash and debris are expected to be sublethal. No sale-specific pipeline landfalls and coastal facility construction are expected to occur or to interact with coastal and marine birds. The effect is expected to be negligible from sale-related oil spills of any size that will seldom contact nonendangered and nonthreatened coastal and marine birds.

*Conclusion*

The cumulative effect of the above-listed, impact-producing factors on coastal and marine birds within the potentially affected area is expected to result in a discernible decline in a local coastal or marine bird population or species, resulting in a change in distribution or abundance. Recruitment will return the population or affected species to their pre-impact level/condition within one to two generations. It is doubtful that this impact will affect regional populations.

## *(b) Endangered and Threatened Species*

This Cumulative Analysis considers the effects of impact-producing factors related to the Central Gulf proposed action, prior and future OCS sales, State oil and gas operations, migration, and habitat loss and degradation on endangered and threatened birds, including the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover. Specific types of impact-producing factors considered in the analysis include migratory behavior, helicopter and service-vessel traffic, pipeline landfalls and coastal construction, fishing equipment, plastic debris, and land use changes.

The effects from the major impact-producing factors are discussed in detail in Section IV.D.1.a.(7)(b) and are described below. Sections providing supportive material for the endangered and threatened bird analysis include III.B.5.(b) (description of endangered and threatened birds), IV.A.2.c. (support activities), IV.A.2.d.(5) (offshore discharges), IV.A.3.a. (onshore infrastructure, activities, and impacts), IV.C.3. (oil spills), and IV.C.5. (oil-spill response activities).

Endangered birds that nest in the CPA, such as some piping plovers, bald eagles, and brown pelicans, are believed to be in decline due to habitat loss from channelization, river control, and subsidence of wetlands (Section III.B.1.b.) (National Geographic Society, 1983a; Turner and Cahoon, 1987; USDOI, FWS, 1988). Overwintering migrant, endangered birds, such as the Arctic peregrine falcon and some piping plovers, are believed to be in decline due to loss and degradation of their nesting habitat in far northern latitudes of the North American continent (National Geographic Society, 1983a). It is expected that habitat loss will periodically affect endangered birds.

As previously described (Section III.B.5.(b)), some piping plovers and the Arctic peregrine falcons are overwintering migrants and/or migrants passing through to wintering grounds outside the country. These birds use specific flight corridors that run the length of the continental U.S. These corridors terminate in distinct localities along the Gulf Coast. Most piping plovers and Arctic peregrine falcons overwinter in discrete localities within a single planning area of the Gulf of Mexico Region. A few of these endangered birds may continue migration. Those in the Western Gulf continue along the coast into Mexico and Central America. Those in the Eastern Gulf continue to the Caribbean. Those that remain on the Western or Eastern Gulf coast exhibit a limited degree of coastal movement within their terminal locality, but do not cross planning areas (Clapp, 1982a and b; Fritts et al., 1983). Discernible effects to these endangered birds as a result of OCS oil and gas activities are not expected because these species have a large areal distribution and do not migrate through more than one planning area.

It is assumed that helicopter traffic will occur on a regular basis, averaging about a million trips per year. The FAA Advisory Circular 91-36C prohibits the use of fixed-wing aircraft lower than an elevation of 152 m and helicopters lower than 300 m during the period of October 15 through April 15 in the vicinity of numerous national wildlife refuges in the Gulf of Mexico to prevent disturbances to the birds (Biological Opinion - Section 7 Consultation, Proposed Exploration Plans for OCS in the Gulf of Mexico; FWS/OES 375.0). The majority of these wildlife refuges provide important critical habitats (feeding, resting, or nesting areas) for endangered and threatened species. Although interactions may occur and be disruptive, effects are expected to be sublethal and, at worst, of a temporary nature. It is expected that helicopter traffic near critical feeding, resting, or nesting areas will rarely disturb the brown pelican, Arctic peregrine falcon, bald eagle, or piping plover because of special prohibitions and adherence to the general, FAA minimum ceiling of 300 m.

It is assumed, that during the peak year, 36,000 OCS-related oil and gas service-vessel trips, 2 shuttle tanker trips, and 299 barge traffic trips will occur as a result of the proposed action, plus prior and future OCS sales in the CPA (Table IV-7). Most of the OCS-related oil and gas traffic occurs in and out of areas that are well away from critical habitats for feeding, resting, or breeding areas of the Arctic peregrine falcon, bald eagle, or piping plover. Some OCS-related service vessel traffic occurs in the vicinity of Cameron, Intracoastal City, Morgan City, and Venice, Louisiana, within several miles of critical habitats (feeding, resting, or breeding areas) for the brown pelican. Although incidents may occur and be disruptive, effects are expected to be sublethal and, at worst of a temporary nature. It is expected that service-vessel traffic will seldom disturb the brown pelican.

Disturbance of brown pelican and piping plover critical feeding, resting, or breeding habitats from pipeline landfalls and onshore construction could result in a reduction or desertion of birds that use the habitats. It is assumed that three new OCS oil- and gas-related pipeline landfalls and three new coastal facilities will be constructed as a result of the proposed action, plus prior and future OCS sales (Table IV-12). Sublethal effects are expected from these activities. It is expected that pipeline landfalls and onshore construction will infrequently interact with critical feeding, resting, or breeding habitats of the brown pelican, Arctic peregrine falcon, or piping plover.

The brown pelican, Arctic peregrine falcon, bald eagle, and piping plover can become entangled in or ingest trash and debris. Interaction with plastic materials can be especially injurious. 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), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. It is assumed that little trash and debris will be lost into the Gulf of Mexico as a result of the proposed action, plus prior and future OCS sales. However, it is expected that some trash and debris will be lost or discarded into the Gulf from non-OCS commercial and recreational endeavors, which are not as highly regulated. Although interactions may occur, effects are expected to be sublethal. It is expected that the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover will periodically become entangled in or ingest trash and debris.

When an oil spill occurs, many factors interact to delimit the severity of effects and extent of damage to threatened and endangered birds. Determining factors include geographic location, oil type, oil dosage, impact area, oceanographic conditions, meteorological conditions, and season (NRC, 1985; USDOI, MMS, 1987b). The direct effect of oiling on birds occurs through the matting of feathers and subsequent loss of insulation and water-repellency, the ingestion of oil, the depression of egg-laying activity, and the reduction of hatching success (Holmes and Cronshaw, 1977; Ainley et al., 1981; Peakall et al., 1981). Transfer of oil from adults to eggs and young during nesting results in significant mortality for new eggs and deformities in hatchlings from eggs further along in incubation (Clapp et al., 1982a). Indirect effects of oil spills include contamination, displacement, and reduction of food sources. Food contamination may cause less severe, sublethal effects decreasing survival and fecundity, affecting behavior, and decreasing survival of young. Less severe, sublethal effects are defined as those that impair the ability of an organism to function effectively without causing direct mortality (NRC, 1985). In the event that oiling of the brown pelican, Arctic peregrine falcon, bald eagle, or piping plover should occur from oil spills less than 1,000 bbl, the effects would primarily be sublethal; few mortalities are expected. The effects of oil spills less than 1,000 bbl are expected to be solely sublethal due to the small area affected. In the event that oil spills of any size should occur in critical habitats for feeding, resting, or breeding, such as inshore, intertidal, and nearshore areas, sublethal effects are expected. It is expected that the extent and severity of effects from oil spills of any size will be lessened by improved coastal oil spill contingency planning and response, deterrence of birds away from the immediate area of an oil spill, and increased percentage of survival from rehabilitation efforts (Section IV.C.6.).

Section IV.C.3. estimates the mean number of offshore spills less than 1,000 bbl occurring as a result of the proposed action, plus prior and future OCS sales in the CPA. It is assumed that 24 spills greater than 1 and less than or equal to 50 bbl will occur each year, and that a few offshore spills will contact coastal areas. It is assumed that 1 offshore spill per year and 1 onshore spill every 5 years greater than 50 and less than 1,000 bbl will occur. None of the offshore spills will contact coastal areas. Although an interaction with spills less than 1,000 bbl is estimated, only sublethal effects are expected. It is estimated that spills less than 1,000 bbl will periodically contact and affect the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover.

It is assumed that 44 crude oil spills greater than or equal to 1,000 bbl will occur as a result of import tankering and the proposed action, plus prior and future OCS sales in the Gulf of Mexico (Table IV-19). Section IV.C.3. identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days critical habitats for feeding, resting, or breeding of the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover in the CPA. The highest probability of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days a coastal bay in the Central Gulf is 32 percent (Timbalier Bay). The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days deltaic marshes is 49 percent. Although an interaction with spills greater than or equal to 1,000 bbl is expected, primarily sublethal effects are expected with infrequent mortalities. It is assumed that an oil spill greater than or equal to 1,000 bbl will periodically contact and affect the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover in the CPA.

Some critical feeding habitats of the brown pelican, Arctic peregrine falcon, and piping plover occur nearshore. The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days nearshore areas (coastline) along the Central Gulf is 85 percent. Sublethal effects from the spills assumed to occur are expected. It is expected that an oil spill greater than or equal to 1,000 bbl will periodically contact and affect nearshore areas (coastline) critical to the feeding of the brown pelican, Arctic peregrine falcon, and piping plover.

*Summary*

The brown pelican, Arctic peregrine falcon, bald eagle, and piping plover may be impacted by helicopter and service-vessel traffic, onshore pipeline landfalls, entanglement in and ingestion of offshore oil- and gas-related plastic debris, and oil spills. The effects of these activities are expected to be sublethal. Lethal effects are expected only from oil spills greater than or equal to 1,000 bbl. Oil spills of any size are expected to be infrequent events that will periodically contact threatened and endangered birds or their critical feeding, resting, or breeding habitats.

The incremental contribution of the proposed action (as analyzed in Section IV.D.1.a.(7)(b)) to the cumulative impact is inconsequential because the effects of sale-specific helicopter and service-vessel traffic, trash and debris, and onshore pipeline landfalls are expected to be sublethal. Lethal effects are expected only from oil spills greater than or equal to 1,000 bbl that are judged to be extraordinary events that will infrequently contact endangered and threatened coastal and marine birds.

*Conclusion*

The impact of the Cumulative Case scenario on endangered and threatened birds within the potentially affected area is expected to result in a decline in species numbers or a temporary displacement from their current distribution, a decline or displacement that will last more than one generation.

### *(8) Impacts on the Gulf Sturgeon*

This Cumulative Analysis considers the effects of impact-producing factors related to the Central Gulf proposed action, prior and future OCS sales, State oil and gas activity, alteration and destruction of habitat, natural catastrophes, and commercial fishing on the Gulf sturgeon. The Gulf sturgeon ranges in nearshore, inshore, and freshwater from the Atchafalaya River in central Louisiana to the Suwannee River in the Florida panhandle. Gulf sturgeon are thought to spawn in rivers from the Pearl River area in western Mississippi to the Suwannee River in the Florida panhandle.

The effects from the major impact-producing factors are discussed in detail in Section IV.D.1.a.(8) and are described below. Sections providing supportive material for the Gulf sturgeon analysis include III.B.6.(b) (description of Gulf sturgeon), IV.B.4. (other major coastal/onshore activities), and IV.C.3. (oil spills).

The direct effects of spilled oil on Gulf sturgeon occur through the ingestion of oil or oiled prey, the uptake of dissolved petroleum products through the gills and epithelium by adults and juveniles, and through mortality of eggs and decreased survival of larvae. In the event that oiling of Gulf sturgeon adults should occur from oil spills greater than or equal to 1,000 bbl, the effects would primarily be sublethal; few mortalities are expected. The effects of oil spills less than 1,000 bbl are expected to be solely sublethal due to the small area affected and their rapid dispersion. It is expected that the extent and severity of effects from oil spills of any size will be lessened by improved coastal oil spill contingency planning (Section IV.C.5.) and by active avoidance of oil spills by adult sturgeon.

Section IV.C.3. estimates the mean number of spills less than 1,000 bbl occurring as a result of the proposed action, plus prior and future OCS sales in the CPA. It is assumed that 24 offshore spills and 1 onshore spill greater than 1 and less than or equal to 50 bbl will occur each year. Of these spills, it is assumed that a few offshore spills will contact coastal areas. It is assumed that 1 offshore spill per year and 1 onshore spill every 5 years greater than 50 and less than 1,000 bbl will occur each year. None of the offshore spills will contact the coast. Although an interaction with spills less than 50 bbl is expected, only sublethal effects are expected. It is expected that spills less than 1,000 bbl will infrequently contact or affect Gulf sturgeon.

It is assumed that 44 crude oil spills greater than or equal to 1,000 bbl will occur as a result of import tankering and the proposed action, plus prior and future OCS sales in the Gulf of Mexico (Table IV-19). Section IV.C.3. identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days coastal areas near Gulf sturgeon. The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days nearshore areas (coastline) along the Central Gulf is 85 percent. There is a 9 percent probability of one or more oil spill greater than or equal to 1,000 bbl occurring and contacting within 10 days the coastal areas of Gulf sturgeon (St. Mary Parish, Louisiana; Hancock County, Mississippi; Mobile and Baldwin Counties, Alabama; and Escambia County, Florida). Although an interaction with spills greater than or equal to 1,000 bbl is expected, primarily sublethal effects are expected with infrequent mortalities. It is expected that oil spills greater than or equal to 1,000 bbl will seldom contact or affect Gulf sturgeon or their habitats.

Non-OCS operations such as dredge-and-fill activities and natural catastrophes can cause the loss of Gulf sturgeon habitats, e.g., nearshore wetland areas. Non-OCS activities such as commercial fishing directly impact Gulf sturgeon.

Dredge-and-fill activities occur throughout the nearshore areas of the United States. They range in scope from propeller dredging by recreational boats to large-scale navigation dredging and fill for land reclamation. Natural catastrophes, including storms, floods, droughts, and hurricanes, can result in substantial damage to Gulf sturgeon habitats. Sublethal effects on Gulf sturgeon are expected from these activities. It is expected that dredge-and-fill activities and natural catastrophes will periodically contact and affect Gulf sturgeon habitats.

Fishing techniques such as trawling, gill netting, or purse seining, when practiced nonselectively, may reduce the standing stocks of the desired target species as well as significantly impact species other than the target. It is estimated that for every 0.5 kg of shrimp harvested, 4 kg of bycatch, which includes a number of Gulf sturgeon, is discarded (Sports Fishing Institute, 1989). Lethal and sublethal effects are expected from commercial fishing. It is expected that commercial fishing will periodically contact and affect Gulf sturgeon.

*Summary*

Activities resulting from the Cumulative scenario have a potential to cause detrimental effects on the Gulf sturgeon. Those activities include oil spills, alteration and destruction of habitat, natural catastrophes, and commercial fishing. The effects of the majority of these activities are expected to be sublethal. Lethal effects are expected from oil spills greater than or equal to 1,000 bbl and from commercial fishing. Oil spills of any size as a result of import tankering, the proposed action, and prior and future lease sales are expected to be infrequent events that will occasionally contact Gulf sturgeon or their habitats. It is expected that the Gulf sturgeon will experience a decline in species numbers or a temporary displacement from their current distribution, a decline or displacement that will last more than one generation.

The incremental contribution of the proposed action (as analyzed in Section IV.D.1.a.(8)) to the cumulative impacts is small because the effects of sale-specific oil spills less than 1,000 bbl are expected to be sublethal.

It is expected that there will be no interaction between sale-related oil spills greater than or equal to 1,000 bbl and oil-spill response activities and the Gulf sturgeon.

*Conclusion*

The impact of the Cumulative Case scenario on the Gulf sturgeon within the potentially affected area is expected to result in a decline in species numbers or a temporary displacement from their current distribution, a decline or displacement that will last more than one generation.

## *(9) Impacts on Commercial Fisheries*

This Cumulative Analysis considers the status of commercial fishery stocks, the effects of impact-producing factors related to the Central Gulf proposed action, prior and future OCS sales, State oil and gas activity, crude oil imports by tanker, and offshore recreational fishing that may occur and adversely affect the commercial fishing industry in the same general area that may be affected by OCS oil and gas activity located in the CPA. Specific types of impact-producing factors considered in the analysis include commercial fishing techniques or practices, loss of wetlands, structure removal, construction of offshore oil and gas platforms, and OCS-produced-water discharge.

Sections providing supportive material for the commercial fisheries analysis include Sections III.B.6. (description of fish resources), III.C.3. (commercial fishing stocks and activities), IV.A.2.d.(3) (use conflicts), IV.A.2.b.(1) (pipelines), IV.A.2.a.(3) (structure removal), IV.A.2.a.(1) (seismic operations), IV.C.3. (oil spills), IV.A.2.d.(8) (subsurface blowouts), and IV.A.2.d.(5) (offshore discharges).

Competition between large numbers of commercial fishermen, between commercial operations employing different fishing methods, and between commercial and recreational fishermen for a given fishery resource, as well as natural phenomena such as weather, hypoxia, and red tides, may reduce standing populations. Fishing techniques such as trawling, gill netting, or purse seining, when practiced nonselectively, may reduce the standing stocks of the desired target species as well as significantly impact species other than the target. Space-use conflicts can result from different forms of commercial operations and between commercial and recreational fisheries. Finally, hurricanes may impact commercial fisheries by destroying oyster reefs, damaging gear and shore facilities, and changing physical characteristics of inshore and offshore ecosystems. The availability and price of key supplies and services, such as fuel, can also affect commercial fishing operations in the Gulf of Mexico.

The majority of commercial species harvested from the Gulf of Mexico are believed to be in serious decline from overfishing. Continued fishing at the present levels may result in rapid declines in commercial landings and eventual failure of certain fisheries. Commercial landings of traditional fisheries, such as shrimp and red snapper, have declined over the past decade despite increases in fishing effort. Commercial landings of recent fisheries, such as shark, black drum, and tuna, have increased exponentially over the past five years, and those fisheries are thought to be in danger of collapse (Angelovic, written comm., 1989; USDOC, NMFS, 1991a). It is expected that overfishing of targeted species and trawl fishery bycatch will adversely affect commercial fishery resources. The severity of the effects of overfishing on the commercial fishing resources could be prominent, involving a decline in populations of commercial importance that will recover to their former level within two to three generation.

Because approximately 92 percent of commercially important species are estuarine dependent, the degradation of inshore water quality and the loss of Gulf wetlands as nursery areas are considered significant threats to the commercial fishing industry (Angelovic, written comm., 1989; Christmas et al., 1988; USEPA, 1989). Loss of wetland nursery areas in the CPA is believed to be the result of channelization, river control, and subsidence of wetlands (Turner and Cahoon, 1987). It is expected that wetlands loss and water quality degradation will adversely affect commercial fishery resources. The severity of the effects of wetlands loss and water quality degradation on commercial fishing resources could be considerable, involving a decline in a population of commercial importance, in the quality of essential habitats, or in commercial fishing activity that will recover to its former level and/or condition in two to three generations.

Those species of commercial importance that are not estuary dependent, such as mackerel, cobia, and crevalle, are considered coastal pelagics. Populations of these species exhibit some degree of coastal movement. These species range throughout the Gulf, move seasonally, and are more abundant in the CPA during the summer (Gulf of Mexico Fishery Management Council, 1985). In general, the coastal movements of these species are restricted to one or two planning areas within the Gulf of Mexico Region and are not truly migratory, as is the case with salmon. The coastal movements of these species are related to reproductive activity, seasonal changes in water temperature, or other oceanographic conditions. Discernible effects to regional populations or subpopulations of these species as a result of OCS oil and gas activities are not expected, because pelagic species are distributed and spawn over a large geographic area and depth range.

Structure removals result in artificial habitat loss and cause fish kills when explosives are used. Table IV-7 assumes that 1,887 structure removals by explosives will occur in the CPA under the Cumulative scenario during the 35-year life of the proposed action. It is assumed that no more than 94 removals will occur in the CPA during this time in any single year. For the purpose of this analysis, it is estimated that structure removals will have a major effect on Central Gulf fisheries near the removal sites because removals will be routine events. However, only those fish proximate to the removal sites will be killed.

The 340 additional platform complexes resulting from the proposed action, plus prior and future OCS sales in the CPA (Table IV-7), are estimated to reduce trawling area by about 15,126 ha (37,361 ac) during the peak year. This represents an inconsequential amount of the total trawling area in the CPA. It is expected that platform emplacement will infrequently affect trawling activity.

Oil spills that contact coastal bays, estuaries, and waters of the OCS during the time when high concentrations of pelagic eggs and larvae are present have the greatest potential to damage commercial fishery resources.

Section IV.C.3. estimates the mean number of offshore spills less than 1,000 bbl occurring in the CPA. It is assumed that 24 spills greater than 1 and less than or equal to 50 bbl will occur offshore each year. A few offshore spills will contact coastal areas. It is assumed that 1 spill greater than 50 and less than 1,000 bbl will occur each year. However, none of these spills is assumed to contact the coastline or inshore areas during the 35-year life of the proposed action. It is expected that oil spills less than 1,000 bbl will occasionally affect coastal bays and marshes essential to the well-being of the commercial fishery resources in the CPA.

Section IV.C.3. estimates the mean number of spills greater than or equal to 1,000 bbl occurring from cumulative activity in the CPA. It is assumed that 7 crude oil spills greater than or equal to 1,000 bbl from platforms and pipelines and 37 spills from tankers will occur in the Gulf of Mexico over the 35-year life of the proposed action. Section IV.C.3. identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl resulting from cumulative activity (the proposed action, prior and future OCS leasing, import tankering, and OCS shuttle tankering) occurring and contacting, within 10 days, coastal bays and marshes essential to the well-being of commercial fishery resources in the CPA.

The estimated mean number of spills greater than or equal to 1,000 bbl to occur and contact nearshore areas (coastline) in the Cumulative Case in the Gulf is two. The estimated mean number of spills greater than or equal to 1,000 bbl to occur and contact within 10 days deltaic marshes is 1 (Table IV-21). Plaquemines Parish, Louisiana, is the land segment with the highest probability (54% from OCS activities and 21% from imports) of occurrence and contact within 10 days by one or more spills greater than or equal to 1,000 bbl. Barataria Bay is the coastal inshore bay with the highest probability (36% from OCS activities) of occurrence and contact within 10 days by one or more spills greater than or equal to 1,000 bbl. The estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days deltaic marshes is 49 percent from platforms, pipelines, and shuttle tankers.

Oil spills greater than or equal to 1,000 bbl originating in port from the tankering of imported oil include those that may occur and contact bays and estuaries. The highest estimated probability of one or more oil spills greater than or equal to 1,000 bbl originating from tankering of imported oil occurring and contacting within 10 days a Central Gulf bay or estuary is 93 percent (Mississippi River ports). The estimated mean number of spills greater than or equal to 1,000 bbl originating from tankering of imported oil occurring and contacting within 10 days a Central Gulf bay or estuary is two. The highest estimated probability of one or more oil spills greater than or equal to 1,000 bbl originating from tankering of imported oil occurring and contacting within 10 days OCS waters in the CPA is 97 percent (Louisiana Offshore Oil Port [LOOP]). The estimated mean number of spills greater than or equal to 1,000 bbl originating from tankering of imported oil and occurring and contacting within 10 days OCS waters in the CPA from LOOP is 3 (Table IV-21).

It is expected that, as a result of cumulative activity, the interaction of oil spills greater than or equal to 1,000 bbl, either assumed to occur and contact or assumed to occur, with commercial fishery resources in the Central Gulf will have a considerable effect on the commercial fishing industry. It is expected that oil spills will regularly contact and affect Central Gulf coastal bays, estuaries, or coastal areas. As a singular example, the highest estimated probability of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days Gulf menhaden during their winter spawning in coastal waters of the CPA is 26 percent over the next 35 years. Therefore, this analysis expects noticeable interaction of commercial fishery resources with oil spills.

*Summary*

Habitat loss results in the decline of commercial populations, essential habitats, and commercial fishing activity. In the Central Gulf coastal zone, habitat loss occurs from channelization, river control, and subsidence of wetlands.

Overfishing results in rapid declines in commercial populations and landings and in the eventual failure and loss of both traditional and recent fisheries. The majority of commercial species harvested from the Gulf of Mexico is believed at present to be in a seriously depleted condition due to overfishing.

The emplacement of one production platform eliminates approximately 6 ha (15 ac) of commercial trawling space. The 340 additional offshore platform complexes will remove 15,126 ha (37,361 ac) from commercial trawling.

Structure removals result in fish kills in the vicinity of the removals, which represents an inconsequential amount of the total trawling area.

Oil spills pose the greatest threat to the commercial fishing industry by direct contact with eggs, larvae, juveniles, or massed spawning adult finfish or shellfish; by contamination of essential estuarine nursery habitat; or by deterrence of commercial fishing activity. It is assumed that 44 oil spills greater than or equal to 1,000 bbl will occur during the 35-year life of the proposed action. The highest estimated probability of contact and affect, contamination, or deterrence involving commercial fishing resources is 97 percent.

The incremental contribution of the proposed action (as analyzed in Section IV.D.1.a.(9)) to the cumulative impact is inconsequential because the effects of sale-specific underwater OCS obstructions, subsurface blowouts, operational discharges, explosive structure removal, space-use conflict, and seismic surveys are expected to be negligible. Substantial effects are expected only from oil spills greater than or equal to 1,000 bbl that will seldom contact areas essential to commercial fisheries.

*Conclusion*

The cumulative effect on the commercial fishing industry within the potentially affected area is expected to result in a discernible decline in populations of commercial importance, in the quality of essential habitats, or in commercial fishing activity. Recruitment will return any affected population, habitat, or activity to pre-impact level and/or condition within two to three generations.

## *(10) Impacts on Recreational Resources and Activities*

## *(a) Beach Use*

This Cumulative Analysis considers the effects of impact-producing factors related to the proposed action (Section IV.D.1.a.(10)(a)), plus those related to prior and future OCS sales, State offshore oil and gas activity, tankering of crude oil imports, merchant shipping, commercial and recreational fishing, defense operations, recreational use of beaches, and other offshore and coastal activity that results in debris, litter, trash, and pollution, which may occur and adversely affect major recreational beaches. Specific impact-producing factors analyzed include oil spills, trash and debris, and platforms and drilling rigs. Other factors such as land development, civil works projects, and natural phenomena have affected, and will continue to affect, beach stabilization (Section IV.D.1.a.(1)(a)); ultimately, these factors may also affect the recreational use of beaches.

One or two 10-day-old oil spills of 1,000 bbl or greater (Table IV-21), and a few spills each year of the size class greater than 1 and less than or equal to 50 bbl are assumed to occur and contact land as a result of Federal OCS activity and crude-oil import tankering (Section IV.C.4.). Such spill contacts will occur between 1993 and 2027 and, according to the OSRA model (Table IV-21), are most likely to affect major recreational beaches in Texas (Galveston/Bolivar Peninsula) and Louisiana (Cameron beaches). Spills greater than or equal to 1,000 bbl (Section IV.C.1) are expected to result in short-term disturbances, causing temporary loss or displacement of water-related, nearshore recreational activity on specific beaches directly or indirectly impacted. Furthermore, over the next 35 years 16 spills 1,000 bbl or greater (Table IV-19) involving tankers carrying imported petroleum liquids could adversely impact beaches in the vicinity of major inshore Gulf of Mexico ports from Mobile to Corpus Christi. It is important to realize, especially in the cumulative impact context, that of all chronic hydrocarbon pollution existing in the Gulf, less than 1 percent is directly related to Gulf of Mexico oil and gas leasing and production (Section IV.C.4.). In terms of effects, chronic natural and human-induced hydrocarbon pollution can manifest itself on beaches as tarballs, which would adversely impact beach users, recreational developments, and personal property. Current tar ball occurrence on the CPA recreational beaches is believed to be derived from sources other than leasing and production in the Gulf of Mexico.

Continued and expanded oil and gas operations in the CPA have contributed to the already serious problem of debris and trash on coastal beaches. Trash and debris detract from the aesthetic quality of beaches, can be hazardous to beach recreational activity, and can increase the cost of beach maintenance programs. Other factors such as merchant shipping, naval operations, offshore commercial and recreational fishing, natural phenomena, recreational use of beaches, State oil and gas activity, tankering, pipelines, operational discharges, condominiums, coastal activity in Mexico and Cuba, and other offshore and coastal activities contribute to flotsam, jetsam, pollution, and litter existing on the major Gulf of Mexico recreational beaches. Trash and debris are a recognized problem affecting enjoyment and maintenance of recreational beaches in the CPA. It has been estimated that OCS oil and gas operations are contributing 10-12 percent of the trash and debris affecting Texas and Louisiana recreational beaches (USEPA, 1990; Parker, personal comm., 1990).

Reports by Lindstedt and Holmes (1988) and the Center for Marine Conservation (1989) indicate Gulf of Mexico beaches from Texas to Mississippi are among the country's most littered shorelines. The reports provide insight into the magnitude and composition of the cumulative trash loads affecting CPA coastal beaches. Items known to be associated with the oil and gas industry have been frequently identified with the beach litter removed from Louisiana and Texas beaches; however, the percentage of the litter attributed to the petroleum industry has noticeably declined in the past few years (Amos, 1991). Regulatory, administrative, and volunteer programs involving government; industry; environmental, school, and civic groups; and private citizens are monitoring and reducing the gravity of the beach litter problem Gulfwide.

There are currently 3,422 platforms on the OCS in the CPA (Table IV-7), and an additional 340 will likely be added from previous sales, this proposal, and future sales over the next 35 years. A total of 169 of these platform complexes are projected for coastal Subareas C-1 and C-3. Those platforms and predevelopment drilling rigs operating in the first three tiers of Federal lease tracts within 3-10 mi of recreational beaches will be visible to beach users during good weather conditions. Vessel and helicopter traffic servicing these operations and those farther offshore will from time to time be seen and heard by beach users. Existing and future oil and gas developments in State waters can exacerbate these aesthetic impacts or render them less onerous. Aesthetic impacts are unlikely to affect the level of beach recreational use in the Gulf Region, but may affect the sensibilities of some beach users, especially those enjoying beach wilderness areas such as Gulf Island National Wilderness Area.

*Summary*

For purposes of this analysis, one or two oil spills 1,000 bbl or greater estimated to preclude short-term recreational use of some Louisiana or Texas beaches at the park or community levels are expected in the next 35 years. However, smaller annual spills throughout the planning area are estimated to preclude short-term use of the small segments of recreational beaches adversely impacted, but will have little effect on local recreational use or tourism. Frequent impacts from man-induced debris and litter derived from both offshore and onshore sources are likely to diminish the tourist potential of CPA beaches and to degrade the ambience of shoreline recreational beaches chronically, thereby affecting the enjoyment of recreational beaches throughout the planning area. Platforms and drilling rigs operating nearshore and seaward of coastal beaches may affect the ambience of beach use, especially near beach wilderness areas. However, pollution and debris associated with the proposed sale will contribute minimally to this impact.

A ton or more per mile of trash and debris has been removed from recreational beaches cleaned in the CPA each fall since 1988. The incremental contribution of the proposed action (as analyzed in Section IV.D.1.a.(10)(a)) to the cumulative impact is expected to be minimal because sale-specific operational activities are unlikely to cause significant beach closures or to generate the need for excessive beach maintenance. Oil pollution events impacting recreational beaches will generate immediate cleanup response from lease site operators, and the oil and gas industry has improved offshore waste management practices and made a strong commitment to participate in the removal of trash and litter from recreational beaches throughout the CPA. Furthermore, MARPOL Annex V and the special efforts to generate cooperation and support for reducing marine debris through the Gulf of Mexico Program's Marine Debris Action Plan should lead to a decline in the level of human-generated trash adversely affecting recreational beaches throughout the Gulf.

*Conclusion*

Although trash and accidental oil spills will continue to affect the ambience of recreational beaches between Alabama and Texas, the level of chronic pollution should decline during the life of the proposed action. Beach use at the regional level is unlikely to change; however, closure of specific beaches or parks directly impacted by one or two oil spills greater than or equal to 1,000 bbl is likely during cleanup operations.

### *(b) Marine Fishing*

This Cumulative Analysis considers the effects of impact-producing factors related to the proposed action (Section IV.D.1.a.(10)(b)), plus those related to prior and future OCS sales; State offshore oil and gas activity; tankering of crude oil imports; other marine vessel traffic and port congestion; and other commercial, military, and recreational offshore activities that might affect offshore marine recreational fishing.

Activity related to OCS oil and gas development is projected to add 340 offshore platforms in the CPA over the next 35 years (Table IV-7). Of these, 169 new platform complexes are projected for the coastal Subareas C-1 and C-3. These new platforms will be the most accessible and the most likely to affect offshore fishing, because they function as high profile, *de facto* artificial reefs. These structures would add to the existing 3,422 petroleum structures on the OCS in the CPA and several permitted artificial reefs also in the planning area. Structure removals are expected to outpace installations in the next 5-10 years (Table IV-7). Studies and observations have shown that, where oil and gas structures are accessible, they are significant attractants of offshore fishermen, and they enhance fishing success. Conversely, anthropogenic pollution and activity (oil and chemical spills, competition between commercial and recreational fishermen and among recreational fishermen, coastal modifications brought on by industrial development and population increases in the coastal zone) and inevitable natural forces, such as subsidence, erosion, anoxia, floods, and freezes, will affect short- and long-term sociological and ecological changes that will indirectly stress fishery resources important to marine recreational fishing and could lead to the increase of restrictive regulations affecting fishing enjoyment and participation. Should there be a sustained, declining trend in offshore fishing trips, the recreational fishing support industry is likely to suffer as well.

The 7 offshore oil spills 1,000 bbl or greater (Table IV-19) from platforms, pipelines, and tankers and 10 inshore tanker spills from Mobile to Port Arthur (Table IV-16), estimated to occur over the next 35 years will cause temporary disinterest in recreational fishing within the area of visible oil slicks, but should not affect the level of recreational fishing within the planning area.

Offshore oil and gas activity has had a very high level of impact on recreational fishing in the CPA; and continued oil and gas development as a result of continued Federal and State offshore lease sales is expected to assist in maintaining recreational fishing levels in CPA offshore areas over the next 35 years. Because of the expected increase in the structure removal rate (currently around 80 per year) and greater interest in artificial reef development Gulfwide, more interest in the use of obsolete oil and gas structures as dedicated reefs in the marine environment is likely. The National Fishing Enhancement Act of 1984 and management measures adopted by NMFS through the planning efforts of the Gulf of Mexico Fishery Management Council will also affect the future of offshore fishing in the CPA.

*Summary*

The incremental contribution of the proposed action (as analyzed in Section IV.D.1.a.(10)(b)) to the cumulative impacts is very low because sale-specific activity will generate only 30 new production platforms in the CPA. This represents only 1 percent of the platforms existing in the CPA. Should any of these platforms be placed within 25 mi of shore near major coastal fishing access areas, they will likely attract some fishermen and divers, but normal offshore fishing patterns strongly associated with existing offshore oil and gas structures are unlikely to change until most old structures have been removed and replaced with permitted artificial reefs.

*Conclusion*

Continued offshore oil and gas development over the next 35 years will continue to support, maintain, and facilitate offshore recreational fishing in the CPA and extend the time offshore oil and gas structures are a focus of offshore fishing activity.

### *(11) Impacts on Archaeological Resources*

The following analysis considers not only the effects of the impact-producing factors related to the proposed action, but OCS activities in the Western Gulf, as well as prior and future OCS sales. Specific types of impact-producing factors considered in this analysis include drilling rig and platform emplacement, pipeline emplacement, anchoring, oil spills, dredging, new onshore facilities, and ferromagnetic debris associated with OCS hydrocarbon activities. Included also in this analysis are trawling, sport diving, commercial treasure hunting, and tropical storms.

Continued OCS oil and gas activities will contribute to the cumulative impacts on historic and prehistoric archaeological resources. Some 46,816 exploration and production wells, 4,282 platform installations, and 39,594 km of pipelines are estimated to occur or to have occurred throughout the entire Gulf of Mexico from the proposed action and prior and future OCS sales (Tables IV-7 and IV-8). Bottom disturbance associated with these impact-producing factors will have the potential to impact archaeological sites. Beginning in 1974, archaeological surveys were required prior to development on the OCS. It is assumed in this analysis that the majority of impacts to archaeological resources occurred in association with development prior to 1974.

The placement of drilling rigs and production platforms has the physical potential to impact prehistoric and/or historic archaeological resources. It is assumed that the standard rig will directly disturb 1.5 ha of soft bottom, the average platform 2 ha. Pile driving associated with platform emplacement may also cause sediment liquefaction an unknown distance from the piling. This liquefaction could result in disturbance of stratigraphy in the area of liquefaction.

Pipeline placement has the physical potential to impact prehistoric and/or historic archaeological resources. Those pipelines placed in water depths of less than 61 m (200 ft) must be buried. Burial depths of 1 m (3 ft) are required with the exception of shipping fairways and anchorage areas, where the burial depths are 10 ft and 15 ft, respectively.

The dredging of new channels as well as maintenance dredging of existing channels has the physical potential to impact historic shipwrecks (Espey, Huston, & Associates, 1990) and prehistoric sites. At present, there are 23 navigation channels that provide OCS access to onshore facilities.

Anchoring associated with platform and pipeline emplacement, as well as service vessel and shuttle tanker activities, may also physically impact prehistoric and/or historic archaeological resources. It is assumed that during pipeline emplacement, an array of eight 20,000-lb anchors is continuously repositioned.

Oil spills have the potential to impact both prehistoric and historic archaeological resources. Impacts to historic resources would be limited to visual impacts and, possibly, physical impacts associated with spill cleanup operations. Impacts to prehistoric archaeological sites would be the result of hydrocarbon contamination of organic materials, which have the potential to date site occupation through radiocarbon dating techniques, as well as possible physical disturbance associated with spill cleanup operations.

New onshore facilities have the potential to impact historic and prehistoric sites both directly and indirectly. Direct physical impacts to archaeological sites could occur from construction activity. Indirect impacts could occur by the "capping" of historic sites by pouring concrete slabs or placing structures on top of archaeological sites.

The OCS oil and gas activities will also generate tons of ferromagnetic structures and debris, which will tend to mask magnetic signatures of significant historic archaeological resources. The task of locating historic resources through an archaeological survey is, therefore, made more difficult as a result of leasing activity.

Trawling has the potential to disturb the uppermost portion of the sediment column (Garrison et al., 1989). There is the potential that transient features associated with archaeological sites (i.e., light, easily transported artifacts) could be disturbed by commercial fishing activity.

Sport diving and commercial treasure hunting are significant factors in the loss of historic data from wreck sites. While commercial treasure hunters generally impact wrecks with intrinsic monetary value, sport divers may collect souvenirs from all types of wrecks.

Tropical cyclones have the potential to impact archaeological resources by wave action and currents. Archaeological resources located in shallow water and not protected by sediments could be scattered by wave or current action.

### *(a) Historic*

Future OCS exploration and development activities in the CPA are expected to result in the drilling of 5,890 exploration and delineation wells and 5,130 development wells, the installation of 340 platforms, and the laying of 5,055 km of offshore pipelines (Table IV-7). The archaeological surveys are expected to reduce the potential for an interaction between an impact-producing activity and an historic prehistoric resource by 95 percent in those CPA areas that have a thin Holocene sediment veneer. Archaeological surveys are estimated to be 90 percent effective in those CPA areas that have a thick blanket of unconsolidated Holocene sediments. Archaeological surveys were first required in 1974, and it is therefore assumed that the major impacts to historic resources resulted from development prior to 1974. The potential of an interaction between rig or platform emplacement and an historic shipwreck is greatly diminished by the survey, but still exists. Such an interaction could result in the loss of significant or unique historic information.

The placement of 5,055 km of pipelines in the CPA is projected. According to Table IV-7, there are currently 28,595 km of pipelines on the Central Planning Area OCS. While the archaeological survey minimizes the chances of impacting an historic shipwreck, there remains a possibility that a wreck could be impacted by pipeline emplacement. Such an interaction could result in the loss of significant or unique historic information.

The setting of anchors for drilling rigs, platforms, and pipeline lay barges, and anchoring associated with oil and gas service vessel trips to the OCS have the potential to impact historic wrecks. The archaeological surveys serve to minimize the chance of impacting historic wrecks; however, these surveys are not seen as infallible and the chance of an impact from future activities exists. A total of about 708,000 shuttle tanker, barge, and service vessel trips are projected for the CPA. Impacts from anchoring on an historic shipwreck may have occurred. There is also a potential for future impacts from anchoring on an historic shipwreck. Such an interaction could result in the loss of significant or unique information.

Oil spills have the potential to impact coastal historic sites directly or indirectly by physical impacts caused by oil spill cleanup operations. According to Table IV-21 there is up to a 85 percent probability of an oil spill greater than or equal to 1,000 bbl occurring and contacting the CPA coastal area within 10 days. There is up to a 73 percent probability that an imported oil spill greater than or equal to 1,000 bbl will occur and contact the CPA coastal area within 10 days. However, the impacts caused by oil spills to coastal historic archaeological resources are generally short term and reversible.

Most channel dredging occurs at the entrances to bays, harbors, and ports. These areas have a high probability for historic shipwrecks, and the greatest concentrations of historic wrecks are likely associated with these features (Garrison et al., 1989). It is reasonable to assume that significant or unique historic archaeological information has been lost as a result of past channel dredging activity. In many areas, the COE requires remote-sensing surveys prior to dredging activities to minimize such impacts (Espey, Huston, & Associates, 1990).

Past, present, and future OCS oil and gas exploration and development will result in the deposition of several tens of thousands of tons of ferromagnetic debris on the seafloor. This modern marine debris will tend to mask the magnetic signatures of historic shipwrecks, particularly in areas that were developed prior to requiring archaeological surveys in the CPA (offshore Subareas C-1, C-2, and C-3). Such masking of the signatures characteristic of historic shipwrecks may have resulted or may yet result in OCS activities impacting a shipwreck containing significant or unique historic information.

Trawling activity in the CPA would only affect the uppermost portions of the sediment column (Garrison et al., 1989). On many wrecks, this zone would already be disturbed by natural factors and would contain only artifacts of low specific gravity that have lost all original context.

According to Table IV-12, 2 gas processing plants requiring 40-60 ha of land will be constructed in coastal Subarea C-4. In addition, 1 terminal requiring 7-24 ha, 2 separation facilities requiring 6 ha per 100,000 bbl oil equivalents processed, 3 pipeline landfalls, and 48 km of onshore pipelines will be necessary to support total Central Planning Area OCS program activities. All of the above onshore facilities are expected to occur within coastal Subarea C-4. Investigations prior to construction can determine if historic archaeological resources exist at the sites.

Because MMS does not have jurisdiction over pipelines in State waters, the archaeological resource protection requirements of the National Historic Preservation Act (NHPA) are not within MMS's jurisdiction. However, other Federal agencies, such as the COE, which lets permits associated with pipelines in State waters, are responsible for the protection of archaeological resources under the NHPA. Therefore, the impacts that might occur to archaeological resources by pipeline construction within State waters should be mitigated under the requirements of the NHPA.

Sport diving and commercial treasure hunting are significant factors in the loss of historic data from wreck sites. While commercial treasure hunters generally impact wrecks with intrinsic monetary value, sport divers may collect souvenirs from all types of wrecks. Since the extent of these activities is unknown, the impact cannot be quantified. However, assuming that any of the data lost have been unique, the impact would be very high.

About half of the coast along the Central Gulf was hit with 16-20 tropical cyclones between the years 1901 and 1955 (DeWald, 1982). The other half, from Atchafalaya Bay in Louisiana to Texas, had a slightly lower incidence of cyclones (11-15). Shipwrecks in shallow waters are exposed to a greatly intensified longshore current during tropical storms (Clausen and Arnold, 1975). Under such conditions, it is highly likely that artifacts of low specific gravities (e.g. ceramics and glass) would be dispersed. Some of the original information contained in the site would be lost in this process, but a significant amount of information would also remain. Overall, a significant loss of data from historic sites has probably occurred, and will continue to occur, in the Central Gulf from the effects of tropical storms. Some of the data lost have most likely been significant or unique.

*Summary*

Several impact-producing factors may threaten historic archaeological resources of the Central Gulf. An impact could result from a contact between an OCS activity (pipeline and platform installations, drilling rig emplacement and operation, dredging, and anchoring activities) and an historic shipwreck located on the continental shelf. The archaeological surveys and resulting archaeological analysis and clearance that are required prior to an operator beginning oil and gas activities in a lease block are estimated to be 90 percent effective at identifying possible historic shipwrecks in areas of the CPA with a high probability for the existence of historic period shipwrecks and a thick blanket of unconsolidated sediments (offshore Subareas C-1, C-2, and C-3). Development of the CPA prior to requiring archaeological surveys has possibly impacted wrecks containing significant or unique historic information.

The loss of several tens of thousands of tons of ferromagnetic debris associated with oil and gas exploration and development could result in the masking of historic shipwrecks. It is expected that dredging, sport diving, commercial treasure hunting, and tropical storms have impacted and will continue to impact historic period shipwrecks. Such impact will likely result in the loss of significant or unique archaeological information.

Onshore development as a result of the proposed action, could result in the direct physical contact between an historic site and new facility construction and pipeline trenching. It is assumed that archaeological investigations prior to construction will serve to mitigate these potential impacts. While the likelihood of an oil spill occurring and contacting the CPA coastline is high, expected effects on historic coastal resources are temporary and reversible. Loss of significant or unique historic archaeological information from commercial fisheries (trawling) is not expected.

The effects of the various impact-producing factors discussed in this analysis have likely resulted in the loss of significant or unique historic archaeological information. In the case of factors related to OCS program activities, it is reasonable to assume that most impacts would have occurred prior to 1974 (the date of initial archaeological survey and clearance requirements). The incremental contribution of the proposed action is expected to be very small due to the efficacy of the required remote-sensing survey and archaeological report. However, there is a possibility of an interaction between bottom-disturbing activity (rig emplacement, pipeline trenching, and anchoring) and an historic shipwreck.

*Conclusion*

The total of OCS program and non-program related impact-producing factors has likely resulted and may yet result in loss of significant or unique historic archaeological information.

### *(b) Prehistoric*

Future OCS exploration and development activities in the CPA are expected to result in the drilling of 5,890 exploration and delineation wells and 5,130 development wells, the installation of 340 platforms, and the laying of 5,055 km of offshore pipelines (Table IV-7). The archaeological surveys are expected to reduce the potential for an interaction between an impact-producing activity and a prehistoric resource by 90 percent. Because archaeological surveys were first required in 1974, it is assumed that the major impacts to historic resources resulted from development prior to 1974. The potential of an interaction between rig or platform emplacement and a prehistoric site is diminished by the survey, but still exists. Such an interaction could result in the loss of significant or unique prehistoric information.

The placement of 5,055 km of pipelines in the CPA is projected. According to Table IV-7, there are currently 28,595 km of pipelines on the Central Planning Area OCS. While the archaeological survey minimizes the chances of impacting a prehistoric site, there remains a possibility that a site could be impacted by pipeline emplacement. Such an interaction could result in the loss of significant or unique archaeological information.

The setting of anchors for drilling rigs, platforms, and pipeline lay barges, and anchoring associated with oil and gas vessel trips to the OCS have the potential to impact shallow, emplaced prehistoric sites. The archaeological surveys minimize the chance of impacting these sites; however, these surveys are not seen as infallible and the chance of an impact from future activities exists. A total of about 708,000 shuttle tanker, barge, and service vessel trips are projected for the CPA (Table IV-12). Impacts from anchoring on a prehistoric shipwreck may have occurred. Such an interaction could result in the loss of significant or unique archaeological information.

Oil spills have the potential to impact coastal prehistoric sites directly, or indirectly by physical impacts caused by oil spill cleanup operations. According to Table IV-21 there is up to a 85 percent probability of an oil spill greater than or equal to 1,000 bbl occurring and contacting the CPA coastal area within 10 days. There is up to a 73 percent probability that an oil spill greater than or equal to 1,000 bbl will occur and contact the CPA coastal area within 10 days. The impacts caused by oil spills to coastal prehistoric archaeological resources can severely distort information relating to the age of the site. Contamination of the site organics by modern hydrocarbons can render dating by C-14 methods useless. This loss might be ameliorated by artifact seriation or other relative dating techniques. Coastal prehistoric sites might also suffer direct impact from beach cleanup operations. Interaction between oil-spill cleanup equipment and a site could destroy fragile artifacts or disturb site context, possibly resulting in the loss of information on the prehistory of North America and the Gulf Coast Region. Some coastal sites may contain significant or unique information.

Most channel dredging occurs at the entrances to bays, harbors, and ports. Bay and river margins have a high probability for the occurrence and preservation of prehistoric sites. Prior channel dredging has disturbed buried and/or inundated prehistoric archaeological sites in the coastal plain of the Gulf of Mexico. It is assumed that some of the sites or site information were unique or significant. In many areas, the COE requires surveys prior to dredging activities to minimize such impacts.

Trawling activity in the CPA would only affect the uppermost portion of the sediment column (Garrison et al., 1989). This zone would already be disturbed by natural factors, and site context to this depth would presumably be disturbed. Therefore, the effect of trawling on prehistoric sites would be very low.

According to Table IV-12, 2 gas processing plants requiring 40 ha to 60 ha of land will be constructed in coastal Subarea C-4. In addition, 1 terminal requiring 7 ha to 24 ha, 2 separation facilities requiring 6 ha per 100,000 bbl oil equivalents processed, 3 pipeline landfalls, and 48 km of onshore pipelines will be necessary to support total Central Planning Area OCS program activities. All of the above onshore facilities are expected to occur within coastal subarea C-4.

Because MMS does not have jurisdiction over pipelines in State waters, the archaeological resource protection requirements of the NHPA are not within MMS's jurisdiction. However, other Federal agencies, such as the COE, which lets permits associated with pipelines in State waters, are responsible for the protection of archaeological resources under the NHPA. Therefore, the impacts that might occur to archaeological resources by pipeline construction within State waters should be mitigated under the requirements of the NHPA.

About half of the coast along the Central Gulf was hit with 16-20 tropical cyclones between the years 1901 and 1955 (DeWald, 1982). The other half, from Atchafalaya Bay in Louisiana to Texas, had a slightly lower incidence of cyclones (11-15). Prehistoric sites in shallow waters and on coastal beaches are exposed to the destructive effects of wave action and scouring currents. Under such conditions, it is highly likely that artifacts would be dispersed and the site context disturbed. Some of the original information contained in the site would be lost in this process. Overall, a significant loss of data from prehistoric sites has probably occurred, and will continue to occur, in the Central Gulf from the effects of tropical storms.

*Summary*

Several impact-producing factors may threaten prehistoric archaeological resources of the Central Gulf. An impact could result from a contact between an OCS activity (pipeline and platform installations, drilling rig emplacement and operation, dredging, and anchoring activities) and a prehistoric archaeological site located on the continental shelf. The archaeological surveys and resulting archaeological analysis and clearance that are required prior to an operator beginning oil and gas activities in a lease block are estimated to be 90 percent effective at identifying possible prehistoric sites in the CPA. Development of the CPA prior to requiring archaeological surveys has possibly impacted sites containing significant or unique prehistoric information.
Expected impacts from dredging and tropical storms are estimated to be very high under the Cumulative scenario. The likelihood of an oil spill occurring and contacting the CPA coastline is high. Such contact could result in loss of significant or unique information relating to the dating of a prehistoric site. Onshore development as a result of the proposed action, could result in the direct physical contact between a prehistoric site and new facility construction and pipeline trenching. It is assumed that archaeological investigations prior

to construction will serve to mitigate these potential impacts. The shallow depth of sediment disturbance caused by commercial fisheries activities (trawling) is not expected to exceed that portion of the sediments which have been disturbed by wave-generated forces.

The effects of the various impact-producing factors discussed in this analysis have likely resulted in the loss of significant or unique prehistoric archaeological information. In the case of factors related to OCS program activities, it is reasonable to assume that most impacts would have occurred prior to 1974 (the date of initial archaeological survey and clearance requirements). The incremental contribution of the proposed action is expected to be very small due to the efficacy of the required remote-sensing survey and concomitant archaeological report and clearance. However, there is a possibility of an interaction between bottom disturbing activity (rig emplacement, pipeline trenching, and anchoring) and a prehistoric archaeological site.

*Conclusion*

The total of OCS program and non-program related impact producing factors has likely resulted and may yet result in loss of significant or unique prehistoric archaeological information.

### *(12) Impacts on Socioeconomic Conditions*

### *(a) Population, Labor, and Employment*

The Cumulative Analysis will focus on the direct, indirect, and induced impacts of the OCS oil and gas industry on the population, labor, and employment of the counties and parishes in the Central Gulf coastal impact area as a result of prior sales, the proposed sales, and future sales in the Gulf of Mexico. Considered also are employment impacts associated with the clean-up of oil spilled during import tankering operations. There would also be other economic impacts, both direct and indirect, associated with the OCS program resulting from its effect on other industries, such as commercial fishing, tourism, and recreational fishing. The direct benefit or loss in these industries is addressed in the sections of this EIS related specifically to those topics. The OCS program's indirect and induced effect on these associated industries is much more difficult to quantify. Nevertheless, it will generally constitute a fraction of the magnitude of the direct impact. Also discussed in the Cumulative Analysis are projected changes in the industrial composition of the regional economy.

Section III.C.1. provides an historical perspective of the oil and gas industry, as well as a brief description of recent events that have significantly affected the level of OCS activity in the Gulf of Mexico. A detailed discussion of historical trends in population, labor, and employment within the coastal impact area of the Central Gulf can be found in Section III.C.2. That section also includes a listing of counties and parishes in the Central Gulf coastal impact area, as well as current statistics and future projections of population, labor, and employment levels for coastal subareas in the region. These projections will serve as a baseline against which impacts will be measured. The methodology developed to quantify these impacts takes into account changes in OCS-related employment, along with population and labor impacts resulting from these employment changes within each individual coastal subarea. For a detailed description of the methodology used in this analysis, see Section IV.D.1.a.(12).

Baseline employment projections for the coastal impact area of the Central Gulf of Mexico can be found in Figure IV-9. Baseline employment projections, excluding jobs generated in the CPA by the OCS program during the 35-year life of the proposed action, are also displayed on this figure. The difference between these two sets of projections accounts for OCS program employment impacts to the counties and parishes of the Central Gulf resulting from prior sales, proposed sales, and future sales in the Central, Western, and Eastern Gulf of Mexico. Sales in the Western and Eastern Gulf can, and do, result in employment impacts to the Central Gulf. The methodology discussion in Section IV.D.1.a.(12) provides an in-depth treatment of the development of these projections.

A total of approximately 3,587,700 person-years of employment (direct, indirect, and induced) are required in the Central Gulf coastal subareas in support of the OCS Program in the Gulf of Mexico during the 35-year

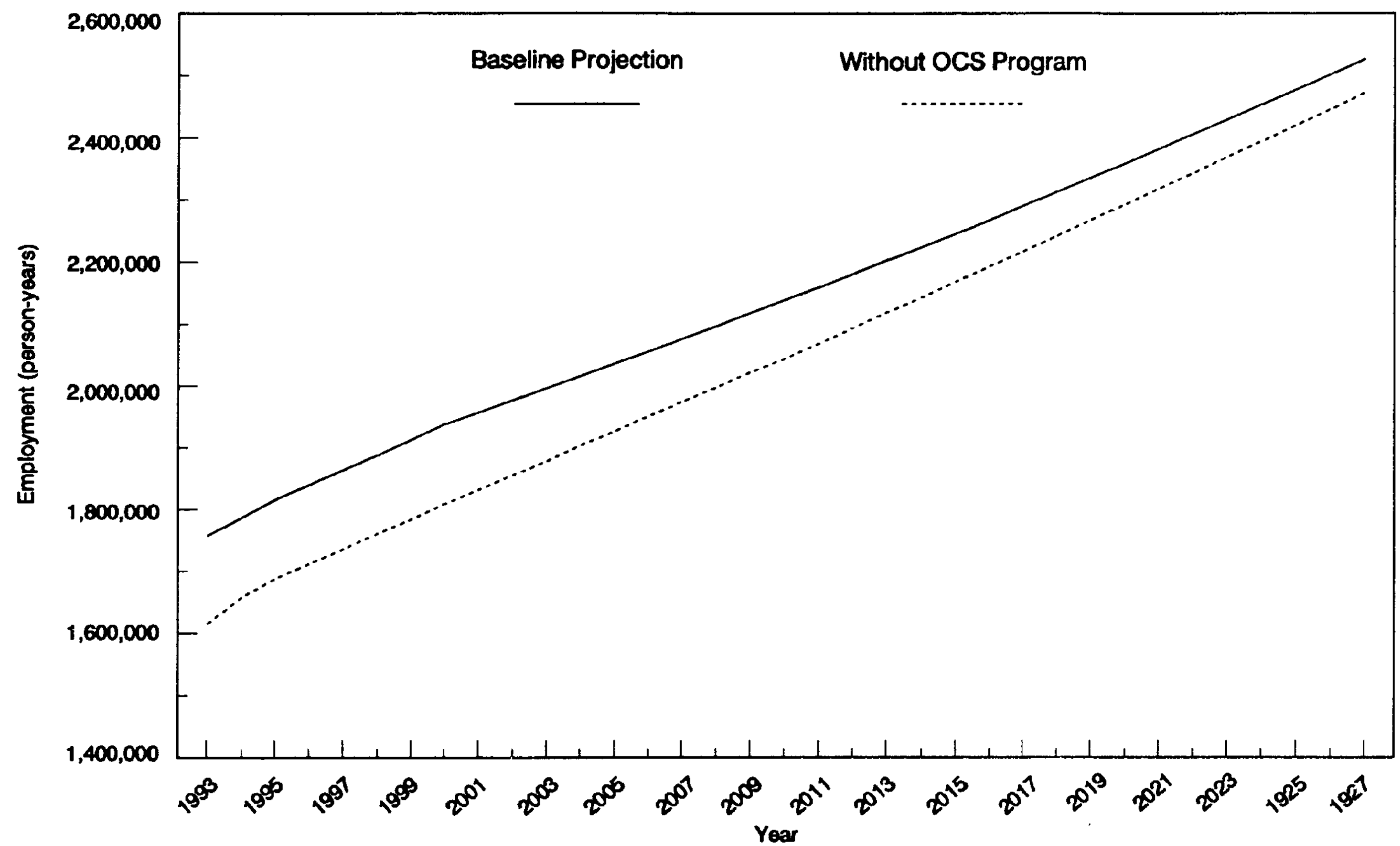



Figure IV-9. Employment Impacts from the OCS Program (Central Planning Area) (USDOI, MMS, Gulf of Mexico OCS Region estimates, 1991).

life of the proposed action. Peak-year impacts occur the first year, in 1993, with approximately 151,400 workers involved in primary, secondary, and tertiary industries. After this initial peak-year employment, impacts decline steadily through the year 2027, reflecting the declining level of OCS-related oil and gas activity projected for the Central Gulf. Direct employment in the primary oil and gas extraction industry (SIC 13) accounts for 45 percent of the total employment impacts projected for the Central Gulf coastal subareas over the life of the proposed action. Exploratory activities peak in the year 2000. Both exploratory and development activities account for approximately 13 percent of the total direct employment impacts resulting from the OCS program in the Central Gulf during the 35-year life of the proposed action. Development and production operations experience peak levels of activity in 1993, contributing 93 percent of the direct employment peak. The main contributor to the overall total employment impact is production operations. Employment in oil and gas production activities and workover operations accounts for over 86 percent of total direct employment impact due to activities in the Central Gulf. Indirect and induced employment impacts in secondary and tertiary industries amount to approximately 30 percent and 25 percent, respectively, of the total employment impact over the life of the proposed action in the Central Gulf.

Table IV-31 displays the cumulative model projections of total OCS-related employment impacts (direct, indirect, and induced) for each coastal subarea throughout the life of the proposed action. Table IV-32 provides estimates of annual impacts to the population and employment of each coastal subarea as a percent of levels expected in absence of the OCS program. These impact estimates represent changes in the new share of the existing population and employment that will be dependent on the OCS oil and gas industry for support as a result of prior sales, the proposed sales, and future sales in the Gulf of Mexico. The Cumulative scenario population and employment impact projections presented in this document are higher than those estimated for recent past EIS's. The current analysis incorporates the benefit of improved information on employment level associated with existing offshore structures and workover operations. These data improvements account for the larger impact projections.

The greatest impact to employment occurs in coastal Subareas C-1 and C-2, with peak-year impact estimates for 1993 of approximately 18.2 and 14.9 percent, respectively. Coastal Subareas C-1 and C-2 collectively provide over 71 percent of the total employment required during the life of the proposed action in support of the OCS program in the Central Gulf. The least impacted coastal subarea is C-4, accounting for only 4 percent of the total employment impact to the Central Gulf. Coastal Subarea C-3 contributes the remaining 25 percent of total planning area employment impacts.

All coastal subareas are expected to experience peak impacts during the first year of the life of the proposed action. The timing of these peak experiences suggests that activities resulting from prior sales are responsible for a significant portion of the employment impact. New OCS development will allow the continuation of some opportunities in the oil and gas industry for currently employed workers or future entrants into the labor force already living in the area. The level of OCS-related employment projected for the Central Gulf will continue to diminish as existing hydrocarbon resources become depleted. Continued leasing in the OCS will only partially offset the decline in available oil- and gas-related employment in the counties and parishes of the CPA.

Employment impacts resulting from oil-spill clean-up activities, because of their highly unpredictable nature, were handled apart from the population and employment model. The level of employment associated with any given clean-up operation is dependent on numerous variables which, in themselves, are also difficult to predict. Nevertheless, the most labor-intensive clean-up operations are those from spills that contact the coastline, particularly recreational beaches. For the purpose of this analysis, it is assumed that only those spills contacting land will involve significant manpower requirements in their clean-up efforts.

Section IV.C. presents estimates of the mean number of offshore spills assumed as a result of the Cumulative Case in the Gulf of Mexico. The probability that one or more offshore spills greater than or equal to 1,000 bbl will occur as the result of the OCS program or import tankering and contact land segments of the Central Gulf within 10 days of the accident can be found in Table IV-21. The highest probability that an offshore spill of this size resulting from the OCS program will occur and contact a CPA land segment within 10 days is 54 percent for Plaquemines Parish (Land Segment 19) in coastal Subarea C-3. Terrebonne Parish (Land Segment 16) in coastal Subarea C-2 carries the second highest probability of occurrence and contact, with a probability of 32 percent. The probability that an offshore spill of this size will occur and contact any

Table IV-31

OCS-Related Employment Projections (Direct+Indirect+Induced)
Cumulative Scenario
(person-years)

| YEAR | W1 | W2 | C1 | C2 | C3 | C4 | WGOM* | CGOM** |
|---|---|---|---|---|---|---|---|---|
| 1993 | 1365 | 8117 | 37946 | 61076 | 37438 | 5454 | 9483 | 141913 |
| 1994 | 1239 | 7318 | 34369 | 55390 | 33924 | 4955 | 8556 | 128639 |
| 1995 | 1287 | 7542 | 34153 | 55176 | 33562 | 4935 | 8829 | 127825 |
| 1996 | 1334 | 7774 | 34096 | 55222 | 33285 | 4904 | 9109 | 127507 |
| 1997 | 1458 | 8371 | 34341 | 55937 | 32994 | 4861 | 9829 | 128134 |
| 1998 | 1517 | 8658 | 34375 | 56163 | 32794 | 4854 | 10175 | 128185 |
| 1999 | 1600 | 9071 | 34717 | 56927 | 32798 | 4855 | 10671 | 129296 |
| 2000 | 1668 | 9373 | 34779 | 57185 | 32618 | 4848 | 11041 | 129430 |
| 2001 | 1544 | 8713 | 33682 | 55188 | 31965 | 4761 | 10257 | 125595 |
| 2002 | 1465 | 8259 | 32593 | 53283 | 31177 | 4679 | 9724 | 121732 |
| 2003 | 1347 | 7608 | 31417 | 51156 | 30436 | 4583 | 8955 | 117592 |
| 2004 | 1243 | 7001 | 29983 | 48619 | 29369 | 4437 | 8245 | 112408 |
| 2005 | 1328 | 7294 | 29178 | 47484 | 28211 | 4288 | 8622 | 109160 |
| 2006 | 1231 | 6771 | 28024 | 45497 | 27343 | 4163 | 8001 | 105027 |
| 2007 | 1179 | 6467 | 27201 | 44103 | 26612 | 4046 | 7646 | 101962 |
| 2008 | 1190 | 6456 | 26404 | 42888 | 25656 | 3895 | 7647 | 98844 |
| 2009 | 1171 | 6303 | 25579 | 41575 | 24856 | 3786 | 7474 | 95796 |
| 2010 | 1193 | 6366 | 25121 | 40909 | 24198 | 3672 | 7559 | 93900 |
| 2011 | 1207 | 6372 | 24427 | 39859 | 23258 | 3512 | 7579 | 91056 |
| 2012 | 1234 | 6433 | 23542 | 38513 | 22163 | 3349 | 7667 | 87567 |
| 2013 | 1235 | 6364 | 22481 | 36871 | 20991 | 3181 | 7598 | 83524 |
| 2014 | 1199 | 6168 | 21807 | 35762 | 20321 | 3054 | 7368 | 80943 |
| 2015 | 1164 | 5962 | 21001 | 34459 | 19555 | 2943 | 7126 | 77958 |
| 2016 | 1170 | 5941 | 20344 | 33462 | 18753 | 2817 | 7111 | 75377 |
| 2017 | 1145 | 5798 | 19726 | 32468 | 18193 | 2746 | 6943 | 73133 |
| 2018 | 1158 | 5820 | 19107 | 31567 | 17423 | 2630 | 6978 | 70726 |
| 2019 | 1120 | 5611 | 18391 | 30398 | 16727 | 2520 | 6731 | 68036 |
| 2020 | 1105 | 5521 | 17875 | 29579 | 16190 | 2437 | 6627 | 66082 |
| 2021 | 1090 | 5427 | 17340 | 28731 | 15667 | 2362 | 6517 | 64101 |
| 2022 | 1095 | 5436 | 16921 | 28099 | 15143 | 2277 | 6531 | 62440 |
| 2023 | 1045 | 5194 | 16344 | 27115 | 14632 | 2184 | 6239 | 60276 |
| 2024 | 1040 | 5156 | 15907 | 26438 | 14148 | 2114 | 6196 | 58608 |
| 2025 | 1017 | 5047 | 15541 | 25834 | 13840 | 2070 | 6063 | 57285 |
| 2026 | 1035 | 5118 | 15224 | 25385 | 13338 | 1979 | 6153 | 55926 |
| 2027 | 1019 | 5034 | 14820 | 24736 | 12929 | 1915 | 6053 | 54400 |
| | 43437 | 233866 | 888754 | 1453056 | 842508 | 126066 | 277303 | 3310383 |

* Western Gulf of Mexico.
** Central Gulf of Mexico.

Source: USDOI, MMS, Gulf of Mexico OCS Region estimates, 1991.

Table IV-32

Population and Employment Impact Levels for the Cumulative Case Scenario
Cumulative Case Scenario
(percent*)

EMPLOYMENT IMPACT LEVELS:

| YEAR | W1 | W2 | C1 | C2 | C3 | C4 |
|---|---|---|---|---|---|---|
| 1993 | 0.4% | 0.3% | 18.2% | 14.9% | 6.2% | 1.4% |
| 1994 | 0.3% | 0.3% | 15.9% | 13.0% | 5.5% | 1.2% |
| 1995 | 0.4% | 0.3% | 15.4% | 12.7% | 5.3% | 1.2% |
| 1996 | 0.4% | 0.3% | 15.1% | 12.5% | 5.2% | 1.2% |
| 1997 | 0.4% | 0.3% | 15.0% | 12.5% | 5.1% | 1.2% |
| 1998 | 0.4% | 0.3% | 14.8% | 12.3% | 5.0% | 1.2% |
| 1999 | 0.4% | 0.3% | 14.7% | 12.3% | 4.9% | 1.1% |
| 2000 | 0.4% | 0.3% | 14.5% | 12.2% | 4.8% | 1.1% |
| 2001 | 0.4% | 0.3% | 13.8% | 11.6% | 4.7% | 1.1% |
| 2002 | 0.4% | 0.3% | 13.2% | 11.0% | 4.5% | 1.1% |
| 2003 | 0.3% | 0.3% | 12.5% | 10.4% | 4.4% | 1.0% |
| 2004 | 0.3% | 0.2% | 11.7% | 9.7% | 4.2% | 1.0% |
| 2005 | 0.3% | 0.2% | 11.3% | 9.4% | 3.9% | 1.0% |
| 2006 | 0.3% | 0.2% | 10.7% | 8.8% | 3.8% | 0.9% |
| 2007 | 0.3% | 0.2% | 10.2% | 8.5% | 3.6% | 0.9% |
| 2008 | 0.3% | 0.2% | 9.8% | 8.1% | 3.5% | 0.8% |
| 2009 | 0.3% | 0.2% | 9.3% | 7.8% | 3.3% | 0.8% |
| 2010 | 0.3% | 0.2% | 9.1% | 7.5% | 3.2% | 0.8% |
| 2011 | 0.3% | 0.2% | 8.7% | 7.3% | 3.0% | 0.7% |
| 2012 | 0.3% | 0.2% | 8.3% | 6.9% | 2.9% | 0.7% |
| 2013 | 0.3% | 0.2% | 7.8% | 6.5% | 2.7% | 0.7% |
| 2014 | 0.3% | 0.2% | 7.4% | 6.3% | 2.6% | 0.6% |
| 2015 | 0.3% | 0.2% | 7.1% | 6.0% | 2.4% | 0.6% |
| 2016 | 0.3% | 0.2% | 6.8% | 5.7% | 2.3% | 0.6% |
| 2017 | 0.2% | 0.2% | 6.5% | 5.5% | 2.2% | 0.6% |
| 2018 | 0.2% | 0.2% | 6.2% | 5.3% | 2.1% | 0.5% |
| 2019 | 0.2% | 0.2% | 5.9% | 5.0% | 2.0% | 0.5% |
| 2020 | 0.2% | 0.1% | 5.7% | 4.8% | 1.9% | 0.5% |
| 2021 | 0.2% | 0.1% | 5.4% | 4.6% | 1.8% | 0.5% |
| 2022 | 0.2% | 0.1% | 5.2% | 4.5% | 1.7% | 0.4% |
| 2023 | 0.2% | 0.1% | 5.0% | 4.3% | 1.7% | 0.4% |
| 2024 | 0.2% | 0.1% | 4.8% | 4.1% | 1.6% | 0.4% |
| 2025 | 0.2% | 0.1% | 4.6% | 4.0% | 1.5% | 0.4% |
| 2026 | 0.2% | 0.1% | 4.5% | 3.8% | 1.5% | 0.4% |
| 2027 | 0.2% | 0.1% | 4.3% | 3.7% | 1.4% | 0.4% |

POPULATION IMPACT LEVELS:

| YEAR | W1 | W2 | C1 | C2 | C3 | C4 |
|---|---|---|---|---|---|---|
| 1993 | 0.4% | 0.3% | 18.2% | 14.9% | 6.2% | 1.4% |
| 1994 | 0.4% | 0.3% | 16.1% | 13.2% | 5.5% | 1.3% |
| 1995 | 0.4% | 0.3% | 15.8% | 12.9% | 5.4% | 1.2% |
| 1996 | 0.4% | 0.3% | 15.7% | 12.8% | 5.4% | 1.2% |
| 1997 | 0.4% | 0.3% | 15.7% | 12.9% | 5.3% | 1.2% |
| 1998 | 0.4% | 0.3% | 15.6% | 12.8% | 5.3% | 1.2% |
| 1999 | 0.4% | 0.3% | 15.7% | 12.9% | 5.2% | 1.2% |
| 2000 | 0.5% | 0.4% | 15.6% | 12.8% | 5.2% | 1.2% |
| 2001 | 0.4% | 0.3% | 15.0% | 12.2% | 5.0% | 1.2% |
| 2002 | 0.4% | 0.3% | 14.3% | 11.6% | 4.9% | 1.1% |
| 2003 | 0.4% | 0.3% | 13.7% | 11.0% | 4.7% | 1.1% |
| 2004 | 0.3% | 0.3% | 12.9% | 10.3% | 4.5% | 1.1% |
| 2005 | 0.4% | 0.3% | 12.4% | 10.0% | 4.3% | 1.0% |
| 2006 | 0.3% | 0.2% | 11.8% | 9.4% | 4.2% | 1.0% |
| 2007 | 0.3% | 0.2% | 11.3% | 9.1% | 4.0% | 1.0% |
| 2008 | 0.3% | 0.2% | 10.9% | 8.7% | 3.9% | 0.9% |
| 2009 | 0.3% | 0.2% | 10.5% | 8.4% | 3.7% | 0.9% |
| 2010 | 0.3% | 0.2% | 10.2% | 8.1% | 3.6% | 0.8% |
| 2011 | 0.3% | 0.2% | 9.8% | 7.9% | 3.4% | 0.8% |
| 2012 | 0.3% | 0.2% | 9.4% | 7.5% | 3.3% | 0.8% |
| 2013 | 0.3% | 0.2% | 8.9% | 7.1% | 3.1% | 0.7% |
| 2014 | 0.3% | 0.2% | 8.5% | 6.8% | 2.9% | 0.7% |
| 2015 | 0.3% | 0.2% | 8.2% | 6.5% | 2.8% | 0.7% |
| 2016 | 0.3% | 0.2% | 7.8% | 6.3% | 2.7% | 0.6% |
| 2017 | 0.3% | 0.2% | 7.5% | 6.0% | 2.6% | 0.6% |
| 2018 | 0.3% | 0.2% | 7.2% | 5.8% | 2.5% | 0.6% |
| 2019 | 0.3% | 0.2% | 6.9% | 5.5% | 2.4% | 0.6% |
| 2020 | 0.3% | 0.2% | 6.7% | 5.3% | 2.3% | 0.5% |
| 2021 | 0.3% | 0.2% | 6.4% | 5.1% | 2.2% | 0.5% |
| 2022 | 0.3% | 0.2% | 6.2% | 5.0% | 2.1% | 0.5% |
| 2023 | 0.2% | 0.2% | 6.0% | 4.7% | 2.0% | 0.5% |
| 2024 | 0.2% | 0.1% | 5.8% | 4.6% | 1.9% | 0.4% |
| 2025 | 0.2% | 0.1% | 5.6% | 4.4% | 1.9% | 0.4% |
| 2026 | 0.2% | 0.1% | 5.4% | 4.3% | 1.8% | 0.4% |
| 2027 | 0.2% | 0.1% | 5.3% | 4.2% | 1.7% | 0.4% |

* Note: Impact levels represent the percent change in population or employment due to the proposal with respect to total levels expected in absence of the proposal.

Source: USDOI, MMS, Gulf of Mexico OCS Region estimates, 1991.

particular land segment of coastal Subarea C-4 in Mississippi and Alabama is less than 5 percent. Every land segment in coastal Subarea C-1 carries a probability of occurrence and contact equal to 6 percent. Based on these probabilities, the assumption is that three offshore spills of approximately 6,500 bbl will occur and contact land somewhere in the CPA as a direct result of the OCS program. An MMS study of oil slick sizes and length of affected coastline provides statistics that lead to the assumption that, on average, a spill of this size would affect approximately 30 km of coastline (USDOI, MMS, 1985c). Based on employment statistics from recent spill clean-up operations along the coast, the assumption is that, for every kilometer of coastline subjected to heavy oiling, approximately 100 temporary workers will be employed for a maximum of 6 weeks. Therefore, an estimated 3,000 workers will spend approximately 6 weeks employed in operations supporting the clean-up of each offshore OCS-related spill of this size that will contact the Central Gulf Coast. This estimate is equivalent to a total of 1,050 person-years of employment over the 35-year life of the proposed action.

The highest probability that an offshore spill greater than or equal to 1,000 bbl will occur from accidents involving import tankering and contact a CPA land segment within 10 days is 23 percent for Cameron Parish (Land Segment 12) in coastal Subarea C-1. Plaquemines Parish (Land Segment 19), in coastal Subarea C-3, has a slightly lower probability of occurrence and contact of 21 percent. The probability that an offshore spill will occur and contact any particular land segment of coastal Subareas C-2 and C-4 is less than 5 percent. Based on these probabilities, the assumption is, that one spill of approximately 22,728 bbl will occur from import tankering operations and contact a land segment somewhere in the CPA. Given the study and assumptions discussed above, this size spill would affect approximately 50 km of coastline and require an estimated 5,000 workers in support of clean-up efforts for approximately 6 weeks. This estimate is equivalent to a total of 580 person-years of employment over the life of the proposed action.

Thirty three spills of the size category greater than 50 bbl and less than 1,000 bbl are assumed to occur in the CPA; however, none will contact the coastline. Eight-hundred and thirty spills of the size category greater than 1 bbl and less than or equal to 50 bbl are assumed to occur in the CPA over the life of the proposed action (Section IV.C.1.). Of these spills, only a few are estimated to contact land. Furthermore, employment impacts resulting from the cleanup of spills this small are expected to be negligible.

In addition to the spills referenced in Table IV-19, a number of spills less than 1,000 bbl and crude oil spills greater than or equal to 1,000 bbl and petroleum product spills are assumed to occur, primarily in the coastal zone. Estimates regarding the size, source, and potential location of these spills can be found in Sections IV.C.1. and 3. The level of clean-up action associated with spills of this type will vary.

Employment levels in the impact area of the Central Gulf states are expected to increase approximately 46 percent from the year 1990 over the life of the proposed action (Section III.C.2.). Projected changes in the industrial composition of the regional economy are considerable (USDOC, Bureau of Economic Analysis, 1990). Mining employment is expected to decrease in Louisiana, Mississippi, and Alabama. The service industry is projected to exhibit the highest growth.

By the year 2020, mining employment in Louisiana is projected to decrease by about 20 percent from 1988 levels (USDOC, Bureau of Economic Analysis, 1990). The construction industry and the government sector in Louisiana will also sustain a significant decline over this time period of approximately 11 percent and 8 percent, respectively. In addition, the manufacturing and wholesale trade industries are projected to experience a modest reduction in employment levels. The sector of highest growth in Louisiana through the year 2020 will very likely be the service industry, which includes establishments primarily engaged in providing a wide variety of services for individuals, business, government, and other organizations. Included in this sector are establishments highly dependent on the tourist industry, such as hotels and other lodging places, recreational camps and parks, amusement services, museums, art galleries, zoological gardens, automotive rental agencies, business advertising, and other miscellaneous personal services. The growth projected for the service industry in Louisiana comes as no surprise, considering the State's efforts to strengthen existing tourism activity in the region.

Mining employment in Mississippi and Alabama is expected to decline by 13 percent and 10 percent, respectively (USDOC, Bureau of Economic Analysis, 1990). The government sector is also projected to experience modest reductions in employment levels. The highest growth sector in these two states will very likely be the service industry. By the year 2020, the service sector in both Mississippi and Alabama is projected to grow by about 30 percent from employment levels experienced in 1988.

Population in the impact area of the Central Gulf states is expected to increase approximately 24 percent from the year 1990 over the life of the proposed action (Section III.C.2). The greatest impact on population from activities associated with the OCS program is expected in those areas with the highest employment impacts, namely coastal subareas C-1 and C-2. Peak year population impacts for coastal areas C-1 and C-2 occur in 1993 and are estimated to be 18.2 percent and 14.9 percent, respectively.

*Summary*

From a cumulative standpoint, the OCS program has had a significant impact in some areas of the Central Gulf. Peak annual changes in the population, labor, and employment of two coastal subareas in the Central Gulf represent as much as 18.2 percent and 14.9 percent of the levels expected in absence of the OCS program in the Gulf of Mexico. However, although total employment impacts are significant, they do not exceed peak levels of activity already experienced in the Central Gulf. It appears that the recent growth in employment to levels expected in 1993 will represent the peak impact of the OCS program over the life of the proposed action. Employment needs in support of OCS oil and gas activity are likely to be met with the existing population and available labor force. Future OCS leasing is expected to offset only partially the declining level of activity already taking place in the oil and gas industry offshore. Similar declining trends are projected for oil and gas production in State waters.

In light of the past and projected decline in oil and gas activities in the Central Gulf, there are numerous and significant efforts to diversify the local economies, particularly in Louisiana. A diversified economy will provide the coastal communities the opportunity to achieve net economic growth in spite of the downturn in the oil and gas industry. The service industry, in particular, is projected to experience significant growth in the region over the life of the proposed action.

On a regional level, the cumulative impact from prior sales, the proposed actions, and future sales on the population, labor, and employment of the counties and parishes of the Central Gulf coastal impact area is significant (approximately 3,587,700 person years of employment over the life of the proposed action). The incremental contribution of the proposed action (as analyzed in Section IV.D.1.a.(12)(a)) to the cumulative impact level is minimal because peak annual changes in the population, labor, and employment of all coastal subareas in the Central and Western Gulf resulting from the proposed action in the Central Gulf represent less than 1 percent of the levels expected in absence of the proposal.

*Conclusion*

On a regional level, the cumulative impact from prior sales, the proposed actions, and future sales on the population, labor, and employment of the counties and parishes of the Central Gulf coastal impact area is significant, amounting to approximately 3,587,700 person-years of employment over the life of the proposed action, plus at least an additional 1,050 person-years of employment associated with the clean-up of three oil spills. Locally, the cumulative impact to population, labor, and employment is highest for coastal Subareas C-1 and C-2 along the western and central Louisiana coastline, lower for coastal Subarea C-3 in southeast Louisiana, and lowest for coastal Subarea C-4 in Mississippi and Alabama. Employment needs in support of OCS oil and gas activity are likely to be met with the existing population and available labor force.

### *(b) Public Services and Infrastructure*

The Cumulative Analysis considers the effects of OCS-related, impact-producing factors from the Central, Western, and Eastern Gulf of Mexico, as well as the effects of prior, current, and future OCS sales, and the effects of non-OCS-related impact-producing factors. Impact-producing factors considered in the analysis include fluctuations in the work force, net migration, relative income, oil and gas activity from State waters, wetlands loss, and tropical storms. Unexpected events (such as the 1973 Arab Oil Embargo) may influence oil and gas activity within the Gulf of Mexico Region. These events cannot be projected and will not be considered in this analysis.

Public services and infrastructure, as used in this analysis, include commonly provided public, semipublic, and private services and facilities, such as education, police and fire protection, sewage treatment, solid-waste disposal, water supply, recreation, transportation, health care, other utilities, and housing. Changes in OCS activities, as well as changes caused by non-OCS-related, impact-producing factors, could result in changes in demands for and usage of public services and infrastructure. Adverse effects could arise if the amount or rate of increase or decrease in the usage significantly exceeded or fell far below the capability of a local area to provide a satisfactory level of service. In addition, a natural disaster, such as a hurricane, could significantly damage infrastructure and create a greater need for service than would be locally available.

Section III.C.1. provides an historical perspective of the oil and gas industry, as well as a brief description of recent events that have significantly affected the level of OCS activity in the Gulf of Mexico. Discussions of population, labor, and employment; public services; and social patterns are presented in Section III.C.2.

As shown in Table IV-31, approximately 3,310,383 person-years of employment (direct, indirect, and induced) are required in the coastal subareas of the Central Gulf to support OCS-related activities during the 35-year life of the proposed action. Peak-year impacts occur during the first year (1993) with approximately 141,913 workers involved in primary, secondary, and tertiary industries. Impacts decline after the peak-year, reflecting the projected decline in the level of OCS-related activities. The largest employment impact will occur in onshore subarea C-2 (Table IV-31). Examination of Table IV-32 reveals that the greatest impact to employment occurs in Subareas C-1 and C-2, with peak-year (1993) impact estimates of 18.2 and 14.9 percent, respectively. It is expected that the level of OCS-related employment projected for the CPA will diminish as existing hydrocarbon resources become depleted. It is assumed that continued leasing in the OCS will only partially offset the decline in available OCS-related oil and gas employment.

Fluctuations in the work force as a result of changing levels of OCS-related oil and gas activity could impact public services and infrastructure during the life of the proposed action. As mentioned above, following the peak-year (1993), total employment in the CPA is expected to decline. Projected changes in the industrial composition of the regional economy over the life of the proposed action reveal a decrease in mining employment in Louisiana of about 20 percent from 1988 levels (USDOC, Bureau of Economic Analysis, 1990). The growth industry in the CPA is expected to be the service industry. It is assumed for the purpose of analysis that the jobs created in the service sector will be lower paying jobs than those in OCS-related activities. This development may result in a lower tax base, making financing for new infrastructure needed in response to normal growth problematic. Layoffs associated with the projected decline in OCS-related employment may place stresses on those private and State agencies responsible for assistance.

Peak-year cumulative impacts are expected to occur in 1993. Following the peak-year, total OCS-related oil and gas employment in the CPA is expected to decline. As mentioned above, projected levels of mining employment in Louisiana are expected to drop by 20 percent by 2020. Expected growth in the service industry will most likely provide employment for some of the work force; however, it is assumed that some out-migration will occur among those persons seeking pay comparable to that of OCS-related employment. It is expected that employment needs in support of OCS oil and gas activity are likely to be met with the existing population and available labor force, requiring little to no in-migration. Out-migration could result in a large loss of population, particularly in OCS-related staging and administrative centers. This could stress the public service and infrastructure base of these centers because of dramatic changes in need.

The relatively high wages paid to OCS-related oil and gas industry personnel in the cumulative case will increase the tax base in coastal parishes and counties beyond what could be expected if there were no OCS activities. As OCS-related employment decreases through time, it is assumed that taxes originating from OCS-related wages and expenditures will decrease. Consequently, maintenance of existing infrastructure and creation of new infrastructure may become problematic.

Oil and gas activity within State waters requires similar public services and infrastructure as do OCS-related oil and gas activities. Further, it is assumed that oil and gas employment from activities within State waters will decline at the same rate, if not faster, than that from Federal OCS waters. Infrastructure needs in support of oil and gas activities in State waters would diminish as employment associated with State-regulated activities decline. Impacts to public services would include increased numbers of individuals requiring assistance. In addition, maintenance of existing infrastructure and creation of new infrastructure may become difficult to support at different levels of oil and gas employment.

About half of the Central Gulf coast was hit with 16-20 tropical cyclones between the years 1901 and 1955 (DeWald, 1982). The other half, from Atchafalaya Bay in Louisiana to Texas, had a slightly lower incidence of cyclones (11-15). Experience with Hurricanes Betsy and Camille has indicated that major hurricanes can have a devastating effect on both public services and community infrastructure. Assuming that several major storms will impact the Central Gulf coastal subareas during the life of the proposed action, hundreds of millions of dollars of damage to existing infrastructure is expected.

Section IV.D.1.d.(1)(b) analyzes the cumulative impact to coastal wetlands. Decreases in sediment load and dispersal, subsidence, indirect impacts from existing canals, and other impact-producing factors are expected to result in the loss of thousands of acres of wetlands per year. Given the physiography of the CPA coastal parishes and counties of the CPA and the proximity of much infrastructure to relict geomorphic features, it is reasonable to assume that transportation networks (roads, bridges, and railroads) will require increasing maintenance and protection from inundation in the future. This is particularly true in the coastal marsh areas.

*Summary*

Declining levels of OCS and tideland oil and gas employment are expected to occur during the life of the proposed action. Economic growth is expected to occur in the service industry; however, the level of pay for these jobs will not be comparable to those lost from OCS-related employment. It is assumed that some out-migration will coincide with declining levels of OCS-related employment and that it will primarily occur from OCS-staging areas and administrative centers.

The decline in the tax base and the needs for public and relocation assistance are expected to result in a deterioration of the existing community infrastructure and level of public service delivery.

Tropical storm activity has occurred in the past and will occur in the future. It is assumed that several major storms will strike CPA coastal parishes and counties during the life of the proposed action. Experience has indicated that these storms could have a major impact on public services and community infrastructure.

Community infrastructure in the coastal parishes and counties is linked to the region's physiography. Continued subsidence and erosion are expected to require expanded maintenance of roads, bridges, and railroads, particularly in CPA coastal marsh areas.

*Conclusion*

The cumulative impact is expected to result in deteriorating conditions of existing infrastructure and difficulties in delivering satisfactory levels of public services.

## *(c) Social Patterns*

The Cumulative Analysis considers the effects of OCS-related, impact-producing factors from the Central, Western, and Eastern Gulf of Mexico as well as the effects of prior, current, and future OCS sales. The analysis also considers the effects of certain non-OCS-related, impact-producing factors. Impact-producing factors considered in the analysis include work force fluctuations, net migration, displacement from traditional occupations, relative income, oil and gas activity from State waters, oil spills, wetlands loss, and tropical storms. Unexpected events (such as the 1973 Arab Oil Embargo) may influence oil and gas activity within the Gulf of Mexico Region. These events cannot be projected and cannot be presumed for this analysis.

Social patterns, as used in this analysis, will include traditional occupations, folkways, social structure, language, family life, and other forms of cultural adaptation to the natural and human environment. It should be noted that impacts not treated in the present analysis (such as technological improvements in communications and transportation) have caused, and will continue to cause, changes within the analysis area. For the purpose of the current analysis, impact-producing factors to social patterns will include work force fluctuations, net migration (both in-migration and out-migration), work scheduling, displacement from traditional occupations (primarily resulting from wetlands loss), relative income, oil and gas activity within State waters, and tropical storms. Adverse effects to social patterns could arise if disruption of social patterns occurred and resulted in changes in traditional occupations, disruption in the viability of extant subcultures, and detrimental effects on family life. As mentioned in Section III.C.2.c., it may be argued that employment in the oil and gas industry could be perceived as a traditional occupation. For the purpose of this analysis, such employment will not be considered as a traditional occupation.

Section III.C.1. provides an historical perspective of the oil and gas industry, as well as a brief description of recent events that have significantly affected the level of OCS activity in the Gulf of Mexico. Discussions of population, labor, and employment; public services; and social patterns are presented in Section III.C.2. Definitions used in this analysis to assess the OCS program's expected level of impact on social patterns is presented in Table S-5.

As stated in Section IV.D.1.d.(12)(a), approximately 3,587,700 person-years of employment (direct, indirect, and induced) are required in the Central Gulf coastal subareas to support OCS-related activities during the 35-year life of the proposed action. Peak-year impacts occur in 1993 with approximately 151,400 workers involved in primary, secondary, and tertiary industries. Impacts decline after the peak year, reflecting the projected decline in the level of OCS-related activities. A breakdown of total employment projections for the life of the proposed action by coastal subareas reveals total employment of 26.8 percent in Subarea C-1, 43.9 percent in Subarea C-2, 25.5 percent in Subarea C-3, and 3.8 percent in Subarea C-4 (Table IV-33). An examination of Table IV-34 reveals that the greatest impact to employment occurs in Subareas C-1 and C-2, with peak-year impact (1993) estimates of 18.2 and 14.9 percent, respectively. It is expected that the level of OCS-related employment projected for the CPA will diminish as existing hydrocarbon resources become depleted. It is assumed that continued leasing in the OCS will only partially offset the decline in available OCS-related oil and gas employment.

The potential effects of work force fluctuations on extant subcultures in the coastal subareas are expected to be greatest when large changes in OCS-related activities result in net positive or negative migration. Under the Cumulative scenario, peak-year employment is projected to occur in 1993, with a steady decline in OCS-related employment over the life of the proposed action. It is likely that employment in OCS-related activities will not require importation of labor and that jobs will be filled by the available labor. Projected changes in the industrial composition of the regional economy over the life of the proposed action reveal a decrease in mining employment in Louisiana of about 20 percent from 1988 levels (USDOC, Bureau of Economic Analysis, 1990). The highest growth in the CPA is expected to occur in the service industry. It is assumed for the purpose of this analysis that jobs created in the service sector will be lower paying than jobs in OCS-related activities. The quality of family life, in some individual cases, could be adversely affected from the stress of decreased family income and loss of security resulting from layoffs in the OCS oil and gas industry. As the level of employment in the OCS-related industry decreases, it is likely that more persons will engage in traditional occupations (such as trapping and shrimping) to supplement their income, possibly leading to overfishing of the resource, which could pose a threat to the continued existence of specific traditional occupations. The cumulative level of impact from work force fluctuations is expected to impact the quality of family life, particularly in Subareas C-1, C-2, and C-3. In addition, impacts to traditional occupations could result from overexploitation of the fisheries resource as individuals turn from employment in oil and gas activities to more traditional occupations.

As mentioned above, projected levels of mining employment in Louisiana are expected to drop by 20 percent by 2020. Expected growth in the service industry will most likely provide employment for some of the work force; however, it is assumed that some out-migration will occur among those persons seeking pay comparable to that of OCS-related employment. It is expected that employment needs in support of OCS oil and gas activity are likely to be met with the existing population and available labor force, requiring little to no in-migration. Out-migration could result in a large population loss, particularly in OCS-related staging and administrative centers. Expected impacts would include a diminishment in the number of those persons engaged part-time in traditional occupations with the possible loss of cultural knowledge, the serious impairment in family life as a result of the departure of extended family members, and potential loss of community cohesion within some of the communities that serve as staging and administrative centers. The cumulative level of impact on social patterns from migration is expected to be high in some communities that serve as staging and administrative centers.

Distance to the site and the type of transportation needed for personnel in OCS-related oil and gas activities results in the normal work schedule occurring as a large block of time on duty (or at site) followed by a large block of time off duty. The schedules may range from 7 days on followed by 7 days off to a 30-day on/30-day off schedule. It has been argued that this type of schedule has allowed for participation in, and continuance of, traditional occupations (Hallowell, 1979; Laska, personal comm., 1991). It is expected that stress will be placed on family life in response to the regular absences of a parent (usually the father). In some cases, it is expected that adaptation to changing family roles will occur. In other cases, it is expected that adaptation will not occur and that there will be deleterious impacts to family life. In the peak year of 1993, 151,400 workers are projected to be involved in primary, secondary, and tertiary industries. Employment in oil and gas production activities and workover operations are projected to account for about 86 percent of this total. Of those persons employed in OCS-related oil and gas activities and working the extended schedule, it is expected that some families will not adapt to these conditions, and deleterious impacts to family life will occur.

Displacement from traditional occupations could originate from destruction of a resource base, space-use conflict, and voluntary shifts from traditional occupations to employment in OCS-related activities. Adverse effects resulting from displacement from traditional occupations could include a diminishment in the number of participants in traditional occupations, the loss of traditional knowledge and cultural heritage, and deleterious impacts to family life. The existence of the Fisherman's Contingency Fund mitigates, to some extent, space-use conflicts associated with commercial fishing. A total of 1,640 claims have been filed as of 1990; 1,230 of these in the Central Gulf. According to Section IV.D.1.d.(1)(b), the cumulative impact to coastal wetlands is expected to be very high. Decreases in sediment load and dispersal, subsidence, indirect impacts from existing canals, and other impact-producing factors are expected to result in the loss of thousands of acres of wetlands per year. However, the incremental contribution of the proposed action is a very small part of this total. The loss of habitat in the cumulative case is expected to adversely affect the pursuit of traditional occupations, in the CPA over the life of the proposed action. The loss of habitat, over time, could result in a loss of traditional occupations. Deleterious effects to family life could result from displacement and loss of traditional roles. The cumulative level of impact from displacement from traditional occupations is expected to be high.

The relatively high wages paid to OCS-related oil and gas industry personnel may result in the voluntary shift of persons engaged in traditional occupations to more lucrative positions within the oil and gas industry. Dependency on these relatively high wages may deleteriously impact family life, particularly in view of the projected decline in OCS-related oil and gas activity over the life of the proposed action. It is expected that many persons who voluntarily leave traditional occupations for employment in OCS-related oil and gas activities will engage in traditional occupations part-time. Some individual cases of serious impairment of family life is expected to occur in association with those persons who, laid off from OCS-related oil and gas activity during the life of the proposed action, cannot find jobs at comparable pay.

Oil and gas activities within State waters are assumed to result in similar adverse effects as do OCS-related oil and gas activity. It is assumed that oil and gas employment from activities within State waters will decline at the same rate, if not faster, than that from Federal OCS waters. As employment from these activities declines through time, more persons may turn to full-time participation in traditional occupation, resulting in overutilization of the resource and threatening the continuation of traditional occupations. Family life could also be seriously impacted by the suite of impact-producing factors associated with activities in State waters.

About half of the Central Gulf coast was hit with 16-20 tropical cyclones between the years 1901 and 1955 (DeWald, 1982). The other half, from Atchafalaya Bay in Louisiana to Texas, had a slightly lower incidence of cyclones (11-15). Experience with major hurricanes in the historical record (cf. Vujnovich, 1974), as well as Hurricanes Betsy and Camille, has indicated that major hurricanes can have a devastating effect on both the natural and human environment. Temporary disruption of traditional occupations and severe impairment of family life, in some individual cases, can result from the effects of tropical storms. It is assumed that several major storms will impact the Central Gulf coastal subareas during the life of the proposed action.

*Summary*

Several impact-producing factors will contribute to impacts expected to occur on social patterns during the life of the proposed action. It is expected that these impacts will be greatest in coastal Subareas C-1, C-2, and C-3.

Declining levels in OCS-related employment are expected to occur during the life of the proposed action. Economic growth is expected in the service industry; however, the level of pay of these jobs will not be comparable to those lost from OCS-related employment. It is assumed that the decline in OCS-related employment will result in more persons engaging in traditional occupations, resulting in overutilization of the resource base and threaten the loss of traditional occupations. Serious impairment of family life is expected to occur in some individual cases.

In the CPA, for the life of the proposed action, OCS-related jobs are expected to be filled by the available labor pool. No in-migration is projected for the coastal subareas. Out-migration may occur as a result of persons seeking pay comparable to that earned in OCS-related industries. Comparatively large amounts of out-migration may occur within localized communities that serve as OCS-related staging and administrative centers, resulting in deleterious impacts to family life in some individual cases. The loss of some persons engaged in the part-time pursuit of traditional occupations would also occur.

The specialized schedule that is necessary for the operation of many OCS-related activities is expected to impair family life seriously in the case of families unable to adapt to changing roles. Deleterious effects on traditional occupations are mitigated by schedule flexibility that allows for part-time participation in traditional occupations.

Displacement from traditional occupations could occur as a result of destruction of the resource base (primarily loss of wetlands), space-use conflicts, and voluntary shifts from traditional occupations to OCS-related employment. The loss of wetlands under the cumulative case is expected to amount to thousands of acres per year. This loss, through time, is expected to seriously impact traditional occupations, cultural heritage, and family life; it may result in the loss of traditional occupations.

Adverse effects from relative wages are expected to be greatest among families who have grown dependent upon the relatively high level of wage paid to persons employed by OCS-related industries. Serious impairment of family life is expected to occur in some individual cases.

Oil and gas activity within State waters is assumed to decline at the same rate, or at a faster rate, than that projected for Federal OCS waters. Impact-producing factors are expected to parallel those found for activity in Federal OCS waters. The levels of impacts are expected to parallel those found for OCS-related activities.

It is assumed that several tropical storms will make contact with the Central Gulf coastal subareas during the life of the proposed action. Experience has shown that these storms can have a devastating, but temporary, impact on traditional occupations. Serious impairment of family life is expected to occur in some individual cases.

The incremental contribution to the proposed action (as analyzed for the Base Case in Section IV.D.1.a.(12)(c)) to the cumulative impact level is minimal because there are no expected dramatic short-term increases or decreases in population of the coastal parishes and counties. In addition, minimal net migration into the coastal subareas is expected, and jobs created by the proposed action will reduce out-migration. The extended work schedules and relatively high wages associated with OCS-related employment will cause minor displacement from traditional occupations.

*Conclusion*

Under the Cumulative scenario, it is expected that some loss of traditional occupations will occur. Deleterious impacts to cultural heritage and family life are also expected to occur in some individual cases. It is expected that these impacts will be greatest in coastal Subareas C-1, C-2, and C-3.

## e. Coastal Zone Management Plans and Land Use

Coastal management policies apply to Sale 142 and to all subsequent activities that affect uses or resources of the coastal zone. Section III.C.6. contains an overview of State Coastal Zone Management Plans. The following assessment focuses on the hypothetical direct and indirect effects of postlease activities (the Base Case scenario of the EIS). Changes made by the lessees as they explore, develop, and produce petroleum products from leases offered in Sale 142 would affect the applicability of this assessment. The MMS is generally prohibited from issuing drilling permits until after the consistency certification review is completed and affirmed by a State. Additional information on the Base Case scenario can be found in Section IV.A.1.

### *(1) Alabama*

The sale analysis area closest to the submerged lands of the State of Alabama is Central coastal Area C-3, which extends offshore from the State 3-mi line. The Alabama coastal counties are Baldwin and Mobile.

According to NOAA, there are no local coastal management plans approved for the State of Alabama. However, local authorities such as municipal and county planning commissions serve in an advisory capacity to local government and, in certain instances, have authority to make development decisions that impact the coastal area. The South Alabama Regional Planning Commission provides ongoing technical assistance to the Alabama Department of Economic and Community Affairs (ADECA) so as to assure consistency with the Alabama Coastal Area Management Plan's (ACAMP) guidelines and objectives when the ADECA lacks sufficient personnel locally to coordinate the coastal area program with local planning commissions. Conflicts with local land use ordinances are not expected to occur as a result of Sale 142, as existing onshore infrastructure is expected to be sufficient.

Issues identified in ACAMP include the following coastal resource issues: coastal development and mineral resources, commercial fishing, hazards management, shoreline erosion, recreation, and transportation. In addition, the following natural resource protection policies are listed: biological productivity, air and water quality, water resources, wetlands and submersed grassbeds, beach and dune protection, wildlife habitat protection, endangered species, and cultural resources protection.

Based on assumptions fully discussed in Sections IV.A. and IV.C., the impacting factors discussed below are assumed for the purposes of analysis. These factors will affect coastal issues identified in ACAMP.

*Coastal Resource Use Policies*

*Coastal Development and Mineral Resources*

The State policy on development encourages and supports "to the maximum extent practicable the continued development of the economic resources of the coastal area, including the port, industrial, energy and recreational resources, so that they may continue their full contribution to the economic well-being of all citizens, and development within coastal Alabama will be carried out in a manner which is consistent with the Board's policies for natural resources" (Policy Statement, Part II, Ch. 3, Sec. I.A.1., ACAMP).

It is also the State's policy to "encourage the extraction of mineral resources in coastal Alabama consistent with the water quality policies and natural resource policies of the Board" (Policy Statement, Part II, Ch. 3, Sec. I.A.2., ACAMP).

The proposed sale will not directly involve development of mineral resources in State lands, though perhaps common depth point data and/or exploration of leases near State lands could shed light on potential energy resources beneath State acreage. In addition, the lease sale may create new jobs and may generate other economic opportunities to the benefit of Alabama and the Nation. An MMS-funded study (Laska, in progress) evaluates the effect of the downturn in the oil industry on the Gulf economy and investigates alternate uses of existing OCS infrastructure for economic development opportunities. Any change of existing social patterns in coastal Alabama as a result of activities on these offshore leases is highly unlikely. Because the coastal zone resources are currently unemployed and underemployed, the sale will result only in a continuation of existing facilities without notable alteration of social patterns. Jobs created as a result of the sale would likely reduce the amount of out-migration when compared to scenarios without the proposal. Economic considerations are also evaluated in the Secretarial Issue Document and the Decision Memorandum for this sale.

Onshore support activities hypothesized to result from activities on these offshore leases will themselves be subject to separate State permits and consistency certification reviews.

*Commercial Fishing*

It is the policy of the State of Alabama "to maintain conditions that support present populations, and where feasible, to enhance marine species and to encourage conservation practices favoring increases of marine and estuarine species which will increase the potential yield of Alabama's coastal fisheries" (Policy Statement, Part II, Ch. 3, Sec. I.A.3., ACAMP).

Sale 142 is not likely to have any significant effects on recreational or commercial fishing in the Alabama coastal zone because the chance of an oil spill occurring and reaching the coast is remote. Further, OCSLA mandates MMS to ensure continued protection and viability of OCS commercial fisheries.

Several Federal measures are available to mitigate fisheries losses beyond the coastal zone, losses that may occur as a result of activities on offshore leases. The Fishermen's Contingency Fund, authorized in OCSLA, is available to pay compensation for damages resulting from fishing gear losses. The MMS regulations (30 CFR 250.40) require identification of subsea object locations and equipment marking to help establish liability for fishing gear losses associated with offshore oil and gas operations. Offshore structures enhance fishing opportunities.

Biological stipulations proposed for this sale contain special provisions for the regulation of discharges and siting of facilities within offshore areas recognized as live-bottom areas of exceptional biological productivity. These stipulations will help to protect fisheries resources. A large number of studies of mud and cutting discharges from offshore oil and gas operations (e.g., NRC, 1983; Zingula, 1975; Menzie, 1983) show rapid dispersal by ocean currents with no long-term, significant biological effects.

*Hazards Management*

It is Alabama's policy that "human activities within hazard management areas, including flood and hurricane prone areas, will be carried out in a manner which sustains the area's natural capability of absorbing the effects of flood and hurricane events, and development within these areas shall be designed, located, and constructed in a way that minimizes the possibility of property damage and human suffering resulting from hazardous events."

Future onshore support is expected to be provided from existing facilities. However, if any hypothesized postlease onshore activities were to occur in Alabama, they would be subject to specific State permits including provisions to ensure consistency with State hazards management programs and policies.

*Shoreline Erosion*

It is the policy of Alabama that "the existing natural or manmade character of coastal shorelines shall be maintained in a manner to prevent the erosion of the Alabama coastline with primary emphasis on nonstructural forms of erosion control, and where feasible, enhancement of the natural protective functions of the shoreline shall be encouraged" (Policy Statement, Sec. I.A.5., ACAMP).

As indicated in Section IV.A.1., onshore support is expected to be provided entirely from existing facilities. However, if any hypothesized postlease onshore development were to occur in Alabama, it would be subject to control by applicable State regulations to ensure consistency with State hazards management programs and policies.

*Recreation*

It is the policy of Alabama that "public access to and use of existing recreational lands and waters, such as beaches, marinas, and fishing grounds, will be safeguarded," and the State "encourages the development of additional recreational opportunities to enhance the well-being of Alabama citizens as well as residents of other States" (Policy Statement, Part II, Ch. 3, Sec. I.A.6., ACAMP).

As indicated in Section IV.A., onshore support is expected to be provided from existing facilities. Marine debris lost from OCS operations associated with drilling and production throughout the lease life may occur from time to time, but the effect of intermittent washup of debris on recreational use of Alabama beaches should be low. The regulations at 30 CFR 250.40 require that offshore operators handle, control, mark, and dispose of containers, equipment, and solid waste through stringent marking, equipment handling, and storage requirements. The MMS inspectors check for compliance with regulations during daily offshore inspections. Failure to comply with regulations leads to official warnings to take corrective action or, if warranted, to cease operations.

Based on information collected at beach cleanups and during marine debris surveys, the estimate is that existing offshore oil and gas operations are responsible for 10-15 percent of the trash and debris adversely affecting the Gulf's shorefront recreational beaches in the CPA. Recent Federal regulations (33 CFR 151) stemming from MARPOL Annex V, as well as periodic MMS directives and information seminars on the debris issue, should lead to better waste handling and less accidental loss of materials and personal items into the marine environment from offshore oil and gas operations. Additionally, industry education and training emphasis on waste management, along with voluntary stewardship commitments by several major oil companies (the adoption of about 30 mi of Louisiana Gulf beaches, and the reduction and recycling of waste materials generated offshore), will also be reflected in a positive way on Alabama's beaches.

In addition, no oil spill greater than or equal to 1,000 bbl is assumed to contact the coast of Alabama as a result of this lease sale. Thus, there is no reason to expect that future activities on offshore leases will affect any areas reserved for recreational uses. If such future activities are proposed, they will be subject to State consistency certification review and, in the case of development, separate State permits.

*Transportation*

It is the policy of Alabama that "recognizing the need for safe, convenient, rapid and economic access to, through and from Alabama's coastal lands and waters, the [ADEM] shall encourage and support the orderly growth of the area's transportation network, provided this growth is consistent with the Board's policies regarding natural resources" (Policy Statement, Part II, Ch. 3, Sec. I.A.7., ACAMP).

Hypothesized transportation activities related to activities on these offshore leases may include delivery of supplies to onshore service bases and subsequent transfer of such supplies to offshore operational locations, transport of work crews to and from offshore locations, and possible future delivery of hydrocarbon discoveries to onshore process locations.

Most of the production from this lease sale may be connected by new pipelines to existing trunk lines for transportation to existing onshore processing facilities in Mississippi, Louisiana, and possibly Texas. If hypothesized postlease transportation activities occur in Alabama, they will be subject to separate State permits and regulations and State consistency review.

*Natural Resource Protection Policies*

*Biological Productivity*

It is the policy of Alabama "to maintain present levels of plants and animals within coastal Alabama; to enhance, where feasible, biological productivity; and to monitor directly these levels through regular sampling" (Policy Statement, Part II, Ch. 3, Sec. II.A.1., ACAMP).

Onshore support facilities and related activities that could result from development on these offshore leases are hypothesized to be of very limited extent and are unlikely to have significant effects on coastal resource protection. Such activities will be described in postlease exploration or development and production plans, which will be subject to State consistency review and, in the case of development, will need separate State permits. Offshore structures enhance biological productivity due to the reef environment created by them.

Coastal zone biological resources may be affected by oil spills associated with offshore operations. Prevention and containment and cleanup of oil spills are addressed through various Federal mitigation and regulation measures. Such measures include MMS requirements for an oil-spill contingency plan, prevention, and response (30 CFR 250.33, 250.34, and 250.42); the platform verification program (30 CFR 250.131, 250.132, and 250.133); and the general OCSLA requirement to apply the best available and safest technologies (BAST). The MMS requires that oil-spill contingency plans (30 CFR 250.42) ensure a full-response oil-spill containment capability, including specification of appropriate equipment and materials, their availability and deployment time, and provisions for varying degrees of response effort, depending on the severity of the spill. The USEPA's development and implementation of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 112) and correlative regional plans are designed to provide a coordinated and integrated response by Federal and State agencies to protect the environment from the damaging effects of accidental oil spills and pollution discharges.

The NCP requires that the U.S. Coast Guard's on-scene coordinator (OSC) obtain the concurrence of the USEPA representative to the Regional Response Team (RRT) and, as appropriate, the concurrence of the RRT representatives from the states having jurisdiction over the navigable waters threatened by the release or discharge; and that, when practicable, the OSC consult with the DOC and DOI natural resource trustees prior to authorizing the use of a chemical agent. Approved chemical agents must be listed on the NCP Product Schedule. The OSC is not required to obtain the aforementioned concurrence when, in the judgment of the OSC, the use of a chemical agent is necessary to prevent or reduce substantially a hazard to human life. Consistent with this, a Memorandum of Understanding, dated August 16, 1971, between the Department of the Interior and the Department of Transportation allows MMS the authority to grant OCS operators approval to use chemical agents within a 500-m radius of the source of pollution to abate the source of pollution only when such agents are deemed necessary as a measure for the safety of personnel and operations.

*Water Quality*

It is the policy of Alabama "to maintain the coastal waters of the State at a quality which will support present levels of estuarine organisms, plants and animals and, where feasible, to enhance and restore water quality to support optimum levels of estuarine organisms, plants, and animals (Policy Statement, Part II, Ch. 3, Sec. II.A.2., ACAMP).

The quality of nearshore and offshore waters is protected through standards and requirements for NPDES permits (40 CFR 122), as mandated in the Federal Water Pollution Control Act (33 U.S.C. 1251 et. seq., as amended). Marine water quality is protected through regulatory requirements, monitoring, and enforcement actions of MMS and USEPA. Discharges in coastal areas are also subject to provisions of the Alabama Code establishing the Alabama Water Improvement Commission, which is now the Water Division of the ADEM. The MMS has established a policy that requires the submission, for approval, of detailed plans for the disposal of all produced solids accumulated as a result of OCS activities (LTL dated November 20, 1990). The existing authorities on- and offshore cited above are sufficient to ensure that future operations on these offshore leases are unlikely to affect water quality adversely.

No onshore water quality degradation is likely to occur in Alabama as a result of activities on offshore leases because no new service bases are likely to be constructed in Alabama (EIS Base Case scenario). Therefore, no additional point source and nonpoint sources of pollution are likely to result. In the unlikely event of any such occurrence, numerous Federal and State water pollution control regulations exist for mitigating any potential adverse effects.

*Water Resources*

"Recognizing that the water resources of the coastal area are held in trust by the State of Alabama for the population of the State," it is Alabama's policy that "these resources shall be managed to ensure the sufficient quantities of clean water are available to meet present and future demands" (Policy Statement, Part II, Ch. 3, Sec. II.A.3., ACAMP).

Typically, to about 1,000 ft, only seawater is used in the Gulf for drilling an offshore well; between 1,000 and 6,000 ft, only seawater gel mud is used; at greater depths, a freshwater lignosulfonate mud is substituted. A small amount of potable water will be needed for domestic uses of personnel living on offshore platforms, but the quantity needed for offshore operations on these leases is likely to be insignificant in coastal Alabama.

*Air Quality*

It is the policy of Alabama "to maintain air quality in coastal Alabama at a level which supports the health and well-being of Alabama's citizens and, where feasible, to enhance air quality (Policy Statement, Part II, Ch. 3, Sec.II.A.4., ACAMP).

Section 5(a)(8) of the OCSLA grants the Department of the Interior exclusive authority and responsibility to prescribe regulations requiring offshore sources of air emissions to be consistent with national ambient air quality standards to the extent offshore activities significantly affect the onshore air quality of a State. Thus, the Department's regulations are the applicable air pollution control requirements of ACAMP under Section 307(f) of the Coastal Zone Management Act (CZMA) for OCS emissions.

The MMS regulations (30 CFR 250.44, 250.45, and 250.46) require offshore lessees to determine through modeling whether their air emissions would result in onshore pollutant concentrations above significance levels. If these levels are projected to be exceeded in an area whose concentrations already exceed air quality standards, the lessee will be required to control fully or offset its emissions so that there would be no effect onshore. If the significance levels are exceeded in areas at present in compliance with standards, the lessee will be required to employ best available control technology (BACT). If predicted onshore concentrations still exceed a standard for the prevention of significant deterioration, measures beyond BACT will be required.

Section 328 of the Clean Air Act (42 U.S.C 7401-7642, as amended) directed the Department of the Interior to conduct a research study examining the impacts from activities on the OCS adjacent to Texas, Louisiana, Mississippi, and Alabama on areas that fail to meet the Federal air quality standards for ozone (40 CFR 50). The MMS has been consulting with USEPA, the States, and others to design a study that will start in 1992. The study will have the following components: (a) a characterization of meteorological regimes associated with ozone episodes in nonattainment areas, (b) an evaluation of meteorological and air quality data from ozone modeling, (c) application of photochemical modeling to estimate impacts from OCS activities on ozone nonattainment areas, (d) a limited field program to collect meteorological data in offshore and coastal areas for future modeling applications, and (e) a set of recommendations for future monitoring and modeling activities.

In addition to the air quality study being planned in Gulf of Mexico, MMS and USEPA have been consulting on the possibility of conducting a preliminary ozone study using the ROM model. A complete set of results and impact assessment will be made when the 3-year study is completed. The EIS (Sections IV.D.1.a.(4) and IV.D.2.a.(4)) reflects MMS's needs and commitment to gather information on ozone formation and dispersion from OCS emissions.

The EIS analysis (Section IV.A.2.d.(6)) indicates that offshore air emissions are not likely to cause degradation of onshore air quality and are not likely to have any significant effect on nonattainment or Prevention of Significant Deterioration Class I areas. Actual measures ordered by the MMS will be determined after additional site-specific studies results are included by lessees when they submit exploration and development and production plans for approval.

*Wetlands and Submersed Grassbeds*

It is the policy of Alabama to maintain the "quality and quantity of coastal wetlands and submersed grassbeds . . . at the level necessary to provide for present levels of habitat for both terrestrial and aquatic life to play their pivotal role in the aquatic food web and to provide natural control for shoreline erosion and, where practicable, to enhance the quality and quantity of these wetlands and submersed grassbeds" (Policy Statement, Part II, Ch. 3, Sec. II.A.5., ACAMP).

Wetlands and submersed grassbeds are essential to coastal zone biological productivity. See Section IV.D.1.e.(2) (Louisiana) for a relevant discussion of wetland impacts and OCS oil and gas activities. If any new onshore facilities are proposed for offshore lease development, potential effects to wetlands and submersed grassbeds in the State's coastal zone will be subject to State consistency certification review. Offshore activities would be located away from wetlands and submerged grass beds.

*Beach and Dune Protection*

"Recognizing the natural value of beaches and dunes for erosion control, wildlife habitat, and recreational opportunities," it is Alabama's policy "to maintain the natural integrity of the beach and dune systems and to restore and enhance these valuable resources where feasible" (Policy Statement, Part II, Ch. 3, Sec. II.A.6., ACAMP).

No new pipeline landfalls or onshore pipeline projects are anticipated in Alabama as the result of offshore lease activities in the Base Case scenario. The chance of an oil spill reaching the coast of Alabama is remote.

*Wildlife Habitat Protection*

It is Alabama's policy "to maintain areas of wildlife habitat sufficient to support present levels of terrestrial and aquatic life, including fish and shellfish, and preserve endangered species of plants and animals and, where feasible, to provide for optimum levels of terrestrial and aquatic life" (Policy Statement, Part II, Ch. 3, Sec. II.A.7., ACAMP).

As discussed in Section IV.D., potential effects of activities on these offshore leases to coastal habitats are projected to be very low. Furthermore, all postlease activities and onshore facilities will be subject to State consistency certification review.

*Endangered Species*

It is the policy of Alabama "to promote and encourage the preservation of the critical habitat of recognized endangered species" (Policy Statement, Sec. II.A.8., ACAMP).

The consultation process established under Section 7 of the Endangered Species Act reviewed possible impacts from leasing and exploration activities on endangered and threatened species and concluded that their continued existence and habitats are not likely to be jeopardized by activities on these leases.

Potential effects on species such as whales, brown pelicans, and loggerhead turtles are considered in this EIS and give reason for no significant concern regarding Alabama coastal areas. If concerns for any such species are later identified, Federal and State endangered species authorities will take steps to ensure their protection.

*Cultural Resources Protection*

"Because of the wealth of unique and representative archaeological and historic sites in coastal Alabama and their educational and cultural values," it is Alabama policy "to support preservation and protection of Alabama's cultural resources" (Policy Statement, Part II, Ch. 3, Sec.II.A.9., ACAMP).

Protection of cultural resources in coastal areas will be ensured by the State of Alabama through this policy and by local units of government through direct land use controls. Further, Federal laws such as the National Historic Preservation Act will protect onshore historic and prehistoric resources that might be affected by this lease sale. The State Office of Historic Preservation will have opportunities to consult with MMS on protection of onshore historic resources, if development is proposed on any lease.

*Policy Exceptions for Compelling Public Interest*

Uses that are determined to degrade the coastal area may be in compliance with the management program if the ADEM finds that there is a "compelling public interest." A compelling public interest is described as being more than mere convenience. It is a right recognized by law, or an economic, environmental health, or social interest shared by most persons in the coastal area and which, if not recognized and protected, would jeopardize the public well-being. The burden of proof that a particular use is of compelling public interest is upon the applicant. In any determination of compelling public interest, the ADEM must consider (a) significant national interest, (b) enhancement or protection of geographic areas of particular concern and areas of preservation and restoration, and (c) significant economic benefit factors. In each review, the ADEM finds whether the use is, on balance, consistent with the management program (see General Rules, Sec. B.2., ACAMP).

### *(2) Louisiana*

The sale analysis area adjacent to the submerged lands of the State of Louisiana is the Central Planning Area, made up of Central coastal Subareas C-1, C-2, and C-3, which extend offshore from the State 3-mi limit. Twenty-one coastal parishes of Louisiana are involved.

Appendix C2 of the Louisiana Coastal Zone Management Plan (LCZMP) outlines the rules and procedures for the State's local coastal management programs. Under the LCZMP, parishes are authorized, though not required, to develop local coastal management programs. Approval of these programs gives the parishes greater authority in regulating coastal development projects that entail uses of local concern. Priorities, objectives, and policies of use of local land use plans must be consistent with the policies and objectives of Act 361 and the State guidelines, except for a variance adopted in Section IV.D. of Appendix C2. The Secretaries of the Departments of Natural Resources and Wildlife and Fisheries may jointly rule on an inconsistent local program based on local environmental conditions or user practices.

State and Federal agencies first review parish programs before they are adopted. According to NOAA, the State of Louisiana has seven approved local coastal management programs (Lafourche, Jefferson, Calcasieu, Orleans, Cameron, St. Bernard, and St. James Parishes). Two others, St. Charles and St. Tammany, are pending NOAA approval. The parish police jury often serves as the permitting agency for projects limited to local concern. Parish level programs function in an advisory capacity to Louisiana's CZM agency, the Coastal Management Division. The energy facility planning process is comprehensively outlined in Appendix E of the LCZMP. Conflicts with local land use plans or ordinances are not expected to occur as a result of Sale 142, as existing onshore infrastructure is expected to be sufficient.

There is currently considerable local concern in the State of Louisiana about OCS waste onshore disposal practices. If OCS drilling and production wastes cannot meet the U.S. Environmental Protection Agency's NPDES effluent limitations or if these limitations require zero offshore discharge, offshore operational wastes must be transported to shore for onshore disposal.

New proposed effluent limitations and their changes to current disposal practices are discussed in Section IV.A.2.d.(5). It is expected that OCS waste resulting from Sale 142 leases would be properly disposed of in approved landfills onshore. Onshore disposal of offshore waste products would be in accordance with USEPA's proposed effluent regulations (40 CFR 435), which list preferred options for each type of waste.

Issues identified in LCZMP include the following: general coastal use guidelines; levees; linear facilities (pipelines); dredged spoil deposition; shoreline modifications, surface alteration, hydrologic and sediment transport modifications; waste disposal; uses that result in the alteration of waters draining into coastal waters; oil, gas, and other mineral activities; and air and water quality.

Assumptions fully discussed in Sections IV.A. and IV.C. indicate that proposed Sale 142 will generate the impacting factors discussed below. These factors will affect coastal issues identified in the LCZMP.

#### *Coastal Use Guidelines*

##### *Guidelines Applicable to All Uses (1.1 through 1.10)*

General guidelines provide basic policy direction for the use of subsequent guidelines. Guidelines 1.1 through 1.3 apply to the determination of consistency for this proposal. Guideline 1.2, consistency with incorporated air and water quality statutes and standards, is also addressed later in this discussion. Guidelines 1.4 and 1.5, regarding taking of property or violations of the terms of a grant of lands or water bottoms, are not applicable because no such activities are included or will result from this lease sale.

Guideline 1.6 lists the general factors that the permitting authority will use in evaluating whether a proposed use is consistent with other guidelines. Nineteen factors are listed. Examples are as follows:

"a) type, nature and location of use."

"b) elevation, soil and water conditions and flood and storm hazard characteristics of site."

"g) economic need for use and extent of impacts of use on economy of locality."

"j) existence of necessary infrastructure to support the use and public costs resulting from use."

"l) proximity to and extent of impacts on important natural features such as beaches, barrier islands, tidal passes . . . ."

"m) extent to which regional, state and national interests are served . . . ."

"p) proximity to and extent of impacts on public lands or historic, recreational or cultural resources."

Additionally, six of the factors deal with effects of the use. Much of the information cited above (e.g., factor b) concerns activities for which specific information is not available at the lease sale stage.

Guideline 1.7 lists 21 categories of adverse effects that potential land and water uses in the coastal zone should avoid creating, to the maximum extent possible.

As previously indicated, no new support facilities are expected in Louisiana's coastal zone as a result of this lease sale (EIS Base Case scenario). Transportation of equipment and materials to support offshore operations is expected to use existing navigation channels through coastal areas. These operations would have only minor incremental effects relative to existing facilities.

The primary factor of concern for sensitive coastal habitats is contact by accidental oil spills. An oil-spill risk analysis, detailed information concerning oil spills and spill containment and cleanup methods, is included in Section IV.C. Predictive results of a computer model run for the EIS analysis, described below and used throughout the rest of this document, assume that no efforts are made to contain or clean up spills or otherwise protect sensitive resources from spill contact.

The mean number of spills over 1,000 bbl estimated to occur in the Central Gulf from Sale 142 is 0.18. This EIS indicates that the sale could result in an approximate 2 percent probability of accidental spills greater than or equal to 1,000 bbl occurring and contacting the coast of Louisiana within 10 days. Further, oil spills greater than or equal to 1,000 bbl that may occur as a result of an accident during exploration or development activities are not assumed to contact coastal habitats proximal to the sale area.

There is no direct relationship between offshore oil and gas activities and wetlands destruction. Therefore, it is impossible to determine direct wetland impacts from a specific offshore activity. The MMS has no jurisdictional or permitting involvement in any possible coastal wetlands mitigation activities in the State of Louisiana. Coastal zone impacts are documented by the State in its Coastal Permitting Process.

Turner and Cahoon's (1987) estimates of OCS-related wetlands loss attributed a large amount of OCS-related wetland losses to the **indirect** effects of canals. They estimated the indirect impacts from OCS-related canals to account for 4 to 13 percent of the total amount of wetland loss that occurred in coastal Louisiana between 1955/1956 and 1978. This range was determined by dividing the length of OCS-related canal spoil banks by the length of all spoil banks in the coast, and multiplying this proportion times the total amount of wetlands loss that could not be accounted for in the direct losses attributable to canal dredging and urban/commercial/agricultural development. The MMS does not consider this indirect impact determination acceptable for several reasons.

First, as stated by Turner and Cahoon, OCS spoil banks may have been overestimated in their calculations because OCS canals and spoil banks tend to be larger and thus more visible on remote-sensing imagery than other canals and spoil banks. Additionally, Turner and Cahoon did not subtract losses related to sediment deprivation and rapid coastal submergence (factors many coastal researchers consider to be the most important causes of wetlands loss) from total wetlands loss before multiplying the total loss number by the proportion of OCS spoil banks. They, therefore, incorrectly attributed losses caused by sediment deprivation and submergence to the indirect impacts of canals. Finally, Turner and Cahoon did not incorporate the body of data generated by the study, much of which was relevant to the evaluation of indirect impacts, into their method of determining OCS indirect impacts.

To conclude, MMS considers the Turner and Cahoon estimates to be no more reliable or better supported by field data than any other attempts in the past to quantify the effects of indirect canal impacts.

Many researchers believe that restoring sediment to the wetlands would solve much of the land loss problem and even result in a significant wetlands gain (Cleveland et al., 1981).

The MMS has funded another study to determine the effects of pipeline and navigation channels on barrier beach erosion along the Gulf coast from Texas to the Florida panhandle (Wicker et al., 1989). This study showed zero-to-minimal impacts from OCS activities on the Louisiana barrier coast.

The MMS is currently funding additional research to evaluate the effects of backfilling OCS channels to restore living resources and enhance fisheries habitat. The MMS has also funded a major study of the effects of marsh management practices on wetlands (Cahoon and Groat, 1990).

No new nearshore pipelines are expected to be emplaced nor are new channels expected to be dredged. Maintenance dredging in existing navigation channels in Louisiana could adversely affect wetlands if the dredged material is disposed of in continuous spoil banks. New OCS-related pipeline and navigation channel projects in coastal Louisiana will occur much more infrequently than in the past because the network currently in place is adequate to accommodate oil and gas production from future resource development. One channel in the Port Fourchon area will be deepened to accommodate larger vessels. The potential contribution of support activities during exploration and/or production on these offshore leases, as compared to all navigation use of channels, is likely to be very small and will be subject to later State consistency certification review.

The northern Gulf coastal zone is one of the major recreational regions of the United States, particularly in connection with marine fishing and beach-related activities. Marine debris lost from operations associated with drilling and production offshore may occur from time-to-time; however, the effect of intermittent washup of debris on the recreational use of Louisiana beaches should be low. The regulations at 30 CFR 250.40 require that offshore operators handle, control, mark, and dispose of containers, equipment, and solid waste through stringent marking, equipment handling, and storage requirements. The MMS inspectors check for compliance with regulations during daily offshore inspections. Failure to comply with regulations leads to official warnings to take corrective action or, if warranted, to cease operations.

Deliberate disposal of any solid waste or garbage items anywhere in the marine environment is strictly prohibited under existing MMS, USEPA, and Coast Guard regulations. Because of increased concern over the prevalence and effects of persistent marine debris, both offshore and on coastal beaches, MMS issued a special advisory (NTL 86-11) in 1986 strongly encouraging the oil and gas industry to take special educational, operational, and awareness measures to reduce or eliminate the their contributions to marine debris in the Gulf of Mexico. Annex V of the International Convention for the Prevention of Pollution from Ships, also known as the MARPOL Protocol, prohibits the dumping of all plastic wastes, including plastic packaging materials and fishing gear, from all ships at sea. The MMS has established a policy that requires submission, for approval, of detailed plans for the disposal of all produced solids accumulated as a result of OCS activities (LTL dated November 20, 1990).

From information collected at beach cleanups and during marine debris surveys, it has been estimated that existing offshore oil and gas operations are responsible for 10-15 percent of the trash and debris adversely affecting the Gulf's shorefront recreational beaches in the CPA. Recent Federal regulations (33 CFR 151) stemming from MARPOL Annex V, as well as periodic MMS directives and information seminars on the debris issue, should lead to better waste handling and less accidental loss of materials and personal items into the marine environment from offshore oil and gas operations. Additionally, industry education and training emphasis on waste management, along with voluntary stewardship commitments by several major oil companies (the adoption of about 30 mi of Louisiana Gulf beaches and the reduction and recycling of waste materials generated offshore), will also be reflected in a positive way on Louisiana's beaches.

Activities on these offshore leases are not expected to have a significant effect on coastal fishery resources. In addition, the effects on fishery resources beyond the coastal zone are likely to be minimal. State review of consistency certifications of exploration and development and production plans will enable more detailed review of site-specific proposed activities as they relate to fisheries and fishing practices. Federal provisions concerning fisheries include the Fishermen's Contingency Fund, which requires payment to fishermen for documented damages, and 30 CFR 250.40, which requires the charting of subsea obstructions and the marking of equipment to establish liability for fisheries losses.

Biological stipulations proposed for the sale (discussed in Section II) contain special provisions for the regulation of discharges and the siting of facilities within offshore areas recognized as areas of exceptional biological productivity. These stipulations will help to protect fisheries resources. Studies of mud (NRC, 1983; Zingula, 1975; Menzie, 1983) and cutting discharges from offshore oil and gas operations show rapid dispersal by ocean currents with no long-term, significant biological effects.

An archaeological resource stipulation has been proposed that will require surveys for investigation and avoidance or protection of cultural resources on the OCS. The State Office of Historic Preservation will have opportunities to consult with MMS on protection of onshore historic resources, if development is proposed on any lease.

In addition, the lease sale may create new jobs and may generate other economic opportunities to the benefit of Louisiana and the Nation. An MMS-funded study (Laska, in progress) evaluates the effect of the downturn in the oil industry on the Gulf economy and investigates alternate uses of existing OCS infrastructure for economic development opportunities. Any change of existing social patterns in coastal Louisiana as a result of activities on these offshore leases is highly unlikely. The sale will result only in a continuation of existing facilities without notable alteration of social patterns because of currently unemployed and underemployed resources in the coastal zone. Jobs created as a result of the sale would likely reduce the amount of out-migration when compared to scenarios without the proposal. Economic considerations are also evaluated in the Secretarial Issue Document and the Decision Memorandum for this sale.

The cumulative effects of the proposed actions that relate to the LCZMP are addressed in Section IV.B. This evaluation meets the criteria of "cumulative" as used in Guideline 1.7 of the LCZMP because it projects all of the reasonably foreseeable effects of the sales, including exploratory drilling, platform installation, support vessel traffic, etc. A separate Cumulative Analysis required under NEPA considers a much broader scope of effects, including proposed Sale 142; subsequent OCS oil and gas sales that are considered reasonably foreseeable; prior OCS oil and gas sales; State oil and gas activity; crude oil imports by tankering; and all other major non-OCS activities and occurrences that may occur and affect a resource in question.

The proposed lease stipulations, MMS rules and regulations (including requirements for oil-spill contingency planning, use of blowout preventers, Best Available and Safest Technology, crew training, and other environmental safeguards), compliance with National Pollutant Discharge Elimination System (NPDES) permits and standards, and other available Federal regulatory mechanisms will effectively mitigate the possible effects of oil and gas activities. Should new onshore facilities be needed for development of these leases, they will be subject to State regulations and separate permits, including State consistency certification review.

Guideline 1.8 defines "to the maximum extent possible," a phrase that modifies many of the guidelines. A use or activity will be consistent, although not fully complying with a standard, if it meets several criteria relating to public benefit; or lacks feasible alternatives or serves important local, State or national interests; or is dependent on water. Federal regulations at 15 CFR 930.32 also define the term "maximum extent practicable" and recognizes there will be circumstances where full consistency with a State program is not possible.

Federal offshore oil and gas leasing serves an important national interest because future energy production resulting from OCS development will help to reduce the Nation's reliance on foreign imports. The LCZMP, through this policy, recognizes the relative importance of a national interest criterion in this guideline to the extent that, even if a use or activity does not fully comply with a standard, it is consistent "to the maximum extent possible."

Guideline 1.9 requires that uses be, to the maximum extent practicable, designed and carried out to permit multiple uses and to avoid use conflict. This lease sale, as pointed out earlier, may eventually result in an outcome that allows for multiple use and avoids use conflict. Offshore conflicts would be limited in scope because certain multiple-use areas are off limits to oil and gas activities (e.g., shipping fairways and selected military warning areas). Other multiple uses, such as boating and fishing, would result in only limited conflicts because of the small areal extent of space used by oil and gas operations.

*Guidelines for Levees (2.1 through 2.6)*

The guidelines for levees apply to those constructed in the coastal zone. No levee construction activities are expected to occur in Louisiana as a result of this lease sale. If any such activities were to be proposed in Louisiana, the State would have opportunities to review such proposals through consistency certifications of Corps of Engineers permits.

*Guidelines for Linear Facilities (3.1 through 3.16)*

Guidelines for linear facilities contain standards for State permitting of siting and installation of pipelines located in onshore or nearshore coastal areas. Most of the production from this lease sale is projected to be sent through existing trunklines for transportation to existing onshore processing facilities in the central and western Gulf coastal areas. No new pipeline landfalls or onshore pipeline projects are anticipated. There may be a small contribution (less than 5%) of barge and tanker operations transporting oil to offloading facilities located at onshore terminals in Louisiana. Any new pipeline construction crossing submerged State lands must be consistent with applicable State regulatory policies to ensure safety in construction and operation.

The Gulf Regional Technical Working Group (RTWG), which is an advisory committee, develops transportation plans for OCS areas. One of the purposes of this coordinated planning effort is to establish corridors for consolidating multiple pipelines, an effort aimed at minimizing seafloor obstructions and adverse environmental effects. These and other efforts of RTWG, which include representatives from the State of Louisiana, help to ensure effective coordination on postlease pipeline-related activities.

*Guidelines for Dredged Spoil Deposition (4.1 through 4.7)*

Guidelines apply to disposal of dredged material in the coastal zone. No new trunklines are expected from projected production on these offshore leases. No dredging solely related to activities taking place on Sale 142 leases is projected to occur. Maintenance dredging of existing canals through barrier passes to accommodate vessel traffic to support the proposed action could alter littoral dynamics in the vicinity of the channel and could affect erosion and deposition patterns. Field studies, however, have not substantiated that dredging has resulted in coastal barrier erosion. In fact, the disposal of dredged material into the coastal, littoral transport system can be used to nourish sediment-starved and eroding coastal barriers. One canal in the Port Fourchon area may be deepened. Should any future exploration or development of Sale 142 leases involve disposal of dredged material, the State will have an opportunity to review such activities in its consistency certification process.

*Guidelines for Shoreline Modifications (5.1 through 5.9)*

These guidelines apply to shoreline modification and protection structures and to harbor structures. No such activities or facilities are expected to result from exploration or development activities on Sale 142 leases. Given the availability of existing harbor space, no new shoreline modifications are likely to be needed. If unforeseen postlease support facilities are proposed, the State will have opportunities to conduct consistency certification reviews.

*Guidelines for Surface Alteration (6.1 through 6.14)*

Guidelines for surface alterations contain two general guidelines (6.1 and 6.5) regarding development in the coastal zone.

Guideline 6.1 encourages industrial, commercial, and other development in suitable areas of the coastal zone. Suitable areas are defined as (a) to the maximum extent practicable, lands 5 ft or more above sea level or fast lands; or (b) those lands where suitable foundation conditions and minimum flood and storm damage risk are already developed or where development would not unreasonably endanger public safety; (c) areas having adequate infrastructure; or (d) having a tradition of similar use. Guideline 6.5 states that coastal water-dependent uses shall be given special consideration in permitting because of the reduced choice of alternatives. Most major postlease activities or facilities in the coastal zone are coastal water-dependent and industrial in nature. The consistency certifications contained in exploration and development and production plans will enable the State to review these activities for consistency.

Other surface alteration guidelines (6.2, 6.4, 6.6 through 6.10, and 6.12 through 6.14) are similar in scope to guidelines affecting pipeline siting and construction. They address siting, construction techniques, design characteristics aimed at avoiding natural features, and alteration of critical and biological resources.

As indicated earlier, no new support facilities are hypothesized to occur in Louisiana's coastal zone. However, should they be needed, the State will have opportunities to conduct consistency certification reviews and issue separate permits.

*Guidelines for Hydrologic and Sediment Transport Modifications (7.1 through 7.9)*

Hydrologic and sediment transport modification guidelines apply to water control structures and marsh-building schemes in the coastal zone. Although these guidelines are not applicable to this lease sale *per se*, because no such structures or activities are included or are likely to result, should a lessee propose development activities involving such modifications, he must obtain an affirmative State consistency certification review and other State permits.

*Guidelines for the Disposal of Wastes (8.1 through 8.9)*

The guidelines for waste disposal apply to the location and operation of waste disposal facilities in the coastal zone and the generation, transportation, treatment, storage, and disposal of hazardous wastes. The requirements and standards in NPDES permits (40 CFR 122) and the regulatory requirements of MMS (30 CFR 250.42) protect the quality of offshore waters. A variety of solid wastes are brought onshore for disposal at nonhazardous oil-field waste (NOW) sites and landfills. Oil and gas waste are exempt from Federal hazardous waste regulations. Because of recent State regulations (LAC 33:IX.708, effective March 20, 1991), impacts from OCS produced waters should be minimized (Section IV.A.3.c.(4)(a)). Current levels of routine point source and nonpoint source discharges are expected to continue because no new infrastructure is projected (Section IV.A.), and no new sources are expected from this proposal.

The oil and gas industry is the dominant supporter and participant in the Louisiana beach adoption and cleanup program. Over three-fourths of Louisiana's adopted beaches and cleanup volunteers are directly associated with the oil companies (Amoco, Chevron, Conoco, CNG, Exxon, Fina, Kerr-McGee, Koch, LL&E, Mobil, Shell, and Texaco). Furthermore, a special subcommittee of the Offshore Operators (Waste Handling & Recycling) has been established to develop and to encourage industrywide strategies and procedures that will reduce and improve the handling of waste materials generated offshore. For example, many offshore oil and gas operators have eliminated the use of styrofoam drinking containers and food packaging materials and have increased the use of bulk containers and compactors. Some companies are testing and implementing comprehensive recycling projects for reusable waste generated offshore. Several ongoing surveys supported and conducted by government, industry, academia, and environmental groups will help monitor industry's record in handling, controlling, and disposing of solid waste and other items associated with offshore operations. The MMS has taken a leading role in establishing the Take Pride Gulf Wide campaign working through the

Gulf of Mexico Program, in which all Gulf user groups are encouraged through education and participation in stewardship projects to become part of the solution instead of the problem.

*Guidelines for Uses that Result in the Alteration of Waters Draining into Coastal Waters (9.1 through 9.3)*

The guidelines apply to water management programs and are not applicable to this lease sale because no such programs are included in or will result from this sale.

*Guidelines for Oil, Gas, and Other Mineral Activities (10.1 through 10.14)*

The guidelines for oil, gas, and other mineral activities address surveying, drilling, or refining activities in the coastal zone and are not applicable to exploration, development, and production activities on the OCS that may occur on Sale 142 leases.

However, some of the guidelines (10.3, 10.4, 10.9 through 10.12, and 10.14) could be applicable to the extent that these are defined as associated exploration, development, or production facilities or activities. Those guidelines that would apply to onshore facility development (10.3, 10.4, 10.9 and 10.10) are modified by the terms "to the maximum extent practicable" or "best practical techniques." The applicable requirement is for exploration and production facilities to be "designed and constructed using best practical techniques to minimize adverse environmental impacts" to the coastal zone.

The EIS analysis indicates that projected adverse impacts of hypothetical, future offshore exploration, development, and production operations on the Louisiana coastal zone are likely to be of a very low level. Further, all OCS exploration, development, and production activities and/or associated facilities will be subject to State consistency certification review if and when they are proposed.

Guideline 10.11 establishes an absolute requirement for environmental protection and emergency or contingency plans for all mineral operations in the coastal zone. Sale 142, however, will not result in any oil, gas, or other mineral operations in the State's coastal area, nor is there any expectation of new or expanded shore bases or refining facilities. Existing Federal regulations (30 CFR 250.33, 250.34, and 250.42) establish similar but more site-specific requirements for approval of such operations on OCS leases. An oil-spill contingency plan (OSCP) is one such requirement. The OSCP's must be submitted for approval with, or prior to, an exploration or development plan. The OSCP, outlining the availability of spill containment and cleanup equipment and trained personnel, is reviewed and updated annually. It must ensure that full response capability could be committed during an oil-spill emergency. This commitment would include specifications for appropriate equipment and materials, their availability, and the time needed for deployment. The plan must also include provisions for varying degrees of response effort, depending on the severity of a spill.

All OCS exploration or development and production plans will be subject to State consistency certification review and must describe how the operator proposes to comply with the environmental protection requirements of pertinent Federal statutory and regulatory requirements.

Guideline 10.12 prohibits the use of chemical agents on coastal zone oil spills without prior approval of the On-Scene Coordinator, in consultation with Louisiana and the USEPA, pursuant to the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR 112). This guideline duplicates similar Federal requirements.

Finally, Guidelines 10.13 and 10.14 address the restoration of mineral exploration or production sites and the avoidance of creating underwater obstructions in the coastal zone. No mineral exploration or production activities will be proposed in the coastal zone of Louisiana. However, on the OCS, offshore sites are subject to the Site Clearance requirements of MMS under NTL 90-01. Requirements established under this NTL ensure that any object (e.g., wellheads, platforms, etc.) installed on an OCS lease is properly removed and the site cleared so as not to conflict with other uses of the OCS.

*State Air and Water Quality Regulatory Provisions*

*Air Quality (Louisiana R.S. 30:1068, 1081-1087)*

State policy on air quality incorporated into the LCZMP is applicable to State onshore areas.

Section 5(a)(8) of the OCSLA grants DOI exclusive authority and responsibility to prescribe regulations requiring offshore sources of air emissions to be consistent with national ambient air quality standards to the extent offshore activities significantly affect the onshore air quality. Thus, the Department's regulations are the applicable air pollution control requirements of the LCZMP under Section 307(f) of CZMA for OCS emissions.

Oil and gas development and production activities on the OCS are required to meet Department air quality regulations (30 CFR 250.44, 250.45, and 250.46). These regulations require offshore lessees to determine through modeling whether their air emissions would result in onshore pollutant concentrations above Department-specified significance levels. If these levels are projected to be exceeded in an area where concentrations already exceed air quality standards, the lessee will be required to control fully or offset its emissions so that there would be no effect onshore. If the significance levels are exceeded in areas at present in compliance with standards, the lessee will be required to employ best available control technology (BACT). If predicted onshore concentrations still exceed a standard for the prevention of significant deterioration, measures beyond BACT will be required.

Because of trends in leasing farther offshore, the levels of activity adjacent to Louisiana parishes are not expected to be large as a result of this sale. This trend toward development farther offshore will result in greater dispersion of emissions, i.e., a very low level of impact.

Section 328 of the Clean Air Act (42 U.S.C. 7401-7642, as amended) directed DOI to conduct a research study examining the impacts from activities on the OCS adjacent to Texas, Louisiana, Mississippi, and Alabama on areas that fail to meet the Federal air quality standards for ozone (40 CFR 50). The MMS has been consulting with USEPA, the States, and others to design a study that will start in 1992. The study will have the following components: (1) a characterization of meteorological regimes associated with ozone episodes in nonattainment areas, (2) an evaluation of meteorological and air quality data from ozone modeling, (3) application of photochemical modeling to estimate impacts from OCS activities on ozone nonattainment areas, (4) a limited field program to collect meteorological data in offshore and coastal areas for future modeling applications, and (5) a set of recommendations for future monitoring and modeling activities.

In addition to the air quality study being planned in the Gulf of Mexico, MMS and USEPA have been consulting on the possibility of conducting a preliminary ozone study using the ROM model. A complete set of results and impact assessment will be made when the 3-year study is completed. The EIS (Sections IV.D.1.a.(4) and IV.D.2.a.(4)) reflects MMS's needs and commitment to gather information on ozone formation and dispersion from OCS emissions.

This EIS analysis (Section IV.A.2.d.(6)) indicates that offshore air emissions are not likely to cause degradation of onshore air quality and are not likely to have any significant effect on nonattainment or Prevention of Significant Deterioration Class I areas. Actual measures ordered by MMS will be determined after reviewing additional site-specific studies submitted by lessees, along with their exploration and development and production plans for approval.

*Water Quality (Louisiana R.S. 30:1068,* 1091-1096; 38:216)

The Federal Water Pollution Control Act (FWPCA) (33 U.S.C. 1251 et. seq., as amended) vests exclusive regulatory authority over discharges on the high seas to USEPA. Under Section 307(f) of CZMA, the applicable water pollution control requirements are those promulgated pursuant to the FWPCA. Inasmuch as Louisiana does not have USEPA approval to administer NPDES permits for coastal waters pursuant to that Act, USEPA's own regulations are the applicable water pollution control requirement of the LCZMP.

All OCS exploratory operations involving discharges will be conducted in compliance with NPDES permits (40 CFR 122) issued by the USEPA. Operational discharges (drilling muds and cuttings, produced waters, deck drainage, and sanitary and domestic wastes) may degrade water quality somewhat, changing measures from background levels, but with little effect to benthic and pelagic organisms in the water column, and then only very close to the source. (No oil-based drilling muds are allowed to be discharged into Federal waters.) The MMS established a policy that requires the submission, for approval, of detailed plans for the disposal of all produced solids accumulated as a result of OCS activities (LTL dated November 20, 1990). The impact to marine waters from oil and gas discharge activities on these offshore leases is considered to be low.

The NCP requires that the U.S. Coast Guard's OSC obtain the concurrence of the USEPA representative to the RRT and, as appropriate, the concurrence of the RRT representatives from the states having jurisdiction over the navigable waters threatened by the release or discharge; and that, when practicable, the OSC consult with the DOC and DOI natural resource trustees prior to authorizing the use of a chemical agent. Approved chemical agents must be listed on the NCP Product Schedule. The OSC is not required to obtain the aforementioned concurrence when, in the judgment of the OSC, the use of a chemical agent is necessary to prevent or reduce substantially a hazard to human life. Consistent with this, a Memorandum of Understanding, dated August 16, 1971, between the Department of the Interior and the Department of Transportation allows MMS the authority to grant OCS operators approval to use chemical agents within a 500-m radius of the source of pollution to abate the source of pollution only when such agents are deemed necessary as a measure for the safety of personnel and operations.

Several activities may adversely affect marine water quality on the OCS and, thus, potentially the coastal waters. Drilling operations, platform and pipeline installation, and platform removal operations may resuspend bottom sediments. Some water quality parameters may change from background levels with little effect to the benthic and pelagic life nearby, and then only very close to the source. The impact from these activities to marine water quality above the OCS is considered to be low.

Existing onshore infrastructure and associated coastal activities in support of oil and gas activities on these leases have the potential to contribute to a low extent to the degradation of regional coastal and nearshore water quality. The barge trips and service-vessel trips expected to occur in Louisiana (Base Case) may further impact water quality by routine release of bilge and ballast waters (estimated at 2,000 liters per day from service vessels) and low-level antifouling paints. Each activity provides only a small measure of continuous contamination. Discharge locations are widespread. Negligible saltwater intrusion could occur from maintenance dredging or deepening of existing navigation channels for large vessel requirements. Such dredging is likely to result in short-term, low-level impacts to the surrounding waters. All dredging would be pursuant to COE permits (33 CFR 330) or be conducted by COE itself, and would be subject to consistency determination from that agency.

No new service bases are expected to be constructed in Louisiana to support activities from Sale 142 leases. Therefore, no additional point or nonpoint sources of pollution are likely to result. Environmental impacts associated with normal service base use include runoff and spillage of fuels and chemicals from the facility, discharges from supply and crew boats, channel bank erosion from vessel traffic, and disturbance of bottom sediments from maintenance dredging. All new onshore facilities must be proposed in exploration or development and production plans, which the State will review for consistency certification. Separate State permits will also be necessary.

Accidental oil spills on the OCS may degrade water quality somewhat, changing measurements from background levels, but with little effect to the pelagic and benthic organisms in the water column and then only in a very limited area close to the source. Accidental oil spills may contribute to a local, low-level impact near some terminals and service bases where the spills have a more probable occurrence; regionally, adverse impacts from such accidental oil spills are assumed to be very low.

In both offshore and coastal areas, authorities cited above are sufficient to ensure that future operations related to the proposed lease sale will not adversely affect water quality.

### *(3) Mississippi*

The Sale 142 analysis area closest to the submerged lands of the State of Mississippi is Central coastal Area C-3, which extends offshore from the State 3-mi line. The Mississippi coastal counties are Hancock, Harrison, and Jackson.

According to NOAA, there are no approved local coastal management plans for the State of Mississippi. The Southern Mississippi Planning and Development District serves in an advisory capacity to the State coastal agencies. Conflicts with Mississippi local land use ordinances are not expected to occur as a result of Sale 142, as existing onshore infrastructure is expected to be sufficient.

Issues identified in the Mississippi Coastal Program (MCP) include the following: coastal wetlands; coastal industrial development; special management areas; air and water pollution; use of coastal water resources; scenic, historical and cultural resources; and fisheries management.

Assumptions fully discussed in Sections IV.A.4. and 5. and IV.C. indicate that proposed Sale 142 will generate the impacting factors discussed below. These factors will affect coastal issues identified in the MCP.

*Coastal Wetlands and Coastal Industrial Development*

Two relevant provisions of the MCP provide the following:

> It is the policy of Mississippi "to favor the preservation of the natural state of the coastal wetlands and to prevent the despoliation and destruction of them, except where a specific alteration of specific coastal wetlands would serve higher public interest in compliance with the public trust in which coastal wetlands are held" (Mississippi Code, Sec. 49-27-3). It is the policy of Mississippi "to provide for reasonable industrial expansion in the coastal area and to insure the efficient utilization of waterfront industrial sites so that suitable sites are conserved for water dependent industry" (Mississippi Code, Sec. 57-15-6(1)(2)).

*Onshore Facilities*

According to the Base Case scenario, no new service bases are expected to be located in coastal Subarea C-4, which includes portions of Mississippi's coastal zone. Onshore development would be subject to State regulation, but would generally be a permitted and encouraged use in the Industrial and Port Areas identified in the MCP. Should new onshore facilities be needed for development of leases, the facilities would be subject to State regulations and separate permits, including State consistency certification review. Such uses would generally be permitted and encouraged in the industrial and port areas identified in the MCP.

*Transportation Activities*

The MMS estimates that most of the production from this lease sale will be transported by new pipelines to existing trunk lines for transportation to existing onshore processing facilities in Mississippi and other Gulf States. No new pipeline landfalls or onshore pipeline projects are anticipated as a result of the Base Case scenario. Any new pipeline construction must be consistent with applicable State regulatory policies to ensure safety in construction and operation. It must also have an affirmative consistency certification review decision issued by the State.

The Gulf of Mexico RTWG, which was established to facilitate coordinated pipeline planning between the State and Federal agencies, would establish pipeline planning corridors to avoid adverse environmental effects. The operations of RTWG, which include representation from the State of Mississippi, will help to promote consistency with State wetlands management guidelines.

*Offshore Operations*

A spill resulting from offshore oil and gas operations could affect Mississippi coastal wetlands. See Section IV.D.1.e.(2)(Louisiana) for a relevant discussion of wetlands impacts and OCS oil and gas operations). Offshore activities would be located away from coastal wetlands. However, the probability of an oil spill greater than or equal to 1,000 bbl actually occurring and contacting within 10 days these wetlands areas is low (less than 0.5%). This EIS indicates that, under the Base Case scenario, no spills greater than or equal to 1,000 bbl are assumed to contact the Mississippi coast. However, in the event of such occurrence, the requirements for oil-spill prevention, oil-spill contingency planning and response, and the platform verification program mitigate against the possibility of adverse effects on the environment. An oil-spill contingency plan (30 CFR 250.42) must contain assurances that a full-response capability exists for commitment in the event of a spill. This plan includes specification of appropriate equipment and materials, their availability and deployment time, and provisions for varying degrees of response effort, depending on the severity of a spill. The platform verification program (30 CFR 250.131, 250.132, and 250.133) ensures that offshore oil and gas structures are designed, fabricated, and installed to prevent structural failure for the safe conduct of operations. In addition, the OCSLA requirement for use of best available and safest technologies (BAST) also helps to ensure protection of coastal wetlands.

Transportation of equipment and materials to support offshore operations is expected to use existing navigation channels through wetland areas. These operations would have only minor incremental effects relative to existing activities.

*Special Management Areas*

The MCP provides for regulation of activities in three categories of Special Management Areas (SMA's). One such category is designated Industrial and Port Areas; these include Port Bienville Industrial Park, Pass Christian Industrial Park, Bayou Bernard Industrial Park, Pascagoula River Industrial Park, Bayou Casotte Industrial Park, and the Moss Point Industrial Park. The State's policy on industrial and port areas is "to provide for reasonable industrial expansion in the coastal area and to ensure the efficient utilization of waterfront industrial sites so that suitable sites are conserved for water dependent industry" (Mississippi Code, Sec. 57-15-6(1)(a)). The other SMA categories are Urban Waterfronts and Shorefront Access Areas.

Among the SMA's identified in the MCP, areas reserved for port and industrial development are most relevant to these lease sales. Mississippi Code, Sec. 49-27-9, exempts water-dependent industry from the need to secure a permit for erection of structures on sites designated as suitable for it. In terms of this lease sale, no onshore development in Mississippi is hypothesized to result. Furthermore, any postlease onshore development in the Mississippi coastal zone would be subject to the State regulations and consistency certification review and concurrence.

*Other Provisions Incorporated into the MCP*

Certain regulatory provisions of the State program are not focused on a designated area basis. These include authorities of the State Air and Water Pollution Control Law, authorities to allocate surface waters and to control the use of groundwater, authorities concerning fisheries management, and authorities for protection of historical and cultural resources.

*Air and Water Pollution Control*

The MCP provides that it is the policy of the State of Mississippi "to conserve the air and waters of the state, and to protect, maintain and improve the quality thereof for public use, for the propagation of wildlife, fish and aquatic life, and for domestic, agricultural, industrial, recreational and other legitimate beneficial uses" (Ch. 1, Sec. 1.4, MCP).

State policy on air quality incorporated into the MCP is clearly applicable to State onshore areas. This EIS analysis indicates that activities related to Sale 142 leases (Section IV.A.2.d.(6)) will cause little degradation of onshore air quality with no significant effect on nonattainment or Prevention of Significant Deterioration Class I areas.

Section 5(a)(8) of the OCSLA grants DOI exclusive authority and responsibility to prescribe regulations requiring offshore sources of air emissions to be consistent with the Clean Air Act national ambient air quality standards to the extent offshore activities significantly affect the onshore air quality of a State. Thus, the Department's regulations are the applicable air pollution control requirements of the MCP under Section 307(f) of the CZMA for OCS emissions.

Oil and gas development and production activities on the OCS are required to meet Department air quality regulations (30 CFR 250.44, 250.45, and 250.46). The Department regulations require offshore lessees to determine through modeling whether their air emissions would result in onshore pollutant concentrations above Department-specified significance levels. If these levels are projected to be exceeded in an area where concentrations already exceed air quality standards, the lessee will be required to control fully or offset its emissions so that there would be no effect onshore. If the significance levels are exceeded in areas at present in compliance with standards, the lessee will be required to employ best available control technology (BACT). If predicted onshore concentrations still exceed a standard for the prevention of significant deterioration, measures beyond BACT will be required.

Section 328 of the Clean Air Act (42 U.S.C. 7401-7642, as amended) directed DOI to conduct a research study examining the impacts from activities on the OCS adjacent to Texas, Louisiana, Mississippi, and Alabama, on areas that fail to meet the Federal air quality standards for ozone (40 CFR 50). The MMS has been consulting with USEPA, the States, and others to design a study that will start in 1992. The study will have the following components: (1) a characterization of meteorological regimes associated with ozone episodes in nonattainment areas, (2) an evaluation of meteorological and air quality data from ozone modeling, (3) application of photochemical modeling to estimate impacts from OCS activities on ozone nonattainment areas, (4) a limited field program to collect meteorological data in offshore and coastal areas for future modeling applications, and (5) a set of recommendations for future monitoring and modeling activities.

In addition to the air quality study being planned in Gulf of Mexico, MMS and USEPA have been consulting on the possibility of conducting a preliminary ozone study using the ROM model. A complete set of results and impact assessment will be made when the 3-year study is completed. The EIS (Sections IV.D.1.a.(4) and IV.D.2.a.(4)) reflects MMS's needs and commitment to gather information on ozone formation and dispersion from OCS emissions.

Each offshore facility is reviewed individually to determine if its emissions will cause a significant effect onshore. Further controls may be required if several facilities combine to create a significant effect. Actual measures ordered by the Department will be determined after additional site-specific studies by lessees and submission of operational plans for approval.

The Clean Water Act (33 U.S.C. 1251 et. seq., as amended) vests exclusive regulatory authority over discharges on the high seas in USEPA. Under Section 307(f) of the CZMA, USEPA regulations concerning water pollution control are the applicable water pollution control requirements of the MCP for OCS discharges.

The NCP requires that the U.S. Coast Guard's OSC obtain the concurrence of the USEPA representative to the RRT and, as appropriate, the concurrence of the RRT representatives from the states having jurisdiction over the navigable waters threatened by the release or discharge; and that, when practicable, the OSC consult with the DOC and DOI natural resource trustees prior to authorizing the use of a chemical agent. Approved chemical agents must be listed on the NCP Product Schedule. The OSC is not required to obtain the aforementioned concurrence when, in the judgement of the OSC, the use of a chemical agent is necessary to prevent or reduce substantially a hazard to human life. Consistent with this, a Memorandum of Understanding dated August 16, 1971, between the Department of the Interior and the Department of Transportation allows MMS the authority to grant OCS operators approval to use chemical agents within a 500-m radius of the source of pollution to abate the source of pollution only when such agents are deemed necessary as a measure for the safety of personnel and operations.

The MMS established a policy that requires the submission, for approval, of detailed plans for the disposal of all produced solids accumulated as a result of OCS activities (LTL dated November 20, 1990). Discharges within State waters are regulated by the NPDES permit system (40 CFR 122) administered by the State of Mississippi pursuant to delegation by USEPA.

No new service bases will be constructed in Mississippi according to the Base Case scenario. Therefore, no additional point source and nonpoint sources of pollution will be created.

In both offshore and coastal areas, authorities cited above are sufficient to ensure that future operations related to the proposed lease sales will not adversely affect water quality.

*Use of Coastal Water Resources*

It is the policy of the State of Mississippi "to put to beneficial use to the fullest extent of which they are capable the water resources of the state, and to prevent the waste, unreasonable use, or unreasonable method of use of water" (Ch. 1, Sec. 1.5, MCP).

Development on the Mississippi OCS will make minimal demands on freshwater supplies. Typically, to about 1,000 ft, only seawater is used in the Gulf for drilling an offshore well; between 1,000 and 6,000 ft, only seawater gel mud is used; at greater depths, a lignosulfonate mud is substituted. Freshwater supplies are required, however, for domestic uses of personnel working on offshore platforms. No new service bases would be constructed; instead, freshwater would be drawn from surface or groundwater sources at existing service bases in Mississippi or other Gulf states, depending upon the proximity of support facilities. The quantity of potable water needed for offshore operations can be significant in water shortage areas but should be insignificant in an area such as coastal Mississippi. Activities on Sale 142 leases are not likely to cause waste, unreasonable use, or unreasonable method of use of water.

*Scenic, Historical, and Cultural Resources*

It is the policy of the State of Mississippi "to preserve the state's historical and archaeological resources, to prevent their destruction, and to enhance these resources wherever possible" (Ch. 1, Sec. 1.6, MCP). Further, it is the policy of the State "to encourage the preservation of natural scenic qualities in the coastal area" (Mississippi Code, Sec. 57-15-6(1)(d)).

The MCP establishes policies for protecting scenic, historic, and cultural resources. An archaeological resource stipulation has been proposed that will require surveys for investigation and avoidance or protection of cultural resources on the OCS. The State Office of Historic Preservation will have opportunities to consult with MMS on protection of onshore historic resources, if development is proposed on any lease. No major spill is assumed to contact the coast of Mississippi as a result of this lease sale.

Marine debris lost from OCS operations associated with drilling and production throughout the Central Gulf over the lease life may occur from time to time, but the effect of intermittent washup of debris on the recreational use of Mississippi beaches should be low. The regulations at 30 CFR 250.40 require that offshore operators handle, control, mark, and dispose of containers, equipment, and solid waste through stringent marking, equipment handling, and storage requirements. The MMS inspectors check for compliance with regulations during daily offshore inspections. Failure to comply with regulations leads to official warnings to take corrective action or, if warranted, to cease operations.

From information collected at beach cleanups and during marine debris surveys, it has been estimated that existing offshore oil and gas operations are responsible for 10-15 percent of the trash and debris adversely affecting the Gulf's shorefront recreational beaches in the CPA. Recent Federal regulations (33 CFR 151) stemming from MARPOL Annex V, as well as periodic MMS directives and information seminars on the debris issue, should lead to better waste handling and less accidental loss of materials and personal items into the marine environment from offshore oil and gas operations. Additionally, industry education and training emphasis on waste management along with voluntary stewardship commitments by several major oil companies (the adoption of about 30 mi of Louisiana Gulf beaches and the reduction and recycling of waste materials generated offshore) will also be reflected in a positive way on Mississippi's beaches.

*Fisheries Management*

It is the policy of the State "to protect, propagate and conserve the state's seafood and aquatic life in connection with the revitalization of the seafood industry of the State of Mississippi" (Ch. 1, Sec. 1.3, MCP).

The Bureau of Marine Resources (BMR) is responsible for enforcement of the Mississippi fisheries code, although the MCP reserves this topic for future development of specific coastal guidelines. Activities on these offshore leases are not expected to have a significant effect on coastal fishery resources. In addition, the effects on fishery resources beyond the coastal zone are likely to be minimal. Potential oil-spill effects on fishery resources are minimal, according to this EIS. State review of consistency certifications of exploration and development and production plans will enable more detailed review of site-specific proposed activities as they relate to fisheries and fishing practices. Federal provisions concerning fisheries include the Fishermen's Contingency Fund, which requires payment to fishermen for documented damages, and 30 CFR 250.40 requirements, which require the charting of subsea obstructions and the marking of equipment to establish liability for fisheries losses and other pollution prevention measures.

*Consideration of National Interest in Siting of Energy Facilities*

The MCP provides that it is the policy of the State of Mississippi "to consider the national interest involved in planning for and in the siting of facilities in the coastal area" (Mississippi Code, Sec. 57-15-6 (1)(C)). Chapter 7, Sec. 1, and Chapter 9, Sec. 7, of the MCP indicate that this policy is to apply to, although it is not limited to, the siting of energy facilities, including offshore oil and gas facilities.

Federal offshore oil and gas leasing serves the national interest because future energy production resulting from OCS development will help to reduce the Nation's reliance on foreign imports. In addition, the lease sales may create new jobs and may generate other economic opportunities to the benefit of the State of Mississippi and the Nation. The MCP, through this policy, recognizes the national interest involved in the development of coastal energy facilities that often result from OCS offshore exploration and development. As described in Section IV.A., this lease sale is not expected to result in construction of new onshore support facilities in the coastal areas of Mississippi.

## *(4) Texas*

The sale analysis area closest to the submerged lands of the State of Texas includes Western offshore Subareas W-1, W-2, and W-3, which extend offshore from the State's 3-marine league line.

The Texas Legislature has distributed authority for coastal resource management among 14 State agencies (Appendix III, Coastal Responsibilities of Texas State Agencies, Texas Coastal Management Plan, January 1991). Conflicts with local land use goals or planning are not expected to occur as a result of Sale 142, as existing onshore infrastructure is expected to be sufficient.

The Texas Coastal Management Plan (TCMP) (State-approved plan) includes the following coastal resource issues: coastal erosion/dune protection, beach access, wetlands loss and degradation, oil spills, marine debris, freshwater inflow, nonpoint-source pollution, and hazardous waste generation and disposal.

Based on assumptions fully discussed in Sections IV.A. and IV.C., the impacting factors generated by the proposed sale are discussed below. These factors will affect coastal issues identified in the TCMP.

*Coastal Erosion/Dune Protection and Beach Access*

No new support facilities, pipeline landfalls, or onshore pipeline projects are anticipated in Texas as the result of activities on offshore leases (Base Case). Several deep-water pipelines will be constructed on Matagorda Island along the Texas coast and towed into deep-water areas off Texas and Louisiana. No new channels are expected to be dredged. One channel in the Corpus Christi area (coastal Subarea W-1) will be deepened to 6.7 m (22 ft) to accommodate larger vessels. Transportation of equipment and materials to support offshore operations is expected to use existing navigation channels through coastal areas (Brazos Santiago Pass, Port Mansfield Cut, Matagorda Ship Channel, Yarborough Pass, Aransas Pass, Corpus Christi Ship Channel, Freeport Harbor Channel, Houston/Texas City/Galveston Ship Channels, and Sabine Pass Ship Channel). These operations would have only minor incremental effects relative to existing facilities. If any hypothesized, postlease onshore development were to occur in Texas, it would be subject to control by applicable State regulations. The Texas General Land Office is responsible for technical assistance and compliance under the Dune Protection Act and for implementation of the Texas Coastal Preserve Program with the Texas Parks and Wildlife Department. The Texas Attorney General's Office protects the public's beach access rights and can bring suit on behalf of other State agencies to enforce State laws.

*Wetlands Loss and Degradation*

Wetlands and submersed grassbeds are essential to the biological productivity of the Texas coastal zone. Given the availability of existing harbor space, no new shoreline modifications are likely to be needed. Additionally, no pipelines are proposed to cross Texas lands. If any new onshore facilities are proposed for development of offshore leases, potential effects to wetlands and submersed grassbeds in the State's coastal zone will be subject to State regulatory review. The TCMP identifies the Texas Parks and Wildlife Department as the State agency that would monitor and enforce a policy of no net loss of wetlands. The Texas Water Commission and the General Land Office would also coordinate with them in this effort.

Coastal zone biological resources may be affected by oil spills associated with offshore operations. Prevention and containment and cleanup of oil spills are addressed through various Federal mitigation and regulation measures (30 CFR 250.42). Such measures include MMS requirements for an oil-spill contingency plan, prevention, and response; the platform verification program; and the general OCSLA requirement to apply the best available and safest technologies (BAST). The MMS requires that oil-spill contingency plans ensure that a full-response capability exists for containment in the event of an oil spill, including specification of appropriate equipment and materials, their availability and deployment time, and provisions for varying degrees of response effort, depending on the severity of the spill. The USEPA's development and implementation of the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR 112) and correlative regional plans are designed to provide a coordinated and integrated response by Federal and State agencies to protect the environment from the damaging effects of accidental oil spills and pollution discharges.

Maintenance dredging in existing navigation channels in Texas could adversely affect wetlands if the dredged material were disposed of in continuous spoil banks. The potential contribution of support activities during exploration and/or production on these offshore leases as compared to all navigation use of channels, is likely to be very small and will be subject to later State regulatory review. The Texas Department of Highways and Public Transportation is responsible for acquiring easements and rights-of-way from the General Land Office for channel expansion, relocation, or alteration.

*Oil Spills*

The primary factor of concern for sensitive coastal habitats is contact by accidental oil spills. An oil-spill risk analysis, detailed information concerning oil spills and spill containment and cleanup methods, is included in Section IV.C. Predictive results of a computer model run for the EIS analysis assume that no efforts are made to contain or clean up spills or otherwise protect sensitive resources from spill contact.

The mean number of spills greater than or equal to 1,000 bbl estimated to occur in the Western Gulf from proposed Sale 143 is 0.07. The EIS indicates that the sale could result in an estimated 0.05 percent probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting the coast of Texas within 10 days.

An OSCP must be submitted for approval to MMS with, or prior to, an exploration or development plan (30 CFR 250.33, 250.34, and 250.42). This OSCP, outlining the availability of spill containment and cleanup equipment and trained personnel, is reviewed and updated annually. It must ensure that full-response capability could be committed during an oil-spill emergency. This commitment would include specification for appropriate equipment and materials, their availability, and the time needed for deployment. The plan must also include provisions for varying degrees of response effort, depending on the severity of a spill.

*Marine Debris*

The State of Texas Gulf coastal zone is one of the major recreational regions of the United States, particularly in connection with marine fishing and beach-related activities. As indicated in Section IV.A.1., onshore support is expected to be provided from existing facilities. Marine debris lost from OCS operations associated with drilling and production throughout the 35-year life of the lease may occur from time to time, but the effect of intermittent washup of debris on the recreational use of Texas beaches should be low. The regulations at 30 CFR 250.40 require that offshore operators handle, control, mark, and dispose of containers, equipment, and solid waste through stringent marking, equipment handling, and storage requirements. The MMS inspectors check for compliance with regulations during daily offshore inspections. Failure to comply with regulations leads to official warnings to take corrective action or, if warranted, to cease operations.

Deliberate disposal of any solid waste or garbage items anywhere in the marine environment is strictly prohibited under existing MMS, USEPA, and Coast Guard regulations. Because of increased concern with the prevalence and effects of persistent marine debris both offshore and on coastal beaches, MMS issued a special advisory (NTL 86-11) in 1986 strongly encouraging the oil and gas industry to take special educational, operational, and awareness measures designed to reduce or eliminate their oil and gas industry's contributions to marine debris in the Gulf of Mexico. Annex V of the International Convention for the Prevention of Pollution from Ships, also known as the MARPOL Protocol, prohibits the dumping of all plastic wastes, including plastic packaging materials and fishing gear, from all ships at sea. The MMS has established a policy that requires the submission, for approval, of detailed plans for the disposal of all produced solids accumulated as a result of OCS activities (LTL dated November 20, 1990).

From information collected at beach cleanups and during marine debris surveys, it has been estimated that existing offshore oil and gas operations are responsible for 10-15 percent of the trash and debris adversely affecting the Gulf's shorefront recreational beaches in the WPA. Recent Federal regulations (30 CFR 151) stemming from MARPOL Annex V, as well as periodic MMS directives and information seminars on the debris issue, should lead to better waste handling and less accidental loss of materials and personal items into the marine environment from offshore oil and gas operations. Additionally, industry education and training emphasis on waste management, along with voluntary stewardship commitments by several major oil companies (the adoption of about 30 mi of Louisiana Gulf beaches and the reduction and recycling of waste materials generated offshore), will also be reflected in a positive way on Texas' beaches.

*Freshwater Inflow, Nonpoint Source Pollution, and Hazardous Waste Generation and Disposal*

Potable water will be needed for domestic uses of personnel living on offshore platforms. However, the EIS estimates that no new service bases are likely to be constructed. The quantity of freshwater needed for offshore operations on these leases is likely to be insignificant in an area such as coastal Texas. The Texas Water Commission has the responsibility of overseeing surface water rights.

The quality of nearshore and offshore waters is protected through standards and requirements for NPDES permits (40 CFR 122), as mandated in the Federal Water Pollution Control Act (33 U.S.C. 1251 et. seq., as amended). Marine water quality is protected through regulatory requirements, monitoring, and enforcement actions of MMS and USEPA. Discharges in coastal areas are also subject to regulation by the Texas Water Commission and Texas Water Development Board.

No onshore water quality degradation is likely to occur in Texas as a result of activities on offshore leases because no new service bases are likely to be constructed in Texas (Base Case). Therefore, no additional point source and nonpoint sources of pollution are likely to result. In the unlikely event of any such occurrence, numerous Federal and State water pollution control regulations for mitigating any potential adverse effects exist.

Operational discharges (drilling muds and cuttings, produced waters, deck drainage, and sanitary and domestic wastes) may degrade water quality somewhat, changing measurements from background levels, but with little effect to benthic and pelagic organisms in the water column, and then only very close to the source. (No oil-based drilling muds are allowed to be discharged into Federal waters.) The impact to marine waters from oil and gas discharge activities on these offshore leases is considered to be low.

The NCP requires that the U.S. Coast Guard's OSC obtain the concurrence of the USEPA representative to the RRT and, as appropriate, the concurrence of the RRT representatives from the states having jurisdiction over the navigable waters threatened by the release or discharge; and that, when practicable, the OSC consult with the DOC and DOI natural resource trustees prior to authorizing the use of a chemical agent. Approved chemical agents must be listed on the NCP Product Schedule. The OSC is not required to obtain the aforementioned concurrence when, in the judgement of the OSC, the use of a chemical agent is necessary to prevent or reduce substantially a hazard to human life. Consistent with this, a Memorandum of Understanding, dated August 16, 1971, between the Department of the Interior and the Department of Transportation allows

MMS the authority to grant OCS operators approval to use chemical agents within a 500-m radius of the source of pollution to abate the source of pollution only when such agents are deemed necessary as a measure for the safety of personnel and operations.

Several activities may adversely affect marine water quality on the OCS and, thus, potentially the coastal waters. Drilling operations, platform and pipeline installation, and platform removal operations may resuspend bottom sediments. Some measures of water quality parameters may change from background levels with little effect to the benthic and pelagic life nearby, and then only very close to the source. The impact from these activities to marine water quality above the OCS is considered to be low. Existing onshore infrastructure and associated coastal activities in support of oil and gas activities on these leases have the potential to contribute to a low extent to the degradation of regional coastal and nearshore water quality. The barge trips and service-vessel trips expected to occur in Texas (Base Case) may further impact water quality by the routine release of bilge and ballast waters (estimated at 2,000 liters per day from service vessels) and low-level antifouling paints. Each activity provides only a small measure of continuous contamination. Discharge locations are widespread. Negligible saltwater intrusion could occur from maintenance dredging of existing navigation channels. Such dredging is likely to result in short-term, low-level impacts to the surrounding waters.

The MMS has established a policy that requires the submission, for approval, of detailed plans for the disposal of all produced solids accumulated as a result of OCS activities (LTL dated November 20, 1990). The USEPA's development and implementation of the National Oil and Hazardous Substances Pollution Contingency Plan and correlative regional plans are designed to provide a coordinated and integrated response by Federal and State agencies to protect the environment from the damaging effects of pollution discharges. Deliberate disposal of any solid waste or garbage items anywhere in the marine environment is strictly prohibited under existing MMS, USEPA, and Coast Guard regulations. The Texas Department of Health regulates programs to protect and promote public health, including those addressing the issue of solid waste. The Texas Water Commission regulates hazardous and industrial solid waste management.

In both offshore and coastal areas, authorities cited above are sufficient to ensure that future operations related to the proposed lease sale will not adversely affect water quality.

## 2. Proposed Western Gulf Sale 143

Proposed Western Gulf Sale 143 is scheduled to be held in August 1993. A detailed description of the proposal is included in Section I.A. Alternatives to the proposed action and mitigating measures are described in Section II.B.

The analyses of impacts are based on scenarios for the Base Case, High Case, and Cumulative Case. These scenarios were formulated to provide sets of assumptions and estimates on the amounts, locations, and timing for OCS exploration, development, and production operations and facilities, both offshore and onshore. These are estimates only and not predictions of what will happen as a result of holding this proposed sale. A detailed discussion of the development scenarios and major, related impact-producing factors is included in Sections IV.A. and B. The four potential mitigating measures (Live Bottom (Pinnacle Trend), Topographic Features, Archaeological Resources, and Military Areas Stipulations) are considered part of the proposed action for analysis purposes.

### a. Alternative A - The Proposed Action

To facilitate the analysis, the Federal offshore area is divided into subareas. The WPA comprises three subareas (W-1, W-2, and W-3) and the coastal region is divided into two coastal subareas (W-1 and W-2). These subareas are delineated on Figure IV-1.

## *(1) Impacts on Sensitive Coastal Environments*

### *(a) Coastal Barrier Beaches*

The major impact-producing factors associated with the proposed action that could affect barrier landforms include oil spills, pipeline emplacements, navigation canal dredging and maintenance dredging, and support infrastructure construction. These impact-producing factors have been discussed in Section IV.D.1.a.(1)(a) and are briefly summarized below.

Oil spills can affect barrier beach stability if cleanup operations remove large quantities of sand, and if the oil contacts and damages sand dune vegetation. The *Alvenus* tanker spill of 1984 provides an example of the possible impacts from an oil spill greater than or equal to 1,000 bbl on coastal barriers in the WPA. The size of this spill (as much as 65,000 bbl) ranks it as one of the largest to have occurred in the Gulf. The greatest accumulation of oil from the spill occurred on middle and western Galveston Island. Road graders were used to move beached oil above the high tide zone. In all, 75,000 $m^3$ of sand were removed from the beach (in comparison, Hurricane Alicia, a major Gulf storm, is estimated to have removed 750,000 $m^3$ of sand). The beach profile changed slightly as a result of the sand removal project, but this change was undetectable after a few spring tides.

Pipeline landfalls across barrier islands have been identified as possible sites of weakness where an island could be breached during storm conditions or where accelerated erosion could thin the island. A recently completed, MMS-funded study, however, showed no minimal impacts to barrier beaches as a result of pipeline crossings (Wicker et al., 1989) in the coastal area affected by the proposed action.

The dredging of new navigation channels through barrier beaches or the stabilization and deepening of barrier inlets or passes could affect barrier landform stability by serving as a sediment sink, depriving beach areas downdrift from the channel or jetty of beach sediments needed for stability. A recently completed MMS study of the navigation channel impacts on barrier beaches indicated accelerated erosion near channels immediately downdrift from a jetty (Wicker et al., 1989).

The construction of new onshore support facilities could result in loss of barrier habitat and the possible need to stabilize the beach from subsequent erosion to protect the construction. Previous studies have shown that efforts to stabilize and "armor" beaches can lead to accelerated erosion.

*Base Case Analysis*

Oil spills associated with the proposed action can occur from a number of sources. Spills can occur offshore as a result of platform accidents, barge or tanker collisions, and pipeline breaks. Spills can also occur inshore as a result of barge, pipeline, and storage tank accidents.

According to Table IV-22, there is less than a 0.5 percent chance of an offshore spill greater than or equal to 1,000 bbl occurring and contacting a coastal barrier within 10 days. Based on this low probability, the assumption is that no spills greater than or equal to 1,000 bbl from offshore sources will occur and contact a coastal barrier. Furthermore, no spills greater than or equal to 1,000 bbl from shuttle tankers in port are assumed to occur under the Base Case scenario.

No offshore spills less than 1,000 bbl are assumed to occur and contact the coast during the 35-year life of the proposed action (Section IV.C.1.). No coastal spills greater than 50 bbl and less than 1,000 bbl are assumed to occur under the Base Case scenario in the WPA. Several spills greater than 1 and less than or equal to 50 bbl are assumed to occur inshore as a result of barge accidents near terminals. There are several ports located behind barrier islands from Matagorda Bay to Sabine Pass that receive barged oil. Further, two terminals in western Louisiana receive oil produced in the WPA (Table IV-16). It is assumed that a few spills near these terminals will occur. The small slick produced as a result of a less-than-50-bbl spill will evaporate and spread as it is transported across a bay or sound before reaching the back side of an island. A small percentage of the oil could also be transported through a barrier channel to the seaward side of the island. The small amount of oil that contacts the beach would be manually cleaned within a week with no removal of beach sand. Furthermore, it is assumed that the Padre Island National Seashore along the South Texas coast will not be contacted by the spill associated with the Base Case because no oil terminals occur in the area (Table IV-16), no oil pipelines make landfall in the area (Visual No. 1), and the offshore area is gas, rather than oil, prone.

Oil from these spills is not assumed to affect sand dune vegetation. In the area, dune line heights range from 0.5 to 1.3 m above mean high tide levels. For tides to reach or exceed these levels, strong southerly winds would have to persist for an extended period prior to or immediately after the spill. An analysis of 37 years of tide gauge data from Grand Isle, Louisiana (data are also available for Galveston, Texas, but have not yet been analyzed), shows that the probability of water levels reaching sand dune elevations ranges from 0 to 16 percent. The combined probabilities of a small spill associated with the proposed action and tidal inundation of sand dune vegetation are a very unlikely event. In addition, the strong winds required to produce the high tides would disperse and spread the oil slick and reduce oil concentrations along the coast. Furthermore, a recent study in Texas has shown that the disposal of oiled sand on vegetated sand dunes had no deleterious effects on the existing vegetation or on the recolonization of the oiled sand (Webb, 1988). Given all of these considerations, it is assumed that oil spills will not affect sand dune vegetation.

No new pipeline landfalls are projected to occur under the Base Case scenario (Table IV-11). Furthermore, in the event of a pipeline landfall as a result of an unforeseen hydrocarbon discovery, modern techniques of pipeline emplacement and planning procedures can reduce pipeline crossing impacts to negligible (LeBlanc, 1985; Mendelssohn and Hester, 1988; Wicker et al., 1989).

No new navigation facilities or infrastructure is expected under the Base Case scenario (Table IV-13); therefore, impacts from these activities are precluded. Some periodic maintenance dredging of navigation channels through barrier passes is expected, but this activity has not been documented as having a noticeable effect on barrier morphology. Furthermore, the contribution of the Base Case scenario to the vessel traffic within navigation channels is very small (Table IV-6), so that only a small percentage of maintenance dredging can be attributed to activities associated with the Base Case.

Section IV.A.3.c.(3)(c) states that a channel in onshore Subarea W-1 (the Corpus Christi, Texas, area) will be deepened to 6.7 m (22 ft) to provide access for larger service vessels that are expected to be used for deep-water operations. Navigable barrier passes in this area exceed this depth. It is assumed that channel deepening will occur in waterways located behind barrier islands that provide access to support base locations. Deepening the channel will not affect barrier islands.

*Summary*

Although a few spills greater than 1 and less than or equal to 50-bbl are assumed to occur in coastal areas of the WPA and contact barrier landforms, these spills will result in only a light oiling of a small stretch of back-barrier beach. The spilled oil will be cleaned manually within a week with no effects on beach morphology.

Impacts from onshore and nearshore construction of OCS-related infrastructure (pipeline landfalls, navigation channels, service bases, platform yards, etc.) are not expected to occur, because no new infrastructure construction is anticipated as a result of the proposed action. Although some maintenance dredging is expected to occur, this activity has not been shown to have a negative impact on barriers, and the need for dredging cannot be attributed to the small percentage of vessel traffic in these channels accounted for by Base Case activities.

*Conclusion*

The proposed action is not expected to result in permanent alterations of barrier beach configurations, except in localized areas downdrift from channels that have been dredged and deepened. The contribution to this localized erosion is expected to be less than 1 percent.

*High Case Analysis*

According to Table IV-22, there is less than a 1 percent chance of an offshore spill greater than or equal to 1,000 bbl occurring and contacting a coastal barrier within 10 days. The assumption based on this low probability is that no spills greater than or equal to 1,000 bbl from offshore sources will contact a coastal barrier. Furthermore, no spills greater than or equal to 1,000 bbl from shuttle tankers in port are assumed to occur under the High Case scenario.

No offshore spills less than 1,000 bbl are assumed to occur and contact the coast during the 35-year life of the proposed action (Section IV.C.1.). No coastal spills greater than 50 and less than 1,000 bbl are assumed to occur inshore under the High Case scenario (Section IV.C.1.). Several spills greater than 1 and less than or equal to 50 bbl are assumed to occur inshore as a result of barge accidents near terminals. There are several ports located behind barrier islands from Matagorda Bay to Sabine Pass that receive barged oil. In addition, two terminals in western Louisiana receive oil produced in the WPA (Table IV-16). It is assumed that one spill near one of these terminals will occur. The small slick produced as a result of a less-than-50-bbl spill will evaporate and spread as it is transported across a bay or sound before reaching the back side of an island. The small amount of oil that contacts a beach would be cleaned manually within a week with no removal of beach sand. No impacts from these small spills are assumed to occur. Furthermore, it is assumed that the Padre Island National Seashore along the South Texas coast will not be contacted by the spill associated with the High Case because no oil terminals occur in the area (Table IV-16), no oil pipelines make landfall in the area (Visual No. 1), and the offshore area is gas, rather than oil, prone.

Oil from these small spills is not assumed to affect sand dune vegetation. In the area, dune line heights range from 0.5 to 1.3 m above mean high tide levels. For tides to reach or exceed these levels, strong southerly winds would have to persist for an extended period prior to or immediately after the spill. An analysis of 37 years of tide gauge data from Grand Isle, Louisiana (data are also available for Galveston, Texas, but have not yet been analyzed), shows that the probability of water levels reaching sand dune elevations ranges from 0 to 16 percent. The combined probabilities of a small spill associated with the proposed action and tidal inundation of sand dune vegetation are a very unlikely event. In addition, the strong winds required to produce the high tides would disperse and spread the oil slick and reduce oil concentrations along the coast. Furthermore, a recent study from Texas has shown that the disposal of oiled sand on vegetated sand dunes had no deleterious effects on the existing vegetation or on the recolonization of the oiled sand (Webb, 1988). The assumption based on all of these considerations is that oil spills will not affect sand dune vegetation.

No new pipeline landfalls are projected to occur under the High Case scenario (Table IV-13). Furthermore, in the event of a pipeline landfall as a result of an unforeseen hydrocarbon discovery, modern techniques of pipeline emplacement and planning procedures can eliminate pipeline crossing impacts (LeBlanc, 1985; Mendelssohn and Hester, 1988; Wicker et al., 1989).

No new navigation facilities or infrastructure are expected to be dredged under the High Case scenario (Table IV-13); therefore, impacts from these activities are precluded. Some periodic maintenance dredging of navigation channels through barrier passes is expected, but this activity has not been documented as having a noticeable effect on barrier morphology. Furthermore, the contribution of the High Case scenario to the vessel traffic within navigation channels is estimated to be only 0.4 percent, so that only a small percentage of maintenance dredging can be attributed to activities associated with the High Case.

Section IV.A.3.c.(3)(c) states that a channel in onshore Subarea W-1 (the Corpus Christi, Texas area) will be deepened to 6.7 m (22 ft) to provide access for larger service vessels that are expected to be used for deep-water operations. Navigable barrier passes in this area exceed this depth. It is assumed that channel deepening will occur in waterways that are located behind barrier islands and provide access to support base locations. Deepening the channel will not affect barrier islands.

*Conclusion*

The High Case scenario is not expected to result in permanent alterations of barrier beach configuration, except in localized areas downdrift from channels that have been dredged and deepened. The contribution to this localized erosion is expected to be less than 1 percent.

### *(b) Wetlands*

The wetlands considered in this analysis include forested wetlands (swamps), tidal marshes, and seagrasses. Seagrasses are restricted in the WPA to shallow water areas behind barrier islands south of Corpus Christi, Texas. The most extensive areas of seagrass beds occur in Laguna Madre. Impact-producing factors resulting from OCS oil and gas activities that could adversely affect wetlands include oil spills, pipeline placements, dredging of new navigation channels, maintenance dredging and vessel usage of existing navigation channels, and construction of onshore facilities in wetland areas. Section IV.D.1.a.(1)(b) contains a discussion of these impact-producing factors, which is summarized below.

Numerous investigators have studied the immediate impacts of oil spills on wetland habitats in the Gulf area. The often times seemingly contradictory impact assessment conclusions from these studies can at least partially be explained by differences in the oil concentrations contacting vegetation, the kinds of oil spilled (heavy or light crude, diesel, fuel oil, etc.), the type of vegetation affected, the season of year, the preexisting stress level of the vegetation, and numerous others factors. In general, however, the data suggest that, in the absence of heavy oiling, impacts will be short-term (plant dieback with recovery within two growing seasons or less) and reversible, i.e., the wetland area will be revegetated without artificial replanting (Webb et al., 1985; Alexander and Webb, 1987; Lytle, 1975; Delaune et al., 1979; Fischel et al., 1989).

The concentration of oil above which impacts to wetlands will be long-term (greater than two growing seasons) and irreversible (plant mortality and some permanent wetland loss in the absence of a replanting program or other form of mitigation) is currently unknown. A dearth of data exists on the long-term (three years or more) effects of oil spills on wetlands recovery and functioning. This EIS assumes that the minimum oil concentrations that result in long-term, permanent impacts will be one of two values, depending on the wetland type contacted. In the stressed environment of coastal Louisiana, where the wetland loss rate has been as high as 0.86 percent per year within the recent past, wetlands are assumed to be more sensitive to oil contacts than elsewhere in the Gulf. The work of Mendelssohn and his colleagues (Fischel et al., 1989; Mendelssohn et al., 1990) is providing much needed data on the long-term effects of oil spills on coastal marshes in Louisiana. The spill (a 300-bbl spill from a pipeline rupture within the marsh) occurred in 1985. The response and recovery of the marsh vegetation have been monitored since that time. The results of these investigations are used in this analysis to develop assumptions about the effects of an oil spill associated with activities in the WPA on wetlands in the western part of coastal Louisiana.

Wetlands in Texas are not experiencing the wetlands loss problem occurring in Louisiana. Texas wetlands occur on a more stable substrate, receive more sediment per unit of wetland area, and have not experienced the alterations (canal dredging) that characterize wetlands in Louisiana. The work of Webb and his colleagues (Webb et al., 1981; Webb et al., 1985; Alexander and Webb, 1983 and 1985) is used to evaluate the impacts of spills in these settings.

The following assumptions, based on the above studies, are being used to analyze the effects of oil spills on coastal wetlands. In the western part of coastal Louisiana, it is assumed that the critical concentration of oil that will result in long-term impacts to wetlands is 0.1 $l/m^2$. Concentrations less than this value will cause dieback of the above-ground vegetation for one growing season, but only limited mortality to the vegetation. Concentrations above this value will result in 35 percent of the contacted vegetation experiencing either dieback or mortality. Within 4 years, 35 percent of this affected area will recover. Recovery will occur for 10 years. After 10 years, it is assumed that 10 percent of the affected wetland area will have been permanently lost as a result of accelerated landloss caused by the spill. If the spill contacts wetlands exposed to wave attack, additional accelerated erosion of the wetland fringe will occur, as documented by Alexander and Webb (1987). Oil will persist in the wetland soil for at least five years.

In Texas, the critical concentration is assumed to be 1.0 $l/m^2$ (Alexander and Webb, 1983). Concentrations below this value will result in above-ground vegetative dieback for one growing season. Concentrations above this value will result in longer-term impacts to wetland vegetation because some complete plant mortality will occur, and these areas will have to be recolonized. It is assumed that 50 percent of the contacted vegetation will dieback or be killed after contact, and that 10 years will be required for complete recovery. In wetlands that border the coast or large estuaries, accelerated shore erosion will occur as a result of the weakened roots of the marsh vegetation being unable to hold the soil together against wave attack.

Seagrass vegetation has generally experienced minor damage from oil-spill occurrences (Zieman et al., 1984; Chan, 1977). The relative insusceptibility of seagrasses to oil-spill impacts is partly the result of their subtidal location, which protects them from direct contact with oil, and partly the result of seagrasses having a large percentage of their biomass occurring as roots and rhizomes, which are buried in sediment. The large root mass allows the plants to regenerate from damage to their vegetative parts. The major impact to seagrass communities from oil spills has been to the associated faunal assemblages.

It is assumed that an oil spill that moves into a seagrass area will cause some damage to the vegetation. The impact will depend on the water depth in the affected area. Seagrasses generally occur at shallow depths. Because of these shallow depths, it is assumed that a spill contact will cause some seagrass dieback for one growing season. No permanent loss of seagrass habitat will result from the spill. The faunal community within the bed will also be affected in terms of community composition and numbers of organisms.

Pipeline projects in wetland areas have both direct and indirect impacts on coastal habitats. Today, pipeline canals are backfilled after the pipeline is installed in its ditch. Backfilling, by partially filling in the canal and leveling spoil banks, greatly reduces impacts caused by drainage alterations and encourages the revegetation of the pipeline canal itself. In the area potentially affected by the proposed sale, it is assumed that a pipeline project in wetlands results in 0.68 ha of deteriorated or converted wetland per kilometer of pipeline (Turner and Cahoon, 1987).

Pipeline installations through seagrass beds affect the habitat due to direct losses from dredging and indirect losses that result from turbidity effects and prop washing from pipe-laying barges.

Service vessels, pipe-laying barges, crude oil barges, and production platforms use navigation channels, some of which were dredged or improved mainly for OCS development, to connect onshore facilities with offshore destinations. The dredging of new navigation canals results in impacts to wetlands similar to the impacts associated with open ditch (nonbackfilled) pipeline canals.

Additional impacts to wetlands can occur from periodic maintenance dredging and deepening of navigation channels, and from the erosion of channel banks as a result of vessel wakes.

Various kinds of onshore facilities have been constructed to service OCS development (Section IV.A.). The construction of these facilities in wetland areas could result in the conversion of wetland habitat to upland.

*Base Case Analysis*

Oil spills associated with the proposed action can occur from a number of sources. Spills can occur offshore as a result of platform accidents, barge or tanker collisions, and pipeline breaks. Spills can also occur inshore as a result of barge, pipeline, and storage tank accidents.

According to Table IV-22, the probability of a spill of 1,000 or more bbl occurring and contacting wetland areas within 10 days under the Base Case ranges from less than 0.5 percent to 1.0 percent. Because of these low probabilities, no spills greater than or equal to 1,000 bbl from offshore sources are assumed to contact coastal wetlands. Further, no spills greater than or equal to 1,000 bbl from shuttle tankers in port are assumed to occur (Table IV-16).

No spills greater than 50 and less than 1,000 bbl are assumed to occur and contact the coast (Section IV.C.1.). Eight offshore spills greater than 1 and less than or equal to 50 bbl are assumed to occur, but none is assumed to contact the coast.

Fewer than 10 spills (Table IV-5) greater than 1 and less than or equal to 50 bbl are assumed to occur onshore or nearshore as a result of pipeline and/or barge accidents. No spills greater than 50 and less than 1,000 bbl are assumed to occur inshore (Table IV-5). The spills greater than 1 and less than or equal to 50 bbl are assumed to occur in association with a pipeline, barge, or shuttle tanker accident. According to Table IV-5, nearly all of the oil transported by pipeline will land in onshore subareas W-1 and W-2, with a small percentage landing in C-3. Most barge traffic will offload in W-2, with some offloading in C-1, and most shuttle tanker offloadings will occur in W-1 and W-2. Based on these considerations, it is assumed that a few spills will occur in onshore subarea W-2, and one spill in W-1. Barge and tanker spills are assumed to occur near terminals. Because many navigation channels used by barge traffic have spoil banks, it is assumed that most of the spilled oil will be confined to the channel. The slick will be quickly transported and spread through the channel by tidal and wind currents. The small amount of the oil transported onto wetland areas is not assumed to have adverse effects on wetland vegetation. The oil will have lost its identity as a slick by the time that it could be transported near seagrass beds. No impacts to the beds are assumed as a result of contact from these low concentrations of oil.

Because pipelines traverse wetland areas, a pipeline accident could result in oil directly contacting wetland habitats. Base concentrations of oil could contact limited areas of wetland vegetation as a result of these spills. Using the assumptions developed in the introduction to this analysis, concentrations of oil greater than 1.0 $l/m^2$ will result in impacts to wetland vegetation that persist for longer than one growing season. Given the small amounts of oil associated with these spills and the likelihood that much of the oil will be confined to a navigable channel, only small amounts of short-term (one growing season) dieback of above ground vegetation are assumed as a result of these spills.

According to Table IV-5, 24,000 bbl of produced sands and 406,000 bbl of drilling fluids will be transported to shore for disposal under the Base Case scenario. According to USEPA information, sufficient disposal capacity exists at operating disposal sites, and no new disposal sites will be required to accommodate these wastes. Therefore, no wetland areas will be disturbed as a result of the establishment of new disposal sites. Some seepage from waste sites may occur into adjacent wetland areas and result in damage to wetland vegetation.

Pipeline landfall projects can affect wetland and seagrass habitats in a number of ways. Modern installation methods and planning procedures, however, have reduced levels of impacts associated with pipeline projects (Turner and Cahoon, 1987). Furthermore, no onshore pipeline projects are expected as a result of the Base Case scenario (Section IV.A.3.b.(1)). Therefore, no impacts are expected.

No new navigation channel dredging is anticipated (Section IV.A.3.c.(3)(c)); however, some maintenance dredging of existing channels will occur during the 35-year life of the proposed action. The disposal of dredged material could negatively affect wetlands if it is deposited onto existing banks or if previously unaffected wetland areas are buried by spoil banks. On the other hand, dredged material could also be used as a sediment supplement in deteriorating wetland areas to enhance wetland growth. As of 1988, however, the use of dredged material for marsh enhancement has been done only on a limited basis (Section IV.B.2.b.(2)). Given an anticipated increasing emphasis on using dredged material for marsh creation purposes, it is assumed that during the 35 year life of the proposed action, dredged material will be used to enhance wetland habitats. Maintenance dredging will also temporarily increase turbidity levels, which could deleteriously affect seagrasses. Major navigation canals, however, are not located near seagrass beds in the area. Only 0.2 percent of channel usage will be accounted for by OCS vessels under the Base Case. Because of this small percentage of usage and the likelihood that much of the dredged material will be used to enhance wetland habitats, it is assumed that no impacts will occur to wetlands from maintenance dredging.

As discussed in Section IV.A.3.c.(3)(c), OCS activities in deep water are requiring larger service vessels for efficient operations. Currently, service bases in Galveston, Texas, and Berwick, Louisiana, are accessible to the larger vessels, and Empire and Cameron, Louisiana, are considered marginally usable. This document assumes that one channel in onshore Subarea W-1 (the Corpus Christi area) will be deepened to 6.7 m (22 ft). Navigable barrier passes in this area exceed this depth. It is assumed that channel deepening will occur in waterways located near support facility locations. As discussed in the analysis of impacts to wetlands in the CPA (Section IV.A.1.a.(1)(b)), the dredged material generated by the deepening project will be used to enhance wetland growth, rather than be disposed of onto spoil banks adjacent to the channel. No impacts to wetlands are therefore anticipated as a result of the channel-deepening project.

Vessel traffic within navigation channels can cause channel bank erosion in wetland areas. An idea of the magnitude of OCS vessel traffic is provided in Tables IV-5 and IV-6, which show projected numbers of barge, service vessel, and shuttle tanker landings and dockings at various ports. Over the 35-year life of the proposed action, about 9 barge trips and 8,300 service vessel trips will occur within navigation channels. Additional vessel usage of navigation channels will be required for pipe-laying barges and the movement of platforms to offshore locations. Most of this vessel traffic will use channels within the Texas (onshore Subareas W-1 and W-2) and western Louisiana coastal zone where the impacts will be assessed. According to Johnson and Gosselink (1982), channels that have high navigational usage in coastal Louisiana widen about 1.5 m/yr more rapidly than channels that have little navigational usage (2.58 m/yr versus 0.95 m/yr). It is assumed that this figure applies to the potential impact area associated with the proposed action, even though most of this area is within the State of Texas. According to Table IV-6, there are 15 channels that are used by OCS vessel traffic related to Sale 143. The OCS usage of these channels will account for about 0.2 percent of the total channel traffic. Assuming an average distance along a channel to a service base and other OCS facilities is 10 km in the area, and that wetlands fringe the channel over one half this distance, the estimate of channel erosion impacts is that less than 1 ha of wetlands will be eroded along channel banks during the 35-year life of the proposed action.

Ten platform complexes are expected to be installed offshore as a result of the Base Case scenario (Table IV-3). The erosion of channel margins as a result of towing production structures through navigation channels is accounted for in the calculations in the previous paragraph. The possibility is considered here that increased emphasis on deep-water operations in the future may require larger platforms that will cause increased channel bank erosion compared to the past. As production moves into deep-water areas of the Gulf, the use of floating production systems, as opposed to fixed platforms, is being considered, particularly for fields of marginal size that cannot economically justify a platform. Two floating production systems are projected to be used under the Base Case scenario for Sale 143. Further, compliant structures are being increasingly used for deep-water operations. These structures use tethering cables rather than massive steel legs for anchoring the platform deck to the seabed. Towing the decks of these platforms through coastal channels will not cause more erosion than towing a traditional platform. Furthermore, in recent years some compliant structure decks have been purchased from overseas manufacturers. Given the above considerations, this analysis does not expect increased erosion of wetlands from the towing of deep-water structures through navigation channels.

No new construction of onshore infrastructure is anticipated (Table IV-14). Therefore, no impacts to wetlands from new construction projects are expected.

*Summary*

No oil spills greater than or equal to 1,000 bbl from offshore or inshore sources are assumed to occur and contact coastal wetlands under the Base Case scenario. Several smaller spills (greater than 1 and less than or equal to 50 bbl) are assumed to contact wetlands from inshore barge and pipeline accidents in coastal Texas. None of these accidents is assumed to result in high-enough oil concentrations contacting wetlands to result in impacts. Seagrass beds will not be affected by the low oil concentrations associated with these spills.

No new dredging projects for pipelines or navigation channels are projected. Few to no impacts from maintenance dredging are expected given the small contribution of OCS vessel traffic to navigational usage of the channels. Furthermore, alternative dredged material disposal methods that could be used to enhance coastal wetland growth exist. Deepening of one channel to accommodate larger service vessels is expected to occur. This project will affect only the upper reaches of a navigation channel near a service base complex. The dredged material will be disposed of in a way that will enhance wetland habitats.

Erosion of wetlands from OCS vessel wakes is expected to result in less than 1 ha of wetlands loss during the 35-year life of the proposed action.

*Conclusion*

The proposed action is expected to result in no permanent alterations of wetland habitats, except for the erosion of less than 1 ha of wetlands along navigation channel margins. These losses could be offset or even exceeded by wetlands gains from the beneficial disposal of dredged material generated during channel maintenance and deepening operations.

*High Case Analysis*

Oil spills associated with the proposed action can occur from a number of sources. Spills can occur offshore as a result of platform accidents, barge or tanker collisions, and pipeline breaks. Spills can also occur inshore as a result of barge, pipeline, and storage tank accidents.

According to Table IV-22, the probability of a spill of 1,000 or more bbl occurring and contacting wetland areas within 10 days under the High Case ranges from less than 0.5 percent to 1.0 percent. Because of these low probabilities, no spills greater than or equal to 1,000 bbl from offshore sources are assumed to contact coastal wetlands. Further, no spills greater than or equal to 1,000 bbl from shuttle tankers in port are assumed to occur (Table IV-16).

No spills greater than 50 and less than 1,000 bbl are assumed to occur and contact the coast (Section IV.C.1.). Eight offshore spills greater than 1 and less than or equal to 50 bbl are assumed to occur, but none is assumed to contact the coast.

Fewer than 10 spills (Table IV-5) greater than 1 and less than or equal to 50 bbl are assumed to occur onshore or nearshore as a result of pipeline and/or barge accidents. No spills greater than 50 bbl are assumed to occur inshore (Table IV-5). The spills greater than 1 and less than or equal to 50 bbl are assumed to occur in association with a pipeline, barge, or shuttle tanker accident. According to Table IV-5, nearly all of the oil transported by pipeline will land in onshore Subareas W-1 and W-2, with a small percentage landing in Subarea C-3. Most barge traffic will offload in W-2, with some offloading in C-1, and most shuttle tanker offloadings will occur in Subareas W-1 and W-2. Based on these considerations, it is assumed that a few spills will occur in onshore Subarea W-2, and one spill in W-1. Barge and tanker spills are assumed to occur near terminals. Because many navigation channels used by barge traffic have spoil banks, it is assumed that most of the spilled oil will be confined to the channel. The slick will be quickly transported and spread through the channel by tidal and wind currents. The small amount of the oil transported onto wetland areas is not assumed to have adverse effects on wetland vegetation. The oil will have lost its identity as a slick by the time that it could be transported near seagrass beds. No impacts to the beds are assumed as a result of contact from these low concentrations of oil.

Because pipelines traverse wetland areas, a pipeline accident could result in oil directly contacting wetland habitats. High concentrations of oil could contact limited areas of wetland vegetation as a result of these spills. Using the assumptions developed in the introduction to this analysis, concentrations of oil greater than 1.0 $l/m^2$ will result in impacts to wetland vegetation that persist for longer than one growing season. Given the small amounts of oil associated with these spills and the likelihood that much of the oil will be confined to a navigable channel, only small amounts of short-term (one growing season) dieback of above-ground vegetation are assumed as a result of these spills.

According to Table IV-5, 64,000 bbl of produced sands and 872,000 bbl of drilling fluids will be transported to shore for disposal under the High Case scenario. According to USEPA information, sufficient disposal capacity exists at operating disposal sites, and no new disposal sites will be required to accommodate these wastes. Therefore, no wetland areas will be disturbed as a result of the establishment of new disposal sites. Some seepage from waste sites may occur into adjacent wetland areas and result in damage to wetland vegetation.

Pipeline landfall projects can affect wetland and seagrass habitats in a number of ways. Modern installation methods and planning procedures, however, have reduced levels of impacts associated with pipeline projects (Turner and Cahoon, 1987). Furthermore, no onshore pipeline projects are expected as a result of the High Case scenario (Section IV.A.3.b.(1)). Therefore, no impacts are expected.

No new navigation channel dredging is anticipated (Section IV.A.3.c.(3)(c)); however, some maintenance dredging of existing channels will occur during the 35-year life of the proposed action. The disposal of dredged material could negatively affect wetlands if it is deposited onto existing banks or if previously unaffected wetland areas are buried by spoil banks. On the other hand, dredged material could also be used as a sediment supplement in deteriorating wetland areas to enhance wetland growth. As of 1988, however, the use of dredged material for marsh enhancement has been done only on a limited basis (Section IV.B.2.b.(2)). Based on an anticipated increasing emphasis on using dredged material for marsh creation purposes, it is assumed that during the 35-year life of the proposed action, dredged material will be used to enhance wetland habitats. Maintenance dredging will also temporarily increase turbidity levels, which could deleteriously affect seagrasses. Major navigation canals, however, are not located near seagrass beds in the area. Only 0.4 percent of channel usage will be accounted for by OCS vessels under the High Case. Because of this small percentage of usage and the likelihood that much of the dredged material will be used to enhance wetland habitats, it is assumed that no impacts will occur to wetlands from maintenance dredging.

As discussed in Section IV.A.3.c.(3)(c), OCS activities in deep water are requiring larger service vessels for efficient operations. Currently, service bases in Galveston, Texas and Berwick, Louisiana, are accessible to the larger vessels, and Empire and Cameron, Louisiana, are considered marginally usable. This document assumes that one channel in onshore Subarea W-1 (the Corpus Christi area) will be deepened to 6.7 m (22 ft). Navigable barrier passes in this area exceed this depth. It is assumed that channel deepening will occur in waterways located near support facility locations. As discussed in the analysis of impacts to wetlands in the CPA (Section IV.A.1.a.(1)(b)), the dredged material generated by the deepening project will be used to enhance wetland growth, rather than disposed of onto spoil banks adjacent to the channel. No impacts to wetlands are therefore anticipated as a result of the channel deepening project.

Vessel traffic within navigation channels can cause channel bank erosion in wetland areas. An idea of the magnitude of OCS vessel traffic is provided in Tables IV-5 and IV-6, which show projected numbers of barge, service vessel, and shuttle tanker landings and dockings at various ports. Over the 35-year life of the proposed action, about 22 barge trips and 19,500 service vessel trips will occur within navigation channels. Additional vessel usage of navigation channels will be required for pipe-laying barges and the movement of platforms to offshore locations. Most of this vessel traffic will use channels within the Texas (onshore subareas W-1 and W-2) and western Louisiana coastal zone, where the impacts will be assessed. According to Johnson and Gosselink (1982), channels that have high navigational usage in coastal Louisiana widen about 1.5 m/yr more rapidly than channels that have little navigational usage (2.58 m/yr versus 0.95 m/yr). It is assumed that this figure applies to the potential impact area associated with the proposed action, even though most of this area is within the State of Texas. According to Table IV-6, there are 15 channels that are used by OCS vessel traffic related to Sale 143. The OCS usage of these channels will account for about 0.4 percent of the total channel traffic. Assuming an average distance along a channel to a service base and other OCS facilities is 10 km in the area, and that wetlands fringe the channel over one half this distance, the estimate of channel erosion impacts is that about 2 ha of wetlands will be eroded along channel banks during the 35-year life of the proposed action.

Thirty platform complexes are expected to be installed offshore as a result of the High Case scenario (Table IV-3). The erosion of channel margins as a result of towing production structures through navigation channels is accounted for in the calculations in the previous paragraph. The possibility is considered here that increased emphasis on deep-water operations in the future may require larger platforms that will cause increased channel bank erosion compared to the past. As production moves into deep water areas of the Gulf, the use of floating production systems, as opposed to fixed platforms, is being considered, particularly for fields of marginal size that cannot economically justify a platform. Two floating production systems are projected to be used under the High Case scenario for Sale 143. In addition, compliant structures are being increasingly used for deep-water operations. These structures use tethering cables rather than massive steel legs for anchoring the platform deck to the seabed. Towing the decks of these platforms through coastal channels will not cause more erosion than towing a traditional platform. Furthermore, in recent years some compliant structure decks have been purchased from overseas manufacturers. Based on the above considerations, this analysis does not expect increased erosion of wetlands from the towing of deep-water structures through navigation channels.

No new construction of onshore infrastructure is anticipated (Table IV-14). Therefore, no impacts to wetlands from new construction projects are expected.

*Summary*

No oil spills greater than or equal to 1,000 bbl from offshore or inshore sources are assumed to occur and contact coastal wetlands under the High Case scenario. Several smaller spills (greater than 1 and less than or equal to 50 bbl) are assumed to contact wetlands from inshore barge and pipeline accidents in coastal Texas. None of these accidents is assumed to result in high-enough oil concentrations contacting wetlands to result in impacts. Seagrass beds will not be affected by the low oil concentrations associated with these spills.

No new dredging projects for pipelines or navigation channels are projected. Few to no impacts from maintenance dredging are expected given the small contribution of OCS vessel traffic to navigational usage of the channels. Furthermore, alternative dredged material disposal methods that could be used to enhance coastal wetland growth exist. Deepening of one channel to accommodate larger service vessels is expected to occur. This project will affect only the upper reaches of a navigation channel near a service base complex. The dredged material will be disposed of in a way that will enhance wetland habitats.

Erosion of wetlands from OCS vessel wakes is not expected to result in more than 2 ha of wetlands loss during the 35-year life of the proposed action.

*Conclusion*

The High Case of the proposed action is expected to result in no permanent alterations of wetland habitats, except for the erosion of about 2 ha of wetlands along navigation channel margins. These losses could be offset or even exceeded by wetlands gains from the beneficial disposal of dredged material generated during channel maintenance and deepening operations.

## *(2) Impacts on Sensitive Offshore Resources*

## *(a) Deep-water Benthic Communities*

The deep-water benthic communities consist of recently discovered organisms that are apparently most abundant in water deeper than 400 m and that derive their energy, in the absence of light, from chemosynthetic processes rather than the photosynthetic processes of shallow water (see Section III.B.2.b. for a more detailed discussion of these communities). The primary chemosynthetic organisms are bacteria, both free-living (as "bacterial mats") and symbiotic in the tissues of other organisms, especially in the gills. The predominant, large animals are tube worms, clams, and mussels. As noted in this section for the Central Gulf (Section IV.D.1.a.(2)(b)), the only impact-producing factor threatening these communities results from those activities that would physically disturb the bottom, such as the routine operations of anchoring, drilling, and pipeline installation, and the rare seafloor blowout accident. Because of the great water depths, routine oil and gas effluent discharges such as muds, cuttings, and sanitary wastes will not cause any deleterious impacts to chemosynthetic communities due to the rapid dilution and dispersion of effluent components (in shallower depths, cuttings tend to form a low mound or to be worked into the surrounding sediments, depending upon the nature of the local sediments, depth of disposal, and physical forces acting upon the pile). In these deep waters, such discharges rapidly disperse, can be measured above background at only very short distances from the discharge point, do not build up on the bottom, and have little biological effect except very close to the discharge point. Because these communities use petroleum hydrocarbons as a food source (and indeed have been seen to be living among oil and gas bubbles), oil spills are not considered to be a potential source of adverse impacts. Thus, oil spills will have no impact on these communities.

As noted above in Section IV.D.1.a.(2)(b), the greatest potential for adverse impacts to occur to deep-water chemosynthetic communities would come from those OCS-related, bottom-disturbing activities associated with pipelaying (Section IV.A.2.b.(1)), anchoring (Section IV.A.2.d.(1)(b)), and structure emplacement (Section IV.A.2.d.(1)(a)), as well as a seafloor blowout (Section IV.A.2.d.(8)). These activities cause localized bottom disturbances and disruption of benthic communities in the immediate area of the drilling. For a detailed discussion of the potential impacts from these activities, see Section IV.D.1.a.(2)(b).

*Base Case Analysis*

Because high-density chemosynthetic communities are found only in water depths greater than 400 m (1,312 ft), they will be found only in the southeast one-eighth of Subplanning Area W-1 and the southern one-third of W-2; they may be found throughout W-3. Thus, these communities will not be exposed to the full level of projected impact-producing factors of Table IV-3. As noted in Table IV-3, in these three subareas a total of 320 wells are assumed to be drilled, 10 platform complexes installed, and 80 km (50 mi) of pipeline installed.

As noted above, the majority of these deep-water communities are of low density and are widespread throughout the deep-water areas of the Gulf. Disturbance to a small area would not result in a major impact to the ecosystem. For purposes of this Base Case analysis, the frequency of such impact is expected to be once every six months to two years, and the severity of such an impact is judged to result in few losses of ecological elements, with no alteration of general relationships.

High-density communities are, as noted above, largely protected by the provisions of NTL 88-11. For purposes of this analysis, the frequency of some small percentage of impact is expected to be once every six months to two years, but the severity of such an impact is such that there may be some loss of ecological elements and/or some alteration of general relationships.

*Summary*

The only impact-producing factor threatening the deep-water benthic communities is physical disturbance of the bottom, which would destroy the organisms comprising these communities. Such disturbance would come from those OCS-related activities associated with pipelaying, anchoring, structure emplacement, and seafloor blowouts. Only structure emplacement is considered to be a threat, and then only to the high-density (Bush Hill-type) communities; the widely distributed low-density communities would not be at risk. The provisions of NTL 88-11 (currently in effect), requiring surveys and avoidance prior to drilling, will greatly reduce, but not completely eliminate, the risk.

*Conclusion*

The proposed action is expected to cause little damage to the physical integrity, species diversity, or biological productivity of either the widespread, low-density chemosynthetic communities or the rarer, widely scattered, high-density Bush Hill-type chemosynthetic communities. Recovery from any damage is expected to take less than two years.

*High Case Analysis*

In the High Case Analysis, the deep-water benthic communities (e.g., chemosynthetic communities) would be subject to the same impact-producing factor as in the Base Case: physical disturbance of the bottom where these communities are found, such as disturbance by rig emplacement, platform and pipeline installation, and anchoring. No other impact-producing factor is expected to present a threat to these deep-water communities. As noted under the Base Case, it is highly unlikely that discharges from the proposed activities would adversely impact the benthos in the water depths (greater than 400 m) being discussed, due to the rapid dilution and dispersion of effluent components.

Furthermore, as in the Base Case, these communities will be found only in the southeast one-eighth of Subarea W-1 and the southern one-third of W-2; they may be found throughout W-3. Thus, these communities will not be exposed to the full level of the projected impact-producing factors of Table IV-3. As noted in Table IV-3, in these three subareas a total of 690 wells are assumed to be drilled, 30 platform complexes installed, and 240 km (150 mi) of pipelines installed.

While the opportunities for impact are somewhat higher for this High Case than for the Base Case, NTL 88-11 will still be effective in detecting the high-density communities and providing for their avoidance.

For purposes of this analysis, the frequency of such impact to the widespread, low-density communities is expected to be once every six months to two years, and the severity of such an impact is judged to result in few losses of ecological elements, with no alteration of general relationships.

For purposes of this analysis, the frequency of some small percentage of impact (given NTL 88-11) to high-density communities is expected to be once every six months to two years, but the severity of such an impact is such that there may be some loss of ecological elements and/or some alteration of general relationships.

*Conclusion*

The High Case scenario is expected to cause little damage to the physical integrity, species diversity, or biological productivity of either the widespread, low-density chemosynthetic communities or the rarer, widely scattered, high-density Bush Hill-type chemosynthetic communities. Recovery from any damage is expected to take less than two years.

## *(b) Topographic Features*

The topographic features of the Western Gulf providing sensitive offshore habitats are listed and described in Section III.B.2.

A Topographic Features Stipulation similar to the one described in Section II.B.1.c.(1) has been made a part of appropriate leases since 1973 and may, at the option of the Secretary, be made a part of appropriate leases resulting from this proposal. As noted in Section II.B.1.c.(1), the stipulation would establish an area (No Activity Zone) in which no bottom-disturbing activities would be allowed and areas around the No Activity Zones (in most cases) in which shunting of all drill effluents to near the bottom would be required. The effectiveness of the stipulation in protecting the biota of the topographic features (banks) is well documented. Thus, the very high potential impacts described in previous EIS's for the biota of the banks would not occur as a result of this proposal if the stipulation were selected for inclusion. The impact analysis presented below is for the proposed action and does include the proposed biological lease stipulation. For a complete description of potential impacts to the banks from oil and gas operations absent the stipulation, see Section IV.D.2.a.(2)(b) of the Final EIS for Sales 131, 135, and 137.

As noted in the section for the Central Gulf (Section IV.D.1.a.(2)(c)), the potential impact-producing factors to the topographic features of the Western Gulf are anchoring and structure emplacement, effluent discharge, blowouts, oil spills, and structure removal. For a detailed discussion of the potential impacts from these activities, see Section IV.D.1.a.(2)(c). A discussion of these impacts in this specific case is given below.

*Base Case Analysis*

Eleven of the 23 topographic features of the Western Gulf are located in Subarea W-1; 12 are in W-2 (in both cases they occupy a very small portion of the entire area). Thus, these communities will not be exposed to the full level of the projected impact-producing factors of Table IV-3; the amounts of wastes discharged in the vicinity of a bank will be some very small fraction of those shown in Table IV-3.

As noted above, the proposed Topographic Features Stipulation would serve to eliminate most of the potential impacts to the biota of the banks from oil and gas operations. The impact-producing factors that may still affect the banks from operations outside the No Activity Zones are drilling effluent discharges, blowouts, and oil spills.

With the adoption of the proposed Topographic Features Stipulation, no discharges of drilling effluents, including produced water, would take place within the No Activity Zones; discharges in areas of 1,000 m, 1, 3, or 4 miles, depending on the bank, around the No Activity Zone would be shunted to within 10 m of the bottom. This procedure would essentially eliminate the threat of drilling effluents and produced water reaching the biota of the bank; however, there may be some small risk of such effluents reaching the bank. For purposes of this analysis, it is estimated that such impacts will occur 5-10 times during the life of this proposal; the severity of such impacts is judged to be such that there may be a loss of a few elements at the regional or local scale, but no interference to the general system performance. Recovery of the system to pre-interference conditions is rapid.

Blowouts do not occur with great frequency (see Section IV.A.2.d.(8) and below), and with the application of the proposed stipulation, none could occur within the No Activity Zones. Blowouts outside the No Activity Zones are unlikely to have an impact on the biota of the banks. Since no blowouts are assumed to occur in Subareas W-1 and W-2, where the banks are found, for purposes of this analysis the frequency of a blowout in the vicinity of a topographic feature is judged not to occur only during the life of this proposal. Even if one were to occur near a bank, it may cause the loss of a few elements at the local scale, but no interference to the general system performance would occur and recovery of the system to pre-interference conditions would be rapid.

There is an estimated 6 percent chance of an oil spill greater than or equal to 1,000 bbl occurring in the Western Gulf as a result of the proposed action (Base Case) (Table IV-19), and it is assumed that 8 small spills of greater than 1 and less than or equal to 50 bbl will occur each year and that no spills of greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action (Section IV.C.1.). It is assumed that no oil spills greater than or equal to 1,000 bbl will occur (Section IV.C.1.; Table IV-3). In the Western Gulf, the East Flower Garden Bank crests the shallowest at 15 m. Therefore, a surface oil spill would assume to have no impact on the biota of the East Flower Garden Bank or the other topographic features because any oil that might be driven to 15 m or deeper would be well below the concentrations needed to cause an impact. However, spills resulting from this proposal are assumed to be subsurface; such spills are likely to rise to the surface, and any oil remaining at depth will be swept clear of the banks by currents moving around the banks (Rezak et al., 1983). As noted above, there have been only 28 oil spills resulting from blowouts on the OCS between 1956 and 1989, and only 2 blowouts are assumed for the entire WPA over the 35-year life of the proposed action (Table IV-3). In the years 1967-1986, there have been only 31 oil spills from pipelines on the OCS, 23 of which were between 50 and 1,000 bbl and only 8 greater than or equal to 1,000 bbl (USDOI, MMS, 1988b). Thus, a blowout is assumed to occur near a bank. If a seafloor oil spill were to occur, the spill would have to come into contact with a biologically sensitive feature. The fact that the topographic features are widely dispersed in the Western Gulf, combined with the probable random nature of spill locations, would serve to limit the extent of damage from any given spill to only one of the sensitive areas. The currents that move around the banks will steer any spilled oil around the banks rather than directly upon them, lessening the severity of impacts. Furthermore, the No Activity Zones established by the proposed Topographic Features Stipulation, would serve to keep such occurrences from very near the banks.

*Summary*

Several impact-producing factors may threaten the communities of the topographic features.

Because of the analytical use of the proposed Topographic Features Stipulation, operational discharges (drilling muds and cuttings, produced waters) would have little impact on the biota of the banks. Recovery from any impact would be rapid.

Blowouts may similarly cause damage to benthic biota, but due to the analytical use of the proposed Topographic Features Stipulation, they would have little impact on the biota of the banks. Recovery from any impact would be rapid.

Oil spills (there is an estimated 6% chance of an oil spill greater than or equal to 1,000 bbl occurring in the Western Gulf as a result of this proposed action) will cause damage to benthic organisms if the oil contacts the organisms; such contact is considered unlikely and, because of the proposed Topographic Features Stipulation, spills would not occur very near to the biota of the banks.

*Conclusion*

The proposed action is expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 $m^2$ would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks.

*Effects of the Base Case Without the Proposed Stipulation*

Several impact-producing factors may threaten the communities of the topographic features.

Vessel anchoring and structure emplacement result in physical disturbance of the benthic environment and are the most likely activities to cause permanent or long-lasting impacts to sensitive offshore habitats. Recovery from damage caused by such activities may take 10 or more years. Impacts from this factor are considered to be serious and potentially irreversible.

Operational discharges (drilling muds and cuttings, produced waters) may impact the biota of the banks due to turbidity and sedimentation, resulting in death to benthic organisms in large areas. Recovery from such damage may take 10 or more years. Impacts from this factor are also considered to be serious and potentially irreversible.

Blowouts may similarly cause damage to benthic biota by resuspending sediments, causing turbidity and sedimentation, and resulting in death to benthic organisms. As noted above, no blowouts are assumed to occur in Subareas W-1 and W-2 where the banks are found; thus, blowouts will have no impact on the biota of the banks.

Oil spills will cause damage to benthic organisms if the oil contacts the organisms. As noted above, impacts from this factor are not considered to be of concern.

Structure removal using explosives (as is generally the case) results in water turbidity, sediment deposition, and potential explosive shock-wave impacts. Severe damage to benthic organisms could result. Recovery from such damage could take more than 10 years. Impacts from this factor are considered to be serious.

It follows from the above that activities resulting from this proposal, absent the Topographic Features Stipulation, especially bottom-disturbing activities, have a potential for causing serious and potentially irreversible impacts to the biota of the topographic features.

*High Case Analysis*

Higher oil and gas activity may be expected near the topographic features of the Western Gulf as a result of the High Case scenario. The biota of the topographic features would be subject to the same impact-producing factors as in the Base Case--discharges associated with drilling, blowouts, and oil spills. As in the Base Case, the topographic features are found only in Subareas W-1 and W-2. Thus, these communities will not be exposed to the full level of the assumed impact-producing factors of Table IV-3; the amounts of wastes discharged in the vicinity of a bank will be some very small fraction of those shown in Table IV-3.

As noted above, the proposed Topographic Features Stipulation would serve to eliminate most of the potential impacts to the biota of the banks from oil and gas operations. Because of the application of the proposed Topographic Features Stipulation, operational discharges (drilling muds and cuttings, produced waters) would have little impact on the biota of the banks. Recovery from any impact would be rapid.

Blowouts may similarly cause damage to benthic biota, but due to the application of the proposed Topographic Features Stipulation, they would have little impact on the biota of the banks. Recovery from any impact would be rapid.

There is an estimated 16 percent chance of one or more oil spills greater than or equal to 1,000 bbl occurring in the Western Gulf as a result of the High Case (Table IV-16). It is also assumed that 20 spills greater than 1 and less than or equal to 50 bbl and that 1 spill greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action. In addition, it is assumed there will be 9 spills of diesel oil and other pollutants, the average size of which will be only 34 bbl (Table IV-3). It is assumed that one oil spill greater than or equal to 1,000 bbl will occur (Section IV.C.1.). As with the Base Case, the widely dispersed nature of the banks and the currents at the banks will serve to prevent oil from impacting the banks. Therefore, it is assumed that no spills of any size will contact the biota of the topographic features.

*Conclusion*

The High Case scenario is expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 $m^2$ would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks.

### *(3) Impacts on Water Quality*

Sections providing supportive material for the water quality analysis include Sections III.A.6. (description of water quality), IV.A.2. (OCS infrastructure, activities, and impacts), IV.B.6. (major sources of oil contamination in the Gulf of Mexico) and IV.C.2. (oil spills--characteristics, fates, and effects).

*Coastal and Estuarine Waters*

As discussed in the Sale 142 analysis (Section IV.D.1.a (3)), riverine flows into the Gulf of Mexico determine estuarine and nearshore water quality, with the Mississippi River being the most significant source of pollution to this region. Major point sources along the Gulf Coast include the petrochemical industry, hazardous waste sites and disposal facilities, agricultural and livestock farming, manufacturing industry activities, fossil fuel and nuclear power plant operations, pulp and paper mill plants, commercial and recreational fishing, municipal wastewater treatment, and maritime shipping activities. The Texas coastal area has been plagued with numerous water quality problems, with most occurring in the Houston-Galveston and Beaumont-Port Arthur areas, where the majority of Texas's energy facilities are located. Galveston Bay receives large nutrient loadings from local sources and has experienced eutrophication problems. The coastal portion of the north-central Gulf of Mexico (primarily Louisiana) is characterized by water quality problems resulting from the discharge or release of industrial and domestic wastes. A more detailed discussion of the Gulf's coastal and estuarine water quality is presented in Section III-6.

Water quality in coastal and nearshore areas adjacent to the WPA may be altered by a number of OCS-related activities resulting from proposed Sale 143. These include routine point and nonpoint source discharges from onshore support facilities; discharges from associated support vessel traffic; canal maintenance dredging and pipeline emplacement actions; onshore disposal of OCS-generated, oil-field wastes; and oil and chemical spills greater than 50 bbl from both onshore and offshore OCS facilities. A general discussion of these impact-producing factors may be found in Section IV.D.1.a.(3).

*Base Case Analysis*

Under the Base Case analysis, it is anticipated that the existing onshore infrastructure base in the Central and Western Gulf is sufficient to support proposed Sale 143 activities and that no new infrastructure will be constructed. Despite this, point and nonpoint source discharges (Section IV.A.3.c.) occurring from existing onshore support facilities may impact coastal and nearshore water quality. Most of the onshore OCS support infrastructure located in the WPA exists in the Beaumont-Port Arthur, Houston-Galveston, and Corpus Christi areas. In addition, support will come from infrastructure located in southwestern Louisiana (Cameron Parish). In these areas, it is anticipated that surface-water contamination from support facilities will occur. Waters near support facilities may be expected to be contaminated with oily substances and oil-field wastes from point source effluent discharges and small spills. For the purpose of this analysis, chronic spills and chronic point source contamination are examined together with nonpoint source runoff. Section IV.C.1. provides assumptions for spills from OCS facilities. It is assumed that fewer than 10 spills greater than 1 but less than or equal to 50 bbl are assumed to result from OCS sale-related activities throughout the Texas and southwest Louisiana coastal zone. It is further assumed that 8 spills of this size class are assumed to result from proposed offshore sale-related activities in the WPA, but few of these spills will contact the coastline. Petroleum hydrocarbons introduced into marine and coastal waters would have various effects depending on the resource impacted, stage of weathering, and local physical and meteorological conditions. Some crude oil components are highly toxic and may cause damage to marine organisms. This toxicity is directly proportional to the crude's aromatic content (Geraci and St. Aubin, 1988). Lower molecular weight hydrocarbon compounds (benzene, toluene, etc.) are considered acutely toxic, but are rapidly lost through evaporation and dissolution during the first days of a spill (Wheeler, 1978). Normal weathering processes encountered by oil spilled in open waters tend to degrade its toxic components. The toxicity of the oil will be altered as weathering occurs, changing the oil's composition. The oxidized derivatives of petroleum hydrocarbons generated during weathering have been shown to be more water soluble than the parent hydrocarbons (Malins et al., 1982a). Boehm and Fiest (1982) indicated that the average reported concentrations of oil generally were less than 1 $\mu g/l$ for pristine areas, 2-100 $\mu g/l$ for spills in nearshore areas, and 100-800 $\mu g/l$ in heavily polluted urban areas. Background levels in the Gulf of Mexico were reported at 0-70 $\mu g/l$. In shallow areas, oil may become entrained in suspended particles and bottom sediments, subsequently being reintroduced into the water column. From these estimates, it is estimated that the effect of chronic contamination of WPA coastal waters due to the proposed sale would be negligible, with water characteristics rapidly returning to background levels. These discharges will, however, remain continuous over the 35-year life of the proposed action.

Table IV-6 provides the number of shuttle tanker trips to each major port, the number of barge trips to terminals by waterway, and the number of service vessel trips to service bases by waterway, respectively. Up to 8,300 service vessel trips, 9 barge trips, and 66 shuttle tanker trips are estimated to result from proposed sale-related activities. The Calcasieu River and Freshwater Bayou (C-1) in Louisiana, and Aransas Pass (W-1), Matagorda Ship Channel (W-1), Houston-Galveston Ship Channel (W-2), and Sabine Pass (W-2) in Texas are expected to receive the bulk of sale-related support vessel trips in the WPA. Besides barge trips to and from platforms, some barge traffic carrying oil from terminals to other terminals or refineries is expected to occur along the Gulf Intracoastal Waterway and adjoining navigation channels.

Antifouling paints used on boats and tankers have been shown to have toxic effects on some marine biota. Increased loadings within coastal waters of tributyltin and copper compounds contained in antifouling paints are well documented (Geochemical and Environmental Research Group, 1988; Delfino et al., 1984). Tributyltin has recently been regulated to decrease the total amounts released into the environment from marine paints. Without knowing what effects the new regulations will have, but knowing that effects have been documented and that such discharges will take place on a routine basis for some of the life of the proposed action, impacts from antifouling paints associated with sale-related marine traffic are assumed to be low. Ballast and bilge waters from shuttle tankers are assumed to be discharged at onshore reception facilities and are not expected to impact coastal water quality. While inshore, service vessels are estimated to discharge approximately 3,000 liters of bilge water per trip in support of sale-related activities. An estimated 21 million liters (1,640 liters/day) will be discharged into coastal waters from vessels supporting the proposed sale activities. Most of these discharges are assumed to occur in coastal Subarea W-2, where sale-related vessel traffic are projected to be the greatest. The amount of bilge water discharged from service boats could result in coastal water quality impacts when discharged into confined waters. Bilge waters may contain toxic petroleum products and metallic compounds leaked from machinery. Given the small concentrations expected, the continuous nature of the discharges over the life of the proposal, the widespread nature of the receiving waters, and the assimilative capacity of water, it is expected that there will be some localized, short-term (up to several weeks) changes in water quality characteristics from background levels, depending on the length of the affected channel, flushing rates, etc.

No new navigation channels are expected to be dredged in association with sale-related activities; however, maintenance dredging of major navigation channels and deepening of some channels to support service vessel traffic are expected to result. Dredging activities are expected to result in localized impacts (primarily elevated water column turbidities) occurring over the duration of the activities (up to several months). Such activities would preclude some recreational and commercial uses within the immediate area. The periods for expected dredging operations will generally allow for the recovery of affected areas between such activities. Impacts from dredging are expected to be somewhat higher near the mouths of major rivers, where sediment inputs are greater.

No new pipelines or canals are projected to be constructed; 82 percent of the oil and most of the gas produced will be transported ashore via the existing pipeline network, while 17 percent of the oil will be shuttle-tankered ashore. Pipelines reduce the need for barge and truck transport of petroleum and the potential for transfer spills. The environmental effects associated with chronic pipeline leakage and malfunction are generally considered small (USDOC, NOAA, 1985). Given this and the small percentage of use of the existing pipeline network in support of the proposed action, impacts from leakage and hydrologic alterations associated with pipelines are considered negligible.

It is assumed the 18 percent of the drilling muds (approximately 744,000 bbl) associated with sale-related drilling activities and 24,000 bbl of produced sand will be brought ashore for disposal (Table IV-4). The improper storage and disposal of such oil-field wastes and contaminated oil-field equipment could result in adverse impacts to surface and ground-waters in proximity to disposal facilities, cleaning sites, and scrap yards. Many of these wastes may be contaminated by NORM (Section IV.A.2.d.(5)). Improper design and maintenance of such facilities could result in adverse impacts to these waters (Section IV.A.3.c.(4)). The quantities of many wastes attributable to OCS activities, and more specifically the proposed action, are largely unknown, as are the associated environmental consequences and health risks. However, study efforts are currently underway by Federal and State government agencies and the oil and gas industry to gather information on NORM, including its fate and effect and disposal and treatment alternatives.

The OSRA model (Table IV-22) indicates a very-low chance (1%) of an oil spill greater than or equal to 1,000 bbl occurring from OCS operations and contacting land along the WPA coastline within 10 days. No oil spills of this size class is assumed to occur from the proposed action (Section IV.C.1.). It is further assumed that no oil spills greater than 50 and less than 1,000 bbl could occur from sale-related activities in the WPA. Should a spill occur, there could be some effects from residual weathered oil reaching coastal waters following a major spill event, primarily in the form of tar material. Impacts from low-level contamination were discussed earlier. Less than 10 oil spills greater than 1 and less than or equal to 50 bbl are assumed to occur in coastal waters from OCS pipelines crossing coastal and nearshore areas or from sale-related shuttle tankering or barging activities (Table IV-4). Petroleum hydrocarbons introduced into marine and coastal waters may have varied effects depending on the resource impacted, stage of weathering, and local physical and meteorological conditions. Some crude oil components are highly toxic and may cause damage to marine organisms due to the crude's aromatic content. It is expected that normal weathering processes encountered will degrade the oil by breaking down its toxic components. Background levels in the Gulf of Mexico were reported at 0-70 $\mu$g/l. In shallow areas, oil may become entrained in suspended particles and bottom sediments, and subsequently be reintroduced into the water column. Given these estimates and the frequent nature of spills over the life of the proposal, the effect of hydrocarbon contamination on the Gulf's coastal waters due to the proposed action is considered negligible, with water characteristics rapidly returning to background levels within several days to weeks.

*Summary*

All existing onshore infrastructure and associated coastal activities occurring in support of proposed Sale 143 will contribute to the degradation of regional coastal and nearshore water quality to a minor extent because each activity provides a low measure of continuous contamination and because discharge locations are widespread, particularly in the Beaumont-Port Arthur, Houston-Galveston, and Corpus Christi areas of Texas and the Cameron Parish area of Louisiana. Process, cooling, boiler, and sewage water effluents will be discharged through the use of the existing infrastructure and facilities. No onshore discharge of OCS produced-water discharges are assumed for the proposed sale. Wastes and contaminated equipment from offshore will be brought ashore for disposal and storage. Adverse impacts could occur to surface and groundwater in proximity to improperly designed and maintained disposal sites and facilities. Maintenance dredging is expected to take place every one or two years and will result in short-term impacts to the surrounding waters. The OCS-related vessel traffic is likely to impact water quality through routine releases of bilge and ballast waters, chronic fuel and tank spills, trash, and low-level releases of the contaminants in antifouling paints. The improper storage and disposal of oil-field wastes and contaminated oil-field equipment would adversely impact surface and ground waters in proximity to disposal facilities, cleaning sites, and scrap yards. Surface and groundwater in proximity to improperly designed and maintained disposal sites and facilities could be adversely impacted with elevated concentrations of arsenic, chromium, zinc, cadmium, mercury, lead, barium, pentachlorophenol, naphthalene, benzene, toluene, and radium.

No oil spills greater than or equal to 1,000 bbl and greater than 50 and less than 1,000 bbl are assumed to occur and contact coastal and nearshore waters. Eighteen spills greater than 1 but less than or equal to 50 bbl are assumed to result from OCS sale-related activities both in the coastal zone and from offshore (Tables IV-3 and IV-5). Of these, fewer than 10, associated with onshore support and vessel activities, are expected to occur in coastal waters. Sale-related spills will introduce oil into nearshore waters, creating elevated hydrocarbon levels (up to 100+ $\mu$g/l) within affected waters. Much of the oil will be dispersed throughout the water column over several days to weeks. In shallow areas, oil may become entrained in suspended particles and bottom sediments. Spills would affect water use for up to several weeks, and then only near the source of the slick. Therefore, the effect of chronic contamination of WPA coastal waters due to the proposed sale is considered negligible, with water characteristics rapidly returning to background levels.

*Marine Waters*

The Gulf of Mexico is a semi-enclosed water body with oceanic inputs through the Yucatan Channel via the Caribbean and with principal outflow through the Straits of Florida. As previously noted, the presence of the Mississippi River, as well as a host of other major drainage systems, strongly influences the northern Gulf of Mexico's marine water quality. Drainage from approximately two-thirds of the area of the United States and more than one-half the area of Mexico empties into the Gulf. This large amount of runoff, with its nonoceanic composition, mixes into the surface water of the northwestern Gulf and makes the chemistry of parts of this system quite different from that of the open ocean. Degradation of the Gulf's marine waters is associated with coastal runoff, riverine inputs, and effluent discharges from offshore enterprises consisting of OCS activities and marine transportation.

Effluents from normal offshore oil and gas operations are complex and may be transformed chemically, biologically, or through radioactive decay when introduced into the marine environment. These wastes may be dissolved and form new substances or may be mixed vertically and horizontally in the water column by small-scale turbulence or large-scale currents, and they may precipitate to the bottom and be absorbed onto bottom sediments, or be recycled by these same processes. These series of transformations will govern a waste's transport through the water column and its effect on marine organisms. The biological effects may be on individual organisms, organism populations, or entire ecosystems, with both long-term and short-term consequences. The method of disposal into the environment, as well as the chemical properties of each constituent, will influence a waste's distribution throughout the Gulf.

The impact-producing factors leading to water quality degradation resulting from offshore OCS oil and gas operations include the resuspension of bottom sediments through exploration and development activities, pipeline construction, and platform-removal operations; the discharge of deck drainage, sanitary and domestic wastes, produced waters, drilling fluids, cuttings, and produced waters; and accidental hydrocarbon discharges due to spills, blowouts, or pipeline leaks. These factors are more thoroughly discussed in Section IV.A.2.

*Base Case Analysis*

Table IV-3 indicates that, under the Base Case scenario, the addition of 210 exploration and delineation wells, 110 development wells, 10 platform complexes, and up to 80 km of pipeline is estimated for the WPA. As a result, an estimated 126 MMbbl of produced waters, 2.24 MMbbl of drilling muds, 546,000 bbl of drill cuttings, 24,000 bbl of produced sand and 335,000 $m^3$ of treated sanitary and domestic wastes may be expected to be generated from the proposed action.

Immediate effects would be brought about by increased drilling, construction, and pipelaying activities, increasing water column turbidities in affected offshore waters. Pipeline construction activities may result in the resuspension of some 40,000 $m^3$ of sediment during the installation of eight kilometers of pipelines in water depths of 61 m (200 ft) and less (Table IV-2). Offshore Subarea W-1 will support all sale-related pipeline burial activities and associated sediment resuspension. Pipeline construction activities may result in the resuspension of settled pollutants, toxic heavy metals, and pesticides, if present. The magnitude and extent of turbidity increases would depend on the hydrographic parameters of the area, nature and duration of the activity, and bottom-material size and composition. Sediments are known to contain the major fraction of trace metals, chlorinated hydrocarbons, and nutrients in aquatic environments. Considering the very low levels of trace metals found in the present-day ocean, despite the continuous output from land sources, sediments serve as a permanent sink for trace metals, etc. Chen et al. (1976) indicated that concerns regarding the release of significant quantities of toxic materials into solution during dredging operations and disposal are unfounded. Their studies indicate that while some trace metals may be released in the parts-per-billion range, others show no release pattern. Most of the concentrations in the soluble phase are well below the allowable concentration levels of the ocean water discharge standards. It was pointed out that trace metals and chlorinated hydrocarbons associated with organics and suspended particles released may present an unknown effect. For the purpose of this analysis, the frequency of activities resulting in resuspension of sediment is judged to occur nearly continuously throughout much of the northwestern and north-central Gulf of Mexico. However, the severity of impacts would result only in some measures of water quality (primarily increased water-column turbidities) changing from background levels, and then only within a distance of 1,000 m from the activity.

Aside from creating increased water column turbidity, explosive platform removal may adversely impact water quality by releasing explosive by-products into the water column upon detonation of charges to sever the legs and pilings of a structure (Table IV-3). Three platforms associated with the proposal are assumed to be removed by explosive methods. The by-products of these events may be gaseous, liquid, or solid, and may be soluble or insoluble in seawater. Virtually all of the products become airborne in the case of a water surface burst (for scare charges), even from relatively deep explosions. In the latter, the gaseous products form a spherical bubble that rises to the surface, resulting in the ejection of most of the gases. The magnitude and extent of turbidity increases would depend upon several hydrographic parameters, the duration of the activity, and bottom-material size and composition. The consensus of this work is that such resuspension has only a short-term, local effect of a very limited nature. Because most of the gases are ejected into the air during rig removal (by explosive means), the very small amounts that remain in the water column should either be dissolved or dispersed so rapidly that water quality in the area would not be seriously affected.

The discharge of 335,000 $m^3$ of treated sanitary and domestic wastes from the various rigs and platforms will increase levels of suspended solids (14-550 mg/l), nutrients, chlorine, and BOD near the point of discharge (Table IV-3). The volume and concentration of such wastes will vary widely over time, occupancy, platform characteristics, and operational situation. Properly operating biological treatment systems at these facilities have effluents containing less than 150 mg/l of suspended solids. These are considered minor discharges and are quickly diluted. The impact to offshore water quality from sale-related, treated sanitary and domestic waste discharges will be negligible, occurring within a few meters of the discharge source.

Up to 126 MMbbl of produced waters are estimated to result from the proposed action. Average annual estimates equate to 3.6 MMbbl, or approximately 9,800 bbl per day. Offshore Subarea W-3 will receive the greatest number of these discharges with 111 MMbbl. Analysis of the findings of numerous investigators (e.g., Mackin, 1973; Gallaway, 1980; Bender et al., 1979; and Reid, 1980) indicates that the estimated effects of these discharges on offshore water quality will be limited to an area in proximity to the discharge source. Higher concentrations of trace metals, salinity, temperature, organic compounds, and radionuclides, and lower dissolved oxygen may be present near the discharge source. Although the distance required to reach background levels will vary according to the volume and characteristics of each discharge, investigators suggest that these levels are reached within a few meters of the source. They agree that rapid dilution and turbulence at the source limit the zone affected by these properties. Because of the continuous nature of oil and gas activities within the northwestern and north-central Gulf of Mexico, the frequency of produced-water discharges is judged to occur somewhat continuously throughout these areas. (Variable discharge volumes will be released continuously throughout the duration of any oil and gas production operation.) The proposed produced-water discharges will be rapidly diluted within the immediate vicinity of the discharge source. Significant increases in water concentrations of dissolved and particulate hydrocarbons and trace metals are not expected outside the initial mixing zone or immediate vicinity of the discharge source. Within the mixing zone of the discharge, long-term effects to water column processes, consisting of localized increases in particulate metal and soluble lower molecular weight hydrocarbon (e.g., benzene, toluene, and xylenes) concentrations, may be implicated. Trace metals and hydrocarbons associated with the discharge may be deposited within sediments near the discharge point.

Some 2.2 MMbbl of drilling muds and 546,000 bbl of drill cuttings are estimated to result from drilling activities associated with the proposed action (Table IV-3). Peak-year estimates are on the order of 283,000 bbl of drilling muds and 72,000 bbl of drill cuttings. Drilling muds and cuttings are routinely discharged into offshore waters and are regulated by NPDES permits. As with produced-water discharges, offshore Subarea W-3 would receive the greatest percentage of these potential discharges. An estimated 1.89 MMbbl of drilling muds and 462,000 bbl of cuttings could be generated in offshore Subarea W-3. It is assumed that 18 percent of these drilling muds (400,000 bbl) associated with sale-related drilling activities would be brought ashore for disposal (Table IV-5). Some 24,000 bbl of produced sands are estimated to be produced in the WPA from the proposed activities. However, these will not be discharged into offshore waters, but rather brought ashore for disposal. As with produced-water discharges, because of the continuous nature of oil and gas activities in the WPA, the frequency of drilling mud and cutting discharges is judged to occur nearly continuously throughout this area. From the work of the investigators cited and previous monitoring studies, it can be concluded that the proposed discharge of drilling fluids and cuttings would encounter rapid dispersion in marine waters. Discharge plumes will be diluted to background levels within a period of several hours and/or within several hundred to 1,000 m of the discharge source. The accumulation of toxic trace metals and hydrocarbons in exposed shelf waters, due to periodic releases of water-based generic muds and cuttings, is unlikely, and the long-term degradation of the water column from such discharges is not a major concern. Few effects are anticipated to most water uses from drilling muds and cutting discharges and then only in an area near the source.

Crude oils contain thousands of different compounds. Hydrocarbons account for up to 98 percent of the total composition. Crude oils often contain wide concentrations of the trace metals nickel, vanadium, iron, sodium, calcium, copper, and uranium. Petroleum hydrocarbons introduced into marine waters may have varied effects on the local biota, with impact severity depending on the resource impacted, stage of weathering, and local physical and meteorological conditions. These effects are discussed in greater detail in Section IV.C. and previously in this analysis under coastal and nearshore. Oil released on the surface will be rapidly dispersed by the action of winds and currents, resulting in rapid transport; whereas for a subsurface spill, some of the oil would be distributed throughout the water column. It is assumed that no oil spills greater than or equal to 1,000 bbl and greater than 50 and less than 1,000 bbl, and approximately eight spills greater than or equal to 1 bbl and less than or equal to 50 bbl will occur from program-related activities offshore in the WPA. In addition, three spills (diesel and oil-based drilling muds) are assumed to occur from drilling and workover activities. The introduction of oil into offshore waters will create elevated hydrocarbon levels (up to 100+ $\mu$g/l) within affected waters. After 10 days, much of the oil will be dispersed throughout the water column over a period of weeks. Little effect on offshore water use is expected, and then only on to an area near the source or slick.

*Summary*

Based on a review projected sale-related support activities, the estimate is that offshore Subarea W-1 would receive the greatest portion of pipeline burial activities, whereas offshore Subarea W-3 would receive the largest amounts of operational discharges. Immediate effects would be brought about by increased drilling, construction, and pipelaying activities, causing an increase in water column turbidities (lasting for several hours with mud discharges, and several weeks with dredging-pipelaying activities) to the affected offshore waters. The magnitude and extent of turbidity increases would depend on the hydrographic parameters of the area, nature, and duration of the activity, and bottom-material particle size and composition. Because of the continuous nature of oil and gas activities in the WPA, the frequency of drilling mud and cutting and produced-water discharges is judged to occur nearly continuously throughout these areas. Proposed produced-water discharges will be rapidly diluted within the immediate vicinity of the discharge source. Significant increases in water concentrations of dissolved and particulate hydrocarbons and trace metals are not expected outside the initial mixing zone or the immediate vicinity of the discharge source. Higher concentrations of trace metals, salinity, temperature, organic compounds, and radionuclides, and lower dissolved oxygen may be present near the discharge source. Within the mixing zone of the discharge, long-term effects to water column processes, consisting of localized increases in particulate metal and soluble lower molecular weight hydrocarbons (e.g., benzene, toluene, and xylenes) concentrations, may be implicated. Trace metals and hydrocarbons associated with the discharge may be deposited within sediments near the discharge point. The proposed discharge of drilling fluids and cutting would encounter rapid dispersion in marine waters. Discharge plumes will be diluted to background levels within a period of several hours and/or within several hundred to 1,000 m of the discharge source. The accumulation of toxic trace metals and hydrocarbons in exposed shelf waters, due to periodic releases of water-based generic muds and cuttings, is unlikely and the long-term degradation of the water column from such discharges is not a major concern. Few effects are anticipated to most water uses from routine activities and discharges and then only in an area near the source.

Program-related spills will introduce oil into offshore waters and create elevated hydrocarbon levels (up to 100+ $\mu g/l$) within affected waters. After 10 days, much of the oil will be dispersed throughout the water column over a period of weeks. Little effect on water use is expected from these spills, and then only in an area near the source and slick.

*Conclusion*

An identifiable change to the ambient concentration of one or more water quality parameters will be evident up to several hundred to 1,000 m from the source and for a period lasting up to several weeks in duration in marine and coastal waters. Chronic, low-level pollution related to the proposal will occur throughout the 35-year life of the proposal.

*High Case Analysis*

*Coastal and Estuarine Waters*

As indicated in the Base Case, it is expected in the High Case scenario that the existing onshore infrastructure base in the Gulf is sufficient to support the proposal. Despite this, point and nonpoint source discharges (discussed in Section IV.A.c.3.) occurring from existing onshore support facilities may impact coastal and nearshore water quality. Most of the onshore OCS support infrastructure located in the WPA exists in the Beaumont-Port Arthur, Houston-Galveston, and Corpus Christi areas. In addition, support will come from infrastructure located in southwestern Louisiana (Cameron Parish). Waters near support facilities may be expected to be contaminated with oily substances and oil-field wastes from point source effluent discharges and small chronic spills. For the purpose of this analysis, chronic spills and chronic point source contamination are examined together with nonpoint source runoff. It is assumed that approximately 30 spills (greater than one bbl and less than 50 bbl) could result in the WPA from activities associated with the proposal. Fewer than 10 of these spills, primarily in Texas and southwestern Louisiana, are assumed in association with onshore sale-related support activities. It is estimated that 75 percent of these smaller spills would range from 1 to 10 bbl and occur in association with crude and product transfer operations in port areas. Lower molecular weight hydrocarbon compounds (benzene, toluene, etc.) are considered acutely toxic, but are rapidly lost through evaporation and dissolution during the first days of a spill (Wheeler, 1978). Normal weathering processes encountered by oil spilled in open waters tend to detoxify its components. In shallow areas, oil may become entrained in suspended particles and bottom sediments, and subsequently be reintroduced into the water column. Given these estimates and the frequent nature of spills over the life of the proposal, the effect of chronic contamination on the Gulf's coastal waters due to the proposed action is considered negligible, with water characteristics rapidly returning to background levels.

Over 19,500 service vessel trips, 22 barge trips, and 171 shuttle tanker trips are estimated to result from the proposed action in the WPA. As indicated in Table IV-6, the Calcasieu River and Freshwater Bayou (C-1) in Louisiana, and Aransas Pass (W-1), Matagorda Ship Channel (W-1), Houston-Galveston Ship Channel (W-2), and Sabine Pass (W-2) in Texas are expected to receive the bulk of sale-related support vessel trips in the WPA. Besides barge trips to and from platforms, some barge traffic carrying oil from terminals to other terminals or refineries is expected to occur along the Gulf Intracoastal Waterway and adjoining navigation channels.

Antifouling paints used on support vessels have been shown to have toxic effects on some marine biota. Increased loadings within coastal waters of tributyltin and copper compounds contained in antifouling paints will take place on a routine basis over the life of the proposal. Ballast and bilge waters from shuttle tankers are assumed to be discharged at onshore reception facilities and are not expected to impact coastal water quality. While inshore, service vessels are estimated to discharge approximately 3,000 liters of bilge water per trip in support of sale-related activities. An estimated 62 million liters (approximately 4,850 liters/day) will be discharged into coastal waters from vessels supporting the proposed sale activities. Bilge water may contain toxic petroleum products and metallic compounds leaked from machinery and could degrade coastal water quality when discharged into confined waters. Given the small concentrations expected and the continuous and widespread nature of the discharges over the life of the proposal, it is expected that there will be some localized, short-term changes (up to several weeks) in water quality characteristics from background levels, depending on the length of the affected channel, flushing rates, etc.

No new navigation channels are expected to be dredged as a result of the proposal. However, maintenance dredging of major navigation channels and deepening of some channels to support service vessel traffic are expected. Dredging activities are expected to result in localized impacts (primarily elevated water column turbidities) occurring over the duration of the activity (up to several months). Such activities would preclude some recreational and commercial water uses within the immediate area of this activity. The time periods for expected dredging operations will generally allow for the recovery of affected areas between such activities. Impacts are expected to be somewhat higher in the Mississippi Delta area because of higher sediment inputs. As with the Base Case, it is estimated that no new onshore pipelines will be constructed due to the proposed action. Up to 82 percent of the oil and most of the gas produced will be transported ashore via the existing onshore pipeline network. Another 17 percent of the oil will be shuttle-tankered ashore. Pipelines reduce the need for surface vessel transport of petroleum and the potential for transfer spills. The environmental effects associated with chronic pipeline leakage and malfunction are generally considered small (USDOC, NOAA, 1985). Given this and the small percentage of use of the existing pipeline network in support of the proposed activities, impacts from leakage and hydrologic alterations associated with pipelines are considered negligible.

As discussed under the Base Case, in addition to those wastes discharged offshore, a number of wastes are brought ashore for disposal. Approximately 872,000 bbl of drilling muds and 64,000 bbl of produced sand from sale-related exploration and production activities would be brought ashore for disposal. In addition, discarded oil-field equipment may also pose a potential environmental threat to areas surrounding storage sites, cleaning sites, scrap yards, and metal reclamation yards. Surfaces of production tubing, holding tanks, separators, heater treaters, and other like equipment may be contaminated with scale material containing NORM (Section IV.A.2.d.(5)). The improper storage and disposal of oil-field wastes and contaminated oil-field equipment would adversely impact surface and ground waters in proximity to disposal facilities, cleaning sites, and scrap yards. Improper design and maintenance of such storage facilities would result in adverse impacts from elevated levels of radium-226 in surrounding water bodies due to surface runoff (Section IV.A.3.C.(4)).

Under the High Case scenario, it is assumed that 1 oil spill greater than or equal to 1,000 bbl would occur from sale-related activities in the WPA. In addition, 1 oil spill greater than 50 and less than 1,000 bbl and 30 spills greater than 1 and less than or equal to 50 bbl could occur from OCS pipeline, platform, and transportation sources offshore in the WPA. It is assumed that as much as 75 percent of the original volume of oil from the spill source will be lost as a result of weathering processes by the time that the slick contacts these coastal areas. It should be noted that there could be some effects from residual weathered oil that could reach coastal waters following a spill event greater than or equal to 1,000 bbl. Impacts from low-level contamination were discussed earlier. As indicated, petroleum hydrocarbons introduced into marine and coastal waters may have varied effects depending on the resource impacted, stage of weathering, and local physical and meteorological conditions. Some crude oil components are highly toxic and may cause damage to marine organisms due to the crude's aromatic content. It is expected that normal weathering processes will degrade the oil by breaking down its toxic components. Background levels in the Gulf of Mexico were reported at 0-70 $\mu$g/l. In shallow areas, oil may become entrained in suspended particles and bottom sediments, subsequently being reintroduced into the water column. Given these estimates and the frequent nature of spills over the life of the proposal, the effect of hydrocarbon contamination on the Gulf's coastal waters due to the proposed action is considered negligible, with water characteristics rapidly returning to background levels within several days to weeks.

*Summary*

All existing onshore infrastructure and associated coastal activities occurring in support of proposed Sale 143 will contribute to the degradation of regional coastal and nearshore water quality to a minor extent because each activity provides a low measure of continuous contamination and because discharge locations are widespread, particularly in the Beaumont-Port Arthur, Houston-Galveston, and Corpus Christi areas of Texas and the Cameron Parish area of Louisiana. Process, cooling, boiler, and sewage water effluents will be discharged due to the use of the existing infrastructure and facilities. No onshore OCS-derived, produced-water discharges are assumed for the proposed sale. Wastes and contaminated equipment from offshore will be brought ashore for disposal and storage. Adverse impacts could occur to surface and groundwater in proximity to improperly designed and maintained disposal sites and facilities. Maintenance dredging is expected to take place every one or two years and will result in short-term, low-level impacts to the surrounding waters. The OCS-related vessel traffic is estimated to impact water quality through routine releases of bilge and ballast waters, chronic fuel and tank spills, trash, and low-level releases of the contaminants in antifouling paints. The improper storage and disposal of oil-field wastes and contaminated oil-field equipment would adversely impact surface and ground waters in proximity to disposal facilities, cleaning sites, and scrap yards. Surface and groundwater in proximity to improperly designed and maintained disposal sites and facilities could be adversely impacted with elevated concentrations of arsenic, chromium, zinc, cadmium, mercury, lead, barium, pentachlorophenol, naphthalene, benzene, toluene, and radium.

One oil spill greater than or equal to 1,000 bbl and 1 oil spill greater than 50 and less than 1,000 bbl are assumed to occur, but not assumed to contact coastal and nearshore waters. An additional 30 spills (greater than 1 but less than or equal to 50 bbl) are assumed to result from OCS sale-related activities both in the coastal zone and from offshore. Of these, fewer than 10, associated with onshore support and vessel activities, are expected to occur in coastal waters. Sale-related spills will introduce oil into nearshore waters, creating elevated hydrocarbon levels (up to 100+ $\mu$g/l) within affected waters. After 10 days, much of the oil will be dispersed throughout the water column over a period of weeks. In shallow areas, oil may become entrained in suspended particles and bottom sediments. Water uses would be affected for up to several weeks from proposed spills and then only near the source of slick. Therefore, the effect of chronic contamination of WPA coastal waters due to the proposed sale is considered negligible, with water characteristics rapidly returning to background levels.

*Marine Waters*

Table IV-3 indicates that, under the High Case scenario, the addition of 420 exploration and delineation wells, 270 development wells, 30 platforms complexes, and up to 240 km of pipeline is estimated for the WPA. As a result, approximately 305 MMbbl of produced waters, 4.8 MMbbl of drilling muds, 1.16 MMbbl of drill cuttings, and 892,000 m$^3$ of treated sanitary and domestic wastes may be expected to be generated from the proposed action.

Immediate effects would be brought about by increased drilling, construction, and pipelaying activities, causing an increase in water column turbidities (lasting for hours with mud discharges, to several weeks with dredging-pipelaying activities) to the affected offshore waters. Installation of an estimated 240 km of new pipelines offshore will result from sale-related activities. Gulfwide, pipeline construction activities may result in the resuspension of up to 40,000 m$^3$ of sediment during the life of the proposed program. All burial activities will occur in water depths of 200 ft and less. Offshore Subarea W-1 will support all sale-related pipeline burial activities and associated sediment resuspension. Pipeline construction activities may result in the resuspension of settled pollutants, toxic heavy metals, and pesticides, if present. The magnitude and extent of turbidity increases would depend on the hydrographic parameters of the area, nature and duration of the activity, and bottom-material size and composition. For the purpose of this analysis, the frequency of activities resulting in resuspension of sediment is judged to occur nearly continuously throughout much of the northwestern and north-central Gulf of Mexico. However, the severity of impacts would result only in some measures of water quality (primarily increased water column turbidities) changing from background levels and that in an area within a distance of 1,000 m from the activity.

Aside from creating increased water column turbidity, explosive platform removal may adversely impact water quality by releasing explosive by-products into the water column upon detonation of charges to sever the legs and pilings of a structure. Six platforms associated with the proposal are assumed to be removed by explosive methods. The by-products of these events may be gaseous, liquid, or solid, and may be soluble or insoluble in water. Virtually all of the products become airborne in the case of a water surface burst (for scare charges), even from relatively deep explosions. The magnitude and extent of turbidity increases would depend upon several hydrographic parameters, the duration of the activity, and bottom-material size and composition. Because most of the gases are ejected into the air during rig removal (by explosive means), the very small amounts that remain in the water column should either be dissolved or dispersed so rapidly that water quality in the area would not be seriously affected.

The discharge of 892,000 $m^3$ of treated sanitary and domestic wastes from the various rigs and platforms will increase levels of suspended solids (14-550 mg/l), nutrients, chlorine, and BOD near the point of discharge. The volume and concentration of such wastes will vary widely over time, occupancy, platform characteristics, and operational situation. Properly operating biological treatment systems at these facilities have effluents containing less than 150 mg/l of suspended solids. These are considered minor discharges and are quickly diluted. The impact to offshore water quality from program-related treated sanitary and domestic waste discharges will be negligible, occurring within a few meters of the discharge source.

Up to 304 MMbbl of produced waters are estimated to result from the High Case. Offshore Subareas W-3 will receive the greatest number of these discharges (274 MMbbl) over the life of the proposal. According to the findings of numerous investigators (e.g. Mackin, 1973; Gallaway, 1980; Bender et al., 1979; Reid, 1980), the estimate of the expected effects of these discharges on offshore water quality is that the effects will be limited to an area in proximity to the discharge source. Higher concentrations of trace metals, salinity, temperature, organic compounds, and radionuclides, and lower dissolved oxygen may be present near the discharge source. Because of the continuous nature of oil and gas activities in the northwestern and north-central Gulf of Mexico, the frequency of produced water discharges is judged to occur nearly continuously throughout these areas. The assumption, based on the work of the investigators cited and historical data, is that the produced-water discharges resulting from the proposal will be rapidly diluted within the immediate vicinity of the discharge source. Significant increases in water concentrations of dissolved and particulate hydrocarbons and trace metals are not expected outside the initial mixing zone or immediate vicinity of the discharge source. Within the mixing zone of the discharge, long-term effects to water column processes, consisting of localized increases in particulate metal and soluble lower molecular weight hydrocarbons (e.g., benzene, toluene, and xylenes) concentrations, may be implicated. Trace metals and hydrocarbons associated with the discharge may be deposited within sediments near the discharge point.

Some 4.8 MMbbl of drilling muds and 1.2 MMbbl of drill cuttings are estimated to result from drilling activities associated with the proposed action. Drilling muds and cuttings are routinely discharged into offshore waters and are regulated by NPDES permits. As with produced water discharges, offshore Subarea W-3 would receive the greatest percentage of these potential discharges. Approximately 4.1 MMbbl of drilling muds and 996,000 bbl of cuttings could be generated in offshore Subarea W-3. It is assumed that 18 percent of the drilling muds (872,000 bbl) associated with sale-related activities would be brought ashore for disposal. Some 64,000 bbl of produced sands are estimated to be produced in the WPA from the proposed activities. However, these will not be discharged into offshore waters, but rather brought ashore for disposal. When discharged into the surrounding offshore waters, drilling muds may create turbidity plumes several hundred meters in length. A 1983 NRC study suggests that, for routine oil and gas discharges, the various components measured, including turbidity, are at background levels by a distance of 1,000 m. Ecomar Inc. (1980) indicated that, due to settling and dilution, suspended solid levels and metal concentrations decrease significantly with distance from the source. As with produced-water discharges, because of the continuous nature of oil and gas activities in the northwestern and north-central Gulf of Mexico, the frequency of drilling mud and cutting discharges is judged to occur nearly continuously throughout these areas. According to the work of the investigators cited and previous monitoring studies, it can be concluded the proposed discharge of drilling fluids and cuttings would encounter rapid dispersion in marine waters. Discharge plumes will be diluted to background levels within a period of several hours and/or within several hundred meters of the discharge source. The accumulation of toxic trace metals and hydrocarbons in exposed shelf waters, due to periodic releases of water-based generic muds and cuttings, is unlikely, and the long-term degradation of the water column from such discharges is not a major concern. Few effects from drilling muds and cutting discharges are expected on water uses, and then only in an area near the source.

Crude oils contain thousands of different compounds formed during initial formation. Hydrocarbons account for up to 98 percent of the total composition. Crude oils often contain wide concentrations of the trace metals nickel, vanadium, iron, sodium, calcium, copper, and uranium. Petroleum hydrocarbons introduced into marine waters may have varied effects on the local biota with impact severity depending on the resource impacted, stage of weathering, and local physical and meteorological conditions. These effects are discussed in greater detail in Section IV.C. Oil released on the surface will be rapidly dispersed by the action of winds and currents, resulting in rapid transport, whereas for a subsurface spill, some of the oil would be distributed throughout the water column. One oil spill greater than or equal to 1,000 bbl, 1 oil spill greater than 50 and less than 1,000 bbl, and approximately 30 spills greater than or equal to 1 bbl and less than or equal to 50 bbl are assumed to occur from program-related activities in the WPA. In addition, nine spills (diesel and oil-based drilling muds) are assumed to occur from drilling and workover activities. The introduction of oil into offshore waters will create elevated hydrocarbon levels (up to 100+ $\mu$g/l) within affected waters. Background levels in the Gulf have been reported at 0-70 $\mu$g/l. After 10 days, much of the oil will be dispersed throughout the water column over a period of weeks. Little effect on offshore water use is anticipated and then only in an area near the source or slick.

*Summary*

Based on analysis of projected sale-related support activities, the estimate is that offshore Subarea W-1 would receive the greatest portion of pipeline burial activities, whereas offshore Subarea W-3 would receive the largest amounts of operational discharges. Immediate effects would be brought about by increased drilling, construction, and pipelaying activities, causing an increase in water column turbidities (lasting for several hours with mud discharges, and several weeks with dredging-pipelaying activities) to the affected offshore waters. The magnitude and extent of turbidity increases would depend on the hydrographic parameters of the area, nature and duration of the activity, and bottom-material size and composition. Because of the continuous nature of oil and gas activities in the WPA, the frequency of drilling mud and cutting and produced water discharges is judged to occur nearly continuously throughout these areas. Produced-water discharges resulting from these proposed activities will be rapidly diluted within the immediate vicinity of the discharge source. Significant increases in water concentrations of dissolved and particulate hydrocarbons and trace metals are not expected outside the initial mixing zone or the immediate vicinity of the discharge source. Higher concentrations of trace metals, salinity, temperature, organic compounds, and radionuclides, and lower dissolved oxygen may be present near the discharge source. Within the mixing zone of the discharge, long-term effects to water column processes, consisting of localized increases in particulate metal and soluble lower molecular weight hydrocarbon (e.g., benzene, toluene, and xylenes) concentrations, may be implicated. Trace metals and hydrocarbons associated with the discharge may be deposited within sediments near the discharge point. The proposed discharge of drilling fluids and cuttings would encounter rapid dispersion in marine waters. Discharge plumes will be diluted to background levels within a period of several hours and/or within several hundred meters of the discharge source. The accumulation of toxic trace metals and hydrocarbons in exposed shelf waters, due to periodic releases of water-based generic muds and cuttings, is unlikely, and the long-term degradation of the water column from such discharges is not a major concern. Few effects on most water uses from routine activities and discharges are expected, and then only in an area near the source.

Program-related spills will introduce oil into offshore waters and create elevated hydrocarbon levels (up to 100+ $\mu$g/l) within affected waters. Much of the oil will be dispersed throughout the water column over several days to weeks. Little effect on water use is anticipated from these spills, and then only in an area near the source and slick.

*Conclusion*

As a result of the proposal, an identifiable change to the ambient concentration of one or more water quality parameters will be evident up to several hundred to 1,000 m from the source and for a period lasting up to several weeks in duration in marine and coastal waters. Chronic, low-level pollution related to the proposal will occur throughout the 35-year life of the proposal.

### *(4) Impacts on Air Quality*

This discussion analyzes the potential degrading effects on air quality by the activities and developments induced by the proposed sale. The following activities will potentially degrade air quality: platform emissions; drilling activities during exploration, delineation, and development; service vessel operation; evaporation of volatile hydrocarbons from surface oil slicks; and fugitive emissions during hydrocarbon venting and offloading. Sections presenting supporting materials and discussions are Sections III.A.2. and 3. (description of Gulf of Mexico meteorology and coastal counties air quality status), IV.C.1. (oil-spill assumptions), and IV.A.2.d.(6) (air emissions).

The parameters of this analysis are the emission factors, surface winds, stability of the overlaying air column, and the height of the atmospheric mixed layer.

Emissions of certain primary pollutants are known to be detrimental to health and welfare. Nitrogen oxide and nitrogen dioxide comprise $NO_x$ emissions. Nitrogen oxide is important because it can be converted into nitrogen dioxide, which can be poisonous. Nitrogen dioxide reacts with water to form nitric acid, which is harmful to vegetation and construction materials. Further, nitrogen dioxide is involved in photochemical reactions that yield ozone, which has significant effects on the atmosphere and the global climate and causes respiratory problems. Carbon monoxide (CO) is a toxic gas that reacts with hemoglobin in the blood and blocks the transfer of oxygen to the body. Carbon monoxide increases cardiovascular diseases, affects the central nervous system, and contributes to the global climate cycle. Sulfur oxides ($SO_x$) can combine with water and oxygen to form very corrosive and irritating acids. These sulphur compounds produce aerosols that act as nuclei for rain, which removes sulphur from the atmosphere. Further, a correlation has been found between $SO_x$ and respiratory diseases such as bronchitis. Volatile organic compounds (VOC), or hydrocarbons, are poisonous to humans at very high concentrations only, cause eye irritation, and play important roles in atmospheric photochemical cycles. Particulate matter has a trimodal distribution, and particles that are smaller than 10 microns ($PM_{10}$) are detrimental to visibility and may cause respiratory problems. The visibility reductions are caused primarily by particle scattering and by light absorption to a lesser extent. This analysis considers mainly total particulate matter (TSP).

Ozone is a secondary pollutant and "is one of the most toxic regulated pollutants under ambient air quality standards" (Godish, 1991, p. 159). It is formed by photochemical reactions involving some of the primary pollutants. Ozone is important to the global climate and causes damage to plants and agricultural crops. At concentrations of 196-784 $\mu gm^{-3}$ and exposures of 1-2 hours, it also affects lung functions. These effects are transient and include reduction of tidal volume, increased respiration rates, increased pulmonary resistance, and changed respiration mechanics (Godish, 1991). Ozone can interfere with or inhibit the immune system.

Emissions of primary pollutants will occur during exploration, development, and production activities. Typical emissions for exploratory and development drilling activities are presented in Section IV.A.2.d.(6).

The above values show that emissions of $NO_x$ are between 4 and 34 times greater than emissions for other pollutants during drilling activities. Statistics of wells drilled between 1985 and 1990 show an average hole depth of 10,318 ft and a drilling period of 33 days. These values are similar to the values of hole depth and drilling period employed in calculating typical emissions from wells, above.

Platform emissions for the Gulf of Mexico region (Section IV.A.2.d.(6)) show $NO_x$, VOC, and CO emissions about three orders of magnitude larger than emissions of $SO_x$ and TSP. The $NO_x$, VOC, and CO emissions seem to be about 10 times greater than emissions from exploratory wells. This discrepancy, however, is just a mathematical artifact, because well rates are based on a 45-day period while platform rates are on a yearly basis. Emission rates during exploration are higher than emission rates during production. Emission factors for other activities, such as helicopters, tankers, loading, and transit operations, were obtained from Jacobs Engineering Group, Inc. (1989) and USEPA (1985).

Other sources of primary pollutants are accidents, such as oil spills and blowouts, related to OCS operations. Typical emissions from OCS accidents consist of hydrocarbons; only blowouts with fires produce other primary pollutants. Even though the emissions rates are large, pollutant input to the atmosphere is not large because large rates cannot be sustained for long periods. Observe that emission rates decreased approximately 50 percent by the second hour.

Once pollutants are released into the atmosphere, transport and dispersion processes start acting. Transport processes of pollutants are carried out by the net wind circulation. The mean wind circulation is discussed in Section III.A.2. During summer the wind regime in the WPA is predominantly onshore at mean speeds of 4 to 6 $ms^{-1}$. Winter wind circulation is predominantly onshore also at mean speeds of 4 to 5 $ms^{-1}$.

Pollutant dispersion or mixing depends on emission height, atmospheric stability, and mixed layer height. The emission height of platforms of the Gulf of Mexico is determined by storm wave heights, storm tides, and a safety factor. For water depths between 10 and 200 m, calculated emission heights are between 31 and 35 m, well inside the mixed layer. For emissions inside the atmospheric boundary layer, the 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 WPA (USDOI, MMS, 1988c) indicate an upward flux year-round, being highest during winter and lowest in summer. The atmospheric stability along WPA coastal areas of the Gulf of Mexico, discussed in Section III.A.2., is either neutral or stable more than 75 percent of the time. Atmospheric stability is also important because it helps to distribute and diffuse the available energy or momentum of the atmosphere.

A mechanism in part responsible for this distribution is buoyancy. It is well known that air density is inversely proportional to temperature. When the sea surface is warmer than the overlying air, the sea heats that air in contact with it. The warmer air becomes lighter, starts to rise, and is replaced by cooler air from above. The rising air acquires a vertical velocity that, when multiplied by its density, becomes a flux of vertical momentum by buoyancy or density difference. Vertical momentum flux can also occur because of mechanically generated turbulence, which is totally unrelated to density differences.

The mixing height is very important because it determines the space available for spreading the pollutants. Although mixing height information throughout the Gulf of Mexico is scarce, measurements near Panama City (Hsu, 1979) show that the mixing height can vary between 400 and 1,300 m, with a mean of 900 m. 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, and daily changes are smaller than in summer.

*Base Case Analysis*

The scenario discussed in Section IV.A. (Table IV-3) for the 35-year life of the proposed action establishes that 210 exploration and delineation and 110 development wells would be drilled, and 10 platform complexes would be emplaced. The sale area has been subdivided into three offshore subareas: W-1, W-2, and W-3 (Figure IV-1). Table IV-3 presents the numbers of exploration, delineation, and development wells; platforms installed; and service-vessel trips for the proposed action in each subarea. The information presented below shows total emissions from wells, platforms, vessels, and other activities in the WPA during the proposed action. Observe that $NO_x$ still is the most emitted pollutant, while TSP is the least emitted. More important is that this information shows that wells contribute mostly $NO_x$, platforms contribute mostly $NO_x$, CO, and VOC, while vessels are contributors of all pollutants. These emissions were calculated by adding the well and platform emissions over the 35-year life of the proposed action. Vessel emissions were calculated using the total number of service-vessel trips presented in Table IV-3. Emissions from other related activities were calculated using information also presented in Table IV-3.

Total OCS Emissions in the WPA
(tons over 35-year life of the proposed action)

| Activity | $NO_x$ | CO | $SO_x$ | THC | TSP |
|---|---|---|---|---|---|
| Service Vessels | 2,797.4 | 7,327.7 | 44.2 | 142.4 | 197.4 |
| LTO Helicopters | 14.2 | 11.5 | 2.2 | 0.6 | 0.5 |
| Cruise Helicopters | 45.8 | 131.0 | 9.8 | 10.7 | 13.1 |
| Blowouts without Fire | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 |
| Spills without Fire | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Barge Loading | 0.0 | 0.0 | 0.0 | 12.4 | 0.0 |
| Tanker Loading | 0.0 | 0.0 | 0.0 | 210.6 | 0.0 |
| Transit Loss | 0.0 | 0.0 | 0.0 | 168.2 | 0.0 |
| Tanker Exhaust | 150.8 | 16.5 | 187.3 | 0.2 | 54.2 |
| Tug Exhaust | 16.3 | 1.6 | 0.2 | 0.7 | 1.0 |
| Exploratory Wells | 2,030.7 | 541.8 | 237.3 | 58.8 | 203.7 |
| Development Wells | 930.8 | 248.3 | 109.2 | 27.3 | 93.6 |
| Platforms | 17,150.0 | 2,234.0 | 30.0 | 6,500.0 | 42.0 |
| Totals | 23,136.0 | 3,512.4 | 620.2 | 7,131.2 | 605.5 |

Total emissions for each subarea in the WPA during the proposed action are presented below. Observe that Subarea W-1, which is the closest to land, would generate the smallest emissions of all pollutants, while Subarea W-3, the farthest from land, would generate the greatest amounts of emissions.

WPA Subareas Total Emissions
(tons over the 35-year life of the proposed action)

| Pollutant | W-1 | W-2 | W-3 |
|---|---|---|---|
| $NO_x$ | 2,313.6 | 4,627.2 | 16,195.2 |
| CO | 351.2 | 702.5 | 2,458.7 |
| $SO_x$ | 62.0 | 124.0 | 434.1 |
| THC | 713.2 | 1,426.4 | 4,992.5 |
| TSP | 60.6 | 121.1 | 423.9 |

The total pollutant emissions per year are not uniform. During the early years of the proposed action, emissions would be small but increase over time with production. After reaching a maximum, emissions would decrease rapidly to zero as all platforms and wells are removed and service vessels trips are no longer needed.

The peak emissions in tons per year for the primary pollutants during the proposed action are indicated below. It is very important to note that well drilling activities and platform complex peak emissions are not necessarily simultaneous, so the combined maximum emissions are not a simple addition of the individual peak emissions. However, it is assumed that service vessel and well and platform peak emissions occur simultaneously. In this analysis the aggregate peak emissions, which are two to five times the mean emissions, will be employed. Use of the peak emissions will provide the most conservative estimates of impact levels to the onshore air quality.

Peak and Mean Emissions in the WPA
(tons over the 35-year life of the proposed action)

| Pollutant | Wells | Platforms | Vessels | Others | Mean | Aggregate |
|---|---|---|---|---|---|---|
| $NO_x$ | 374.25 | 857.50 | 86.41 | 0.00 | 661.03 | 1,001.41 |
| CO | 99.85 | 111.70 | 13.95 | 0.00 | 100.35 | 152.65 |
| $SO_x$ | 43.75 | 1.50 | 6.96 | 0.00 | 17.72 | 50.16 |
| THC | 10.85 | 325.00 | 4.42 | 11.86 | 204.45 | 342.28 |
| TSP | 37.55 | 2.10 | 7.61 | 0.00 | 17.30 | 44.81 |

The mean emissions were computed by dividing the total emissions by the 35-year life of the proposed action. Peak emissions from wells and platforms are obtained from their temporal distribution. Observe that platforms and wells have the greatest peak emissions, while vessels have smaller emissions. This is contrary to the emission rates, where wells have greater emission rates than platforms.

To estimate the potential impact of offshore emissions on offshore and onshore air quality, a steady state box model (Lyons and Scott, 1990) was employed. The model is an expression of mass conservation and assumes that pollutants are vertically dispersed and sources uniformly distributed. For the purpose of these air quality analyses, an assumption of uniform distribution of average size sources throughout the planning areas at this stage is a reasonable approach. Predominance of unstable atmospheric conditions over the sea, as discussed in Section III.A.2., ensures that pollutants are dispersed homogeneously. The model was applied to $NO_x$ emissions because these are the largest emissions. Concentrations for other pollutants can be estimated by multiplying the $NO_x$ concentrations by the ratio of the pollutant emissions over the $NO_x$ emissions. These concentrations are $[CO]=0.152[NO_x]$; $[SO_x]=0.050[NO_x]$; and $[TSP]=0.333[NO_x]$. Notice that concentrations of primary pollutants other than $NO_x$ would be smaller by more than 80 percent. Because VOC emissions are not inert, the box model cannot be used to assess their impacts on air quality. Impacts from VOC and CO will be estimated by comparing the offshore and onshore emission rates.

The box model was applied to the following conditions: onshore and offshore winds with speeds ranging from 1 to 7 $ms^{-1}$; a mean mixing height of 900 m; and a low mixing height of 300 m. During periods of winds blowing offshore, impacts to the onshore air quality from offshore WPA emissions are very low because the pollutants are transported offshore. Conditions of onshore winds indicate that concentrations reaching land from Subarea W-1 varied between 0.24 and 0.05 $\mu gm^{-3}$ for speeds from 1 to 7 $ms^{-1}$ and a mixing height of 900 m; for a 300-m mixing height, concentrations varied from 0.72 to 0.10 $\mu gm^{-3}$ under the same wind speeds.

Concentrations for pollutants other than VOC would be smaller, as indicated above. The MMS regulations (30 CFR 250.44) do not establish annual significance levels for CO and VOC. For these pollutants, a comparison of emission rates will be used to assess impacts. Formulas to compute the emission rates in tons/yr for CO are $3,400 \cdot D^{2/3}$ and $33.3 \cdot D$ for VOC. In these formulas, D represents distance in statute miles from the shoreline to the source. The CO exempt emission level in Subarea W-1 is 15,781.4 tons/yr, which is greater than peak emissions from the whole WPA. The exemption emission level of VOC in Subarea W-1 is 333 tons/yr, while the aggregate emissions level is estimated as 342.28 tons/yr. Transport of pollutants toward onshore areas has a maximum frequency of 85 percent during summer and only 34 percent during winter. Thus, the box model results are very conservative estimates of pollutant contributions to the onshore air quality status. The modeling effort does not consider removal processes such as rain, which in the WPA has a high frequency (Section III.A.2.) and would reduce impact levels to onshore air quality.

Using the OCD Model (USDOI, MMS, 1986a), MMS has also studied the impacts of $NO_x$ offshore emissions. Conducted off the Galveston, Brazos, and High Island Areas, Texas, the study used 250 offshore sources and employed a 300-m mixing height, which coincides with the lower mixing height employed in the box model. The model run in this study represents an aggregation of all sources. The annual arithmetic mean varied between 0.01 and 0.19 $\mu gm^{-3}$, which is below the $NO_2$ national standard of 100 $\mu gm^{-3}$. All other inert pollutants would have lower concentrations.

A recent dispersion analysis of $NO_x$ emissions from 16 proposed OCS platforms along the Texas offshore area was completed (USDOI, MMS, 1991c). Annual average concentrations peaked around 0.04 $\mu gm^{-3}$ and the highest 1-hour concentration never exceeded 1.54 $\mu gm^{-3}$. These results agree with our previous assessments that the proposed action will have low impacts on the onshore air quality. Therefore, it is reasonable to assume that concentrations derived from emissions associated with the proposed action, 20 platforms spread over 145.3 billion square meters, would have a much smaller effect.

Oil-spill effects on air quality are examined below. It is assumed that oil spills in the category greater than 1 and equal to or less than 50 bbl, as well as greater than 50 and less than 1,000 bbl, would have low impacts on air quality degradation because their input of pollutants (it is assumed that 30% of the spill evaporates in three days) would be very small. Information from OCS accidents indicates emissions of fewer than 100 tons/hour by the second hour. For spills greater than or equal to 1,000 bbl, emissions are about 285 tons/hour or smaller. But no impacts from spills greater than or equal to 1,000 bbl will occur because it is assumed that no oil spill greater than or equal to 1,000 bbl will occur in the WPA during the proposed action. If the dispersion of emissions is taken into account, effects on offshore air quality would be temporary.

Nearly 18 percent of OCS crude-oil production is offloaded from surface vessels at ports. The unintentional emissions from these offloading operations are estimated as 223 tons for the Base Case over the 35-year life of the proposed action. This represents 3.1 percent of the total VOC emissions. Emissions from service vessels are expected to produce negligible effects on air quality.

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 used in this analysis represents the equivalent diameter, which is the diameter of a sphere that will 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 $\mu m$ and a third peak with a diameter larger than 2 $\mu m$. Particles with diameters of 2 $\mu m$ or larger settle very close to the source (residence time of approximately ½ day, Lyons and Scott, 1990), so their concentration on these areas would be low. For particles smaller than 2 $\mu m$, which do not settle fast, wind transport determines their impacts. Results from the box model indicate that the largest concentration for TSP will be 0.24 $\mu gm^{-3}$, which is less than the allowable annual increase level of 5 $\mu gm^{-3}$. Section III.A.3. indicates that in coastal areas the $PM_{10}$ is around 50 $\mu gm^{-3}$ and the national standard is 150 $\mu gm^{-3}$, making the OCS contribution unimportant. Therefore, matter would have a low impact on the visibility of PSD Class I areas.

Blowouts are accidents related to OCS activities and are defined as an uncontrolled flow of fluids from a wellhead or wellbore. In the Gulf of Mexico OCS there have been 116 blowouts over a period of 19 years (1971-1989) (Section IV.A.2.d.(8)). This represents an average of about 6 blowouts per year, but the number of wells drilled is a better indicator. The estimated number of blowouts, at a rate of 7 blowouts per 1,000 wells drilled, is 2 blowouts during the proposed action in the WPA. The air pollutant emissions from blowouts depend on the amount of oil and gas released, duration of the accident, and the occurrence or not of fire during the blowout.

Because of technological advances the duration of blowouts has decreased, and about 61 percent of recent blowouts last 1 day or less, 19 percent last between 2 and 3 days, 7 percent last between 4 and 7 days, and 13 percent last more than 7 days (Fleury, 1983). Further, most blowouts occurred without fire (MMS Database). The amount of oil released during these accidents has been small. The total emission of THC is 24 tons over the life of the proposed action. It must be remembered that these are conservative estimates and that the total amount of THC may be less; the VOC will also be less because it is a fraction of the THC.

Ozone is of great concern because of its environmental considerations. In the WPA five counties have nonattainment status for this pollutant (Section III.A.3.). Ozone measurements (Texas Air Control Board, 1989) in 1988 were discussed in Section III.A.3. and details can be found therein. Concentrations at three coastal sites indicate that the national standard was exceeded in two (Houston and the Beaumont-Port Arthur-Brazoria area) and the third was a border case (Corpus Christi). However, impacts from the OCS cannot be assessed because ozone is not emitted but formed by photochemical processes, which were not modeled in this analysis. However, the $NO_x$ concentrations, even if all were converted to ozone, will not change the status of the areas discussed above. Recently, MMS awarded one study to do a preliminary ozone exercise with USEPA using the Regional Oxidant Model (ROM) for episodes with onshore transport. A second study is near award for a 3-year study of ozone formation and transport from OCS activities in the Gulf of Mexico.

*Summary*

Emissions of pollutants into the atmosphere from the activities associated with the proposed action are estimated to have minimal effects on offshore air quality because of the prevailing atmospheric conditions, emission heights, and pollutant concentrations. Effects on air quality from emissions from OCS activities in onshore areas is expected to be small because of the atmospheric regime, the emission rates, and the distance of these emissions from the coastline. The above discussion is based on average conditions; however, there will be days of low mixing heights and wind speeds that could increase impacts. These conditions are characterized by fog formation, which in the Gulf occurs about 35 days a year, mostly during winter. Impact from these conditions is reduced in winter because the onshore winds have the smallest frequency, and rain removal is greatest.

*Conclusion*

Emissions of pollutants into the atmosphere from activities for the proposed action are expected to have concentrations that would not change the onshore air quality classifications. Increases in onshore concentrations of air pollutants from the proposed action are estimated to be about 1 $\mu gm^{-3}$ (box model steady concentrations). This concentration will have minimal impacts during winter because onshore winds occur only about 34 percent of the time and maximum impacts in summer, when onshore winds occur 85 percent of the time.

*High Case Analysis*

The scenario discussed in Section IV.A. (Table IV-3) for the High Case establishes that 420 exploration and delineation wells and 270 development wells would be drilled, and 30 platform complexes would be emplaced. The sale area has been subdivided into three offshore subareas: W-1, W-2, and W-3 (Figure IV-1). This discussion analyzes the potential degrading effects on air quality of OCS-related activities in each subarea. Table IV-3 presents for the High Case the numbers of exploration, delineation, and development wells; platforms installed; and service vessel trips for each subarea.

The following table shows total emissions from wells, platforms, and vessels in the WPA for the High Case. Observe that $NO_x$ is the most emitted pollutant, while TSP is the least emitted. More important is that this information shows that wells and vessels contribute mostly $NO_x$; platforms contribute mostly $NO_x$, CO, and VOC. These emissions were calculated by adding the well and platform emissions over time. Vessel emissions were calculated using the total number of service vessel trips presented in Table IV-3. Emissions from other related activities were calculated using information presented in Table IV-3 and emission factors from Jacobs (1989) or USEPA (1985).

Total OCS Emissions in the WPA
(tons over 35-year life of the proposed action)

| Activity | $NO_x$ | CO | $SO_x$ | THC | TSP |
|---|---|---|---|---|---|
| Service Vessels | 6,572.2 | 769.9 | 103.8 | 334.4 | 463.7 |
| LTO Helicopters | 40.6 | 32.8 | 6.3 | 1.7 | 1.6 |
| Cruise Helicopters | 131.3 | 375.0 | 28.1 | 30.6 | 37.5 |
| Blowouts without Fire | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 |
| Spills without Fire | 0.0 | 0.0 | 0.0 | 255.0 | 0.0 |
| Barge Loading | 0.0 | 0.0 | 0.0 | 32.2 | 0.0 |
| Tanker Loading | 0.0 | 0.0 | 0.0 | 547.6 | 0.0 |
| Transit Loss | 0.0 | 0.0 | 0.0 | 437.3 | 0.0 |
| Tanker Exhaust | 390.7 | 42.7 | 485.3 | 0.6 | 140.4 |
| Tug Exhaust | 39.8 | 4.0 | 0.5 | 1.8 | 2.4 |
| Exploratory Wells | 4,061.4 | 1,083.6 | 474.6 | 117.6 | 407.4 |
| Development Wells | 1,790.0 | 477.5 | 210.0 | 52.5 | 180.0 |
| Platforms | 51,450.0 | 6,762.0 | 90.0 | 19,500.0 | 126.0 |
| Totals | 64,476.0 | 9,547.5 | 1,398.6 | 21,311.8 | 1,359.0 |

Total emissions for each subarea in the WPA during the High Case are presented below. Observe that Subarea W-1, which is the closest to land, generates the smallest emissions of all pollutants, while Subarea W-3, the farthest from land, generates the greatest amounts of emissions.

Total Emissions in WPA Subareas
(tons over the 35-year life of the proposed action--High Case)

| Pollutant | W-1 | W-2 | W-3 |
|---|---|---|---|
| $NO_x$ | 2,149.2 | 10,746.0 | 51,580.8 |
| CO | 318.3 | 1,591.3 | 7,638.0 |
| $SO_x$ | 46.6 | 233.1 | 1,118.9 |
| THC | 710.4 | 3,552.0 | 17,049.4 |
| TSP | 45.3 | 226.5 | 1,087.2 |

The total pollutant emissions per year are not uniform. During the early years of the proposed action, emissions would be small and increase over time with production. After reaching a maximum, emissions would decrease rapidly to zero as all platforms and wells are removed and service vessel trips are no longer needed.

The following table presents the peak emissions in tons per year for the primary pollutants during the High Case. It is very important to note that well drilling activities and platform peak emissions are not necessarily simultaneous. However, it is assumed that emissions from service vessels and other activities and well and platform peak emissions occur simultaneously. In this analysis the aggregate peak emissions, which are two to four times the mean emissions, will be employed. Use of peak emissions will provide the most conservative estimates of impact levels to the onshore air quality.

Peak and Mean Emissions in the WPA
(tons/year)

| Pollutant | Wells | Platforms | Vessels | Others | Mean | Aggregate |
|---|---|---|---|---|---|---|
| $NO_x$ | 909.64 | 2,572.50 | 204.99 | 0.00 | 1,842.17 | 2,849.09 |
| CO | 242.69 | 335.10 | 34.98 | 0.00 | 272.79 | 389.18 |
| $SO_x$ | 106.36 | 4.50 | 17.83 | 0.00 | 39.96 | 116.73 |
| THC | 26.39 | 975.00 | 10.55 | 40.29 | 612.84 | 1,027.93 |
| TSP | 91.28 | 6.30 | 18.45 | 0.00 | 38.83 | 103.75 |

The mean emissions were computed by dividing the total emissions by the 35-year life of the proposed action. Peak emissions from wells and platforms are obtained from their temporal distribution. Platforms and wells have the greatest peak emissions, while vessels have smaller emissions. This phenomenon is contrary to the emission rates, where wells have greater rates than platforms.

The effects of the pollutants considered in this analysis were described in the Base Case analysis and will not be repeated here. The reader may consult that section.

Because the meteorological conditions described in the Base Case will not change for this analysis, neither will they be repeated. The only changes that occur in the High Case are those related to infrastructures and resources. These changes are reflected in an increase of emissions for all analyzed pollutants. A comparison of High Case emissions per year with those of the Base Case shows that these would increase by 1.5 to 2 times.

To estimate the potential impact of offshore emissions on offshore and onshore air quality, a steady state box model (Lyons and Scott, 1990) was employed. The model is an expression of mass conservation and assumes that pollutants are vertically dispersed and sources uniformly distributed. For the purpose of these air quality analyses, an assumption of uniform distribution of average size sources throughout the planning areas at this stage is a reasonable approach. Predominance of unstable atmospheric conditions over the sea, as discussed in Section III.A.2., ensures that pollutants are dispersed homogeneously. The model was applied to $NO_x$ emissions because these are the largest emissions. Concentrations for other pollutants can be estimated by multiplying the $NO_x$ concentrations by the ratio of the pollutant emissions over the $NO_x$ emissions. Concentrations of primary pollutants other than $NO_x$ would be smaller by more than 80 percent. Because VOC emissions are not inert, the box model cannot be used to assess their impacts on air quality. Impacts from VOC and CO will be estimated by comparing the offshore and onshore emission rates.

The box model was applied to the following conditions: onshore and offshore winds with speeds ranging from 1 to 7 $ms^{-1}$, a mean mixing height of 900 m, and a low mixing height of 300 m. During periods of winds blowing offshore, impacts to the onshore air quality from offshore WPA emissions are very low because the pollutants are transported offshore. Conditions of onshore winds indicate that concentrations reaching land from Subarea W-1 varied between 0.75 and 0.10 $\mu gm^{-3}$ for speeds from 1 to 7 $ms^{-1}$ and a mixing height of 900 m; for a 300-m mixing height, concentrations varied from 2.24 to 0.30 $\mu gm^{-3}$ under the same wind speeds.

Concentrations for pollutants other than VOC would be smaller, as indicated above. Impacts to air quality from $NO_x$ are low because the only ambient concentration reported (94 $\mu gm^{-3}$) was below the national standard (100 $\mu gm^{-3}$), and the OCS contribution will not cause it to exceed. The MMS regulations (30 CFR 250.44) do not establish annual significance levels for CO and VOC. For these pollutants, a comparison of emission rates will be used to assess impacts. Formulas to compute the emission rates in tons/yr for CO are $3{,}400 \cdot D^{2/3}$ and $33.3 \cdot D$ for VOC. In these formulas, D represents distance in statute miles from the shoreline to the source. The CO exempt emission level in Subarea W-1 is 15,781.4 tons/yr, which is greater than peak emissions from the whole WPA. The exemption emission level of VOC in Subarea W-1 is 333 tons/yr, while the platform emission level is estimated at 32.5 tons/yr. Transport of pollutants toward onshore areas have a frequency maximum of 85 percent during summer and only 34 percent during winter. Thus, the box model results are very conservative estimates of pollutant contribution to onshore air quality. The modeling effort does not consider removal processes such as rain, which in the WPA has a high frequency (Section III.A.2.) and would reduce impact levels to onshore air quality.

Further, using an approved numerical model, the OCD Model (USDOI, MMS, 1986a), MMS has further studied the impacts of offshore emissions. Conducted off the Galveston, Brazos, and High Island Areas, Texas, the study used 250 offshore sources and employed a 300-m mixing height, which coincides with the lower mixing height employed in the box model. The model run in this study represents an aggregation of all sources. The annual arithmetic mean varied between 0.82 and 1.83 $\mu gm^{-3}$, which is below the national standard of 100 $\mu gm^{-3}$. All other inert pollutants will have lower concentrations.

A recent dispersion analysis of $NO_x$ emissions from 16 proposed OCS platforms along the Texas offshore area was completed (USDOI, MMS, 1991c). Annual average concentrations peaked around 0.04 $\mu gm^{-3}$ and the highest 1-hour concentration never exceeded 1.54 $\mu gm^{-3}$. These results agree with our previous assessments that the proposed action will have low impacts on the onshore air quality. Therefore, it is reasonable to assume that concentrations derived from emissions associated with the proposed action, 30 platforms spread over 145.3 billion square meters, would have a much smaller effect.

Oil-spill effects on air quality are examined below. It is assumed that oil spills in the category greater than 1 and equal to or less than 50 bbl, as well as greater than 50 and less than 1,000 bbl, would have low impacts on air quality because their input of pollutants (it is assumed that 50% of the spill evaporates in three days) would be very small. Information from OCS accidents indicates emissions of fewer than 100 tons/hour by the second hour. For spills greater than or equal to 1,000 bbl, emissions are about 285 tons/hour or smaller. A single spill greater than or equal to 1,000 bbl is assumed as a result of the High Case. If the dispersion of emissions is taken into account, effects on offshore air quality would be temporary.

Nearly 18 percent of OCS crude-oil production is offloaded from surface vessels at ports. The estimated VOC emissions during offloading are 579.8 tons during the 35-year life of the proposed action. These emissions represent 2.7 percent of the total VOC emissions of the High Case. Current industry practice is to extend pipelines to new production facilities when feasible; barging, then, would be needed only during the construction phase. Emissions from service vessels are expected to produce negligible effects on air quality.

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 used in this analysis represents the equivalent diameter, which is the diameter of a sphere that will 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 $\mu m$ and a third peak with a diameter larger than 2 $\mu m$. Particles with diameters of 2 $\mu m$ or larger settle very close to the source (residence time of approximately ½ day, Lyons and Scott, 1990), so their concentrations on these areas would be low. For particles smaller than 2 $\mu m$, which do not settle fast, wind transport determines their impacts. Results from the box model indicate that the largest concentration for TSP will be 0.78 $\mu gm^{-3}$, which is less than the allowable annual increase level of 5 $\mu gm^{-3}$. Besides, Section III.A.3. indicates that in the coastal areas the suspended particulate matter is around 50 $\mu gm^{-3}$ and the national 24-hour standard is 150 $\mu gm^{-3}$, making the OCS contribution unimportant.

Blowouts are accidents related to OCS activities and are defined as an uncontrolled flow of fluids from a wellhead or wellbore. In the Gulf of Mexico OCS there have been 116 blowouts over a period of 19 years (1971-1989) (Section IV.A.2.d.(8)). This represents an average of about 6 blowouts per year, but the number of wells drilled is a better indicator. The estimated number of blowouts, at a rate of 7 blowouts per 1,000 wells drilled, is 5 blowouts during the High Case in the WPA. 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.

Because of technological advances the duration of blowouts has decreased, and about 61 percent of recent blowouts last 1 day or less, 19 percent last between 2 and 3 days, 7 percent last between 4 and 7 days, and 13 percent last more than 7 days (Fleury, 1983). Further, most blowouts occurred without fire (MMS Database). The amount of oil released during these accidents has been small. For this analysis, a blowout of 500 bbl per day will be assumed. Using the distribution of blowouts cited earlier, three blowouts will last 1 day, one blowout will last 2.5 days, and one blowout will last 5.5 days. No statistics exist on the amount of gas released during a blowout; however, for this analysis, a rate of 1 Bcf-per-day will be assumed. The emission rate for a blowout without fire is 2,000 lb per hour of THC for a 1,000 bbl-per-day and 1 Bcf-per-day blowout accident. Using our assumption of oil released, we estimate the rate could then be reduced by half, or 1,000 lb per hour of

THC. The total emission of THC is 138 tons over the life of the proposed action. It must be remembered that these are conservative estimates and that the total amount of THC may be less; the VOC will also be less because it is a fraction of the THC.

Ozone is of great concern because of its environmental considerations. In the WPA five counties have nonattainment status for this pollutant (Section III.A.3.). Ozone measurements (Texas Air Control Board, 1989) made in 1988 were discussed in Section III.A.3., to which the interested reader is referred. Concentrations at three coastal sites indicate that the national standard was exceeded in two (Houston and the Beaumont-Port Arthur-Brazoria area) and the third was a border case (Corpus Christi). However, impacts from the OCS cannot be assessed because ozone is not emitted but formed by photochemical processes, which were not modeled in this analysis. However, the $NO_x$ concentrations, even if all were converted to ozone, will not change the status of the areas discussed above.

Emissions of pollutants into the atmosphere from the activities associated with the High Case are expected to have a minimal impact on offshore air quality because of the prevailing atmospheric conditions and emission heights. The effects on inshore areas of pollutants from subareas far from the coastline are expected to be low at all times; subareas close to the coastline will have low impacts throughout the year. However, it seems that VOC emissions could pose a problem to the onshore areas of the WPA from the High Case.

*Conclusion*

Emissions of pollutants into the atmosphere from activities for the High Case are expected to have concentrations that would not change the onshore air quality classifications. Increases in onshore concentrations of air pollutants from the High Case are estimated to be about 1 $\mu gm^{-3}$ (box model steady concentrations). This concentration will have minimal impacts during winter because onshore winds occur only about 34 percent of the time and maximum impacts in summer, when onshore winds occur 85 percent of the time. However, these concentrations will be reduced by rain removal, which is high through most of the year.

## *(5) Impacts on Marine Mammals*

### *(a) Nonendangered and Nonthreatened Species*

This section discusses the effects of the proposed action on nonendangered marine mammals. Twenty-eight nonendangered species of marine mammals of the Order Cetacea, which includes whales and dolphins, have been identified in the Gulf of Mexico (Table III-5). By an order of magnitude, the bottlenose dolphin is the most common cetacean in this area. Its distribution and movement suggest that there are several distinctive populations in the Gulf.

The major impact-producing factors related to the proposed action that may affect Gulf nonendangered cetaceans include operational discharges, helicopter and service-vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills and oil-spill response activities. These impact-producing factors are discussed in detail by the National Research Council (1985), Boesch and Rabalais (1987d), Geraci and St. Aubin (1988), USDOI, MMS (1982a and 1987d), and API (1989) and are described below.

Produced waters, drilling muds, and drill cutting discharges can potentially impact cetaceans by displacing or reducing their food sources. Offshore operational discharges are not lethal to cetaceans and are diluted and dispersed rapidly to the extent that adverse effects to cetacean food sources do not occur (API, 1989; NRC, 1983). The suspended particulate matter in the discharge plume could temporarily inhibit the ability of a cetacean to locate its prey visually or acoustically.

Noise from helicopter and service-vessel traffic may elicit a startle reaction from cetaceans or mask their sound reception. This effect is sublethal and at worst of a short-term temporary nature (Gales, 1982). Dolphins are known to actively seek out and accompany service vessels for some distance with no adverse effects. Service vessels could collide with and directly impact cetaceans, but due to dolphin maneuverability and echo-location, encounters of this type are extremely rare (Slijper, 1979; Kraus, personal comm., 1987).

Exploration, delineation, and production structures produce sounds at intensities and frequencies that can be heard by cetaceans. The decibel levels of these sounds dissipate to the tolerance of most cetaceans within 15 m of the sound source. Odontocetes (toothed cetaceans) communicate and echo-locate at frequencies higher than the dominant sounds generated by offshore drilling and production activities. For example, bottlenose dolphins are sensitive to sound levels in the 143-180 dB range; this high range is unlikely to be generated by offshore drilling operations (Gales, 1982).

Explosive platform removals can interfere with communications, disturb behavior, reduce hearing sensitivity or cause hemorrhaging in cetaceans (USDOI, MMS, 1990b). The effects are primarily sublethal and short-term; however, cetaceans proximate to detonation would likely sustain fatal injuries. Mortalities and fatal injuries have been speculated, but none has been documented. In order to minimize the likelihood of removals occurring when cetaceans may be nearby, MMS has issued guidelines for explosive platform removal to offshore operators. These guidelines include daylight detonation only, staggered charges, placement of charges 5 m below the seafloor, and pre- and post-detonation surveys of surrounding waters.

The sources of acoustical pulse used in seismic surveys are generated by airguns. Should seismic-generated sound waves exceed the ambient "background" noise they may interfere with cetacean communication or disturb behavior. Although ambient sound levels in marine environments are highly variable, effects from seismic surveys are limited because seismic sound pressure dissipates to under 200 dB at distances beyond 30 m from the acoustic source (Gales, 1982). Of course, cetaceans in proximity to the source of acoustic transmission could be disturbed by noise. However, the pressure encountered by cetaceans during dives and from natural underwater sounds are often in excess of those produced by seismic activities at the acoustic source. In addition, cetacean populations are highly dispersed, and individual cetaceans easily avoid acoustic interference. The effects on cetaceans from seismic surveys are primarily sublethal and mostly constitute short-term avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans, causing skin and eye irritation, asphyxiation from inhalation of toxic fumes, food reduction or contamination, oil ingestion, and displacement from preferred habitats or migration routes (Goodale et al., 1981; Gruber, 1981; Geraci and St. Aubin, 1988). When an oil spill occurs, many factors interact to delimit the severity of effects and the extent of damage to cetaceans. Determining factors include geographic location, oil type, oil dosage, impact area, oceanographic conditions, meteorological conditions, and season (NRC, 1985; USDOI, MMS, 1987b). Cetaceans themselves may actively avoid an oil spill, thereby limiting the effects and lessening the extent of damage to their populations. Less severe, sublethal effects are defined as those that impair the ability of an organism to function effectively without causing direct mortality (NRC, 1985).

Geraci and St. Aubin (1988) noted that determining the risk to cetaceans from an interaction with oil was extremely difficult because of the host of variables involved in the interaction. Generally, species with large ranges and mobility that feed in the water column versus at the surface or on the bottom are less vulnerable to oil. This suggests that Mysticetes (baleen whales) are the most vulnerable, followed by bottlenose dolphins and wide-ranging odontocetes. Although the coastal habitats of the bottlenose dolphin are assumed to be oiled than offshore areas, Geraci and St. Aubin (1982) suggest that dolphins are able to detect and avoid oil. Skin and eye irritation and respiratory disorders caused by contacting oil are sublethal and of a temporary nature (Geraci and St. Aubin, 1988). Death or debilitating illness caused by oil ingestion or by consumption of contaminated food requires large volumes and long-term chronic interactions. Long-term interactions, which could shorten life expectancy or reduce fecundity, have not been studied.

*Base Case Analysis*

The major impact-producing factors analyzed below are related to the proposed action and include operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills, and oil-spill response activities.

An estimated 2,241,000 bbl of drilling muds, 546,000 bbl of drill cuttings, and 1.3 MMbbl of produced waters are assumed to be generated offshore as a result of the proposed action. These effluents are routinely discharged into offshore marine waters and are regulated by the U.S. Environmental Protection Agency's NPDES permits. It is estimated that nonendangered cetaceans will have some interaction with these discharges. Direct effects to cetaceans are expected to be sublethal, and effects to cetacean food sources are not expected due to the rapid offshore dilution and dispersion of operational discharges. It is estimated that operational discharges will rarely contact and affect nonendangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis averaging about 4,000 trips per year. The FAA Advisory Circular 91-36C encourages the use of fixed-wing aircraft above an elevation of 152 m and helicopters above 300 m. It is estimated that at these elevations no cetaceans will be affected by OCS helicopter traffic. It is also estimated that helicopter traffic will rarely disturb and affect nonendangered cetaceans because of special prohibitions and adherence to the general, FAA-recommended minimum ceiling of 300 m.

It is assumed that about 237 OCS-related oil/gas service vessel trips will occur annually as a result of the proposed action and that 66 shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-3). Noise from service-vessel traffic may elicit a startle reaction from cetaceans or mask their sound reception. This effect is sublethal and, at worst, of a short-term, temporary nature. Cetaceans can avoid service vessels, and operators can avoid cetaceans. It is estimated that service vessel traffic will rarely contact and affect nonendangered cetaceans.

It is assumed that 210 exploration and delineation wells and 110 development wells will be drilled and will produce sounds at intensities and frequencies that could be heard by cetaceans. It is estimated that noise from drilling activities will last no longer than two months at each location. However, the decibel level of these sounds dissipates to the tolerance of most cetaceans within 15 m of the source. Odontocetes communicate at higher frequencies than the dominant sounds generated by drilling platforms. Sound levels in this range are not estimated to be generated by drilling operations (Gales, 1982). The effects on cetaceans from platform noise are expected to be sublethal. It is estimated that drilling noise will rarely disturb and affect nonendangered cetaceans.

Explosive platform removals can interfere with communication, disturb behavior, reduce hearing sensitivity, or cause hemorrhaging in cetaceans. It is estimated that three production platforms will be removed by explosives from the Gulf of Mexico as a result of the proposed action. These removals are assumed to occur during the last 12 years of the life of the proposed action and no more than one in any given year. It is expected that structure removals will cause sublethal effects on cetaceans. No mortalities are expected because of the MMS guidelines for explosive removals (USDOI, MMS, 1990a, Appendix B). It is estimated that structure removals will rarely disturb and affect nonendangered cetaceans.

Seismic surveys use airguns to generate pulses. It is assumed that only these methods will be used in seismic surveys as a result of the proposed action (Section IV.A.2.). It is expected that effects on cetaceans from seismic surveys are primarily sublethal constituting short-term avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans, causing skin and eye irritation, asphyxiation from inhalation of toxic fumes, food reduction or contamination, oil ingestion, and displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from sale-related oil spills greater than or equal to 1,000 bbl, the effects would primarily be sublethal; few mortalities are assumed. The effects of sale-related oil spills less than 1,000 bbl are assumed to be solely sublethal due to the inconsiderable area affected and their rapid dispersion. It is assumed that the extent and severity of effects from sale-related oil spills of any size will be lessened by improved coastal oil spill contingency planning (Section IV.C.5.) and by active avoidance of oil spills by cetaceans.

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring from the proposed action in the WPA. It is assumed that 8 spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action. It is estimated that the 8 spills will occur offshore and that none will contact land. It is assumed that no spill greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action. Although an interaction with spills less than 1,000 bbl may occur, only sublethal effects are assumed. It is estimated that spills less than 1,000 bbl will infrequently contact and affect nonendangered cetaceans.

Section IV.C.1. estimates the mean number of spills greater than or equal to 1,000 bbl resulting from the proposed action in the WPA. It is assumed that no crude oil spill greater than or equal to 1,000 bbl will occur from either a platform or pipeline in the Western Gulf during the 35-year life of the proposed action. It is estimated that an oil spill greater than or equal to 1,000 bbl will not contact or affect nonendangered cetaceans in the WPA.

*Summary*

Activities resulting from the proposed action have a potential to affect nonendangered cetaceans detrimentally. These cetaceans could be impacted by operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills, and oil-spill response activities. The effects of the majority of these activities are estimated to be sublethal. Lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl. Sale-related oil spills of any size are estimated to be extraordinary events that will rarely contact nonendangered and nonthreatened cetaceans.

*Conclusion*

The impact of the Base Case scenario on nonendangered and nonthreatened cetaceans within the potentially affected area is expected to result in sublethal effects that occur periodically and result in short-term physiological or behavioral changes, as well as some degree of avoidance of the impacted area(s).

*High Case Analysis*

The major impact-producing factors analyzed below are related to the proposed action and include operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills and oil-spill response activities.

An estimated 4,819,000 bbl of drilling muds, 1.1 MMbbl of drill cuttings, and 3 MMbbl of produced waters are assumed to be discharged annually as a result of the proposed action. These effluents are routinely discharged into offshore marine waters and are regulated by the U.S. Environmental Protection Agency's NPDES permits. It is estimated that nonendangered cetaceans will have some interaction with these discharges. Direct effects to cetaceans are assumed to be sublethal, and effects to cetacean food sources are not assumed due to the rapid offshore dilution and dispersion of operational discharges. It is estimated that operational discharges will rarely contact and affect nonendangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis, averaging about 10,000 trips each year. The FAA Advisory Circular 91-36C encourages the use of fixed-wing aircraft above an elevation of 152 m and helicopters above 300 m. It is estimated that at these elevations no cetaceans will be affected by OCS helicopter traffic. It is also estimated that helicopter traffic will rarely disturb and affect nonendangered cetaceans because of special prohibitions and adherence to the general, FAA-recommended minimum ceiling of 300 m.

It is assumed that about 557 OCS-related oil/gas service vessel trips will occur annually as a result of the proposed action and that 171 total shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-3). Noise from service-vessel traffic may elicit a startle reaction from cetaceans or mask their sound reception. This effect is sublethal and at worst of a short-term, temporary nature. Cetaceans can avoid service vessels, and operators can avoid cetaceans. It is estimated that service vessel traffic will rarely contact and affect nonendangered cetaceans.

It is assumed that 420 exploration and delineation wells and 270 development wells will be drilled and will produce sounds at intensities and frequencies that could be heard by cetaceans. It is estimated that noise from drilling activities will last no longer than two months at only one location. However, the decibel level of these sounds dissipates to the tolerance of most cetaceans within 15 m of the source. Odontocetes communicate at higher frequencies than the dominant sounds generated by drilling platforms. Sound levels in this range are not likely to be generated by drilling operations (Gales, 1982). The effects on cetaceans from platform noise are expected to be sublethal. It is estimated that drilling noise will rarely disturb and affect nonendangered cetaceans.

Explosive platform removals can interfere with communication, disturb behavior, reduce hearing sensitivity or cause hemorrhaging in cetaceans. It is estimated that six structures will be removed by explosives from the

Gulf of Mexico as a result of the proposed action. These removals are assumed to occur during the last 12 years of the life of the proposed action and no more than 2 in any single year (Table IV-3). It is expected that structure removals will cause sublethal effects on cetaceans. No mortalities are expected because of the MMS guidelines for explosive removals (USDOI, MMS, 1990a, Appendix B). It is estimated that structure removals will rarely disturb and affect nonendangered cetaceans.

Seismic surveys use airguns to generate pulses. It is assumed that only these methods will be used in seismic surveys as a result of the proposed action. It is expected that effects on cetaceans from seismic surveys are primarily sublethal, constituting short-term avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans, causing skin and eye irritation, asphyxiation from inhalation of toxic fumes, food reduction or contamination, oil ingestion, and displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from sale-related oil spills greater than or equal to 1,000 bbl, the effects would primarily be sublethal; few mortalities are assumed. The effects of sale-related oil spills less than 1,000 bbl are assumed to be solely sublethal due to the inconsiderable area affected and their rapid dispersion. It is assumed that the extent and severity of effects from sale-related oil spills of any size will be lessened by improved coastal oil-spill contingency planning (Section IV.C.5.) and by active avoidance of oil spills by cetaceans.

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring from the proposed action in the WPA. It is assumed that 20 spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action. It is estimated that the 20 spills will occur offshore and that none will contact land (Section IV.A.2.). It is assumed that 1 spill greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action, and it is estimated that the spill will occur offshore and that none of the oil will contact land. Although an interaction with spills less than 1,000 bbl may occur, only sublethal effects are assumed. It is estimated that spills less than 1,000 bbl will infrequently contact and affect nonendangered cetaceans. The impact level is assumed to be low.

Section IV.C.1. estimates the mean number of spills greater than or equal to 1,000 bbl resulting from the proposed action in the WPA. It is assumed that one crude oil spill greater than or equal to 1,000 bbl will occur from either a platform or pipeline in the Western Gulf during the 35-year life of the proposed action. Table IV-22 identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting areas within 10 days where cetaceans have been surveyed. There is a 5 percent probability that an oil spill greater than or equal to 1,000 bbl will occur and contact within 10 days cetacean habitats at or beyond the shelf break of the WPA. There is a 1 percent probability that an oil spill greater than or equal to 1,000 bbl will occur and contact within 10 days coastal areas of Texas (Table IV-22). Although an interaction with spills greater than or equal to 1,000 bbl may occur, infrequent mortalities are assumed with primarily sublethal effects. It is estimated that an oil spill greater than or equal to 1,000 bbl will rarely contact and affect nonendangered cetaceans in the WPA.

Activities resulting from the proposed action have a potential to affect nonendangered cetaceans detrimentally. These cetaceans could be impacted by operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills, and oil-spill response activities. The effects of the majority of these activities are estimated to be sublethal. Lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl. Sale-related oil spills of any size are estimated to be extraordinary events that will rarely contact nonendangered and nonthreatened cetaceans.

*Conclusion*

The impact of the High Case scenario on nonendangered and nonthreatened cetaceans within the potentially affected area is assumed to result in sublethal effects that are chronic and could result in persistent physiological or behavior changes, as well as some degree of avoidance of the impacted area(s).

### *(b) Endangered and Threatened Species*

This section discusses the effects of the proposed action on blue, right, sei, humpback, fin, and sperm whales. For a detailed discussion of these species, see Section III.B.3.a.(2). The sperm whale is the species most commonly seen in the Gulf of Mexico.

The major impact-producing factors related to the proposed action are discussed in detail by the National Research Council (1985), Boesch and Rabalais (1987), Geraci and St. Aubin (1988), USDOI, MMS (1982a and 1987d), and API (1989), and are described in the preceding section (Section IV.D.2.a.(5)(a), nonendangered and nonthreatened species).

*Base Case Analysis*

The major impact-producing factors analyzed below are related to the proposed action and include operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills, and oil-spill response activities.

An estimated 2,241,000 bbl of drilling muds, 546,000 bbl of drill cuttings, and 1.1 MMbbl of produced waters are assumed to be generated offshore as a result of the proposed action (Table IV-3). These effluents are routinely discharged into offshore marine waters and are regulated by the U.S. Environmental Protection Agency's NPDES permits. It is estimated that endangered cetaceans will have some interaction with these discharges. Direct effects to cetaceans are expected to be sublethal, and effects to cetacean food sources are not expected due to the rapid offshore dilution and dispersion of operational discharges. It is estimated that operational discharges will rarely contact and affect endangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis, averaging about 4,000 trips per year. The FAA Advisory Circular 91-36C encourages the use of fixed-wing aircraft above an elevation of 152 m and helicopters above 300 m. It is estimated that at these elevations no cetaceans will be affected by OCS helicopter traffic. It is also estimated that helicopter traffic will rarely disturb and affect endangered cetaceans because of special prohibitions and adherence to the general, FAA-recommended minimum ceiling of 300 m.

It is assumed that about 237 OCS-related oil/gas service-vessel trips will occur annually as a result of the proposed action and that 66 shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-3). The shuttle tanker trips are expected to occur in coastal Subarea W-3, inshore of the areas where sperm and fin whales have been sighted. Noise from service vessel traffic may elicit a startle reaction from cetaceans or mask their sound reception. This effect is sublethal and, at worst, of a short-term, temporary nature. Cetaceans can avoid service vessels, and operators can avoid cetaceans. It is estimated that service-vessel traffic will rarely contact and affect endangered cetaceans.

It is assumed that 210 exploration and delineation wells and 110 development wells will be drilled and will produce sounds at intensities and frequencies that could be heard by cetaceans. It is estimated that noise from drilling activities will last no longer than two months at each location. However, the decibel level of these sounds dissipates to the tolerance of most cetaceans within 15 m of the source. Odontocetes communicate at higher frequencies than the dominant sounds generated by drilling platforms. Sound levels in this range are not likely to be generated by drilling operations (Gales, 1982). The effects on cetaceans from platform noise are expected to be sublethal. It is estimated that drilling noise will rarely disturb and affect endangered cetaceans.

Explosive platform removals can temporarily interfere with communication, disturb behavior, permanently reduce hearing sensitivity, or cause hemorrhaging in cetaceans. It is estimated that three production platforms will be removed using explosives from the Gulf of Mexico as a result of the proposed action. These removals are assumed to occur during the last 12 years of the life of the proposed action, with no more than 1 removal in any given year (Table IV-3). It is expected that structure removals will cause sublethal effects on cetaceans. No mortalities are expected because of the MMS guidelines for explosive removals (USDOI, MMS, 1990a, Appendix B). It is estimated that structure removals will rarely disturb and affect endangered cetaceans.

Seismic surveys use airguns to generate pulses. It is assumed that only these methods will be used in seismic surveys as a result of the proposed action (Section IV.A.2.). It is expected that effects on cetaceans from seismic surveys are primarily sublethal, constituting short-term avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans, causing skin and eye irritation, asphyxiation from inhalation of toxic fumes, food reduction or contamination, oil ingestion, and displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from sale-related oil spills greater than or equal to 1,000 bbl, the effects would primarily be sublethal; few mortalities are assumed. The effects of sale-related oil spills less than 1,000 bbl are assumed to be solely sublethal due to the inconsiderable area affected and their rapid dispersion. It is assumed that the extent and severity of effects from sale-related oil spills of any size will be lessened by improved coastal oil-spill contingency planning (Section IV.C.5.) and by active avoidance of oil spills by cetaceans.

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring from the proposed action in the WPA. It is assumed that eight spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action. It is estimated that the eight spills will occur offshore and that none will contact land. It is assumed that no spill greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action. Although an interaction with spills may occur, only sublethal effects are assumed. It is estimated that small spills will infrequently contact and affect endangered cetaceans.

Section IV.C.1. estimates the mean number of spills greater than or equal to 1,000 bbl resulting from the proposed action in the WPA. It is assumed that no crude oil spill greater than or equal to 1,000 bbl will occur from either a platform or pipeline in the Western Gulf during the 35-year life of the proposed action. It is estimated that a oil spill greater than or equal to 1,000 bbl will not contact or affect endangered cetaceans in the WPA.

*Summary*

Activities resulting from the proposed action have a potential to affect endangered cetaceans detrimentally. These cetaceans could be impacted by operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills, and oil-spill response activities. The effects of the majority of these activities are estimated to be sublethal. Lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl. Sale-related oil spills of any size are estimated to be extraordinary events that will rarely contact endangered and threatened cetaceans.

*Conclusion*

The impact of the Base Case scenario on endangered and threatened cetaceans within the potentially affected area is assumed to result in sublethal effects that occur periodically and result in short-term physiological or behavioral changes, as well as some degree of avoidance of the impacted area(s).

*High Case Analysis*

The major impact-producing factors analyzed below are related to the proposed action and include operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills, and oil-spill response activities.

An estimated 4,819,000 bbl of drilling muds, 1.1 MMbbl of drill cuttings, and 3 MMbbl of produced waters are assumed to be generated offshore as a result of the proposed action. These effluents are routinely discharged into offshore marine waters and are regulated by the U.S. Environmental Protection Agency's NPDES permits. It is estimated that endangered cetaceans will have some interaction with these discharges. Direct effects to cetaceans are expected to be sublethal, and effects to cetacean food sources are not expected due to the rapid offshore dilution and dispersion of operational discharges. It is estimated that operational discharges will rarely contact and affect endangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis, averaging about 10,000 trips per year. The FAA Advisory Circular 91-36C encourages the use of fixed-wing aircraft above an elevation of 152 m and helicopters above 300 m. It is estimated that at these elevations no cetaceans will be affected by OCS helicopter traffic. It is also estimated that helicopter traffic will rarely disturb and affect endangered cetaceans because of special prohibitions and adherence to the general, FAA-recommended minimum ceiling of 300 m.

It is assumed that about 557 OCS-related oil/gas service-vessel trips will occur during the peak year of the proposed action, and that 171 total shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-3). Noise from service vessel traffic may elicit a startle reaction from cetaceans or mask their sound reception. This effect is sublethal and, at worst, of a short-term, temporary nature. Cetaceans can avoid service vessels, and operators can avoid cetaceans. It is estimated that service-vessel traffic will rarely contact and affect endangered cetaceans.

It is assumed that 420 exploration and delineation wells and 270 development wells will be drilled and will produce sounds at intensities and frequencies that could be heard by cetaceans. It is estimated that noise from drilling activities will last no longer than two months at only one location. However, the decibel level of these sounds dissipates to the tolerance of most cetaceans within 15 m of the source. Odontocetes communicate at higher frequencies than the dominant sounds generated by drilling platforms. Sound levels in this range are not likely to be generated by drilling operations (Gales, 1982). The effects on cetaceans from platform noise are expected to be sublethal. It is estimated that drilling noise will rarely disturb and affect endangered cetaceans.

Explosive platform removals can interfere with communication, disturb behavior, reduce hearing sensitivity, or cause hemorrhaging in cetaceans. It is estimated that six production platforms will be removed by explosives from the Gulf of Mexico as a result of the proposed action. These removals are assumed to occur during the last 12 years of the life of the proposed action, with no more than 2 in any given year (Table IV-3). It is expected that structure removals will cause sublethal effects on cetaceans. No mortalities are expected because of the MMS guidelines for explosive removals (USDOI, MMS, 1990a, Appendix B). It is estimated that structure removals will rarely disturb and affect endangered cetaceans.

Seismic surveys use airguns to generate pulses. It is assumed that only these methods will be used in seismic surveys as a result of the proposed action (Section IV.A.2.). It is expected that effects on cetaceans from seismic surveys are primarily sublethal, constituting short-term avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans, causing skin and eye irritation, asphyxiation from inhalation of toxic fumes, food reduction or contamination, oil ingestion, and displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from sale-related oil spills greater than or equal to 1,000 bbl, the effects would primarily be sublethal; few mortalities are assumed. The effects of sale-related oil spills less than 1,000 bbl are assumed to be solely sublethal due to the inconsiderable area affected and their rapid dispersion. It is assumed that the extent and severity of effects from sale-related oil spills of any size will be lessened by improved coastal oil-spill contingency planning (Section IV.C.5.) and by active avoidance of oil spills by cetaceans.

Section IV.C.1 estimates the mean number of spills less than 1,000 bbl occurring from the proposed action in the WPA. It is assumed that 20 spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action. It is estimated that the 20 spills will occur offshore and that none will contact land. It is assumed that 1 spill greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action, and it is estimated that the spill will occur offshore and that no oil will contact land. Although an interaction with small spills may occur, only sublethal effects are assumed. It is estimated that small spills will infrequently contact and affect endangered cetaceans.

Section IV.C.1. estimates the mean number of spills greater than or equal to 1,000 bbl resulting from the proposed action in the WPA. It is assumed that one crude oil spill greater than or equal to 1,000 bbl will occur from either a platform or pipeline in the Western Gulf during the 35-year life of the proposed action. Table IV-22 identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting areas within 10 days where cetaceans have been surveyed. There is a 5 percent probability that an oil spill greater than or equal to 1,000 bbl will occur and contact within 10 days cetacean habitats at or beyond the shelf break of the WPA. There is a 1 percent probability that an oil spill greater than or equal to 1,000 bbl will occur and contact within 10 days coastal areas of Texas (Table IV-22). Although an interaction with spills greater than or equal to 1000 bbl may occur, infrequent mortalities are assumed with primarily sublethal effects. It is expected that an oil spill greater than or equal to 1,000 bbl will rarely contact and affect endangered cetaceans in the WPA.

Activities resulting from the proposed action have a potential to affect endangered cetaceans detrimentally. These cetaceans could be impacted by operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills, and oil-spill response activities. The effects of the majority of these activities are estimated to be sublethal. Lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl. Sale-related oil spills of any size are estimated to be extraordinary events that will rarely contact endangered and threatened cetaceans.

*Conclusion*

The impact of the High Case scenario on endangered and threatened cetaceans within the potentially affected area is assumed to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes, as well as some degree of avoidance of or displacement from the impacted area(s).

### *(6) Impacts on Marine Turtles*

This section discusses the effect of the proposed action on the loggerhead, Kemp's ridley, hawksbill, green, and leatherback marine turtles of the Gulf of Mexico. The major impact-producing factors related to the proposed action are discussed in detail in *Decline of the Sea Turtles: Causes and Prevention* (NRC, 1990) and are described below.

The major impact-producing factors related to the proposed action that may affect Gulf marine turtles include anchoring, structure installation, pipeline placement, dredging, operational discharges, vessel traffic, explosive platform removals, OCS-related trash and debris, oil-spill response activities, and oil spills.

Anchoring, structure installation, pipeline placement, dredging, and operational discharges may adversely affect marine turtle habitat through destruction of seagrass beds and live-bottom communities. Effects to these habitats from the above mentioned impact-producing factors are described and analyzed in detail in Sections IV.D.1.a.(1) and (2).

Noise from service-vessel traffic may elicit a startle reaction from marine turtles. This effect is sublethal and, at worst, of a short-term, temporary nature (NRC, 1990). Service vessels could collide with and directly impact marine turtles. Vessel-related injuries were noted in 9 percent of the marine turtles stranded in the Gulf of Mexico during 1988 (USDOC, NMFS, 1989b). This observation was not able to distinguish between live and dead turtles struck by boats. Marine turtles spend no more than 4 percent of their time at the surface, and less time than that during the winter (Byles, 1989; Lohoefener et al., 1990).

Explosive platform removals can cause capillary damage, disorientation, and loss of motor control in marine turtles (Duronslet et al., 1986). The effects are primarily sublethal and short-term; however, marine turtles proximate to detonation would likely sustain fatal injuries. Mortalities and fatal injuries have been speculated, but none has been documented. Although marine turtles occur near offshore oil and gas structures, aerial surveys in the Western Gulf have shown no statistical correlation between marine turtles and offshore structures (Lohoefener, personal comm., 1989). To minimize the likelihood of removals occurring when marine turtles may be nearby, MMS has issued guidelines for explosive platform removal to offshore operators. These guidelines include daylight detonation only; use of high-velocity explosives each less than 23 kg; staggered charges; placement of charges 5 m below the seafloor, and pre- and post-detonation surveys of surrounding waters.

Marine turtles can become entangled in monofilament fishing line, netting, 6-pack yokes, etc., which may result in injury or mortality. Marine turtles are known to be attracted to floating plastic debris because of its resemblance to their preferred food, the jellyfish. Ingestion of plastic and styrofoam materials could result in drowning, lacerations, digestive disorders or blockage, and reduced mobility resulting in starvation (Balazs, 1985; Carr, 1987; USDOC, NOAA, 1988d; Heneman and the Center for Environmental Education, 1988; USDOI, MMS, 1989a). 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), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989.

Oil-spill response activities, such as vehicular and vessel traffic in shallow areas of seagrass beds and live-bottom communities, can adversely affect sea turtle habitat and cause displacement from these preferred areas. These habitats receive particular consideration during oil-spill cleanup. Because of the special designation and general status of those areas, oil-spill contingency plans include special notices to minimize adverse effects from vehicular traffic during cleanup activities and to maximize the protection efforts to prevent contact of these areas with spilled oil (Section IV.C.5.).

Oil spills can adversely affect marine turtles by toxic external contact, toxic ingestion or blockage of the digestive tract, asphyxiation, entrapment in tar or oil slicks, habitat destruction, and displacement from preferred habitats (Fritts and McGehee, 1981; Vargo et al., 1986; Boesch and Rabalais, 1987; Lutz, 1989). Pelagic life stages are particularly vulnerable to contacting or ingesting oil because the currents that concentrate oil spills also form the debris mats that these life stages inhabit (Vargo et al., 1986). Fritts and McGehee (1982) noted that sea turtle eggs were rendered infertile on contact with oil.

When an oil spill occurs, many factors interact to delimit the severity of effects and the extent of damage to cetaceans. Determining factors include geographic location, oil type, oil dosage, impact area, oceanographic conditions, meteorological conditions, and season (NRC, 1985; USDOI, MMS, 1987b). Less severe, sublethal effects are defined as those that impair the ability of an organism to function effectively without causing direct mortality (NRC, 1985).

*Base Case Analysis*

The major impact-producing factors related to the proposed action that may affect Gulf marine turtles include anchoring, structure installation, pipeline placement, dredging, operational discharges, OCS-related trash and debris, vessel traffic, explosive platform removals, oil-spill response activities, and oil spills.

The impact from anchoring, structure installation, pipeline placement, dredging, and operational discharges on seagrass bed and live-bottom sea turtle habitat is analyzed in detail in Sections IV.D.1.a.(1) and (2).

To summarize the effects on wetlands and estuaries, it is expected that a dieback of up to 10-15 ha of wetlands will occur for less than one growing season from contact with spilled oil. Up to 5.5 ha of wetlands and estuaries could be eroded along navigation channels as a result of vessel traffic within the channels. Effects to wetlands and estuaries will occur along the north Texas coast. To summarize the effects on seafloor habitats little or no damage is expected to the physical integrity, species, diversity, or biological productivity of topographic features or live bottoms. Small areas of 5-10 $m^2$ would be affected for less than two years, probably on the order of four weeks. Offshore operational discharges are not lethal to marine turtles and are diluted and dispersed rapidly within 1 km of the discharge point to the extent that adverse effects to marine turtle food sources do not occur (API, 1989; NRC, 1983). It is expected that effects on marine turtles from anchoring, structure installation, pipeline emplacement, and dredging will be indistinguishable from the long-term (25-50 years) natural variability within populations of marine turtles. It is expected that marine turtles will avoid 5-10 $m^2$ of live-bottom areas for up to a month and that this avoidance of impoverished foraging areas will have no effect on marine turtles. The suspended particulate matter in operational discharges offshore is expected to cause sublethal effects by inhibition of the ability of marine turtles to locate their prey visually within 1 km of the discharge point for the short time period (less than one hour) spent traversing the plume.

Sublethal effects on marine turtles or their habitats are expected from these impact-producing factors. Based on the aforementioned analyses, the estimate is that anchoring, structure installation, pipeline placement, dredging, and operational discharges will rarely contact and affect marine turtles or their habitats.

Marine turtles can become entangled in or ingest trash and debris. It is assumed that some OCS-related trash and debris will be accidentally lost into the Gulf and available for interaction with marine turtles. Although mortalities could occur, primarily sublethal effects are expected. It is estimated that OCS oil- and gas-related trash and debris will rarely interact with and affect marine turtles.

Explosive platform removals can cause capillary damage, disorientation, loss of motor control, and fatal injuries in marine turtles. It is estimated that three production platforms will be removed by explosives from the Gulf of Mexico as a result of the proposed action. It is assumed that these removals occur during the last 12 years of the life of the proposed action with no more than 1 in any single year and that some of the platform removals will occur beyond the continental shelf. As benthic feeders, Gulf of Mexico hard shell marine turtles do not use habitats beyond the shelf break. Although the pelagic life stages of all marine turtles use these habitats, there is no correlation between marine turtles and the presence of offshore structures beyond the shelf break. It is expected that structure removals will cause sublethal effects on marine turtles. No mortalities are expected because of the MMS guidelines for explosive removals (USDOI, MMS, 1990a, Appendix B) and because the removals occur away from preferred offshore habitats. It is estimated that structure removals will rarely disturb and affect marine turtles.

It is assumed that about 237 OCS-related oil and gas service-vessel trips will occur annually as a result of the proposed action and that 66 shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-3). Noise from service-vessel traffic may elicit a startle reaction from marine turtles. This effect is sublethal and, at worst, of a short-term, temporary nature. Collision between service vessels and surfaced marine turtles would likely cause fatal injuries. It is assumed that service-vessel traffic and marine turtles will rarely be in close proximity. Although a low percentage of stranded marine turtles have shown indications of vessel collision, it cannot be determined what types of vessel were involved and whether these injuries occurred before or after death. Marine turtles are known to spend 4 percent or less of their time at the surface and to sound upon vessel approach. In addition, marine vessel operators can avoid marine turtles. It is estimated that service-vessel traffic will rarely contact and affect marine turtles.

Oil spills and oil-spill response activities can adversely affect marine turtles by toxic external contact, toxic ingestion or blockage of the digestive tract, asphyxiation, entrapment in tar or oil slicks, habitat destruction, and displacement from preferred habitats. Oil-spill response activities such as vehicular and vessel traffic are assumed to contact marine turtle habitat, such as shallow areas of seagrass beds and live-bottom communities, in the event of contact with a oil spill greater than or equal to 1,000 bbl. Sublethal effects are assumed due to the particular consideration these areas receive during oil-spill cleanup to minimize adverse effects from traffic during cleanup activities and to maximize protection efforts to prevent contact of these areas with spilled oil. It is estimated that oil-spill response activities will rarely contact and affect marine turtle habitat.

In the event that oiling of marine turtles should occur from sale-related oil spills greater than or equal to 1,000 bbl, the effects would primarily be sublethal; few mortalities are assumed. The effects of sale-related oil spills less than 1,000 bbl are assumed to be solely sublethal due to the inconsiderable area affected and their rapid dispersion. It is assumed that the extent and severity of effects from sale-related oil spills of any size will be lessened by improved coastal oil-spill contingency planning (Section IV.C.5.) and by active avoidance of oil spills by marine turtles.

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring from the proposed action in the WPA. It is assumed that eight spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action (Table IV-3). It is estimated that the 8 spills will occur offshore and that none will contact land. It is assumed that no spill greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action. Although an interaction with spills less than 1,000 bbl may occur, only sublethal effects are assumed. It is estimated that small spills will infrequently contact and affect marine turtles.

Section IV.C.1. estimates the mean number of spills greater than or equal to 1,000 bbl resulting from the proposed action in the WPA. It is assumed that no crude oil spill greater than or equal to 1,000 bbl will occur from either a platform or pipeline in the Western Gulf during the 35-year life of the proposed action. It is estimated that an oil spill greater than or equal to 1,000 bbl will not contact and affect marine turtles in the WPA.

*Summary*

Activities resulting from the proposed action have a potential to affect marine turtles detrimentally. Marine turtles could be impacted by anchoring, structure installation, pipeline placement, dredging, operational discharges, OCS-related trash and debris, vessel traffic, explosive platform removals, oil-spill response activities, and oil spills. The effects of the majority of these activities are estimated to be sublethal. Lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl. Sale-related oil spills of any size are estimated to be extraordinary events that will rarely contact marine turtles.

*Conclusion*

The impact of the Base Case scenario on marine turtles within the potentially affected area is assumed to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes.

*High Case Analysis*

The major impact-producing factors related to the proposed action that may affect Gulf marine turtles include anchoring, structure installation, pipeline placement, dredging, operational discharges, OCS-related trash and debris, vessel traffic, explosive platform removals, oil-spill response activities, and oil spills.

The impact from anchoring, structure installation, pipeline placement, dredging, and operational discharges on seagrass bed and live-bottom sea turtle habitat is analyzed in detail in Sections IV.D.1.a.(1) and (2).

To summarize the effects on wetlands and estuaries, it is expected that a dieback of up to 10-15 ha of wetlands will occur for less than one growing season from contact with spilled oil. Up to 5.5 ha of wetlands and estuaries could be eroded along navigation channels as a result of OCS-vessel traffic within the channels. Effects to wetlands and estuaries will occur in Louisiana and along the north Texas coast. To summarize the effects on seafloor habitats, little or no damage is expected to the physical integrity, species, diversity, or biological productivity of topographic features or live bottoms. Small areas of 5-10 $m^2$ would be affected for less than two years, probably on the order of four weeks. Offshore operational discharges are not lethal to marine turtles and are diluted and dispersed rapidly within 1 km of the discharge point to the extent that adverse effects to marine turtle food sources do not occur (API, 1989; NRC, 1983). It is expected that effects on marine turtles from anchoring, structure installation, pipeline emplacement, and dredging will be indistinguishable from the long-term (25-50 years) natural variability within populations of marine turtles. It is expected that marine turtles will avoid 5-10 $m^2$ of live-bottom areas for up to a month and that this avoidance of impoverished foraging areas will have no effect on marine turtles. The suspended particulate matter in operational discharges offshore are expected to cause sublethal effects by inhibition of the ability of marine turtles to locate its prey visually within 1 km of the discharge point for the short time period (less than one hour) spent traversing the plume.

Sublethal effects on marine turtles or their habitats are expected from these impact-producing factors. Based on the aforementioned analyses, the estimate is that anchoring, structure installation, pipeline placement, dredging, and operational discharges will rarely contact and affect marine turtles or their habitats.

Marine turtles can become entangled in or ingest trash and debris. It is assumed that some OCS-related trash and debris will be accidentally lost into the Gulf and available for interaction with marine turtles. Although mortalities could occur, primarily sublethal effects are expected. It is estimated that OCS oil- and gas-related trash and debris will rarely interact with and affect marine turtles.

Explosive platform removals can cause capillary damage, disorientation, loss of motor control, and fatal injuries in marine turtles. It is estimated that six production platforms will be removed by explosives from the Gulf of Mexico as a result of the proposed action. It is assumed that these removals occur during the last 12 years of the life of the proposed action with no more than 2 in any single year and that some of the platform removals will occur in habitats beyond the continental shelf. As benthic feeders, Gulf of Mexico hard-shell marine turtles do not use habitats beyond the shelf break. Although the pelagic life stages of all marine turtles do use these habitats, there is no correlation between marine turtles and the presence of offshore structures beyond the shelf break. It is expected that structure removals will cause sublethal effects on marine turtles. No mortalities are expected because of the MMS guidelines for explosive removals (USDOI, MMS, 1990a, Appendix B) and because the removals occur away from preferred offshore habitat. It is estimated that structure removals will rarely disturb and affect marine turtles.

It is assumed that about 557 OCS-related oil and gas service-vessel trips will occur annually as a result of the proposed action and that 185 shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-3). Noise from service-vessel traffic may elicit a startle reaction from marine turtles. This effect is sublethal and, at worst, of a short-term, temporary nature. Collision between service vessels and surfaced marine turtles would likely cause fatal injuries. It is assumed that service-vessel traffic and marine turtles will rarely be in close proximity. Although a low percentage of stranded marine turtles have shown indications of vessel collision, it cannot be determined what types of vessel were involved and whether these injuries occurred before or after death. Marine turtles are known to spend 4 percent or less of their time at the surface and to sound upon vessel approach. In addition, marine vessel operators can avoid marine turtles. It is estimated that service-vessel traffic will rarely contact and affect marine turtles.

Oil spills and oil-spill response activities can adversely affect marine turtles by toxic external contact, toxic ingestion or blockage of the digestive tract, asphyxiation, entrapment in tar or oil slicks, habitat destruction, and displacement from preferred habitats. Oil-spill response activities such as vehicular and vessel traffic are assumed to contact marine turtle habitat, such as shallow areas of seagrass beds and live-bottom communities, in the event of contact with an oil spill greater than or equal to 1,000 bbl. Sublethal effects are assumed due to the particular consideration these areas receive during oil-spill cleanup to minimize adverse effects from traffic during cleanup activities and to maximize protection efforts to prevent contact of these areas with spilled oil. It is estimated that oil-spill response activities will rarely contact and affect marine turtle habitat.

In the event that oiling of marine turtles should occur from sale-related oil spills greater than or equal to 1,000 bbl, the effects would primarily be sublethal; few mortalities are assumed. The effects of sale-related oil spills less than 1,000 bbl are assumed to be solely sublethal due to the inconsiderable area affected and their rapid dispersion. It is assumed that the extent and severity of effects from sale-related oil spills of any size will be lessened by improved coastal oil-spill contingency planning (Section IV.C.5.) and by active avoidance of oil spills by marine turtles.

Section IV.C.1. estimates the mean number of small spills less than 1,000 bbl occurring from the proposed action in the WPA. It is assumed that 20 spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action. It is estimated that the 20 spills will occur offshore and that none will contact land. It is assumed that one spill greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action, and it is estimated that the spill will occur offshore and that no oil will contact land. Although an interaction with small spills may occur, only sublethal effects are assumed. It is estimated that small spills will infrequently contact and affect marine turtles.

Section IV.C.1. estimates the mean number of spills greater than or equal to 1,000 bbl resulting from the proposed action in the WPA. It is assumed that 1 crude oil spill will occur from either a platform or pipeline in the Western Gulf during the 35-year life of the proposed action. Table IV-22 identifies the estimated risk of one or more oil spills occurring and contacting marine turtle habitat within 10 days. The highest estimated probability of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting marine turtle habitat within 10 days in the Western Gulf is 1 percent (Texas coastal areas). There is a 5 percent probability that a oil spill will occur and contact within 10 days pelagic turtle habitat beyond the shelf break of the WPA. Although an interaction with spills greater than or equal to 1,000 bbl may occur, infrequent mortalities are assumed with primarily sublethal effects. It is expected that an oil spill greater than or equal to 1,000 bbl will rarely contact and affect marine turtles in the WPA.

Activities resulting from the proposed action have a potential to affect marine turtles detrimentally. Marine turtles could be impacted by anchoring, structure installation, pipeline placement, dredging, operational discharges, OCS-related trash and debris, vessel traffic, explosive platform removals, oil-spill response activities, and oil spills. The effects of the majority of these activities are estimated to be sublethal. Lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl. Sale-related oil spills of any size are estimated to be extraordinary events that will rarely contact marine turtles.

*Conclusion*

The impact of the High Case scenario on marine turtles within the potentially affected area is assumed to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes.

### *(7) Impacts on Coastal and Marine Birds*

The sources and severity of impacts to coastal and marine birds associated with the proposed action in the WPA are those sale-related activities discussed for the Base Case in the CPA. As noted in Section IV.D.1.a.(7) for the Base Case, effects on coastal and marine birds could come from oil spills, disturbance from OCS service-vessel and helicopter traffic, displacement from onshore pipeline landfalls and facility construction, and entanglement and ingestion of offshore oil- and gas-related plastic debris. A more detailed discussion of the potential effects from these impact-producing factors is found in Section IV.D.1.a.(7).

Sections providing supportive material for the coastal and marine bird analysis include Sections III.B.5. (description of coastal and marine birds), IV.C.1. and 3. (oil spills), IV.A.2.c. (support activities), IV.A.3.a.(1) (service and construction facilities), and IV.A.2.d.(9) (loss of trash and debris).

When an oil spill occurs, many factors interact to delimit the severity of effects and the extent of damage to coastal and marine bird populations. The direct effect of oiling on birds occurs through the matting of feathers and subsequent loss of body insulation and water-repellency, the ingestion of oil, the depression of egg-laying activity, and the reduction of hatching success. The impacts from spills less than 1,000 bbl differ in severity and kind from those of spills greater than or equal to 1,000 bbl.

Rehabilitation of oiled birds and deterrence away from the immediate area of an oil spill are procedures proven to limit the severity of the effect and lessen the extent of damage to populations of coastal and marine birds. Survival of rehabilitated oiled birds varies from 30 to 90 percent.

Disturbance created from OCS-related service-vessel traffic could affect coastal and marine birds, resulting in reduced use or desertion of coastal feeding, resting, or breeding/nesting habitats. Helicopter traffic that is OCS-related could disturb feeding, resting, or breeding/nesting behavior of birds or cause abandonment of preferred habitat. Disturbance by either service-vessel or helicopter traffic could contribute to population losses by relocation of birds to areas where they may experience increased environmental or physiological stress.

Pipeline landfalls and coastal construction can displace coastal and marine birds from coastal feeding, resting, or nesting habitats. Dredging can displace coastal and marine birds, and the resultant habitat may be so changed that it is no longer suitable as feeding, resting, or nesting habitat. Coastal construction can alter coastal habitat to the extent that the area can no longer be suitable as feeding, resting, or breeding/nesting habitat for coastal and marine birds. Displacement can contribute to population losses by relocation of birds to areas where they may experience increased environmental or physiological stress.

Coastal and marine birds can also be adversely affected by entanglement or ingestion of OCS-related trash and debris. The MMS prohibits the disposal of 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 plastic at sea, went into effect January 1, 1989.

### *(a) Nonendangered and Nonthreatened Species*

*Base Case Analysis*

The Gulf of Mexico is populated by migrant and nonmigrant species of coastal and marine birds. This broad category consists of four main groups: seabirds, waterfowl, wading birds, and shorebirds.

The major impact-producing factors analyzed below are related to the proposed action and include oil spills, OCS helicopter and service-vessel traffic, pipeline landfalls and coastal facility construction, and oil- and gas-related plastic debris.

In the event that oiling of coastal and marine birds should occur from sale-related spills, the effect of any oiling is assumed to be lessened due to the nature of Southern Louisiana Crude: directly, by its chemical composition and traits; and indirectly, by an increase in the percentage of survival from rehabilitation efforts. The effect of spilled oil on coastal and marine birds is assumed to result in a partial, short-term decrease in a local population within the vicinity of spilled oil.

In the event that sale-related oil spills should occur in critical feeding habitats of coastal and marine birds, sublethal and some lethal effects are assumed. Sublethal effects are assmed to be lessened by deterrence of birds away from the oiled area and improved coastal oil-spill contingency planning and response (Section IV.C.5.). Sublethal effects of spilled oil within critical feeding habitats of coastal and marine birds are assumed to result in a partial, short-term decrease in a local population within the vicinity of the affected feeding habitats.

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring from the proposed action in the WPA. It is assumed that 8 offshore spills and fewer than 10 onshore spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action. None of the offshore spills will contact the coastline. It is assumed that no spill greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action as a result of the proposed action. For the purpose of this analysis, it is estimated that spills less than 1,000 bbl will rarely contact and affect feeding, resting, or nesting habitats. The effect to Gulf coastal and marine birds is assumed to be negligible.

Section IV.C.1. estimates the mean number of oil spills greater than or equal to 1,000 bbl resulting from the proposed action in the WPA. It is assumed that no crude oil spill greater than or equal to 1,000 bbl will occur and contact feeding, resting, or nesting habitat of coastal and marine birds in the WPA. For the purpose of this analysis, it is estimated that an OCS oil spill greater than or equal to 1,000 bbl will not interact with Gulf coastal and marine birds or their feeding, resting, or nesting habitats.

The majority of coastal and marine bird feeding habitats occur nearshore. It is assumed that no crude oil spills greater than or equal to 1,000 bbl will occur and contact nearshore feeding habitats in the WPA. For the purpose of this analysis, it is estimated that an OCS oil spill greater than or equal to 1,000 bbl will not interact with Gulf coastal and marine birds or their nearshore feeding habitats.

It is assumed that no spills greater than or equal to 1,000 bbl, originating from OCS tankering, will occur and contact a Western Gulf bay, estuary, or nearshore area. For the purpose of this analysis, it is estimated that a oil spill greater than or equal to 1,000 bbl and originating from OCS tankering will not interact with Gulf coastal and marine birds or their feeding, resting, or nesting habitats.

Helicopter and service-vessel traffic related to OCS activities could disturb feeding, resting, or nesting behavior of birds or cause abandonment of preferred habitat. This impact-producing factor could contribute to population losses by displacement of birds to areas where they may experience increased environmental or physiological stress. The FAA Advisory Circular 91-36C prohibits the use of fixed-wing aircraft lower than an elevation of 152 m and helicopters lower than 300 m during the period of October 15 through April 15 in the vicinity of numerous national wildlife refuges along the Gulf of Mexico in order to prevent disturbances to the birds (Biological Opinion - Section 7 Consultation, Proposed Exploration Plans for OCS in the Gulf of Mexico; FWS/OES 375.0). The majority of these wildlife refuges provide important feeding, resting, and nesting areas for coastal and marine birds. Although an incident may occur and be disruptive, the effect is, at worst, of a temporary nature. It is assumed that helicopter traffic will not disturb Gulf coastal and marine birds because of special prohibitions and adherence to the general, FAA-recommended minimum ceiling of 300 m. For the purpose of this analysis, it is estimated that OCS-related flights at the appropriate altitude will rarely disturb Gulf coastal and marine birds. The effect on Gulf coastal and marine birds is assumed to be negligible.

It is assumed that about 237 OCS-related oil and gas service-vessel trips will occur annually as a result of the proposed action and that 66 shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-3). For the purpose of this analysis, it is estimated that service-vessel traffic will rarely disturb feeding, resting, or nesting habitats. The effect on Gulf coastal and marine birds will be negligible.

Disturbance of coastal and marine bird nesting and feeding habitats from pipeline landfalls and onshore construction could result in a reduction of or desertion by birds that use the habitats. It is assumed that no new OCS oil- and gas-related pipeline landfalls or coastal facilities will be constructed as a result of the proposed action in the WPA (Section IV.A.3.b.). For the purpose of this analysis, it is estimated that pipeline landfalls and onshore construction will not interact with feeding, resting, or nesting habitats of Gulf coastal and marine birds.

Coastal and marine birds can become entangled in or ingest trash and debris. Interaction with plastic materials can be especially injurious and cause mortalities. It is assumed that coastal and marine birds will seldom become entangled in or ingest OCS-related trash and debris. 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), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. For the purpose of this analysis, it is estimated that OCS oil- and gas-related plastic debris will rarely interact with Gulf coastal and marine birds, and the effect will be negligible.

*Summary*

Activities resulting from the proposed action have the potential to affect Western Gulf coastal and marine birds detrimentally. It is estimated that the effects from the major impact-producing factors on coastal and marine birds are negligible and of nominal occurrence. As a result, there will no perceivable disturbance to Gulf coastal and marine birds.

*Conclusion*

The impact of the Base Case scenario on nonendangered and nonthreatened coastal and marine birds within the potentially affected area is assumed to result in no discernible decline in a population or species, and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to predisturbance condition in less than one generation.

*High Case Analysis*

The major impact-producing factors analyzed below are related to the proposed action and include oil spills, OCS helicopter and service-vessel traffic, pipeline landfalls and coastal facility construction, and oil- and gas-related plastic debris.

In the event that oiling of coastal and marine birds should occur from sale-related spills, the effect of any oiling is assumed to be lessened due to the nature of Southern Louisiana Crude: directly, by its chemical composition and traits; and indirectly, by an increase in the percentage of survival from rehabilitation efforts. The effect of spilled oil on coastal and marine birds is assumed to result in a partial, short-term decrease in a local population within the vicinity of spilled oil.

In the event that sale-related oil spills should occur in critical feeding habitats of coastal and marine birds, sublethal effects are assumed. These are assumed to be lessened by deterrence of birds away from the oiled area and improved coastal oil-spill contingency planning and response (Section IV.C.6.). Sublethal effects of spilled oil within critical feeding habitats of coastal and marine birds are assumed to result in a partial, short-term decrease in a local population within the vicinity of the affected feeding habitats.

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring from the proposed action in the WPA. It is assumed that 20 offshore spills and fewer than 10 onshore spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action. None of the offshore spills will contact the coastline. It is assumed that one offshore spill greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action and that it will not contact the coastline. For the purpose of this analysis, it is expected that spills less than 1,000 bbl will rarely contact and affect feeding, resting, or nesting habitats, and that the effect on Gulf coastal and marine birds is assumed to be negligible.

Section IV.C.1. estimates the mean number of oil spills greater than or equal to 1,000 bbl resulting from the proposed action in the WPA. It is assumed that one crude oil spill greater than or equal to 1,000 bbl will occur from either a platform or pipeline in the Western Gulf during the 35-year life of the proposed action. Table IV-22 identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days coastal and marine birds and their feeding, resting, or nesting habitats. The highest probability of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting a coastal bay in the Western Gulf within 10 days is 1 percent (Galveston Bay). The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting Texas coastal marshes within 10 days is 1 percent. For the purpose of this analysis, it is expected that an oil spill greater than or equal to 1,000 bbl will rarely contact and affect Gulf coastal and marine birds or their feeding, resting, or nesting habitats. The effect to Gulf coastal and marine birds is assumed to be negligible.

The majority of coastal and marine bird feeding habitats occur nearshore. The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting nearshore feeding habitat (coastline) along the Western Gulf within 10 days is 2 percent. For the purpose of this analysis, it is expected that an oil spill greater than or equal to 1,000 bbl will rarely contact and affect nearshore feeding habitats. The effect on Gulf coastal and marine birds is assumed to be negligible.

It is assumed that no spills greater than or equal to 1,000 bbl originating from OCS tankering will occur and contact within 10 days a Western Gulf bay, estuary, or nearshore area. For the purpose of this analysis, it is expected that an oil spill greater than or equal to 1,000 bbl from OCS-related activities will not interact with Gulf coastal and marine birds or their feeding, resting, or nesting habitats. Therefore, the impact level is assume to be very low.

Helicopter and service-vessel traffic that is OCS-related could disturb feeding, resting, or nesting behavior of birds or cause abandonment of preferred habitat. This impact-producing factor could contribute to population losses by displacement of birds to areas where they may experience increased environmental or physiological stress. The FAA Advisory Circular 91-36C prohibits the use of fixed-wing aircraft lower than an elevation of 152 m and helicopters lower than 300 m during the period of October 15 through April 15 in the vicinity of numerous national wildlife refuges in the Gulf of Mexico to prevent disturbances to the birds (Biological Opinion - Section 7 Consultation, Proposed Exploration Plans for OCS in the Gulf of Mexico; FWS/OES 375.0). The majority of these wildlife refuges provide important feeding, resting, and nesting areas for coastal and marine birds. Although an incident may occur and be disruptive, the effect is, at worst, of a temporary nature. It is assumed that helicopter traffic will not disturb Gulf coastal and marine birds because of special prohibitions and adherence to the general, FAA-recommended minimum ceiling of 300 m. For the purpose of this analysis, it is estimated that OCS-related flights at the appropriate altitude will rarely disturb Gulf coastal and marine birds. The effect on Gulf coastal and marine birds is assume to be negligible.

It is assumed that about 557 OCS-related oil and gas service-vessel trips will occur during the peak year of the proposed action and that 171 shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-3). For the purpose of this analysis, it is estimated that service-vessel traffic will rarely disturb feeding, resting, or nesting habitats. The effect on Gulf coastal and marine birds will be negligible.

Disturbance of coastal and marine bird nesting and feeding habitats from pipeline landfalls and onshore construction could result in a reduction of or desertion by birds that use the habitats. It is assumed that no new OCS oil and gas-related pipeline landfalls and one pipeyard will be constructed as a result of the proposed action in the WPA (Section IV.A.3.b.). For the purpose of this analysis, it is estimated that pipeline landfalls and onshore construction will not interact with feeding, resting, or nesting habitats of Gulf coastal and marine birds.

Coastal and marine birds can become entangled in or ingest trash and debris. Interaction with plastic materials can be especially injurious and cause mortalities. It is assumed that coastal and marine birds will seldom become entangled in or ingest OCS-related trash and debris. 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), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. For the purpose of this analysis, it is estimated that OCS oil and gas-related plastic debris will rarely interact with seabirds. The effect on Gulf coastal and marine birds will be negligible.

Activities resulting from the proposed action have the potential to affect Western Gulf coastal and marine birds detrimentally. It is estimated that the effects from the major impact-producing factors on coastal and marine birds are negligible and of nominal occurrence. As a result, there will no perceivable disturbance to Gulf coastal and marine birds.

*Conclusion*

The impact of the High Case scenario on nonendangered and nonthreatened coastal and marine birds within the potentially affected area is assume to result in no discernible decline in a population or species, and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to predisturbance condition in less than one generation.

## *(b) Endangered and Threatened Species*

This section discusses the effects of the proposed action on endangered and threatened birds, including the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover. It summarizes and incorporates the discussion of the effects on the brown pelican and piping plover in Section IV.D.2.a.(7)(a) (nonendangered and nonthreatened birds) of this document, and additional information as cited. Oil spills, OCS service-vessel and helicopter traffic, onshore pipeline construction, and entanglement and ingestion of offshore oil- and gas-related plastic debris are sources of potential adverse impacts. The effects on birds from these impact-producing factors are discussed under nonendangered and nonthreatened birds (Section IV.D.2.a.(7)(a)). Any activity that is a result of the proposed action and that results in the mortality of an endangered or threatened bird represents a substantial impact on the species under discussion, as above.

*Base Case Analysis*

It is assumed that helicopter traffic will occur on a regular basis, averaging about 4,000 trips per year. The FAA Advisory Circular 91-36C prohibits the use of fixed-wing aircraft lower than an elevation of 152 m and helicopters lower than 300 m during the period of October 15 through April 15 in the vicinity of numerous national wildlife refuges in the Gulf of Mexico to prevent disturbances to the birds (Biological Opinion - Section 7 Consultation, Proposed Exploration Plans for OCS in the Gulf of Mexico; FWS/OES 375.0). The majority of these wildlife refuges provide important critical habitats (feeding, resting, or nesting areas) for endangered and threatened species. Although interactions may occur and be disruptive, effects are expected to be sublethal and, at worst, of a temporary nature. It is estimated that helicopter traffic near critical feeding, resting, or nesting areas will rarely disturb the brown pelican, Arctic peregrine falcon, bald eagle, or piping plover because of special prohibitions and adherence to the general, FAA-recommended minimum ceiling of 300 m.

It is assumed that about 237 OCS-related oil and gas service-vessel trips will occur as a result of the proposed action and that 66 shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-3). Most of the OCS-related oil and gas traffic occurs in and out of areas that are well away from critical habitats (feeding, resting, or nesting areas) for the Arctic peregrine falcon, bald eagle, or piping plover. Some OCS-related service vessel traffic occurs in the vicinity of Port O'Connor, Freeport, Galveston, and Sabine Pass, Texas, within several miles of critical habitats (feeding, resting, or nesting areas) for the brown pelican. Although incidents may occur and be disruptive, effects are expected to be sublethal and, at worst, of a temporary nature. It is estimated that service-vessel traffic will rarely disturb the brown pelican.

Disturbance of brown pelican, Arctic peregrine falcon, and piping plover critical feeding, resting, or nesting habitats from pipeline landfalls and onshore construction could result in a reduction or desertion of birds that use the habitats. It is assumed that no new OCS oil- and gas-related pipeline landfalls or coastal facilities will be constructed as a result of the proposed action in the WPA (Section IV.A.3.b.). It is estimated that pipeline landfalls and onshore construction will not interact with critical feeding, resting, or nesting habitats of the brown pelican, Arctic peregrine falcon, or piping plover.

The brown pelican, Arctic peregrine falcon, bald eagle, and piping plover can become entangled in or ingest trash and debris. Interaction with plastic materials can be especially injurious. 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), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. It is assumed that very little trash and debris will be lost into the Gulf of Mexico as a result of the proposed action. Although interactions may occur, effects are expected to be sublethal. It is estimated that the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover will rarely become entangled in or ingest OCS-related trash and debris.

When an oil spill occurs, many factors interact to delimit the severity of effects and the extent of damage to endangered and threatened birds. Determining factors include geographic location, oil type, oil dosage, impact area, oceanographic conditions, meteorological conditions, and season (NRC, 1985; USDOI, MMS, 1987b). The direct effect of oiling on birds occurs through the matting of feathers and subsequent loss of body insulation and water-repellency, the ingestion of oil, the depression of egg-laying activity, and the reduction of hatching success (Holmes and Cronshaw, 1977; Ainley et al., 1981; Peakall et al., 1981). Transfer of oil from adults to eggs and young during nesting results in significant mortality for new eggs and deformities in hatchlings from eggs further along in incubation (Clapp et al., 1982a). Indirect effects of oil spills include contamination, displacement, and reduction of food sources. Food contamination may cause less severe, sublethal effects decreasing survival and fecundity, affecting behavior, and decreasing survival of young. Less severe, sublethal effects are defined as those that impair the ability of an organism to function effectively without causing direct mortality (NRC, 1985).

In the event that oiling of the brown pelican, Arctic peregrine falcon, bald eagle, or piping plover should occur from sale-related oil spills greater than or equal to 1,000 bbl, the effects would primarily be sublethal; few mortalities are assumed. The effects of sale-related oil spills less than 1,000 bbl are assumed to be solely sublethal due to the inconsiderable area affected. In the event that sale-related oil spills of any size should occur in critical habitats for feeding, resting, or nesting, such as inshore, intertidal, and nearshore areas, sublethal effects are assumed. It is assumed that the extent and severity of effects from sale-related oil spills of any size will be lessened by improved coastal oil-spill contingency planning and response, deterrence of birds away from the immediate area of an oil spill, and increased percentage of survival from rehabilitation efforts (Section IV.C.5.).

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring from the proposed action in the WPA. It is assumed that 8 offshore spills and fewer than 10 onshore spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action. None of the spills will contact the coastline. It is assumed that no spill greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action. It is estimated that spills less than 1,000 bbl will not interact with the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover.

Section IV.C.1. estimates the mean number of spills greater than or equal to 1,000 bbl resulting from the proposed action in the WPA. It is assumed that no crude oil spill greater than or equal to 1,000 bbl will occur from a platform, pipeline, or OCS tankering in the Western Gulf during the 35-year life of the proposed action. It is estimated that an oil spill greater than or equal to 1,000 bbl will not interact with the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover in the WPA.

Some critical feeding habitats of the brown pelican, Arctic peregrine falcon, and piping plover occur nearshore. It is assumed that no crude oil spills greater than or equal to 1,000 bbl will occur and contact critical feeding habitats (nearshore areas) in the Western Gulf. It is estimated that an oil spill greater than or equal to 1,000 bbl will not interact with nearshore areas (coastline) critical to the feeding of the brown pelican, Arctic peregrine falcon, and piping plover.

*Summary*

The brown pelican, Arctic peregrine falcon, bald eagle, and piping plover may be impacted by helicopter and service-vessel traffic, onshore pipeline landfalls, entanglement in and ingestion of offshore oil- and gas-related plastic debris, and oil spills. The effects of these activities are estimated to be sublethal. Lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl. Sale-related oil spills of any size are estimated to be extraordinary events that will rarely contact threatened and endangered birds or their critical feeding, resting, or nesting habitats.

*Conclusion*

The impact of the Base Case scenario on endangered and threatened birds within the potentially affected area is assumed to result in no discernible decline in a population or species, and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to predisturbance condition in less than one generation.

*High Case Analysis*

It is assumed that helicopter traffic will occur on a regular basis, averaging about 10,000 trips per year. The FAA Advisory Circular 91-36C prohibits the use of fixed-wing aircraft lower than an elevation of 152 m and helicopters lower than 300 m during the period of October 15 through April 15 in the vicinity of numerous national wildlife refuges in the Gulf of Mexico to prevent disturbances to the birds (Biological Opinion-Section 7 Consultation, Proposed Exploration Plans OCS in the Gulf of Mexico; FWS/OES 375.0). The majority of these wildlife refuges provide critical habitats (feeding, resting, or nesting areas) for endangered and threatened species. Although interactions may occur and be disruptive, effects are expected to be sublethal and, at worst, of a temporary nature. It is estimated that helicopter traffic near critical habitats (feeding, resting, or nesting areas) will rarely disturb the brown pelican, Arctic peregrine falcon, bald eagle, or piping plover because of special prohibitions and adherence to the general, FAA-recommended minimum ceiling of 300 m.

It is assumed that 557 OCS-related oil and gas service-vessel trips will occur as a result of the proposed action and that 171 shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-3). Most of the OCS-related oil and gas traffic occurs in and out of areas that are well away from critical habitats for feeding, resting, or nesting areas of the Arctic peregrine falcon, bald eagle, or piping plover. Some OCS-related service vessel traffic occurs in the vicinity of Port O'Connor, Freeport, Galveston, and Sabine Pass, Texas, within several miles of critical feeding, resting, or nesting areas for the brown pelican. Although incidents may occur and be disruptive, effects are expected to be sublethal and, at worst, of a temporary nature. It is estimated that service-vessel traffic will rarely disturb the brown pelican.

Disturbance of brown pelican, Arctic peregrine falcon and piping plover critical feeding, resting, or nesting habitats from pipeline landfalls and onshore construction could result in a reduction or desertion of birds that use the habitats. It is assumed that no new OCS oil- and gas-related pipeline landfalls or coastal facilities will be constructed as a result of the proposed action in the WPA (Section IV.A.3.b.). It is estimated that pipeline landfalls and onshore construction will not interact with critical feeding, resting, or nesting habitats of the brown pelican, Arctic peregrine falcon, or piping plover.

The brown pelican, Arctic peregrine falcon, bald eagle, and piping plover can become entangled in or ingest trash and debris. Interaction with plastic materials can be especially injurious. 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), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. It is assumed that very little trash and debris will be lost into the Gulf of Mexico as a result of the proposed action. Although interactions may occur, effects are expected to be sublethal. It is estimated that the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover will rarely become entangled in or ingest OCS-related trash and debris.

In the event that oiling of the brown pelican, Arctic peregrine falcon, bald eagle, or piping plover should occur from sale-related oil spills greater than or equal to 1,000 bbl, the effects would primarily be sublethal; few mortalities are assumed. The effects of sale-related oil spills less than 1,000 bbl are assumed to be sublethal. In the event that sale-related oil spills of any size should occur in critical feeding, resting, or nesting habitats, such as inshore, intertidal, and nearshore areas, of the brown pelican, Arctic peregrine falcon, and piping plover, sublethal effects are assumed. The extent and severity of effects from sale-related oil spills will be lessened by improved coastal oil-spill contingency planning and response, deterrence of birds away from the oiled area, and increased percentage of survival from rehabilitation efforts (Section IV.C.5.).

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring from the proposed action in the WPA. It is assumed that 20 offshore spills and fewer than 10 onshore spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action. None of the spills will contact the coastline. It is assumed that 1 offshore spill greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action and that it will not contact the coastline. Although an interaction with spills less than 1,000 bbl may occur, only sublethal effects are assumed. It is estimated that small spills will seldom contact and affect the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover.

Section IV.C.1. estimates the mean number of oil spills greater than or equal to 1,000 bbl resulting from the proposed action in the WPA. It is assumed that one crude oil spill greater than or equal to 1,000 bbl will occur from either a platform or pipeline in the Western Gulf during the 35-year life of the proposed action.

Table IV-22 identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days critical habitats for feeding, resting, or nesting of the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover in the WPA. The highest probability of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days a coastal bay in the Western Gulf is 1 percent (Galveston Bay). The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting Texas coastal marshes within 10 days is 1 percent. Although an interaction with spills greater than or equal to 1,000 bbl may occur, primarily sublethal effects are expected with infrequent mortalities. It is estimated that an oil spill greater than or equal to 1,000 bbl will rarely contact and affect the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover in the WPA.

Some feeding habitats of the brown pelican, Arctic peregrine falcon, and piping plover occur nearshore. The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days nearshore areas (coastline) along the Western Gulf is 2 percent. Although an incident may occur, sublethal effects are assumed. It is estimated that an oil spill greater than or equal to 1,000 bbl will rarely contact and affect nearshore areas (coastline) critical to the feeding of the brown pelican, Arctic peregrine falcon, and piping plover.

The brown pelican, Arctic peregrine falcon, bald eagle, and piping plover may be impacted by helicopter and service-vessel traffic, onshore pipeline landfalls, entanglement in and ingestion of offshore oil- and gas-related plastic debris, and oil spills. The effects of these activities are estimated to be sublethal. Lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl. Sale-related oil spills of any size are estimated to be extraordinary events that will rarely contact threatened and endangered birds or their critical habitats for feeding, resting, or nesting habitats.

*Conclusion*

The impact of the High Case scenario on endangered and threatened birds within the potentially affected area is assumed to result in no discernible decline in a population or species, and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to predisturbance condition in less than one generation.

### *(8) Impacts on Commercial Fisheries*

The sources and severity of impacts to commercial fisheries in the WPA are the same as those discussed for the Base Case in the CPA. As noted in Section IV.D.1.a.(9) for the Base Case, effects on commercial fisheries could come from emplacement of production platforms, underwater OCS obstructions, production platform removals, seismic surveys, oil spills, subsurface blowouts, and OCS discharges of drilling muds. A more detailed discussion of the potential effects from these impact-producing factors can be found in Section IV.D.1.a.(9).

Sections providing supportive material for the commercial fisheries analysis include Sections III.B.6. (description of fish resources), III.C.3. (commercial fishing stocks and activities), IV.A.2.d.(3) (use conflicts), IV.A.2.b.(1) (pipelines), IV.A.2.a.(3) (structure removal), IV.A.2.a.(1) (seismic operations), IV.C.1. and 3. (oil spills), IV.A.2.d.(8) (subsurface blowouts), IV.A.2.d.(5) (offshore discharges), IV.A.3.c.(5) (onshore discharges), and IV.D.1.a.(9) (impacts on Central Gulf commercial fisheries).

The emplacement of a production platform, with a surrounding 100-m navigational safety zone, results in the loss of approximately 6 ha of bottom trawling area to commercial fishermen and causes space-use conflicts. Gear conflicts from underwater OCS obstructions such as pipelines result in losses of trawls and shrimp catch, business downtime, and vessel damage.

Lessees are required to remove all structures and underwater obstructions from their leases in the Federal OCS within one year of the lease's relinquishment or termination. The great majority of platforms are removed with subbottom plastic explosives. There is concern over a possible connection between the lethal effects of platform removals to reef fish and declines in reef fish populations in the Gulf.

The sources of acoustical pulse used in seismic surveys are generated by airguns. Airguns have little effect on even the most sensitive fish eggs at distances of 5 m from the discharge.

When an oil spill occurs, many factors interact to delimit the severity of effects and the extent of damage to commercially important fish populations. The direct effects of spilled oil on fish occur through the ingestion of oil or oiled prey, the uptake of dissolved petroleum products by adults and juveniles, and through mortality of eggs and decreased survival of larvae. The effects from chronic or small oil spills differ in severity and kind from those of spills greater than or equal to 1,000 bbl.

The effects on and the extent of damage from an oil spill to Gulf commercial fisheries are restricted by time and location. For OCS-related oil spills to have a substantial effect on a commercial fishery resource, a large number of eggs and larvae would have to be concentrated in the immediate spill area. Oil components also would have to be present in highly toxic concentrations during the time when both eggs and larvae were in the pelagic stage (Longwell, 1977).

Subsurface oil- and natural gas-well blowouts resuspend sediments and release varying amounts of hydrocarbons into the water column (USDOI, MMS, 1987a). Both effects may be detrimental to commercial fishery resources.

Commercial fishery resources could also be adversely affected by the discharge of drilling muds. Drilling muds contain materials toxic to marine fishes; however, dilution is extremely rapid in offshore waters.

*Base Case Analysis*

The major impact-producing factors analyzed below are related to the proposed action and include underwater OCS obstructions, OCS drilling mud discharge, production platform removal, production platform emplacement, seismic surveys, oil spills, and subsurface blowouts.

Gear conflicts are caused by underwater OCS obstructions such as pipelines. Section IV.A.4.b. estimates the kilometers of new offshore pipeline resulting from the proposed action in the WPA. It is expected that 80 km of pipeline will be installed in the WPA during the 35-year life of the proposed action (Table IV-3). In Subarea W-1, the area of concentrated bottom trawl fishing, only 10 percent, or 8 km, of pipeline will be installed during the 35-year life of the proposed action. Gear conflicts are mitigated by the FCF. During Fiscal Year (FY) 1990, 198 claims were processed, with 77 percent being approved for a total of $836,799. The economic loss from gear conflicts for FY 90 was less than 0.2 percent of the value ($640 million) of Gulf commercial fisheries landings for 1990. For the purpose of this analysis, it is expected that installed pipelines will rarely conflict with bottom trawl fishing and will have a negligible effect on Western Gulf fisheries.

Drilling mud discharges (Table IV-3) contain chemicals toxic to marine fishes; however, this is only at concentrations four or five orders of magnitude higher than those found more than 300 m from the discharge point. Offshore discharges of drilling muds will rapidly dilute to background levels and have a negligible effect on Western Gulf fisheries.

Structure removal results in artificial habitat loss and causes fish kills when explosives are used. Table IV-3 estimates that three structure removals using explosives will occur in the WPA during the 35-year life of the proposed action. It is assumed that these removals will occur during the last 12 years of the life of the proposed action and no more than one in any given year. For the purpose of this analysis, it is estimated that structure removals will have a negligible effect on Western Gulf fisheries because removals will be rare events that kill only those fish proximate to the removal site.

Ten offshore platform complexes (Table IV-3) are expected to result from the proposed action, eliminating 300 ha (741 ac) of the trawling area during the 35-year life of the proposed action in the WPA. In subarea W-1, the area of concentrated bottom trawl fishing, only one platform complex will be installed, eliminating 15 ha (37 ac). For the purpose of this analysis, it is estimated that space-use conflicts are rare. The effect of space lost to trawl fishing in the Gulf from the construction of platforms is negligible because the extent of the area lost to commercial trawling is less than 0.01 percent of the available trawl fishing area in either Subarea W-1 or in the WPA.

Seismic surveys will occur in both coastal and offshore areas of the WPA. For purposes of this analysis, it is assumed that seismic surveys will have a negligible effect on Gulf commercial fisheries because of the prevalent use of airguns (Section IV.A.2.).

In the event that sale-related oil spills should occur in coastal bays, estuaries, and waters of the OCS proximate to mobile adult finfish or shellfish, the effects and the extent of damage are expected to be limited and lessened due to some capability of adult fish to avoid an oil spill and to metabolize hydrocarbons and to excrete both metabolites and parent compounds from their gills and liver. For floating eggs and larvae contacted by spilled oil, the effect is expected to be lethal. The effect of oil spills on commercial fishery resources is expected to result in a partial, long-term decrease in a commercial population, in an essential habitat, or in local fishing activity.

Section IV.C.1. estimates the mean number of oil spills less than 1,000 bbl resulting from the proposed action in the WPA. It is assumed that eight spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action and that none of the offshore spills will contact the coastline. It is assumed that no spill greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action. For the purpose of this analysis, it is estimated that spills less than 1,000 bbl will rarely contact and affect the coastal bays and marshes critical to the well-being of commercial fisheries in the WPA. The effect on Gulf commercial fisheries is expected to be negligible.

Section IV.C.1. estimates the mean number of oil spills greater than or equal to 1,000 bbl resulting from the proposed action in the WPA. It is assumed that no crude oil spills greater than or equal to 1,000 bbl will occur and contact the coastal bays and marshes critical to the well-being of commercial fisheries in the WPA. For the purpose of this analysis, it is estimated that an OCS oil spill greater than or equal to 1,000 bbl will not interact with Gulf commercial fisheries. .

Although the quantity of commercial landings in the WPA of migratory species is comparatively small, these species are of high value. Migratory species could be affected by oil spills occurring in the coastal area. It is assumed that no crude oil spills greater than or equal to 1,000 bbl will occur and contact nearshore and coastal areas critical to migratory commercial fisheries in the WPA. For the purpose of this analysis, it is estimated that an OCS oil spill greater than or equal to 1,000 bbl will not interact with Gulf commercial fisheries.

Oil spills greater than or equal to 1,000 bbl originating in port from OCS-related tankering include those that may occur and contact coastal bays, estuaries, and nearshore areas. It is assumed that no spills greater than or equal to 1,000 bbl originating from tankering will occur and contact a Western Gulf bay, estuary, or nearshore area. For the purpose of this analysis, it is estimated that an oil spill greater than or equal to 1,000 bbl and that is OCS-related will not interact with Gulf commercial fisheries.

Subsurface blowouts of both oil and natural gas wells are detrimental to commercial fishery resources. Loss of well control and resultant blowouts are rare on the Gulf OCS (only 157 out of approximately 27,000 exploration and development wells since 1956, with 12 resulting in the release of more than one barrel of oil). It is assumed that there will be 2 blowouts in the WPA resulting from the proposed action during the 35-year life of the proposed action. For the purpose of this analysis, it is estimated that the rare subsurface blowout on the Gulf OCS will have a negligible effect on Gulf commercial fisheries.

*Summary*

Activities resulting from the proposed action may detrimentally affect Western Gulf commercial fisheries. It is estimated that the effects from the major impact-producing factors on commercial fisheries in the WPA are negligible and of nominal occurrence. As a result, there will be no perceivable disturbance to Gulf commercial fisheries.

*Conclusion*

The impact of the Base Case scenario on commercial fisheries within the potentially affected area is expected to result in no discernible decrease in a population of commercial importance, its essential habitat, or in commercial fisheries on a local scale. Any affected population is expected to recover to predisturbance condition in less than one generation.

*High Case Analysis*

The major impact-producing factors analyzed below are related to the proposed action and include underwater OCS obstructions, OCS drilling mud discharge, production platform removal, production platform emplacement, seismic surveys, oil spills, and subsurface blowouts.

Gear conflicts are caused by underwater OCS obstructions such as pipelines. Section IV.A.3.b. estimates the kilometers of new offshore pipeline resulting from the proposed action in the WPA. It is expected that 240 km of pipeline will be installed in the WPA during the 35-year life of the proposed action (Table IV-3). In subarea W-1, the area of concentrated bottom trawl fishing, only 3 percent, or 8 km, of pipeline will be installed during the 35-year life of the proposed action. Gear conflicts are mitigated by the FCF. During FY 90, 198 claims were processed, with 77 percent being approved for a total of $836,799. This economic loss from gear conflicts for FY 90 was less than 0.2 percent of the value ($640 million) of Gulf commercial fisheries landings for 1990. For the purpose of this analysis, it is expected that installed pipelines will rarely conflict with bottom trawl fishing and will have a negligible effect on Western Gulf fisheries.

Drilling mud discharges (Table IV-3) contain chemicals toxic to marine fishes; however, this is only at concentrations four or five orders of magnitude higher than those found more than 300 m from the discharge point. Offshore discharges of drilling muds will rapidly dilute to background levels and have a negligible effect on Western Gulf fisheries.

Structure removal results in artificial habitat loss and causes fish kills when explosives are used. Table IV-3 estimates that six structure removals using explosives will occur in the WPA during the 35-year life of the proposed action. It is assumed that these removals will occur during the last 12 years of the life of the proposed action, with no more than two in any single year. For the purpose of this analysis, it is estimated that structure removals will have a negligible effect on Western Gulf fisheries because removals will be rare events that kill only those fish proximate to the removal site.

Thirty offshore platform complexes (Table IV-3) are expected to result from the proposed action, eliminating 300 ha (741 ac) of trawling area during the 35-year life of the proposed action in the WPA. In Subarea W-1, the area of concentrated bottom trawl fishing, only one platform complex will be installed, eliminating 15 ha (37 ac). For the purpose of this analysis, it is estimated that space-use conflicts are rare. The effect of space lost to trawl fishing in the Gulf from the construction of platforms is negligible because the extent of the area lost to commercial trawling is less than 0.01 percent of the available trawl fishing area in either Subarea W-1 or in the WPA.

Seismic surveys will occur in both coastal and offshore areas of the WPA. For purposes of this analysis, it is assumed that seismic surveys will have a negligible effect on Gulf commercial fisheries because of the prevalent use of airguns (Section IV.A.2.).

In the event that sale-related oil spills should occur in coastal bays, estuaries, and waters of the OCS proximate to mobile adult finfish or shellfish, the effects and the extent of damage are expected to be limited and lessened due to some capability of adult fish to avoid an oil spill and to metabolize hydrocarbons and to excrete both metabolites and parent compounds from their gills and liver. For floating eggs and larvae contacted by spilled oil, the effect is expected to be lethal. The effect of oil spills on commercial fishery resources is expected to result in a partial, long-term decrease in a commercial population, in an essential habitat, or in local fishing activity.

Section IV.C.1. estimates the mean number of oil spills less than 1,000 bbl resulting from the proposed action in the WPA. It is assumed that 20 offshore spills greater than 1 and less than or equal to 50 bbl will occur during the 35-year life of the proposed action and that none of the offshore spills will contact the coastline. It is assumed that one spill greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action, and that it will not contact the coastline. For the purpose of this analysis, it is estimated that small spills will rarely contact and affect the coastal bays and marshes critical to the well-being of commercial fisheries in the WPA, and that the effect on Gulf commercial fisheries is expected to be negligible.

Section IV.C.1. estimates the mean number of oil spills greater than or equal to 1,000 bbl resulting from the proposed action in the WPA. It is assumed that one crude oil spill greater than or equal to 1,000 bbl will occur from either a platform or pipeline in the Western Gulf during the 35-year life of the proposed action.

Table IV-22 identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days the coastal bays and marshes critical to the well-being of commercial fisheries in the WPA. The highest probability of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days a coastal bay in the Western Gulf is 1 percent (Galveston Bay). The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days the Texas coastal marshes is 1 percent. For the purpose of this analysis, it is expected that a oil spill greater than or equal to 1,000 bbl will seldom contact and affect the coastal bays and marshes critical to the well-being of commercial fisheries in the WPA.

Although the quantity of commercial landings in the WPA of migratory species is comparatively small, these species are of high value. Migratory species could be affected by oil spills occurring in the coastal area. The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days the nearshore and coastal areas along the Western Gulf is 2 percent. For the purpose of this analysis, it is estimated that an oil spill greater than or equal to 1,000 bbl will occur but rarely contact and affect nearshore and coastal areas critical to migratory commercial fisheries in the WPA.

Oil spills greater than or equal to 1,000 bbl originating in port from OCS-related tankering include those that may occur and contact coastal bays, estuaries, and nearshore areas. It is assumed that no spills greater than or equal to 1,000 bbl from tankering will occur and contact a Western Gulf bay, estuary, or nearshore area. For the purpose of this analysis, it is expected that an oil spill greater than or equal to 1,000 bbl and that is OCS-related will not interact with Gulf commercial fisheries.

Subsurface blowouts of both oil and natural gas wells are detrimental to commercial fishery resources. Loss of well control and resultant blowouts are rare on the Gulf OCS (only 157 out of approximately 27,000 exploration and development wells since 1956, with 12 resulting in the release of more than one barrel of oil). It is assumed that there will be 5 blowouts in the WPA resulting from the proposed action during the 35-year life of the proposed action. For the purpose of this analysis, it is estimated that the rare subsurface blowout on the Gulf OCS will have a negligible effect on Gulf commercial fisheries.

Activities resulting from the proposed action may detrimentally affect Western Gulf commercial fisheries. It is estimated that the effects from the major impact-producing factors on commercial fisheries in the WPA are inconsequential and of nominal occurrence. As a result, there will be little perceivable disturbance to Gulf commercial fisheries.

*Conclusion*

The impact of the High Case scenario on commercial fisheries within the potentially affected area is expected to result in a partial, short-term decrease in a population of commercial importance, in an essential habitat, or in commercial fisheries on a local scale. Any affected population is expected to recover to predisturbance condition in one generation.

### *(9) Impacts on Recreational Resources and Activities*

### *(a) Beach Use*

Section IV.D.1.a.(10)(a) presents a general discussion regarding chronic trash and debris and oil spills greater than or equal to 1,000 bbl as the major threats to the use and appreciation of recreational beaches exposed to the effects of Gulf of Mexico OCS leasing and development in the WPA. Described also is the severity of impact assumed to occur to beach use from interaction with a major oil spill or chronic trash and debris. Visual No. 2 identifies the general location of major shorefront recreational beaches along the Texas coast.

*Base Case Analysis*

Exploration and production on blocks leased in the Western Gulf of Mexico, and transportation of produced oil and gas, could lead to oil spills greater than or equal to 1,000 bbl (6% probability) (Table IV-19) throughout the 35-year life of the proposed action (1993-2027). Wind, waves, and currents could cause spills to interact with major shorefront recreational beaches throughout the WPA and CPA.

The OSRA estimates (Table IV-22) indicate the proposed action is estimated (less than a 0.05% probability) to result in the occurrence and contact of an oil spill greater than or equal to 1,000 bbl within 10 days of an accident with a major recreational beach anywhere in the Gulf region. It is assumed, therefore, for purposes of this analysis that an oil spill greater than or equal to 1,000 bbl will not impact recreational beaches in the WPA from operations resulting from proposed Sale 143.

As noted in Section IV.C.1., one spill in the size class greater than 1 and less than or equal to 50 bbl is estimated to occur every five years during the 35-year project life. None of these chronic, offshore, sale-related spills is assumed to contact a recreational beach; therefore, no impact to recreational beaches is assumed from this size spill.

Some litter from OCS accidents, carelessness, and noncompliance with OCS antipollution regulations and directives is estimated to come ashore on recreational beaches from OCS operations associated with the proposed action. New operational practices and continuing industry training and awareness programs focused on the beach litter problem are expected to minimize the level of indiscriminate and irresponsible trash disposal and accidental loss of solid wastes from OCS oil and gas operations. Recreational beaches in Texas are esimated to be impacted from this waterborne trash. Incremental effects from the proposed action on litter are unlikely to be perceptible by beach users or administrators because the activity from the proposal will constitute only a very small percentage of the existing OCS activity in the WPA and is estimated to be offset by the number of terminating leases in the next 35 years. Litter on recreational beaches from OCS operations will adversely affect the ambience of the beach environment, will detract from the enjoyment of beach activities, and can increase administrative costs on maintained beaches.

*Summary*

Marine debris lost from OCS operations associated with drilling 320 new wells and producing oil and gas from 10 new platform complexes throughout the WPA will occur from time to time; however, the incremental impact from intermittent washup on Texas beaches from proposed Sale 143 should be minimal.

*Conclusion*

The proposed action is expected to result in periodic loss of solid waste items estimated to wash up on recreational beaches, which is expected to diminish enjoyment of some beach visits but is unlikely to affect the number or type of visits currently occurring on Texas beaches.

*High Case Analysis*

The causes and severity of impacts associated with the High Case scenario would be derived from the same impacting factors identified under the Base Case scenario, above. Included are oil spills and trash and debris.

The OSRA estimates (Table IV-22) indicate that, even with more optimistic oil and gas finds from the proposed action, the estimated probability of an oil spill greater than or equal to 1,000 bbl occurring and contacting within 10 days a major recreational beach anywhere in the Gulf region is estimated up to 1 percent chance. As noted in Section IV.C.1., it is assumed that about 1 spill greater than 1 and less than or equal to 50 bbl will occur every two years, but only a small number will occur in proximity to coastal resources, and none will reach the beach.

With 690 wells drilled and 30 platform complexes producing oil and gas throughout the life of the proposed action (Table IV-3), it is estimated that the level of accidental and irresponsible trash loss from OCS operations will increase from the Base Case, and most of this solid waste will wind up on Texas' recreational beaches.

*Conclusion*

The proposed action is expected to result in periodic loss of solid waste items estimated to wash up on recreational beaches, which is expected to diminish enjoyment of some beach visits but is unlikely to affect the number or type of visits currently occurring on Texas beaches. Although the level of chronic pollution to Texas beaches is estimated to increase from the Base Case, the level of beach use should not change.

## *(b) Marine Fishing*

Section IV.D.1.a.(10)(b) presents a general introductory discussion on how oil and gas production platforms might affect offshore fish and offshore fishing. Described also is the severity of impact is estimated to occur to recreational fishing from oil spills.

*Base Case Analysis*

The impacting factors considered in the Base Case analysis and discussed below include platform installations and removals and oil spills.

Table IV-3 projects the installation of 10 new platform complexes (25 structures) as the result of proposed Sale 143. Most of these platforms will be emplaced in the first 5-15 years of the 35-year project life and will remain on site for about 20 years prior to termination of production and removal. Only one platform complex is projected for installation in coastal Subarea W-1 (Table IV-3) and could be placed from 10 to 80 mi from shore. The other nine platform complexes will be placed at least 50 mi from shore (coastal Subareas W-2 and W-3) and will have little effect, if any, on marine recreational fishing. Platforms installed in coastal Subarea W-1 that are within 30 mi of shore and near major fishing access areas such as Galveston, Brownsville, or Port Aransas are expected to attract many offshore recreational fishing boats. Fishing success is likely to be much better around oil and gas structures than in most other offshore areas of the WPA. There are about 380 platform complexes (Table IV-8) off the Texas coast in Federal waters, and individual platform installations are unlikely to have a major influence on the scope of Texas offshore fishing. However, they could influence individual fishermen who would visit these new platforms during the estimated 20-year platform life span. The one new platform complex installed in coastal Subarea W-1 would replace fishing opportunities being lost by platforms that will be removed in the next 5-10 years and would extend the time offshore platforms continue to be a principal focus of offshore recreational fishing in the WPA.

The 10 platform complexes (25 structures) resulting from this sale will be removed towards the end of the project life. Therefore, any nearshore structures placed in coastal Subarea W-1 will be lost as fish-attracting devices accessible to recreational fishermen, and their effect on recreational fishing would be negated. Removal of the structures resulting from this proposal with the use of explosives (80% of installations) will kill or adversely impact the sport fish directly associated with the structure at the time of removal, but will have no detectable effect on the amount or enjoyment of offshore fishing in general.

Even though there is an estimated 6 percent probability in the WPA for an oil spill of 1,000 bbl or greater to occur from the proposed sale (Table IV-19), such a spill is unlikely to impact marine recreational fishing beyond the area of the oil slick during the short time it is detectable on the water. Eight spills greater than 1 and less than or equal to 50 bbl are assumed to occur (Table IV-3) and may also temporarily redirect some marine recreational fishing activity.

*Summary*

One platform complex (2-3 structures) installed as a result of this proposal within 30 mi of shore is expected to attract fishermen and to improve fishing success in the immediate vicinity of the platform complex for a period of about 20 years. No oil spills greater than or equal to 1,000 bbl are assumed to occur, and the few spills greater than 1 and less than 50 bbl that are assumed will have little or no impact of marine fishing.

*Conclusion*

One platform complex (2-3 structures) installed as a result of this proposal within 30 mi of shore is expected to attract fishermen and improve fishing success in the immediate vicinity of the platform complex for a period of about 20 years.

*High Case Analysis*

Under the High Case analysis it is estimated one platform complex (2-3 structures), the same number projected for the Base Case, will be installed in coastal Subarea W-1 (Table IV-3). This complex could be placed within 10 to 30 mi of shore and become a popular fishing location for offshore marine recreational fishermen. The number of projected platform complexes in offshore Subarea W-2 will increase from 2 to 5, and in offshore Subarea W-3 from 7 to 24. These additional structures will function as artificial reefs and attract sport fish, but are unlikely to have much impact on offshore recreational fishing because they will be located over 50 mi from shore.

The estimated probability of an oil spill greater than or equal to 1,000 bbl occurring increases from 6 to 16 percent under the High Case scenario (Table IV-19). However, the general effect of one spill greater than or equal to 1,000 bbl on offshore recreational fishing, if the spill were to occur, is expected not to extend beyond the immediate area and short-term life of the associated slick.

*Conclusion*

The High Case scenario will result in the installation of one platform complex (2-3 structures) that should attract offshore recreational fishermen and improve fishing success. The effect of the High Case on recreational fishing is expected to be the same as for the Base Case

### *(10) Impacts on Archaeological Resources*

Lease blocks with a high probability for the occurrence of prehistoric, prehistoric and historic, or historic archaeological resources may by found in the Western Gulf. Those blocks with a high probability for prehistoric archaeological resources may be found landward of a line that roughly follows the 45-m bathymetric contour. Those blocks with a high probability for historic archaeological resources have been recently refined as a result of an MMS-funded study (Garrison et al., 1989). A new Notice to Lessees (NTL 91-02) concerning remote-sensing survey methodology and report writing requirements for archaeological resources in the Gulf of Mexico OCS has been issued. Briefly stated, the NTL increases remote-sensing survey linespacing density for historic shipwreck survey to 50 m from the previous 150 m. The NTL also requires submission of an increased amount of magnetometer data to facilitate in-house MMS analysis. Survey and report requirements for prehistoric site survey have not been changed. Since 1974, leases offered have contained an archaeological resource stipulation. Section II.A.1.c.(3) presents a proposed stipulation as a mitigating measure for leases resulting from the proposed action, the impact analysis for which, including the proposed archaeological resource stipulation, is presented below.

It should be noted that a rulemaking, which will incorporate the archaeological stipulation into regulation under 30 CFR 250.25, has been proposed. Presently, lessees or operators are required to comply with the remote-sensing survey and report requirements upon invocation of the stipulation by MMS. The proposed rulemaking will convert the stipulation into an operational regulation.

Sections providing supportive material for the archaeological resources analysis include Sections III.C.5. (description of archaeological resources), IV.A.4. (offshore infrastructure), IV.A.5. (onshore infrastructure), and IV.C.1. and 3. (oil spills)

A number of OCS-related factors may cause adverse impacts to archaeological resources. Damage caused by the placement of drilling rigs, production platforms, pipelines, dredging, and anchoring could destroy artifacts or disrupt the provenance and stratigraphic context of artifacts, sediments, and paleoindicators from which the scientific value of the archaeological resource is derived. Oil spills could destroy the ability to date prehistoric sites by radiocarbon dating techniques. Ferromagnetic debris associated with OCS oil and gas activities would tend to mask magnetic signatures of significant historic archaeological resources.

Offshore development could result in an interaction between a drilling rig, platform, pipeline, dredging, or anchors and an historic shipwreck. This direct physical contact with a wreck site could destroy fragile ship 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, and the concomitant loss of information on maritime culture for the time period from which the ship dates.

The placement of drilling rigs and production platforms has the physical potential to impact prehistoric and/or historic archaeological resources. It is assumed that the standard rig will directly disturb 1.5 ha of soft bottom, the average platform 2 ha. Pile driving associated with platform emplacement may also cause sediment liquefaction an unknown distance from the piling, disrupting stratigraphy in the area of liquefaction.

Pipeline placement has the physical potential to impact prehistoric and/or historic archaeological resources. Those pipelines placed in water depths of less than 61 m (200 ft) must be buried. Burial depths of 1 m (3 ft) are required with the exception of shipping fairways and anchorage areas, where the requirements are 10 and 15 ft, respectively.

The dredging of new channels, as well as maintenance dredging of existing channels, has the physical potential to impact historic shipwrecks (Espey, Huston, & Associates, 1990). There are 23 navigation channels that provide OCS access to onshore facilities. It is assumed that one channel in the Western Gulf will have to be deepened to provide access for larger offshore boats serving deeper waters.

Anchoring associated with platform and pipeline emplacement, as well as service vessel and shuttle tanker activities, may also physically impact prehistoric and/or historic archaeological resources. It is assumed that during pipeline emplacement, an array of eight 20,000-lb anchors is continuously repositioned.

Oil spills have the potential to impact both prehistoric and historic archaeological resources. Impacts to historic resources would be limited to visual impacts and, possibly, physical impacts associated with spill cleanup operations. Impacts to prehistoric archaeological sites would be the result of hydrocarbon contamination of organic materials, which have the potential to date site occupation through radiocarbon dating techniques, as well as possible physical disturbance associated with spill cleanup operations.

The OCS oil and gas activities will also generate tons of ferromagnetic structures and debris, which will tend to mask magnetic signatures of significant historic archaeological resources. The task of locating historic resources through an archaeological survey is, therefore, made more difficult as a result of leasing activity.

## *(a) Historic*

### *Base Case Analysis*

Since likely locations of archaeological sites cannot be delineated without first conducting a remote-sensing survey of the seabed and near-surface sediments, MMS, by virtue of the proposed Archaeological Resource Stipulation, would require an archaeological survey be conducted prior to development of lease tracts within the high probability zones for historic and prehistoric archaeological resources. Generally, in the western portion of the WPA, where unconsolidated sediments are thicker, it is likely that sidescan sonar will not detect shipwrecks buried beneath the mud. In this area (portions of Subarea W-1), the effectiveness of the survey for detecting historic shipwrecks of composite and wooden construction would depend on the capability of a magnetometer towed at a 50-m line spacing (as specified in NTL 91-02) to detect ferromagnetic masses of the size characteristically associated with shipwrecks. Clausen and Arnold (1975) have concluded that magnetometer reliability for detecting ferrous objects at 150-m survey line spacing is 25-30 percent. It is assumed that an initial survey at a 50-m linespacing interval will be 90 percent effective at locating historic shipwrecks. The survey would therefore reduce the potential for an interaction by 90 percent.

According to Table IV-3, under the Base Case, 210 exploration, delineation, and development wells will be drilled, and 10 production platforms and 80 km of pipelines will be installed in the Western Gulf. Of this number, 30 exploration, delineation, and development wells will be drilled, and 3 platforms and 24 km of pipelines will be installed within Subareas W-1 and W-2, where the majority of lease blocks with a high probability for historic period shipwrecks are located. Under current survey requirements, as much as 10 percent of this activity would occur without accurate information about the proximity of the activity to an historic resource. The recent MMS study (Garrison et al., 1989) has refined the high probability area (ARZ1) for the occurrence of historic period shipwrecks. A Letter to Lessees was issued on November 30, 1990, redefining the high probability area for historic shipwrecks. The location of any proposed activity within a lease block that has a high probability for historic shipwrecks requires archaeological clearance prior to operations. Considering that the expanded database contains 159 shipwrecks in the entire Western Gulf OCS, the probability of an OCS activity contacting and damaging a shipwreck in the western part of the WPA is fairly low. If an oil and gas structure contacted an historic resource, there could be the loss of significant or unique information.

In the eastern part of the WPA, where shipwrecks are more likely to be detected by sidescan sonar due to a thin Holocene sediment veneer overlying an indurated Pleistocene surface, the increased survey linespacing density (50 m) will reduce the potential for a direct physical contact between an impact-producing factor and a shipwreck by an estimated 95 percent. The effectiveness of the survey would reduce the potential impacts of OCS activities to historic shipwrecks in the eastern part of the WPA. There is a very small possibility that an historic shipwreck could be impacted by OCS activities. Should such an impact occur, however, significant or unique archaeological information could be lost.

Onshore historic properties include sites, structures, and objects such as historic buildings, forts, lighthouses, homesteads, cemeteries, and battlefields. Sites already listed on the National Register of Historic Places and those considered eligible for the Register have already been evaluated as being able to make a unique or significant contribution to science. At present, unidentified historic sites may contain unique historic information and would have to be assessed after discovery to determine the importance of the data.

Onshore development as a result of the proposed action could result in the direct physical contact between the construction of new onshore facilities or pipeline canals and previously unidentified historic sites. This direct physical contact with an historic site could cause physical damage to, or complete destruction of, information on the history of the region and the Nation. However, no new onshore pipelines or facilities are projected in the Base Case for proposed Sale 143. There is, therefore, no expected impact to onshore historic sites in the WPA from onshore development.

Maintenance dredging associated with the proposed action has the potential to impact a historic shipwreck. Maintenance dredging in the Port Mansfield Entrance Channel is believed to impact the *Santa Maria de Yciar*, which sank on April 29, 1554 (Espey, Huston & Associates, 1990). Table IV-6 indicates that, under the Base Case less than 0.1 percent of the ship traffic through the Port Mansfield Cut is related to OCS use. Therefore, the impact to the *Santa Maria de Yciar* directly attributable to OCS use as a result of the proposed action is extremely low. As this shipwreck is a unique historic archaeological resource, the impact level of maintenance dredging, in general, is considered to be very high. That portion of the impact attributable to OCS activities resulting from the Base Case is extremely low. Table IV-6 lists eight major navigation channels in the WPA. The percent of OCS usage of these channels in all cases is less than 0.1 percent.

Should an oil spill contact a coastal historic site, such as a fort or a lighthouse, the major impact would be visual because of oil contamination of the site and its environment. According to Table IV-22 the probability of a spill occurring and contacting within 10 days the coast of the WPA is 1 percent under the Base Case. This impact is expected to be temporary and, reversible.

Since all platform locations within the high probability areas for the occurrence of historic and prehistoric archaeological resources are given archaeological clearance prior to setting the structure, removal of the structure should not result in any adverse impact to archaeological resources. This is consistent with the findings of the *Programmatic Environmental Assessment: Structure Removal Activities, Central and Western Gulf of Mexico Planning Areas* (USDOI, MMS, 1987c).

*Summary*

The greatest potential impact to an historic archaeological resource as a result of the proposed action would result from a contact between an OCS offshore activity (platform installation, drilling rig emplacement, dredging, or pipeline project) and an historic shipwreck. A recently completed, MMS-funded study (Garrison et al., 1989) has resulted in the refinement of the high probability areas for the location of historic period shipwrecks.

A new NTL for archaeological resource surveys in the Gulf of Mexico Region (NTL 91-02) has increased the survey linespacing density for historic shipwreck surveys from 150 m to 50 m.

Most other activities associated with the proposed action are expected to have very low impacts on historic archaeological resources. No new onshore infrastructure construction or pipeline landfalls are expected as a result of the proposed action. Historic cultural resources, therefore, will not be affected by these activities. The chance of contact from an oil spill associated with the proposed action is very low. Furthermore, the impact from an oil-spill contact on an historic coastal site, such as a fort or lighthouse, would be visual due to oil contamination. These impacts would be temporary and reversible. Impacts from dredging are expected to be low.

An OCS activity 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.

*Conclusion*

There is a very small possibility of an impact between OCS oil and gas activities and a historic shipwreck or site. Should such an impact occur, unique or significant historic archaeological information could be lost.

*Effects of the Base Case Without the Proposed Stipulation*

The greatest impact to an historic cultural resource as a result of the proposed action would result from a contact between an OCS offshore activity (platform installation, drilling rig emplacement, and pipeline projects) and an historic shipwreck. The Archaeological Resource Stipulation, which is considered part of the proposed action, requires remote-sensing surveys in areas designated to have a high probability for historic archaeological resources. It should also be noted that a proposed new regulation under 30 CFR 250.25 will incorporate the stipulation into operational regulations. The OCS Lands Act, as amended, states that a permit for geological exploration shall be issued only if such exploration does not disturb any site, structure, or object of historical or archaeological interest. As the only means to determine whether objects of historical or archaeological interest would be impacted by geological exploration, the archaeological surveys that are required under the current stipulation would still be necessary to comply with the OCS Lands Act, as amended. The effects of the impact-producing factors on historic archaeological resources without the Archaeological Resource Stipulation in place would, therefore, remain the same as those when the stipulation is considered part of the proposed action.

The archaeological surveys (under NTL 91-02) that are conducted prior to initiating oil and gas activities within a lease block are estimated to be 95 percent effective in locating historic shipwrecks in areas where sidescan sonar is effective in identifying shipwrecks. In areas where sidescan sonar is ineffective because of thick accumulations of sediment on the seafloor (these areas roughly account for 50% of the WPA), magnetometer data, which is estimated at being 90 percent effective at locating ferrous objects from historic shipwrecks at the 50-m linespacing required in NTL 91-02, will be the only means to detect shipwrecks. A recently completed, MMS-funded study (Garrison et al., 1989) has provided new data on shipwreck locations.

Most other activities associated with the proposed action are not expected to affect historic archaeological resources. No new onshore infrastructure construction or pipeline landfalls are expected as a result of the proposed action. Historic cultural resources, therefore, will not be affected by these activities. The chances of contact from an oil spill associated with the proposed action is very low. Furthermore, the impact from an oil-spill contact on an historic coastal site, such as a fort or a lighthouse, would be visible due to oil contamination. These impacts would be temporary and reversible. Impacts from dredging directly attributed to the proposed action are considered to be low.

To summarize, because of incomplete knowledge on the location of shipwrecks in the Gulf, an OCS activity could contact a shipwreck. 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.

*High Case Analysis*

Lease blocks with a high probability for the occurrence of prehistoric, prehistoric and historic, or historic archaeological resources may by found in the Western Gulf. Those blocks with a high probability for prehistoric archaeological resources may be found landward of a line that roughly follows the 45-m bathymetric contour. An LTL dated November 30, 1990, redefined the high probability areas for the presence of historic period shipwrecks. An NTL (91-02), which changes survey methodology requirements for historic shipwreck survey, shall become effective February 17, 1992. Section II.B.1.c.(2) presents a stipulation as a proposed mitigating measure for leases resulting from the proposed action, the impact analysis for which, including the potential archaeological resource stipulation, is presented below. It should also be noted that a proposed rulemaking that creates an operational regulation to replace the Archaeological Stipulation has been issued.

Sections providing supportive material for the archaeological resources analysis include Sections III.C.5. (description of archaeological resources), IV.A.4. (offshore infrastructure), IV.A.5.a. (onshore infrastructure), and IV.C.1. and 3. (oil spills).

A number of OCS-related factors may cause adverse impacts to archaeological resources. Damage caused by the placement of drilling rigs, production platforms, pipelines, dredging, and anchoring could destroy artifacts or disrupt the provenance and stratigraphic context of artifacts, sediments, and paleoindicators from which the scientific value of the archaeological resource is derived. Oil spills could destroy the ability to date prehistoric sites by radiocarbon dating techniques. Ferromagnetic debris associated with OCS oil and gas activities would tend to mask magnetic signatures of significant historic archaeological resources.

The placement of drilling rigs and production platforms has the physical potential to impact prehistoric and/or historic archaeological resources. Pile driving associated with platform emplacement may also cause sediment liquefaction an unknown distance from the piling. Pipeline placement has the physical potential to impact prehistoric and/or historic archaeological resources. The anchoring associated with platform and pipeline emplacement, as well as service vessel and shuttle tanker activities, may also physically impact prehistoric and/or historic archaeological resources.

Maintenance dredging associated with the proposed action has the potential to impact an historic shipwreck. As a shipwreck may represent a unique historic archaeological resource, dredging may result in damage or loss of significant or unique archaeological information; however, the frequency of impact related to the proposed action is extremely low.

Oil spills have the potential to impact both prehistoric (by contamination of organic materials, which have the potential to date site occupation through radiocarbon dating techniques) and historic archaeological resources (limited to visual impacts and physical impacts associated with spill cleanup operations).

The OCS oil and gas activities will also generate tons of ferromagnetic structures and debris, which will tend to mask magnetic signatures of significant historic archaeological resources.

According to Table IV-3, under the High Case, 690 exploration, delineation, and development wells will be drilled, and 20 production platforms and 240 km of pipelines will be installed in the Western Gulf. Of this number, 100 exploration and production wells will be drilled, and 6 platforms and 48 km of pipelines will be installed within Subareas W-1 and W-2, where the majority of lease blocks with a high probability for historic period shipwrecks are located. Under current survey requirements, as much as 10 percent of this activity would occur without accurate information about the proximity of the activity to an historic resource. The recent MMS study (Garrison et al., 1989) and LTL have redefined the high probability area for the occurrence of historic period shipwrecks. The location of any proposed activity within a lease block that has a high probability for historic shipwrecks requires archaeological clearance prior to operations. Considering that the expanded database contains 159 shipwrecks in the entire Western Gulf OCS, the probability of an OCS activity contacting and damaging a shipwreck is fairly low. If an oil and gas structure contacted an historic resource, there could be damage to or loss of significant or unique historic archaeological information. The greater effectiveness of the survey would further reduce the potential impact to historic shipwrecks in the eastern part of the WPA.

Onshore historic properties include sites, structures, and objects such as historic buildings, forts, lighthouses, homesteads, cemeteries, and battlefields. Development as a result of the proposed action could result in the direct physical contact between the construction of new onshore facilities or pipeline canals and previously unidentified historic sites. No new offshore facilities are projected to be constructed under the High Case. Because no land is projected to be disturbed, impacts to coastal historic properties in the WPA are not expected to occur.

Should an oil spill contact a coastal historic site, such as a fort or a lighthouse, the major impact would be visual because of oil contamination of the site and its environment. This impact would most likely be temporary and reversible.

Since all platform locations within the high probability areas for the occurrence of historic and prehistoric archaeological resources are given archaeological clearance prior to setting the structure, removal of the structure should not result in any adverse impact to archaeological resources. This is consistent with the findings of the *Programmatic Environmental Assessment: Structure Removal Activities, Central and Western Gulf of Mexico Planning Areas* (USDOI, MMS, 1987c).

*Conclusion*

There is a very small possibility of an impact between OCS oil and gas activities and an historic shipwreck or site. Should such an impact occur, unique or significant historic archaeological information could be lost.

## *(b) Prehistoric*

Offshore development as a result of the proposed action could result in an interaction between a drilling rig, a platform, a pipeline, dredging, or anchors and an inundated prehistoric site. This direct physical contact with a site could destroy fragile artifacts or site features and could disturb artifact provenance and site stratigraphy. The result would be the loss of archaeological data on prehistoric migrations, settlement patterns, subsistence strategies, and archaeological contacts for North America, Central America, South America, and the Caribbean.

*Base Case Analysis*

The archaeological surveys, coupled with archaeological analysis and clearance of proposed location of operations, are estimated to be 90 percent effective in allowing identification and avoidance of high probability areas for site occurrence. According to Table IV-3, under the Base Case, 210 exploration, delineation, and development wells will be drilled, and 10 production platforms and 80 km of pipelines will be installed in the Western Gulf. In-house analysis by MMS shows it is likely that some of these potential impacts will occur within Subarea W-3 which has no potential for the occurrence of prehistoric archaeological sites. Removing Subarea W-3 from the projected impacts resulting from the proposed action leaves 30 exploration, delineation, and development wells; 3 production platforms; and 24 km of pipelines installed (Table IV-3). The limited amount of impact to the seafloor throughout the WPA, coupled with the effectiveness of the survey and resulting archaeological clearance, is sufficient to assume a low potential for interaction between an impact-producing factor and a prehistoric archaeological site.

Onshore prehistoric archaeological resources include sites, structures, and objects such as shell middens, earth middens, campsites, kill sites, tool manufacturing areas, ceremonial complexes, and earthworks. Currently, unidentified onshore prehistoric sites would have to be assessed after discovery to determine the uniqueness or significance of the information that they contain. Sites already listed in the National Register of Historic Places and those considered eligible for the Register have already been evaluated as having the potential for making a unique or significant contribution to science. Of the unidentified coastal prehistoric sites that could be impacted by onshore development, some may contain unique information.

Onshore development as a result of the proposed action could result in direct physical contact between construction of new onshore facilities or a pipeline landfall and a previously unidentified prehistoric site. This direct physical contact with a prehistoric site could destroy fragile artifacts or site features and could disturb the site context. The result would be the loss of information on the prehistory of North America and the Gulf Coast Region. No new onshore facilities or pipeline landfalls, however, are projected for the Base Case as a result of proposed Sale 143 (Table IV-12). There should, therefore, be no impact to onshore WPA prehistoric sites from onshore development.

Should an oil spill contact a coastal prehistoric site, the potential for dating the site using C-14 could be destroyed. This loss of information might be ameliorated by ceramic or lithic seriation or other relative dating techniques. Previously unrecorded coastal sites could also experience an impact from oil-spill cleanup operations. Cleanup equipment could destroy fragile artifacts or site features and could disturb the site context. The result would be the loss of information on the prehistory of North America and the Gulf Coast Region. Some of the coastal prehistoric sites that might be impacted by beach cleanup operations may contain unique information. In coastal Texas, prehistoric sites occur frequently along the barrier islands and mainland coast and the margins of bays and bayous. Thus, any spill that contacts the land would involve a potential impact to a prehistoric site. The probability of a spill greater than or equal to 1,000 bbl occurring and contacting the WPA coast within 10 days is 1 percent (Table IV-22). Based on this low probability, the assumption is that no spills greater than or equal to 1,000 bbl will affect prehistoric archaeological resources.

Furthermore, it is assumed that a small spill of greater than 50 and less than 1,000 bbl will occur and contact the coastline during the 35-year life of the proposed action. A few spills greater than 1 and less than or equal to 50 bbl is assumed to contact the coast during the 35-year life of the proposed action. By the time these spills contact the shore, however, there it is expected that not enough oil is available to cover an exposed shell midden or other site to the extent that a large percentage of the organic remains in the site would be contaminated.

All platform locations within the high probability areas for the occurrence of historic and prehistoric archaeological resources are given archaeological clearance prior to setting the structure; removal of the structure should not result in any adverse impact to archaeological resources. This is consistent with finding of the *Programmatic Environmental Assessment: Structural Removal Activities, Central and Western Gulf of Mexico Planning Areas* (USDOI, MMS, 1987c).

*Summary*

Several impact-producing factors may threaten the prehistoric archaeological resources of the Western Gulf. An impact could result from a contact between an OCS activity (pipeline and platform installations, drilling rig emplacement and operation, dredging, and anchoring activities) and a prehistoric site located on the continental shelf. The archaeological surveys and archaeological clearance of sites that are required prior to an operator beginning oil and gas activities in a lease block are estimated to be 90 percent effective at identifying possible prehistoric sites. The survey and clearance provide a significant reduction in the potential for a damaging interaction between an impact-producing factor and a prehistoric site. There is a very small possibility of an OCS activity contacting a prehistoric site. Should such contact occur, there could be damage to or loss of significant or unique archaeological information.

Onshore development as a result of the proposed action could result in the direct physical contact from new facility construction, pipeline trenching, and navigation canal dredging. None of these activities is expected to occur under the Base Case.

Should an oil spill contact a coastal prehistoric site, the potential for dating the site using radiocarbon methods could be destroyed. Oil-spill cleanup operations could physically impact coastal prehistoric sites. Previously unrecorded sites could also experience an impact from oil-spill cleanup operations on beaches. The probability of a spill greater than or equal to 1,000 bbl occurring and contacting a coastal prehistoric site within 10 days is very low (1%) (Table IV-22), and it is assumed that no contact will occur. A few spills greater than 1 and less than or equal to 50 bbl are assumed to contact the coast, but these small spills would probably not cover an exposed site, such as a shell midden, with enough oil to contaminate all the datable organic remains. The impact level from oil-spill contact is assumed to be very low.

*Conclusion*

There is a very small possibility of an impact between OCS oil and gas activities and a prehistoric archaeological site. Should such an impact occur, there could be damage to or loss of significant or unique prehistoric archaeological information.

*Effects of the Base Case Without the Proposed Stipulation*

Several impact-producing factors may threaten the prehistoric archaeological resources of the Western Gulf. An impact could result from a contact between an OCS activity (pipeline and platform installations, drilling rig emplacement and operation, and anchoring activities) and a prehistoric site located on the continental shelf. The Archaeological Resource Stipulation, which is considered part of the proposed action, requires remote-sensing surveys in areas designated to have a high probability for prehistoric archaeological resources. It should also be noted that a proposed new regulation under 30 CFR 250.25 will incorporate the stipulation into operational regulations. The OCS Lands Act, as amended, states that a permit for geological exploration shall be issued only if such exploration does not disturb any site, structure, or object of historical or archaeological interest. As the only means to determine whether objects of historical or archaeological interest would be impacted by geological exploration, the archaeological surveys that are required under the current stipulation would still be necessary to comply with the OCS Lands Act, as amended. The effects of the impact-producing factors on prehistoric archaeological resources without the Archaeological Resource Stipulation in place would, therefore, remain the same as those when the stipulation is considered a part of the proposed action.

The archaeological surveys that are required prior to an operator beginning oil and gas activities in a lease block are estimated to be 90 percent effective in identifying possible prehistoric sites. The survey provides a significant reduction in the potential for a damaging interaction between an impact-producing factor and a prehistoric site.

Should such an impact occur, there could be damage to or loss of significant or unique prehistoric archaeological information.

Onshore development as a result of the proposed action could result in the direct physical contact between new facility construction, pipeline trenching, and navigation canal dredging. None of these activities are expected to occur under the Base Case.

Should an oil spill contact a coastal prehistoric site, the potential for dating the site using radiocarbon methods could be destroyed. Previously unrecorded sites could also experience an impact from oil-spill cleanup operations on beaches. The probability of a spill greater than or equal to 1,000 bbl contacting a coastal prehistoric site is very low, and it is assumed that no contact will occur. It is also assumed that no oil spills greater than 1 and less than or equal to 50 bbl will contact the coast.

*High Case Analysis*

The higher level of offshore development projected for the High Case would increase the potential for an interaction between an impact-producing factor and a prehistoric site. Should an interaction occur, the potential exists for the loss of significant or unique archaeological information.

Offshore development as a result of the proposed action could result in an interaction between a drilling rig, a platform, a pipeline, dredging, or anchors and an inundated prehistoric site. This direct physical contact with a site could destroy fragile artifacts or site features and could disturb artifact provenance and site stratigraphy. The result would be the loss of archaeological data on prehistoric migrations, settlement patterns, subsistence strategies, and archaeological contacts for North America, Central America, South America, and the Caribbean.

Likely locations for archaeological sites can be delineated with high-resolution seismic data. As the high probability zone for the occurrence of prehistoric sites on the OCS approximates the 45-m bathymetric contour, Subarea W-3, which is deeper than 45 m in its entirety, is assumed to have no potential for the occurrence of these sites.

The archaeological surveys, coupled with archaeological analysis and clearance of proposed location of operations, are estimated to be 90 percent effective in allowing identification and avoidance of high probability areas for site occurrence. According to Table IV-3, under the High Case, 690 exploration, delineation, and development wells will be drilled, and 30 production platforms and 240 km of pipelines will be installed in the Western Gulf. Removing Subarea W-3 from the projected impacts resulting from the High Case leaves 100 exploration, delineation, and development wells; 6 production platforms; and 48 km of pipelines installed. The limited amount of impact to the seafloor throughout the WPA, coupled with the effectiveness of the survey and resulting archaeological clearance, is sufficient to assume a low potential for interaction between an impact-producing factor and a prehistoric archaeological site.

No new onshore development is expected as a result of the High Case. Because no land is projected to be disturbed, impacts to coastal WPA prehistoric archaeological sites are not expected to occur.

Should an oil spill contact a coastal prehistoric site, the potential for dating the site using C-14 could be destroyed. Previously unrecorded coastal sites could also experience an impact from oil-spill cleanup operations, which could destroy fragile artifacts or site features and disturb the site context. The result would be the loss of information on the prehistory of North America and the Gulf Coast Region. In coastal Texas, prehistoric sites occur frequently along the barrier islands and mainland coast and the margins of bays and bayous. Thus, any spill that contacts the land would involve a potential impact to a prehistoric site. The probability of a spill greater than or equal to 1,000 bbl occurring and contacting the WPA coast within 10 days is 1 percent (Table IV-22). Based on this low probability, the assumption is that no spills greater than or equal to 1,000 bbl will affect prehistoric archaeological resources. Furthermore, it is estimated that a spill greater than 50 and less than 1,000 bbl will occur and contact the coastline during the 35-year life of the proposed action. It is also assumed that no OCS spills greater than 1 and less than or equal to 50 bbl will contact the coast during the 35-year life of the proposed action.

All platform locations within the high probability areas for the occurrence of historic and prehistoric archaeological resources are given archaeological clearance prior to setting the structure; removal of the structure should not result in any adverse impact to archaeological resources. This is consistent with finding of the *Programmatic Environmental Assessment: Structural Removal Activities, Central and Western Gulf of Mexico Planning Areas* (USDOI, MMS, 1987c).

*Conclusion*

There is a very small possibility of an impact between OCS oil and gas activities and a prehistoric archaeological site. Should such an impact occur, there could be damage to or loss of significant or unique prehistoric archaeological information.

### *(11) Impacts on Socioeconomic Conditions*

### *(a) Population, Labor, and Employment*

The importance of the oil and gas industry to the coastal communities of the Gulf of Mexico is significant, particularly in Louisiana and eastern Texas. Dramatic changes in the level of OCS oil and gas activity over recent years have brought forth similar fluctuations in population, labor, and employment in the Gulf of Mexico region. State government and citizen concern over the Gulf Coast's economic dependence on the oil and gas industry has made clear the need for an analysis of the impact of the OCS program on the social and economic well-being of affected communities.

This section focuses on an analysis of the direct, indirect, and induced impacts of the OCS oil and gas industry on the population, labor, and employment of counties and parishes in the Central and Western Gulf coastal impact area caused by the proposed action in the Western Gulf. There would also be other economic impacts, both direct and indirect, associated with the proposed actions because of their effect on other industries, such as commercial fishing, tourism, and recreational fishing. The direct benefit or loss in these industries is addressed in the sections of this EIS related specifically to those topics. The OCS program's indirect and induced effect on these associated industries is much more difficult to quantify. Nevertheless, it will generally constitute a fraction of the magnitude of the direct impact.

Section III.C.1. provides an historical perspective of the oil and gas industry, as well as a brief description of recent events that have significantly affected the level of OCS activity in the Gulf of Mexico. A detailed discussion of historical trends in population, labor, and employment within the coastal impact area of the Central and Western Gulf can be found in Section III.C.2. Included also in that section is a listing of counties and parishes in the Central and Western Gulf coastal impact area, as well as current statistics and future projections of population, labor, and employment levels for coastal subareas in the region. These projections will serve as a baseline against which impacts will be measured.

The methodology developed to quantify these impacts on population, labor, and employment takes into account changes in OCS-related employment, along with population and labor impacts resulting from these employment changes within each individual coastal subarea. For analysis purposes, the projections of OCS-related employment are classified into three categories: direct, indirect, and induced employment.

Direct employment associated with the oil and gas industry consists of those workers involved in oil and gas exploration, development, and production operations, including geophysical and seismograph surveys, exploratory drilling, well operation, maintenance, and other contract support services. These activities are covered under the Standard Industrial Classification (SIC) Code 13--Oil and Gas Extraction. To facilitate the analysis, several assumptions were made regarding the employment associated with SIC 13 activity projected to result from the proposed action. These assumptions are estimates of typical levels of activity and employment based on historical observations:

Exploration Activity - One rig can drill an average of nine per wells per year with approximately 133 workers.

Development Activity - One platform rig can drill an average of six wells per year with a crew of approximately 115 workers.

Production Activity - One offshore platform can operate with an average crew of 28 workers.

A population and employment computer model developed at MMS uses these and other assumptions to translate estimates of exploration, development, and production activities associated with the proposed action into annual projections of direct employment for each planning area. Planning area level employment projections are apportioned to offshore subareas on the basis of each offshore subarea's hydrocarbon resource potential and projected share of the offshore infrastructure. Employment within each offshore subarea is then allocated to coastal subareas on the basis of an allocation matrix developed at MMS. This matrix allocates direct employment offshore to those coastal subareas where the onshore support facilities for that particular offshore site are expected to be located. The matrix was derived from an analysis of the historical and proposed location of onshore support facilities for the different actual or planned drilling sites offshore. The allocation matrix also accounts for the fact that employment impacts from offshore activity are not constrained by planning area or subarea boundaries. In other words, oil and gas development in the CPA can and does impact the coastal communities of the Western Gulf and vice versa.

Indirect employment resulting from activities in the primary oil and gas extraction industry occurs in secondary or supporting oil- and gas-related industries. Section III.C.2. provides a listing of those industries considered in the projection of indirect employment. Employment in the Sanitary Service Industry, which supports oil-spill clean-up activities (SIC 4959), was not included as part of indirect employment in the model because the manpower requirements for oil-spill clean-up activities are highly unpredictable. The level of employment involved in any given clean-up effort is influenced by a variety of factors, such as whether or not the oil comes ashore, the coastal formation, weather conditions at the time of the incident, type and quantity of oil spilled, as well as the extent and duration of the oiling. Nevertheless, employment in oil-spill clean-up activities has been included in the Base Case analysis as an external adjustment to the population and employment model, using assumptions regarding the size of potential oil spills presented in Section IV.C.1 and IV.C.3.

Based on an analysis of actual industry-specific employment levels in the counties of the coastal impact area, a multiplier was determined to estimate indirect employment from direct employment projections for the oil and gas extraction industry. The indirect employment multiplier determined for this analysis was 0.67.

Induced employment in tertiary industries is generated from both direct and indirect employment and includes jobs that are created or supported by the expenditures of employees in primary and secondary industries. Induced employment results from the demand for consumer goods and services such as food, clothing, housing, and entertainment. Based on a previous MMS analysis of employment impacts, the induced employment multiplier for this analysis was estimated to be 0.33.

The total employment impact to each coastal subarea because of the proposed action is the sum of its direct, indirect, and induced employment impact projections. The population dependent on the income from oil- and gas-related employment for their subsistence was derived from total employment estimates based on an analysis of the historic ratio of population to employment in the coastal subareas. Labor impacts were addressed using both population and employment data to assess the supply and demand for workers trained in oil- and gas-related trades.

To arrive at a bottom-line level of impact for population, labor, and employment, the population and employment model is used to convert the projections to a format that facilitates analysis and comparison. This conversion involves the estimation of annual changes in population, labor, and employment projections for the proposed action as a percent of the population, labor, and employment levels expected in absence of the proposal for each coastal subarea. The projections of population and employment described in Section III.C.2. were used as a baseline for the analysis. These baseline projections assume the continuation of existing social, economic, and technological trends; therefore, they also include population and employment resulting from the continuation of current patterns in OCS leasing activity. To derive population and employment levels in absence of the proposal, the population and employment impacts estimated for the proposed action were subtracted from the baseline projections which, inherently, include impacts from the proposal.

*Base Case Analysis*

Baseline employment projections for the coastal impact area of the Central and Western Gulf can be found in Figure IV-10. Displayed also on this figure are baseline employment projections excluding jobs generated by the proposed action in the Western Gulf. The methodology discussion preceding this Base Case analysis provides a description of these projections. A total of approximately 24,000 person-years of employment (direct, indirect, and induced) are required in the Central and Western Gulf coastal subareas in support of the proposed sale in the Western Gulf throughout its 35-year life. Over 72 percent of the total employment generated by the proposed action in the Western Gulf is expected to be supported by the coastal communities of the CPA. Peak-year impacts occur in 1997 and 1998, with a total of approximately 1,500 workers involved in primary, secondary, and tertiary industries. Exploratory activities, which occur during the first 11 years of the life of the proposed action, are the main contributor to peak-year direct and total employment impacts. After this initial peak in 1997 and 1998, total employment impacts begin to decline as oil and gas exploration is reduced in areas leased under the proposed action. Employment impacts resulting from development activities remain fairly steady from 1995 through 2016. A second, smaller total employment peak impact is experienced during the years 2009 through 2015, when employment resulting from production activities offshore reaches its peak. Oil and gas production operations are the greatest contributor to overall employment impacts, accounting for approximately 50 percent of total direct employment impacts caused by activities in the Western Gulf. Direct employment in the primary oil and gas extraction industry (SIC 13) accounts for 45 percent of the total employment impact projected for the coastal subareas of the Central and Western Gulf. Indirect and induced employment impacts in secondary and tertiary industries amount to approximately 30 percent and 25 percent, respectively, of the total employment impacts over the life of the proposed action in the Western Gulf.

Table IV-33 displays the model projections of total OCS-related employment impacts (direct, indirect, and induced) from Sale 143 in the Western Gulf to the coastal subareas of the CPA and WPA throughout the life

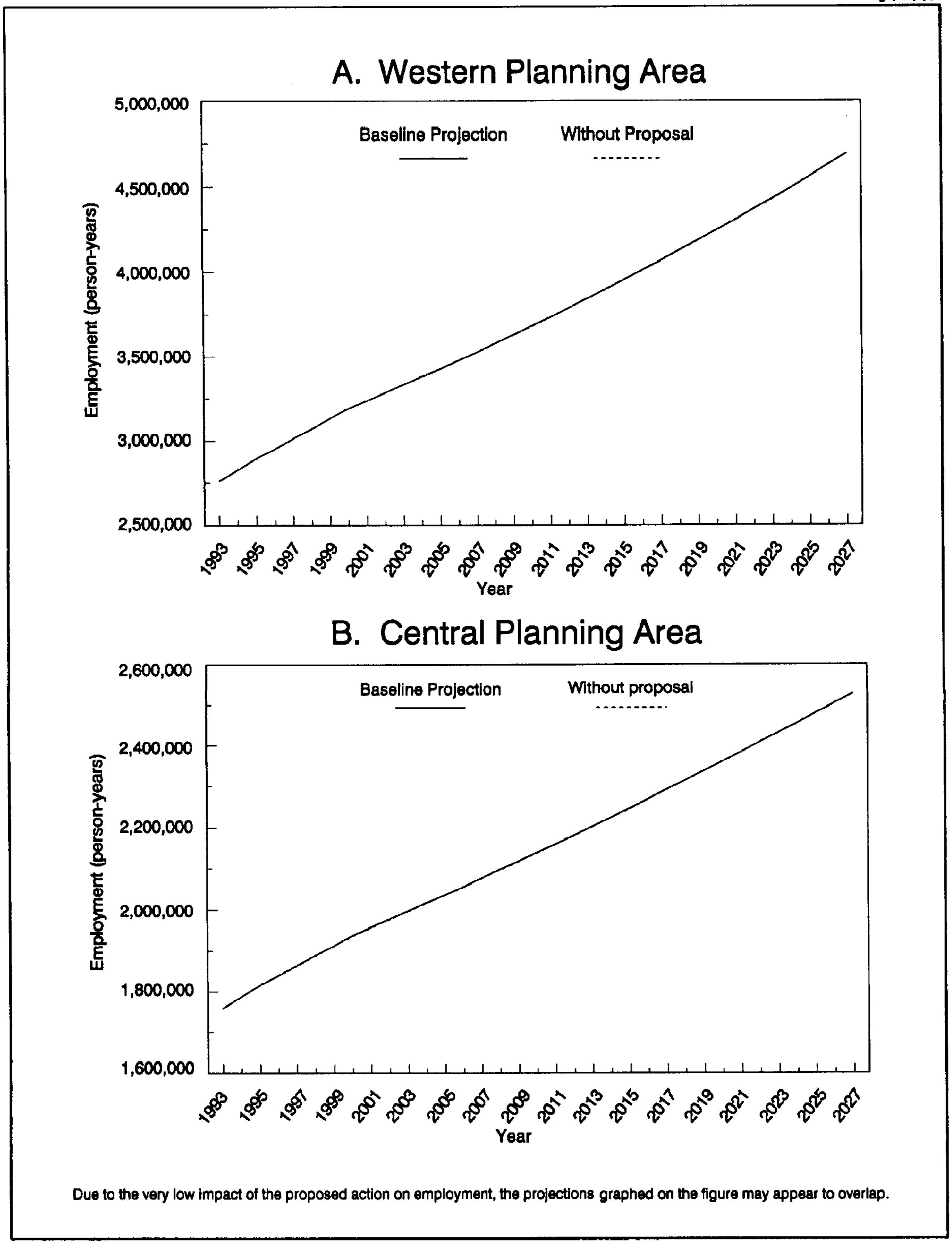



Figure IV-10. Base Case Employment Impacts from Western Gulf Sale 143 (USDOI, MMS, Gulf of Mexico OCS Region estimates, 1991).

Table IV-33

Base Case OCS-Related Employment Projections (Direct+Indirect+Induced)
Western Gulf Sale 143
(person-years)

| YEAR | W1 | W2 | C1 | C2 | C3 | C4 | WGOM* | CGOM** |
|---|---|---|---|---|---|---|---|---|
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 3 | 34 | 31 | 96 | 0 | 0 | 38 | 126 |
| 1995 | 21 | 165 | 145 | 436 | 0 | 0 | 186 | 582 |
| 1996 | 21 | 165 | 145 | 436 | 0 | 0 | 186 | 582 |
| 1997 | 39 | 317 | 281 | 849 | 0 | 0 | 356 | 1130 |
| 1998 | 39 | 317 | 281 | 849 | 0 | 0 | 356 | 1130 |
| 1999 | 40 | 298 | 263 | 784 | 0 | 0 | 338 | 1046 |
| 2000 | 44 | 314 | 275 | 814 | 0 | 0 | 357 | 1089 |
| 2001 | 41 | 242 | 207 | 589 | 0 | 0 | 283 | 796 |
| 2002 | 41 | 242 | 207 | 589 | 0 | 0 | 283 | 796 |
| 2003 | 42 | 223 | 188 | 523 | 0 | 0 | 265 | 712 |
| 2004 | 38 | 189 | 158 | 428 | 0 | 0 | 227 | 585 |
| 2005 | 43 | 185 | 151 | 393 | 0 | 0 | 228 | 545 |
| 2006 | 43 | 185 | 151 | 393 | 0 | 0 | 228 | 545 |
| 2007 | 43 | 185 | 151 | 393 | 0 | 0 | 228 | 545 |
| 2008 | 43 | 185 | 151 | 393 | 0 | 0 | 228 | 545 |
| 2009 | 47 | 201 | 164 | 424 | 0 | 0 | 247 | 587 |
| 2010 | 47 | 201 | 164 | 424 | 0 | 0 | 247 | 587 |
| 2011 | 47 | 201 | 164 | 424 | 0 | 0 | 247 | 587 |
| 2012 | 47 | 201 | 164 | 424 | 0 | 0 | 247 | 587 |
| 2013 | 47 | 201 | 164 | 424 | 0 | 0 | 247 | 587 |
| 2014 | 47 | 201 | 164 | 424 | 0 | 0 | 247 | 587 |
| 2015 | 47 | 201 | 164 | 424 | 0 | 0 | 247 | 587 |
| 2016 | 43 | 185 | 151 | 393 | 0 | 0 | 228 | 545 |
| 2017 | 36 | 139 | 111 | 274 | 0 | 0 | 175 | 385 |
| 2018 | 32 | 123 | 99 | 244 | 0 | 0 | 155 | 342 |
| 2019 | 28 | 108 | 86 | 213 | 0 | 0 | 136 | 300 |
| 2020 | 24 | 93 | 74 | 183 | 0 | 0 | 116 | 257 |
| 2021 | 20 | 77 | 62 | 152 | 0 | 0 | 97 | 214 |
| 2022 | 16 | 62 | 49 | 122 | 0 | 0 | 78 | 171 |
| 2023 | 12 | 46 | 37 | 91 | 0 | 0 | 58 | 128 |
| 2024 | 8 | 31 | 25 | 61 | 0 | 0 | 39 | 86 |
| 2025 | 4 | 15 | 12 | 30 | 0 | 0 | 19 | 43 |
| 2026 | 4 | 15 | 12 | 30 | 0 | 0 | 19 | 43 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1094 | 5544 | 4649 | 12727 | 0 | 0 | 6638 | 17376 |

* Western Gulf of Mexico.
** Central Gulf of Mexico.

Source: USDOI, MMS, Gulf of Mexico OCS Region estimates, 1991.

of the proposed action. Table IV-34 provides estimates of annual impacts to the population and employment of each coastal subarea as a percent of levels expected in absence of the proposal. These impact estimates represent changes in the new share of the existing population and employment that will be dependent on the OCS oil and gas industry for support as a result of the proposed action. These impact estimates alone do not provide enough information to determine whether employment needs will be met with the population and labor force in the area or with immigrants and new labor force from other areas. However, this issue will be addressed later in the Base Case analysis.

The greatest impact to employment is expected in coastal Subareas C-1 and C-2, with peak-year impact estimates for 1997 and 1998 of 0.11 and 0.17 percent, respectively. The coastal communities of the CPA are expected to support over 72 percent of the total employment generated by the Western Gulf sale. Coastal Subareas W-1 and W-2 both have relatively small peak employment impacts of 0.01 percent. The WPA contributes the remaining 28 percent of the total employment required in support of the proposed action in the Western Gulf.

Employment impacts resulting from oil-spill clean-up activities, because of their highly unpredictable nature, were handled apart from the population and employment model. The level of employment associated with any given clean-up operation is dependent on numerous variables which, in themselves, are also difficult to predict. Nevertheless, the most labor-intensive clean-up operations are those from spills that contact the coastline, particularly recreational beaches. For the purpose of this analysis, it is assumed that only those spills contacting land will involve significant manpower requirements in their clean-up efforts. Based on employment statistics from recent spill clean-up operations along the coast, the assumption is that for every kilometer of coastline subjected to heavy oiling, approximately 100 temporary workers will be employed for a maximum of 6 weeks.

Section IV.C.1. presents estimates of the mean number of offshore spills assumed to result from the proposed action in the WPA. The probability that one or more spills greater than or equal to 1,000 bbl will occur and contact land within 10 days of the accident is 1 percent (Table IV-22). Based on the low probability of a spill of this size occurring and contacting land within 10 days, the assumption is that no significant employment requirements will result from the clean-up of offshore spills of this size category in the Base Case. No spills of the size category greater than 50 bbl and less than 1,000 bbl are assumed to occur or contact the coastline of the Western Gulf (Table IV-3). Eight spills of the size category greater than 1 bbl and or equal to 50 bbl are estimated to occur in the WPA over the life of the proposed action. However, none is assumed to contact the coastline of the Western Gulf (Section IV.C.1.). Furthermore, employment impacts resulting from the clean-up of spills this small are assumed to be negligible.

In addition to the offshore spills referenced above, a number of small onshore spills are expected to occur (Table IV-5). The level of clean-up action associated with spills of this size will be minimal.

The greatest impact on population from activities associated with Sale 143 is expected in coastal Subareas C-1 and C-2 with peak year impact estimates for 1997 and 1998 of 0.11 and 0.17 percent, respectively (Table IV-34). The coastal communities of the Western Gulf have relatively small peak population impacts of 0.01 percent.

The level of OCS-related employment expected to result from the proposed action in the Western Gulf is not significant enough to attract new residents and labor force to the area. Analysis of historical trends has shown that only population impacts greater than 1 percent typically involve positive net migration to any given area. None of the coastal subareas is projected to experience population impacts greater than 1 percent because of the proposed action. Labor force impacts will parallel population and employment impacts. Jobs are expected to be filled by currently unemployed or underemployed workers or by future entrants into the labor force already living in the area. Therefore, employment demands in support of the proposed action will be met with the existing population and available labor force.

*Summary*

Peak annual changes in the population, labor, and employment of all coastal subareas in the Central and Western Gulf resulting from the proposed action in the Western Gulf represent less than 1 percent of the levels expected in absence of the proposal. The coastal communities of the CPA are expected to support over 72

Table IV-34

Population and Employment Impact Levels for the Base Case Scenario
Western Gulf Sale 143
(percent*)

EMPLOYMENT IMPACT LEVELS:

| YEAR | W1 | W2 | C1 | C2 | C3 | C4 |
|---|---|---|---|---|---|---|
| 1993 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 1994 | 0.00% | 0.00% | 0.01% | 0.02% | 0.00% | 0.00% |
| 1995 | 0.01% | 0.01% | 0.06% | 0.09% | 0.00% | 0.00% |
| 1996 | 0.01% | 0.01% | 0.06% | 0.09% | 0.00% | 0.00% |
| 1997 | 0.01% | 0.01% | 0.11% | 0.17% | 0.00% | 0.00% |
| 1998 | 0.01% | 0.01% | 0.11% | 0.17% | 0.00% | 0.00% |
| 1999 | 0.01% | 0.01% | 0.10% | 0.15% | 0.00% | 0.00% |
| 2000 | 0.01% | 0.01% | 0.10% | 0.15% | 0.00% | 0.00% |
| 2001 | 0.01% | 0.01% | 0.07% | 0.11% | 0.00% | 0.00% |
| 2002 | 0.01% | 0.01% | 0.07% | 0.11% | 0.00% | 0.00% |
| 2003 | 0.01% | 0.01% | 0.07% | 0.10% | 0.00% | 0.00% |
| 2004 | 0.01% | 0.01% | 0.06% | 0.08% | 0.00% | 0.00% |
| 2005 | 0.01% | 0.01% | 0.05% | 0.07% | 0.00% | 0.00% |
| 2006 | 0.01% | 0.01% | 0.05% | 0.07% | 0.00% | 0.00% |
| 2007 | 0.01% | 0.01% | 0.05% | 0.07% | 0.00% | 0.00% |
| 2008 | 0.01% | 0.01% | 0.05% | 0.07% | 0.00% | 0.00% |
| 2009 | 0.01% | 0.01% | 0.05% | 0.07% | 0.00% | 0.00% |
| 2010 | 0.01% | 0.01% | 0.05% | 0.07% | 0.00% | 0.00% |
| 2011 | 0.01% | 0.01% | 0.05% | 0.07% | 0.00% | 0.00% |
| 2012 | 0.01% | 0.01% | 0.05% | 0.07% | 0.00% | 0.00% |
| 2013 | 0.01% | 0.01% | 0.05% | 0.07% | 0.00% | 0.00% |
| 2014 | 0.01% | 0.01% | 0.05% | 0.07% | 0.00% | 0.00% |
| 2015 | 0.01% | 0.01% | 0.05% | 0.07% | 0.00% | 0.00% |
| 2016 | 0.01% | 0.01% | 0.05% | 0.06% | 0.00% | 0.00% |
| 2017 | 0.01% | 0.00% | 0.03% | 0.04% | 0.00% | 0.00% |
| 2018 | 0.01% | 0.00% | 0.03% | 0.04% | 0.00% | 0.00% |
| 2019 | 0.01% | 0.00% | 0.03% | 0.03% | 0.00% | 0.00% |
| 2020 | 0.00% | 0.00% | 0.02% | 0.03% | 0.00% | 0.00% |
| 2021 | 0.00% | 0.00% | 0.02% | 0.02% | 0.00% | 0.00% |
| 2022 | 0.00% | 0.00% | 0.01% | 0.02% | 0.00% | 0.00% |
| 2023 | 0.00% | 0.00% | 0.01% | 0.01% | 0.00% | 0.00% |
| 2024 | 0.00% | 0.00% | 0.01% | 0.01% | 0.00% | 0.00% |
| 2025 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 2026 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 2027 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

POPULATION IMPACT LEVELS:

| YEAR | W1 | W2 | C1 | C2 | C3 | C4 |
|---|---|---|---|---|---|---|
| 1993 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 1994 | 0.00% | 0.00% | 0.01% | 0.02% | 0.00% | 0.00% |
| 1995 | 0.01% | 0.01% | 0.06% | 0.09% | 0.00% | 0.00% |
| 1996 | 0.01% | 0.01% | 0.06% | 0.09% | 0.00% | 0.00% |
| 1997 | 0.01% | 0.01% | 0.11% | 0.17% | 0.00% | 0.00% |
| 1998 | 0.01% | 0.01% | 0.11% | 0.17% | 0.00% | 0.00% |
| 1999 | 0.01% | 0.01% | 0.10% | 0.16% | 0.00% | 0.00% |
| 2000 | 0.01% | 0.01% | 0.11% | 0.16% | 0.00% | 0.00% |
| 2001 | 0.01% | 0.01% | 0.08% | 0.12% | 0.00% | 0.00% |
| 2002 | 0.01% | 0.01% | 0.08% | 0.12% | 0.00% | 0.00% |
| 2003 | 0.01% | 0.01% | 0.07% | 0.10% | 0.00% | 0.00% |
| 2004 | 0.01% | 0.01% | 0.06% | 0.08% | 0.00% | 0.00% |
| 2005 | 0.01% | 0.01% | 0.06% | 0.08% | 0.00% | 0.00% |
| 2006 | 0.01% | 0.01% | 0.06% | 0.07% | 0.00% | 0.00% |
| 2007 | 0.01% | 0.01% | 0.06% | 0.07% | 0.00% | 0.00% |
| 2008 | 0.01% | 0.01% | 0.06% | 0.07% | 0.00% | 0.00% |
| 2009 | 0.01% | 0.01% | 0.06% | 0.08% | 0.00% | 0.00% |
| 2010 | 0.01% | 0.01% | 0.06% | 0.08% | 0.00% | 0.00% |
| 2011 | 0.01% | 0.01% | 0.06% | 0.08% | 0.00% | 0.00% |
| 2012 | 0.01% | 0.01% | 0.06% | 0.08% | 0.00% | 0.00% |
| 2013 | 0.01% | 0.01% | 0.06% | 0.08% | 0.00% | 0.00% |
| 2014 | 0.01% | 0.01% | 0.06% | 0.08% | 0.00% | 0.00% |
| 2015 | 0.01% | 0.01% | 0.06% | 0.08% | 0.00% | 0.00% |
| 2016 | 0.01% | 0.01% | 0.05% | 0.07% | 0.00% | 0.00% |
| 2017 | 0.01% | 0.00% | 0.04% | 0.05% | 0.00% | 0.00% |
| 2018 | 0.01% | 0.00% | 0.03% | 0.04% | 0.00% | 0.00% |
| 2019 | 0.01% | 0.00% | 0.03% | 0.04% | 0.00% | 0.00% |
| 2020 | 0.01% | 0.00% | 0.03% | 0.03% | 0.00% | 0.00% |
| 2021 | 0.00% | 0.00% | 0.02% | 0.03% | 0.00% | 0.00% |
| 2022 | 0.00% | 0.00% | 0.02% | 0.02% | 0.00% | 0.00% |
| 2023 | 0.00% | 0.00% | 0.01% | 0.02% | 0.00% | 0.00% |
| 2024 | 0.00% | 0.00% | 0.01% | 0.01% | 0.00% | 0.00% |
| 2025 | 0.00% | 0.00% | 0.00% | 0.01% | 0.00% | 0.00% |
| 2026 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 2027 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

* Note: Impact levels represent the percent change in population or employment due to the proposal with respect to total levels expected in absence of the proposal.

Source: USDOI, MMS, Gulf of Mexico OCS Region estimates, 1991.

percent of the total employment generated by the Western Gulf sale. The WPA contributes the remaining 28 percent of total employment impacts. Employment resulting from oil-spill clean-up activities due to the proposed action is negligible. It is expected that employment demands in support of the proposed action will be met with the existing population and available labor force in the region.

*Conclusion*

The Base Case impact of the proposed action in the Western Gulf on the population, labor, and employment of the counties and parishes of the Central and Western Gulf coastal impact area is expected to be less than 1 percent of the levels expected in the absence of the proposal.

*High Case Analysis*

Population, labor, and employment impacts resulting from the Western Gulf proposed action in the High Case are approximately two-and-a-half times as high as those expected in the Base Case. A total of approximately 62,600 person-years of employment (direct, indirect, and induced) are required in the Central and Western Gulf coastal subareas in support of the proposed action for the High Case. Over 75 percent of the total employment generated by the proposed action in the Western Gulf is expected to be supported by the coastal communities of the CPA. Peak-year impacts occur in 1998, with approximately 3,400 workers involved in primary, secondary, and tertiary industries. Direct employment in the primary oil and gas extraction industry (SIC 13) accounts for 45 percent of the total employment impact projected for the coastal subareas of the Central and Western Gulf over the life of the proposed action. Exploratory activities, which occur during the first 12 years of the life of the proposed action, are the main contributor to peak-year direct and total employment impacts. After their initial peak in 1998, total employment impacts begin to decline as oil and gas exploration is reduced in areas leased under the proposed action. Peak employment impacts resulting from development activities take place soon after exploratory activities reach their peak, but are much less intense. Even though exploratory activities drive peak-year employment impacts, the greatest contributor to overall employment impacts for the High Case is production operations. Employment in oil and gas production activities accounts for approximately 56 percent of total direct employment impacts resulting from production in the Western Gulf. Indirect and induced employment impacts in secondary and tertiary industries amount to approximately 30 and 25 percent, respectively, of the total employment impacts over the life of the proposed action in the Western Gulf.

Table IV-35 displays the model projections of total OCS-related employment impacts (direct, indirect, and induced) from Sale 143 in the Western Gulf to the coastal subareas of the CPA and WPA throughout the life of the proposed action in the High Case. Table IV-36 provides estimates of peak annual impacts to the population and employment of each coastal subarea as a percent of levels expected in absence of the proposal. These impact estimates represent changes in the new share of the existing population and employment that will be dependent on the OCS oil and gas industry for support as a result of the proposed action. These impact estimates alone do not provide enough information to determine whether employment needs will be met with the existing population and labor force in the area or with immigrants and new labor force from other areas.

The greatest impact to employment is expected in coastal Subareas C-1 and C-2, with peak-year impact estimates for 1998 of 0.24 percent and 0.39 percent, respectively. The coastal communities of the CPA are expected to support over 75 percent of the total employment generated by the Western Gulf sale. Coastal Subareas W-1 and W-2 have small peak employment impacts of 0.02 and 0.03 percent, respectively. The WPA contributes the remaining 25 percent of the total employment required in support of the proposed action in the Western Gulf.

Employment impacts resulting from oil-spill clean-up activities, because of their highly unpredictable nature, were handled apart from the population and employment model. The level of employment associated with any given clean-up operation is dependent on numerous variables which, in themselves, are also difficult to predict. Nevertheless, the most labor-intensive clean-up operations are those from spills that contact the coastline, particularly recreational beaches. For the purpose of this analysis, it is assumed that only those spills

Table IV-35

High Case OCS-Related Employment Projections (Direct+Indirect+Induced)
Western Gulf Sale 143
(person-years)

| YEAR | W1 | W2 | C1 | C2 | C3 | C4 | WGOM* | CGOM** |
|---|---|---|---|---|---|---|---|---|
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 7 | 68 | 62 | 191 | 0 | 0 | 75 | 253 |
| 1995 | 32 | 292 | 261 | 799 | 0 | 0 | 323 | 1061 |
| 1996 | 32 | 292 | 261 | 799 | 0 | 0 | 323 | 1061 |
| 1997 | 58 | 539 | 483 | 1476 | 0 | 0 | 597 | 1959 |
| 1998 | 77 | 720 | 646 | 1981 | 0 | 0 | 798 | 2627 |
| 1999 | 69 | 625 | 559 | 1701 | 0 | 0 | 694 | 2261 |
| 2000 | 80 | 712 | 635 | 1927 | 0 | 0 | 792 | 2562 |
| 2001 | 70 | 590 | 523 | 1560 | 0 | 0 | 660 | 2082 |
| 2002 | 76 | 634 | 562 | 1683 | 0 | 0 | 710 | 2245 |
| 2003 | 69 | 563 | 498 | 1471 | 0 | 0 | 632 | 1969 |
| 2004 | 62 | 495 | 436 | 1280 | 0 | 0 | 557 | 1716 |
| 2005 | 66 | 510 | 447 | 1295 | 0 | 0 | 576 | 1742 |
| 2006 | 66 | 510 | 447 | 1295 | 0 | 0 | 576 | 1742 |
| 2007 | 66 | 510 | 447 | 1295 | 0 | 0 | 576 | 1742 |
| 2008 | 66 | 510 | 447 | 1295 | 0 | 0 | 576 | 1742 |
| 2009 | 66 | 507 | 444 | 1275 | 0 | 0 | 573 | 1718 |
| 2010 | 66 | 507 | 444 | 1275 | 0 | 0 | 573 | 1718 |
| 2011 | 66 | 507 | 444 | 1275 | 0 | 0 | 573 | 1718 |
| 2012 | 66 | 507 | 444 | 1275 | 0 | 0 | 573 | 1718 |
| 2013 | 66 | 507 | 444 | 1275 | 0 | 0 | 573 | 1718 |
| 2014 | 66 | 507 | 444 | 1275 | 0 | 0 | 573 | 1718 |
| 2015 | 66 | 507 | 444 | 1275 | 0 | 0 | 573 | 1718 |
| 2016 | 62 | 479 | 419 | 1206 | 0 | 0 | 542 | 1625 |
| 2017 | 55 | 421 | 368 | 1049 | 0 | 0 | 476 | 1416 |
| 2018 | 49 | 379 | 331 | 946 | 0 | 0 | 428 | 1277 |
| 2019 | 44 | 337 | 295 | 843 | 0 | 0 | 381 | 1138 |
| 2020 | 33 | 251 | 219 | 617 | 0 | 0 | 284 | 836 |
| 2021 | 27 | 209 | 182 | 514 | 0 | 0 | 236 | 697 |
| 2022 | 22 | 167 | 146 | 411 | 0 | 0 | 189 | 557 |
| 2023 | 16 | 125 | 109 | 309 | 0 | 0 | 142 | 418 |
| 2024 | 11 | 84 | 73 | 206 | 0 | 0 | 95 | 279 |
| 2025 | 5 | 42 | 36 | 103 | 0 | 0 | 47 | 139 |
| 2026 | 4 | 28 | 24 | 69 | 0 | 0 | 32 | 93 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1690 | 13639 | 12023 | 35242 | 0 | 0 | 15329 | 47265 |

* Western Gulf of Mexico.
** Central Gulf of Mexico.

Source: USDOI, MMS, Gulf of Mexico OCS Region estimates, 1991.

Table IV-36

Population and Employment Impact Levels for the High Case Scenario
Western Gulf Sale 143
(percent*)

EMPLOYMENT IMPACT LEVELS:

| YEAR | W1 | W2 | C1 | C2 | C3 | C4 |
|---|---|---|---|---|---|---|
| 1993 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 1994 | 0.00% | 0.00% | 0.02% | 0.04% | 0.00% | 0.00% |
| 1995 | 0.01% | 0.01% | 0.10% | 0.16% | 0.00% | 0.00% |
| 1996 | 0.01% | 0.01% | 0.10% | 0.16% | 0.00% | 0.00% |
| 1997 | 0.02% | 0.02% | 0.18% | 0.29% | 0.00% | 0.00% |
| 1998 | 0.02% | 0.03% | 0.24% | 0.39% | 0.00% | 0.00% |
| 1999 | 0.02% | 0.02% | 0.21% | 0.33% | 0.00% | 0.00% |
| 2000 | 0.02% | 0.03% | 0.23% | 0.37% | 0.00% | 0.00% |
| 2001 | 0.02% | 0.02% | 0.19% | 0.29% | 0.00% | 0.00% |
| 2002 | 0.02% | 0.02% | 0.20% | 0.31% | 0.00% | 0.00% |
| 2003 | 0.02% | 0.02% | 0.18% | 0.27% | 0.00% | 0.00% |
| 2004 | 0.02% | 0.02% | 0.15% | 0.23% | 0.00% | 0.00% |
| 2005 | 0.02% | 0.02% | 0.16% | 0.23% | 0.00% | 0.00% |
| 2006 | 0.02% | 0.02% | 0.15% | 0.23% | 0.00% | 0.00% |
| 2007 | 0.02% | 0.02% | 0.15% | 0.23% | 0.00% | 0.00% |
| 2008 | 0.02% | 0.02% | 0.15% | 0.23% | 0.00% | 0.00% |
| 2009 | 0.02% | 0.02% | 0.15% | 0.22% | 0.00% | 0.00% |
| 2010 | 0.02% | 0.02% | 0.15% | 0.22% | 0.00% | 0.00% |
| 2011 | 0.02% | 0.02% | 0.15% | 0.22% | 0.00% | 0.00% |
| 2012 | 0.01% | 0.02% | 0.14% | 0.21% | 0.00% | 0.00% |
| 2013 | 0.01% | 0.01% | 0.14% | 0.21% | 0.00% | 0.00% |
| 2014 | 0.01% | 0.01% | 0.14% | 0.21% | 0.00% | 0.00% |
| 2015 | 0.01% | 0.01% | 0.14% | 0.21% | 0.00% | 0.00% |
| 2016 | 0.01% | 0.01% | 0.13% | 0.20% | 0.00% | 0.00% |
| 2017 | 0.01% | 0.01% | 0.11% | 0.17% | 0.00% | 0.00% |
| 2018 | 0.01% | 0.01% | 0.10% | 0.15% | 0.00% | 0.00% |
| 2019 | 0.01% | 0.01% | 0.09% | 0.13% | 0.00% | 0.00% |
| 2020 | 0.01% | 0.01% | 0.07% | 0.10% | 0.00% | 0.00% |
| 2021 | 0.01% | 0.01% | 0.05% | 0.08% | 0.00% | 0.00% |
| 2022 | 0.00% | 0.00% | 0.04% | 0.06% | 0.00% | 0.00% |
| 2023 | 0.00% | 0.00% | 0.03% | 0.05% | 0.00% | 0.00% |
| 2024 | 0.00% | 0.00% | 0.02% | 0.03% | 0.00% | 0.00% |
| 2025 | 0.00% | 0.00% | 0.01% | 0.02% | 0.00% | 0.00% |
| 2026 | 0.00% | 0.00% | 0.01% | 0.01% | 0.00% | 0.00% |
| 2027 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

POPULATION IMPACT LEVELS:

| YEAR | W1 | W2 | C1 | C2 | C3 | C4 |
|---|---|---|---|---|---|---|
| 1993 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 1994 | 0.00% | 0.00% | 0.02% | 0.04% | 0.00% | 0.00% |
| 1995 | 0.01% | 0.01% | 0.10% | 0.17% | 0.00% | 0.00% |
| 1996 | 0.01% | 0.01% | 0.10% | 0.16% | 0.00% | 0.00% |
| 1997 | 0.02% | 0.02% | 0.19% | 0.30% | 0.00% | 0.00% |
| 1998 | 0.02% | 0.03% | 0.25% | 0.40% | 0.00% | 0.00% |
| 1999 | 0.02% | 0.02% | 0.22% | 0.34% | 0.00% | 0.00% |
| 2000 | 0.02% | 0.03% | 0.25% | 0.38% | 0.00% | 0.00% |
| 2001 | 0.02% | 0.02% | 0.20% | 0.31% | 0.00% | 0.00% |
| 2002 | 0.02% | 0.02% | 0.22% | 0.33% | 0.00% | 0.00% |
| 2003 | 0.02% | 0.02% | 0.19% | 0.29% | 0.00% | 0.00% |
| 2004 | 0.02% | 0.02% | 0.17% | 0.25% | 0.00% | 0.00% |
| 2005 | 0.02% | 0.02% | 0.17% | 0.25% | 0.00% | 0.00% |
| 2006 | 0.02% | 0.02% | 0.17% | 0.25% | 0.00% | 0.00% |
| 2007 | 0.02% | 0.02% | 0.17% | 0.24% | 0.00% | 0.00% |
| 2008 | 0.02% | 0.02% | 0.17% | 0.24% | 0.00% | 0.00% |
| 2009 | 0.02% | 0.02% | 0.16% | 0.24% | 0.00% | 0.00% |
| 2010 | 0.02% | 0.02% | 0.16% | 0.24% | 0.00% | 0.00% |
| 2011 | 0.02% | 0.02% | 0.16% | 0.23% | 0.00% | 0.00% |
| 2012 | 0.02% | 0.02% | 0.16% | 0.23% | 0.00% | 0.00% |
| 2013 | 0.02% | 0.02% | 0.16% | 0.23% | 0.00% | 0.00% |
| 2014 | 0.02% | 0.02% | 0.16% | 0.23% | 0.00% | 0.00% |
| 2015 | 0.02% | 0.02% | 0.16% | 0.23% | 0.00% | 0.00% |
| 2016 | 0.02% | 0.02% | 0.15% | 0.21% | 0.00% | 0.00% |
| 2017 | 0.01% | 0.01% | 0.13% | 0.18% | 0.00% | 0.00% |
| 2018 | 0.01% | 0.01% | 0.12% | 0.16% | 0.00% | 0.00% |
| 2019 | 0.01% | 0.01% | 0.10% | 0.15% | 0.00% | 0.00% |
| 2020 | 0.01% | 0.01% | 0.08% | 0.11% | 0.00% | 0.00% |
| 2021 | 0.01% | 0.01% | 0.06% | 0.09% | 0.00% | 0.00% |
| 2022 | 0.01% | 0.00% | 0.05% | 0.07% | 0.00% | 0.00% |
| 2023 | 0.00% | 0.00% | 0.04% | 0.05% | 0.00% | 0.00% |
| 2024 | 0.00% | 0.00% | 0.02% | 0.03% | 0.00% | 0.00% |
| 2025 | 0.00% | 0.00% | 0.01% | 0.02% | 0.00% | 0.00% |
| 2026 | 0.00% | 0.00% | 0.01% | 0.01% | 0.00% | 0.00% |
| 2027 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

* Note: Impact levels represent the percent change in population or employment due to the proposal with respect to total levels expected in absence of the proposal.

Source: USDOI, MMS, Gulf of Mexico OCS Region estimates, 1991.

contacting land will involve significant manpower requirements in their clean-up efforts. Based on employment statistics from recent spill clean-up operations along the coast, the assumption is that, for every kilometer of coastline subjected to heavy oiling, approximately 100 temporary workers will be employed for a maximum of 6 weeks.

Section IV.C.1. presents estimates of the mean number of offshore spills assumed to result from the proposed action for the High Case in the WPA. The probability that one or more spills greater than or equal to 1,000 bbl will occur and contact land within 10 days of the accident is 2 percent (Table IV-22). Based on the low probability of an offshore spill of this size occurring and contacting land within 10 days, the assumption is that no significant employment requirements will result from the clean-up of offshore spills of this size category in the High Case. One spill of the size category greater than 50 bbl and less than 1,000 bbl is assumed to occur (Table IV-3); however, it will not contact the coastline (Section IV.C.1.). Twenty spills of the size category greater than 1 bbl and less than or equal to 50 bbl are assumed to occur in the WPA over the life of the proposed action. However, none of these spills is assumed to contact land (Section IV.C.1.). Furthermore, employment impacts resulting from the clean-up of offshore spills this small is assumed to be negligible.

In addition to the small offshore spills referenced above, a number of small onshore spills are expected to occur (Table IV-5). The level of clean-up action associated with spills of this size are minimal.

The greatest impact on population from activities associated with Sale 143 in the High Case is expected in coastal Subareas C-1 and C-2 with peak-year impact estimates for 1998 of 0.25 and 0.40 percent, respectively (Table IV-36). The communities of the Western Gulf coastal Subareas W-1 and W-2 have relatively small peak population impacts of 0.02 and 0.03 percent, respectively.

The level of OCS-related employment expected to result from the proposed action for the High Case in the Western Gulf is approximately two-and-a-half times as large as that estimated for the Base Case. However, it is still not significant enough to attract new residents and labor force to the area. Analysis of historical trends has shown that only population impacts greater than 1 percent typically involve positive net migration to any given area. None of the coastal subareas is projected to experience population impacts greater than 1 percent as the result of the proposed action in the High Case. Labor force impacts will parallel population and employment impacts. Jobs are expected to be filled by currently unemployed or underemployed workers or by future entrants into the labor force already living in the area. Therefore, employment demands in support of the proposed action for the High Case in the Western Gulf will be met with the existing population and available labor force.

Peak annual changes in the population, labor, and employment of all coastal subareas in the Central and Western Gulf resulting from the proposed action in the Western Gulf for the High Case represent less than 1 percent of the levels expected in absence of the proposal. The coastal communities of the CPA are expected to support over 75 percent of the total employment generated by the Western Gulf sale. The WPA contributes the remaining 25 percent of total employment impacts. Employment resulting from oil-spill clean-up activities due to the proposed action is negligible. It is expected that employment demands in support of the proposed action will be met with the existing population and available labor force in the region.

*Conclusion*

The High Case impact of the proposed action in the Western Gulf on the population, labor, and employment of the counties and parishes of the Central and Western Gulf coastal impact area is expected to be less than 1 percent of the levels expected in the absence of the proposal.

## *(b) Public Services and Infrastructure*

Public services and infrastructure, as used in this analysis, include commonly provided public, semipublic, and private services and facilities, such as education, police and fire protection, sewage treatment, solid-waste disposal, water supply, recreation, transportation, health care, other utilities, and housing. Changes in demands for and usage of public services and infrastructure could result from OCS activities. Adverse effects could arise if the amount or rate of increase or decrease in the usage significantly exceeded or fell far below the capability of a local area to provide a satisfactory level of service.

Sections providing supportive material for this analysis include Sections III.C.2. (description of socioeconomic issues), IV.A.2. (offshore infrastructure), IV.A.3. (onshore infrastructure), IV.C.1. and 3. (oil spills), and IV.D.2.a.(11)(a) (impacts on population, labor, and employment).

For the purpose of this analysis, OCS-related, impact-producing factors to public services and community infrastructure will include work force fluctuations, migration (both in-migration and out-migration), and the effect of relative income. These impact-producing factors are interrelated and derive from or result in increased population. It should be noted that these impact-producing factors also pertain to social patterns and will be analyzed in Section IV.D.2.a.(11)(c).

*Base Case Analysis*

Baseline employment projections and information relating to the model analysis used to arrive at these projections are presented in Section IV.D.2.a.(11)(a). This information is incorporated by reference. Unexpected events (such as the 1973 Arab Oil Embargo) may influence oil and gas activity within the Gulf of Mexico Region. These events cannot be projected and will not be considered in this analysis.

Approximately 24,014 person-years of employment (direct, indirect, and induced) are required to sustain the proposed action throughout its 35-year life (Table IV-33). Over 72 percent of the total employment generated by the proposed action in the Western Gulf is expected to be supported by the CPA coastal communities. Total employment breakdown by coastal subarea for the life of the proposed action is 5 percent for Subarea W-1, 23 percent for Subarea W-2, 19 percent for Subarea C-1, and 53 percent for Subarea C-2. In the peak year of 1997, approximately 1,486 person-years of total employment will be required to support the proposed action. The greatest amount of this employment is expected to lie within Subarea C-2. A comparison between the expected population and employment impacts for the coastal subareas as a result of the proposed action and the expected population and employment without the proposal may be seen in Table IV-34. The greatest impact to employment is expected to occur in coastal Subareas C-1 and C-2, with peak-year impact estimates in 1997 of 0.11 and 0.17 percent, respectively.

A major impact of OCS-generated activities, new population associated with increased service demands, will be significantly mitigated by planning and other measures undertaken at the Federal, State, regional, and local levels. All the potential onshore development areas either have or participate in local and/or regional planning programs. The objectives of these programs include orderly and efficient growth management that minimizes fiscal, social, and environmental impacts. This analysis assumes that future Federal, State, and local management efforts will be effective at avoiding or mitigating many potential adverse effects on the quality of public services and infrastructure that might occur as a result of the kinds of planned, long-term economic growth and development anticipated by the local and regional planning community.

Short-term fluctuations in the work force as a result of changing levels of OCS-related oil and gas activity could impact social services and community infrastructure in several ways. Large amounts of short-term layoffs of oil and gas industry personnel could stress the abilities (both in terms of work load and available funding) of public and private agencies whose mission is to aid persons with severe financial difficulties. The need for public or private assistance could force the diversion of funds needed for the maintenance of community infrastructure, such as schools and roads. Large, short-term increases in the work force could result in net positive migration and cause a scarcity of housing, a shortage of municipal personnel (i.e., policemen, firemen, engineers, etc.), and an increase in the cost of living. A comparison with Table IV-34 reveals that there are no significant differences expected in population and employment between the proposed action and levels expected without the proposal in coastal Subareas C-3 and C-4. None of the coastal subareas in the CPA and WPA is expected to experience population impacts greater than 0.17 percent (1997-peak year) as a result of the proposed action. It is expected that employment related to the proposed action will not require importation of labor and that the existing labor pool will be adequate to supply labor needs. The proposed action is expected to provide jobs for unemployed, underemployed, and new employees already living in the area (Section IV.D.2.a.(11)(a)). Excess labor capacity of the coastal subareas is expected to provide sufficient human resources to maintain adequate levels of public services and infrastructure.

Migration into a coastal subarea (in-migration) as a response to increased levels of OCS-related oil and gas activity could result in increased stress on both public and private agencies in assisting newly relocated persons and in providing basic services to an expanding population. In addition, not all persons who migrate to an area seeking employment will find it. This failure causes additional stress on social service agencies. In-migration into an area may result in dramatic population increases, stressing community schools, roads, law enforcement agencies, and other community infrastructure. Migration out of a coastal subarea (out-migration) in response to lowered levels of OCS-related oil and gas activity could jeopardize secondary and tertiary jobs that were created during periods of increased population, stressing social service agencies. Community infrastructure created in response to a larger population could become a redundant expense as a result of out-migration. An analysis of historical trends indicates that population impacts of greater than 1 percent involve positive net migration into a given area. Table IV-34 indicates that population impacts are not expected to exceed this figure under the Base Case. Therefore, it is expected that the proposed action will not produce in-migration into the coastal subareas of the Gulf of Mexico. The proposed action will result in the need for approximately 24,014 person-years of total employment throughout its 35-year life. These jobs are expected to be filled by unemployed, underemployed, and newly employed persons already living in the area. By providing these jobs, the proposed action will reduce the amount of out-migration comparative to that which might occur without the proposal.

The relatively high wages paid to OCS-related oil and gas industry personnel could result in an increase in population from in-migration and a concomitant increase in the local cost of living. Impacts to social services could come from the need for assistance of those living on fixed incomes, as well as those unemployed as a result of the decline of businesses unable to operate in an environment of high wage scale. Impacts to community infrastructure could come from the defection of community workers from infrastructure-related activities to higher paying jobs in the oil and gas industry. The employment needs of the proposed action are not expected to exceed the labor capacity of the Gulf coastal subareas. As mentioned above, an analysis of historical trends indicates that in-migration should not be expected as a result of the proposed action. In addition, jobs created by the proposal would likely reduce the amount of migration out of the coastal subareas when compared to scenarios without the proposal. It is expected that employees leaving public service and infrastructure-based jobs could be replaced by the existing labor pool and area residents entering the job market. Revenues generated by Federal, State, and local taxes from employment related to the proposed action are expected to mitigate any increased needs for public services generated by the proposed action.

*Summary*

Impacts to public services and infrastructure would be related to dramatic population increases or decreases, which are not projected as a result of the proposed action. Specific impact-producing factors examined in this analysis include work force fluctuations, migration into or out of the coastal subareas, and the relatively high wages made by personnel involved in the oil and gas industry. An analysis of historical trends indicates that population impacts of greater than 1 percent involve positive net migration into a given area. Under the Base Case, population impacts are not expected to exceed peak-year impacts of 0.17 percent. No positive net migration into the coastal subareas of the Central and Western Gulf is expected to occur as a result of the proposed action. It is expected that employment needs will be met by those currently employed in the oil and gas industry as well as the unemployed and the underemployed, and new employees already living in the area. In addition, jobs created by the proposal would likely reduce the amount of migration out of the coastal subareas when compared to scenarios without the proposal. It is expected that employees leaving public service and infrastructure-related jobs could be replaced from the existing labor pool.

*Conclusion*

Population and employment impacts that result from the proposed action under the Base Case scenario will not result in disruption to community infrastructure and public services beyond what is anticipated by in-place planning and development agencies.

*High Case Analysis*

Baseline employment projections and information relating to the model analysis used to arrive at these projections are presented in Section IV.D.2.a.(11)(a). This information is incorporated by reference. Unexpected events (such as the 1973 Arab Oil Embargo) may influence oil and gas activity within the Gulf of Mexico Region. These events cannot be projected and will not be considered in this analysis.

Approximately 62,594 person-years of employment (direct, indirect, and induced) are required to sustain the proposal under the High Case throughout its 35-year life (Table IV-35). Over 75 percent of the total employment generated by the High Case in the Western Gulf is expected to be supported by the CPA coastal communities. Total employment breakdown by coastal subarea for the life of the proposal under the High Case is 3 percent for Subarea W-1, 22 percent for Subarea W-2, 19 percent for Subarea C-1, and 56 percent for Subarea C-2. In the peak year of 1998, approximately 3,425 person-years of total employment are required to support the High Case. The greatest amount of this employment is expected to lie within Subarea C-2. A comparison between the expected population and employment impacts for the coastal subareas as a result of the High Case and the expected population and employment without the proposal may be seen in Table IV-38. The greatest impact to employment is expected to occur in coastal Subareas C-1 and C-2, with peak-year impact estimates in 1998 of 0.24 and 0.39 percent, respectively.

A major impact of OCS-generated activities, new population associated with increased service demands, will be significantly mitigated by planning and other measures undertaken at the Federal, State, regional, and local levels. All of the potential onshore development areas either have or participate in local and/or regional planning programs. The objectives of these programs include orderly and efficient growth management that minimizes fiscal, social, and environmental impacts. This analysis assumes that future Federal, State, and local management efforts will be effective at avoiding or mitigating many potential adverse effects on the quality of public services and infrastructure, effects that might occur as a result of the kinds of planned, long-term economic growth and development anticipated by the local and regional planning community.

Short-term fluctuations in the work force as a result of changing levels of OCS-related oil and gas activity could impact social services and community infrastructure in several ways. Large amounts of short-term layoffs of oil and gas industry personnel could stress the abilities (both in terms of work load and available funding) of public and private agencies whose mission is to aid persons with severe financial difficulties. The need for public or private assistance could force the diversion of funds needed for the maintenance of community infrastructure, such as schools and roads. Large, short-term increases in work force could result in net positive migration and cause a scarcity of housing, a shortage of municipal personnel (i.e., policemen, firemen, engineers, etc.), and an increase in the cost of living. A comparison with Table IV-36 reveals that there are no significant differences in population and employment between the proposed action and the levels expected without the proposal in coastal Subareas C-3 and C-4. None of the coastal subareas in the CPA and WPA is expected to experience population impacts greater than 0.40 percent (1998-peak year) as a result of the High Case. It is expected that employment related to the High Case will not require importation of labor and that the existing labor pool will be adequate to supply labor needs. The High Case is expected to provide jobs for the unemployed and the underemployed, and new employees already living in the area (Section IV.D.2.a.(11)(a)). Excess labor capacity of the coastal subareas is expected to provide sufficient human resources to maintain adequate levels of public services and infrastructure.

Migration into a coastal subarea (in-migration) as a response to increased levels of OCS-related oil and gas activity could result in increased stress on both public and private agencies in assisting newly relocated persons and in providing basic services to an expanding population. In addition, not all persons who migrate to an area seeking employment will find it, causing additional stress on social service agencies. In-migration may result in dramatic population increases, stressing community schools, roads, law enforcement agencies, and other community infrastructure. Migration out of a coastal subarea (out-migration) in response to lowered levels of OCS-related oil and gas activity could jeopardize secondary and tertiary jobs that were created during periods of increased population, stressing social service agencies. Community infrastructure created in response to a larger population could become a redundant expense as a result of out-migration. An analysis of historical trends indicates that population impacts of greater than 1 percent involve positive net migration into a given area. Table IV-38 indicates that population impacts are not expected to exceed this figure under the High

Case. It is therefore expected that the proposal will not produce in-migration into the coastal subareas of the Gulf of Mexico. The High Case will result in the need for approximately 62,594 person-years of total employment throughout the 35-year life of the proposed action. These jobs are expected to be filled by the unemployed and the underemployed and newly employed persons already living in the area. By providing these jobs, the High Case will reduce the amount of out-migration compared to that which might occur without the proposal.

The relatively high wages paid to OCS-related oil and gas industry personnel could result in a population increase from in-migration and a concomitant increase in the local cost of living. Impacts to social services could come from the need for assistance of those living on fixed incomes, as well as those unemployed as a result of the decline of businesses unable to operate in an environment of high wage scale. Impacts to community infrastructure could come from the defection of community workers from infrastructure-related activities to higher paying jobs in the oil and gas industry. The employment needs of the High Case are not expected to exceed the labor capacity of the Gulf coastal subareas. As mentioned above, an analysis of historical trends indicates that in-migration should not be expected as a result of the proposal. In addition, jobs created by the proposal would likely reduce the amount of migration out of the coastal subareas when compared to scenarios without the proposal. It is also assumed that the High Case will not produce out-migration from the Coastal Subareas of the Gulf of Mexico. It is expected that employees leaving public service and infrastructure-based jobs could be replaced from the existing labor pool and new employees in the area entering the job market. Revenues generated by Federal, State, and local taxes from employment related to the High Case are expected to mitigate any increased needs for public services generated by the proposal.

Impacts to public services and infrastructure would be related to dramatic population increases or decreases, which are not projected as a result of the proposed action. Specific impact-producing factors examined in this analysis include work force fluctuations, migration into or out of the coastal subareas, and the relatively high wages made by personnel involved in the oil and gas industry. An analysis of historical trends indicates that population impacts of greater than 1 percent involve positive net migration into a given area. Under the High Case, population impacts are not expected to exceed a peak-year (1998) impact of 0.40 percent. No positive net migration into the coastal subareas of the Central and Western Gulf is expected to occur as a result of the High Case. It is expected that employment needs will be met by those currently employed in the oil and gas industry as well as the unemployed and the underemployed, and new employees already living in the area. In addition, jobs created by the proposal would likely reduce migration out of the coastal subareas when compared with scenarios without the proposal. It is expected that employees leaving public service and infrastructure-related jobs could be replaced from the existing labor pool.

*Conclusion*

Population and employment impacts that result from the proposed action under the High Case scenario will not result in disruption to community infrastructure and public services beyond what is anticipated by in-place planning and development agencies.

## *(c) Social Patterns*

This impact analysis includes the coastal parishes and counties of the Central and Western Gulf of Mexico (Section III.C.2.(a)). Social patterns, as used in this analysis, include traditional occupations, folkways, social structure, language, family life, and other forms of cultural adaptation to the natural and human environment. It should be noted that impacts unrelated to OCS oil and gas activity (such as technological improvements in communications and transportation) have caused, and will continue to cause, changes within the analysis area. However, the present analysis will consider only the effects of OCS-related oil and gas activity on the social patterns of the Central and Western Gulf coastal subareas.

Sections providing supportive material for this analysis include Sections III.C.3. (description of socioeconomic issues), IV.A. (offshore infrastructure), IV.C.1. and 3. (oil spills), IV.D.2.a.(1)(b) (impacts on sensitive coastal environments), IV.D.2.a.(8) (impacts on commercial fisheries), IV.D.2.a.(11)(a) (impacts on population, labor, and employment), and IV.D.2.a.(11)(b) (impacts on public services and infrastructure).

For the purpose of this analysis, OCS-related, impact-producing factors to social patterns will include work force fluctuations, net migration (both in-migration and out-migration), work scheduling, displacement from traditional occupations, and relative income. Many of these impact-producing factors result in or derive from population growth. Adverse effects to social patterns could arise if disruption of social patterns occurred and resulted in changes in traditional occupations, disruption in the viability of extant subcultures, and detrimental effects on family life. As mentioned in Section III.C.2.c., it may be argued that employment in the oil and gas industry could be perceived as a traditional occupation; however, for the purpose of this analysis, it will not be so.

*Base Case Analysis*

Baseline employment projections and information relating to the model analysis used to arrive at these projections are presented in Section IV.D.2.a.(11)(a). This information is incorporated by reference. Unexpected events (such as the 1973 Arab Oil Embargo) may influence oil and gas activity on the OCS within the Gulf of Mexico Region. These events cannot be projected and cannot be presumed for this analysis.

The proposed action will result in approximately 24,000 person-years of employment (direct, indirect, and induced) throughout its 35-year life (Table IV-33). Over 72 percent of the total employment generated by the proposed action in the Western Gulf is expected to be supported by the CPA coastal communities. Total employment breakdown by coastal subarea for the life of the proposed action is 5 percent for Subarea W-1, 23 percent for Subarea W-2, 19 percent for Subarea C-1, and 53 percent for Subarea C-2. In the peak year of 1997, approximately 1,500 person-years of total employment are required to support the proposed action. The greatest amount of this employment is expected to lie within Subarea C-2. A comparison between the expected population and employment impacts for the coastal subareas as a result of the proposed action and the expected population and employment without the proposal is shown in Figure IV-10 and in Table IV-34. The greatest impact to employment is expected to occur in coastal Subareas C-1 and C-2, with peak-year impact estimates in 1997 and 1998 of 0.11 and 0.17 percent, respectively.

Short-term fluctuations in the workforce as a result of changing levels of activities could affect social patterns in several ways. Large amounts of short-term layoffs in oil and gas industry personnel could result in large numbers of persons returning to traditional ways of employment (i.e., fishing, trapping, farming, etc.), thereby stressing the various resources that would be exploited. A large increase in the hiring of oil and gas industry personnel could attract persons engaged in traditional occupations, leaving fewer persons in them in the coastal subareas and, perhaps, resulting in the loss of traditional knowledge associated with these occupations.

The potential effects of work force fluctuations on extant subcultures in the coastal subareas are expected to be greatest when large changes in OCS-related activity result in net positive or negative migration. The quality of family life, in pertinent individual cases, could be adversely affected from the stress of decreased family income and loss of security resulting from layoffs in the OCS oil and gas industry. The expected impact on family life, in pertinent individual cases, from increased hiring in the OCS-related oil and gas industry would be decreased monetary stress and an increased financial security. Problems related to work scheduling may arise and are discussed below. As mentioned above, employment impacts under the proposed action are not expected to exceed 0.17 percent in the peak years of 1997 and 1998. Projected employment associated with the proposed action is expected to come from those already employed in OCS-related activities and from the unemployed and underemployed, and new employees already living in the coastal subareas. It is expected that the proposed action will not result in large increases or decreases in OCS-related employment within the Central and Western Gulf coastal subareas.

Both in-migration and out-migration could adversely affect social patterns in the Central and Western Gulf coastal subareas. Expected adverse effects of in-migration include the loss of cultural homogeneity, the loss of community cohesion, and changes in the quality of life with possible associated stresses to social patterns. Expected adverse effects of out-migration include stress placed on family life by the departure of extended family members; the departure of persons who are engaged, part-time, in traditional occupations, and impacts to community cohesion by the departure of long-time residents. Projected population impacts in the Central and Western Gulf coastal subareas are not expected to exceed 0.17 percent (1997 and 1998-peak years). An analysis of historical trends indicates that only population impacts greater than 1 percent typically involve positive net migration into a given area. None of the coastal subareas is projected to experience population impacts greater than 1 percent as a result of the proposed action. Employment in support of the proposed action is expected to come from those currently employed in OCS-related oil and gas activities as well as the unemployed and underemployed, and new employees already living in the area. It is assumed that employment as a result of the proposal will decrease the amount of out-migration compared to that which would occur without the proposal.

Distance to the site and the type of transportation needed for personnel in OCS-related oil and gas activities result in the normal work schedule occurring as a large block of time on duty (or at site) followed by a large block of time off duty. The schedules may range from 7 days on followed by 7 days off to a 30 day-on/30 day-off schedule. It has been argued that this type of schedule has allowed for the participation in, and continuance of, traditional occupations (Hallowell, 1979; Laska, personal comm., 1991). It is expected that stress will be placed on family life in response to the regular absences of a parent (usually the father). In some cases, however, it is expected that adaptation to changing family roles will occur. In other cases, however, it is expected that adaptation will not occur and that deleterious impacts to family life, in pertinent individual cases, will occur. In the peak years of 1997 and 1998, approximately 1,500 person-years of total employment are required to support the proposed action. Many of those employed will be working in secondary and tertiary jobs and will not encounter the extended work schedule mentioned above. Impacts to family life are expected to be serious in some individual cases.

Displacement from traditional occupations could originate from destruction of a resource base, space-use conflict, and voluntary shifts from traditional occupations to employment in OCS-related activities. Adverse effects resulting from displacement from traditional occupations could include a diminishment in the number of participants in traditional occupations, the loss of traditional knowledge and cultural heritage, and deleterious impacts to family life. Space-use conflicts have been discussed in Section IV.D.2.a.(8). The existence of the Fisherman's Contingency Fund mitigates, to some extent, space-use conflicts associated with commercial fishing. A total of 239 claims was filed in 1990 and $212,453.24 were paid to persons attributing damage to OCS-related debris. According to Sections IV.D.1.a.(1)(b) and IV.D.2.a.(1)(b), the proposed action is expected to have a very low impact on coastal wetlands in both the CPA and WPA. It is therefore assumed that very little displacement from traditional occupations will occur as a result of OCS-related destruction of wetlands. As mentioned above, the extended work schedule associated with many OCS-related jobs may allow for continued participation in traditional occupations. It is expected that relatively few persons will be displaced from traditional occupations as a result of the proposed action.

The relatively high wages paid to OCS-related oil and gas industry personnel can result in the voluntary shift of persons engaged in traditional occupations to more lucrative positions within the oil and gas industry. Dependency on these relatively high wages may have deleterious impacts on family life, particularly if layoffs occur and the wage-earner cannot find work at comparable pay. It is assumed that some persons engaged in lower-paying traditional occupations will seek employment in OCS-related oil and gas activities. Those engaged in extended work schedules will retain the ability to participate in traditional occupations on a part-time basis. Employment projections for the life of the proposed action indicate that peak-year employment (1997 and 1998) will total approximately 1,485 persons for each of the two peak years throughout the Central and Western Gulf coastal subareas. It is expected that employment will come from persons already working in OCS-related oil and gas activities, as well as the unemployed and underemployed, and new employees already living in the area. The relatively small amount of employment associated with the proposed action in comparison with total employment in the Central and Western Gulf lessens the impact of relatively high wages paid to OCS-related oil and gas industry personnel on social patterns.

*Summary*

Impacts on social patterns would be related to dramatic changes in population and the disruption of environmental resources, as well as conditions inherent to OCS-related employment (i.e., work scheduling and rate of pay). Specific impact-producing factors examined in this analysis include work force fluctuations, migration into or out of the coastal subareas, work scheduling, displacement from traditional occupations, and relative income. An analysis of historical trends indicates that population impacts of greater than 1 percent typically involve positive net migration into a given area. Under the Base Case, population impacts are not expected to exceed the peak-year impact of 0.17 percent. No positive net migration into Central and Western coastal subareas is expected to occur as a result of the proposal and that employment will occur from those currently employed in the oil and gas industry, as well as the unemployed and underemployed, and new employees already living in the area. It is expected that jobs created by the proposal would likely reduce the amount of out-migration when compared to scenarios without the proposal. It is expected that minor displacement from traditional occupations will occur as a result of the proposed action. This displacement will be mitigated, to some extent, by the extended work schedule associated with OCS-related employment. The extended work schedule is expected to have some deleterious effects on family life in some individual cases. Impacts caused by the displacement of traditional occupations and relative wages are expected to occur to a minimal extent.

*Conclusion*

No net migration is expected to occur as a result of the proposed action. Deleterious impacts on social patterns are expected to occur in some individual cases as a result of extended work schedules, displacement from traditional occupations, and relative wages.

*High Case Analysis*

Baseline employment projections and information relating to the model analysis used to arrive at these projections are presented in Section IV.D.2.a.(11)(a). This information is incorporated by reference. Unexpected events (such as the 1973 Arab Oil Embargo) may influence oil and gas activity on the OCS within the Gulf of Mexico Region. These events cannot be projected and cannot be presumed for this analysis.

Approximately 62,600 person-years of employment (direct, indirect, and induced) are required to sustain the proposed action in the High Case throughout its 35-year life (Table IV-35). Over 75 percent of the total employment generated by the High Case in the Western Gulf is expected to be supported by the CPA coastal communities. Total employment breakdown by coastal subarea for the life of the proposed action under the High Case is 3 percent for Subarea W-1, 22 percent for Subarea W-2, 19 percent for Subarea C-1, and 56 percent for Subarea C-2. In the peak year of 1998, approximately 3,400 person-years of total employment are required to support the High Case. The greatest amount is expected to occur within Subarea C-2. A comparison between the expected population and employment impacts for the coastal subareas as a result of the High Case and the expected population and employment without the proposal is shown in Table IV-35. The greatest impact to employment is expected to occur in coastal Subareas C-1 and C-2, with peak-year impact estimates in 1998 of 0.24 and 0.39 percent, respectively.

Short-term work force fluctuations as a result of changing levels of activities could affect social patterns in several ways. Large amounts of short-term layoffs in oil and gas industry personnel could result in large numbers of persons returning to traditional ways of employment (i.e., fishing, trapping, farming, etc.), thereby stressing the various resources that would be exploited. A large increase in the hiring of oil and gas industry personnel could attract persons engaged in traditional occupations, leaving fewer persons in them in the coastal subareas and, perhaps, resulting in the loss of traditional knowledge associated with these occupations.

The potential effects of work force fluctuations on extant subcultures in the coastal subareas are expected to be greatest when large changes in OCS-related activity result in net positive or negative migration. The quality of family life, in pertinent individual cases, could be adversely affected from the stress of decreased family income and loss of security resulting from layoffs in the oil and gas industry. The expected impact on family life, in pertinent individual cases, from increased hiring in the OCS-related oil and gas industry would be decreased monetary stress and an increased financial security. Problems related to work scheduling may arise and are discussed below. As mentioned above, employment impacts under the High Case are not expected to exceed 0.39 percent in the peak year of 1998. Projected employment associated with the proposal is expected to come from those already employed in OCS-related activities and from the unemployed and underemployed, and new employees already living in the coastal subareas. It is expected that the High Case will not result in large increases or decreases in OCS-related employment within the Central and Western Gulf coastal subareas.

Both in-migration and out-migration could have an adverse effect on social patterns in the Central and Western Gulf coastal subareas. Expected adverse effects of in-migration could include the loss of cultural homogeneity, the loss of community cohesion, and changes in the quality of life with possible associated stresses to social patterns. Expected adverse effects of out-migration could include stress placed on family life by the departure of extended family members; the departure of persons engaged, part-time, in traditional occupations; and impacts to community cohesion by the departure of long-time residents. As mentioned above, projected population and employment impacts in the Central and Western Gulf coastal subareas are not expected to exceed 0.40 percent (1998-peak year). An analysis of historical trends indicates that only population impacts greater than 1 percent typically involve positive net migration into a given area. None of the coastal subareas is projected to experience population impacts greater than 1 percent as a result of the High Case. Employment in support of the proposal is expected to come from those currently employed in OCS-related oil and gas activities as well as the unemployed and underemployed, and new employees already living in the area. It is assumed that employment as a result of the proposal will decrease the amount of out-migration, compared to that which would occur without the proposal.

Distance to the site and the type of transportation needed for personnel in OCS-related oil and gas activities result in the normal work schedule occurring as a large block of time on duty (or at site) followed by a large block of time off duty. The schedules may range from 7 days on followed by 7 days off to a 30 day-on/30 day-off schedule. It has been argued that this type of schedule has allowed for the participation in, and continuance of, traditional occupations (Hallowell, 1979; Laska, personal. comm., 1991), thereby assisting in the maintenance of cultural viability. It is expected that stresses will be placed on family life in response to the regular absences of a parent (usually the father). In some cases, it is expected that adaptation to changing family roles will occur. In other cases, it is expected that adaptation will not occur and that deleterious impacts to family life, in pertinent individual cases, will occur. In the peak year of 1998, approximately 3,400 person-years of total employment are required to support the proposed action. Many of those employed will be working in secondary and tertiary jobs and will not encounter the extended work schedule mentioned above. Of those persons employed in OCS-related oil and gas activity and working the extended schedule, it is expected that some families will not adapt to these conditions and that deleterious impacts to family life will occur. Impacts to family life are expected to be serious in some individual cases.

Displacement from traditional occupations could originate from destruction of a resource base, space-use conflict, and voluntary shifts from traditional occupations to employment in OCS-related activities. Adverse effects resulting from displacement from traditional occupations could include a diminishment in the number of participants in traditional occupations, the loss of traditional knowledge and cultural heritage, and deleterious impacts to family life as a result of the displacement. Space-use conflicts have been discussed in Section IV.D.2.a.(8). The existence of the Fisherman's Contingency Fund mitigates, to some extent, space-use conflicts associated with commercial fishing. A total of 239 claims was filed and $212,453.24 were paid to persons attributing damage to OCS-related debris. According to Sections IV.D.1.a.(1)(b) and IV.D.2.a.(1)(b), the High Case is expected to have a very low impact on coastal wetlands in both the CPA and WPA. It is therefore assumed that very little displacement from traditional occupations will occur as a result of OCS-related destruction of wetlands. As mentioned above, the extended work schedule associated with many OCS-related jobs may allow for continued participation in traditional occupations. It is expected that relatively few persons will be displaced from traditional occupations as a result of the High Case.

The relatively high wages paid to OCS-related oil and gas industry personnel can result in the voluntary shift of persons engaged in traditional occupations to more lucrative positions within the oil and gas industry. Dependency on these relatively high wages may have deleterious impact on family life, particularly if layoffs occur and the wage-earner cannot find work at comparable pay. It is assumed that some persons engaged in lower-paying traditional occupations will seek employment in OCS-related oil and gas activities. Those engaged in extended work schedules will retain the ability to participate in traditional occupations on a part-time basis. Employment projections for the life of the proposed action under the High Case indicate that peak-year employment (1998) will total approximately 3,400 persons throughout the Central and Western Gulf coastal subareas. It is expected that employment will come from persons already working in OCS-related oil and gas activities, as well as the unemployed and the underemployed, and new employees already living in the area. The relatively small amount of employment associated with the High Case in comparison with total employment in the Central and Western Gulf lessens the impact of relatively high wages paid to OCS-related oil and gas industry personnel on social patterns.

Impacts to social patterns would be related to dramatic changes in population and the disruption of environmental resources, as well as conditions inherent to OCS-related employment (i.e., work scheduling and rate of pay). Specific impact-producing factors examined in this analysis include work force fluctuations, migration into or out of the coastal subareas, work scheduling, displacement from traditional occupations, and relative income. An analysis of historical trends indicates that population impacts of greater than 1 percent typically involve positive net migration into a given area. Population impacts under the High Case are not expected to exceed the peak-year impact of 0.40 percent. No positive net migration into Central and Western Gulf coastal subareas is expected to occur as a result of the proposal. It is expected that employment will occur from those currently employed in the oil and gas industry, as well as the unemployed and underemployed, and new employees already living in the area. It is expected that jobs created by the proposal would likely reduce the amount of out-migration when compared to scenarios without the proposal. It is also expected that minor displacement from traditional occupations will occur as a result of the proposed action. This displacement will be mitigated, to some extent, by the extended work schedule associated with OCS-related employment. However, the extended work schedule is expected to have some deleterious effects on family life in some individual cases. Impacts caused by the displacement of traditional occupations and relative wages are expected to occur to a minimal extent.

*Conclusion*

No net migration is expected to occur as a result of the proposed action. Deleterious impacts on social patterns are expected to occur in some individual cases as a result of extended work schedules, displacement from traditional occupations, and relative wages.

## b. Alternative B - The Proposed Action Excluding the Blocks Near Biologically Sensitive Topographic Features

Alternative B would offer 4,628 unleased blocks in the WPA for leasing; it differs from Alternative A (the proposed action) only by not offering the 87 unleased blocks of the 200 total blocks that are possibly affected by the Topographic Features Stipulation (Section II.B.1.c.(1)), plus the two deferred blocks at the Flower Garden Banks. All the assumptions and estimates are the same as in the Base Case of Alternative A. Details are presented in Sections I.A. and II.B.2.

The analyses of impacts are based on the Base Case scenario of Alternative A. These scenarios were formulated to provide sets of assumptions and estimates on the amounts, locations, and timing for OCS exploration, development, and production operations and facilities, both offshore and onshore. These are estimates only and not predictions of what will happen as a result of holding this proposed sale. A detailed discussion of the development scenarios and major related impact-producing factors is included in Sections IV.A. and B.

It should be emphasized that the analyses of impacts to the various resources under Alternative B are very similar to those for Alternative A. The reader should refer to the appropriate discussions under Alternative A for additional and more detailed information regarding impact-producing factors and their expected effects on the various resources.

To facilitate the analysis, the Federal offshore area is divided into subareas. The WPA is comprised of three subareas (W-1, W-2, and W-3) and the coastal region is divided into two coastal subareas (W-1 and W-2). These subareas are delineated on Figure IV-1.

### *(1) Impacts on Sensitive Coastal Environments*

#### *(a) Coastal Barrier Beaches*

The activities that could affect barrier beaches under Alternative B include oil spills, pipeline emplacements, dredging of new navigation channels, maintenance dredging and vessel usage of existing navigation channels, and the construction of onshore facilities on barrier features. Alternative B does not directly affect the severity of impacts expected from activities associated with OCS development because the deleted offshore sensitive habitats are located at a distance offshore from coastal barriers.

No spills greater than or equal to 1,000 bbl or spills greater than or equal to 50 and less than 1,000 bbl are assumed to occur and contact WPA coastal barriers under Alternative B. As in the Base Case, there is a less than 0.5 percent chance of occurrence of and contact from a spill of 1,000 bbl or greater, and no spills greater than or equal to 50 and less than 1,000 bbl are assumed to contact barrier features. One or two spills greater than 1 and less than 50 bbl will occur inshore and contact the landward side of barrier beaches. These spills will contact about 2 km of coast and will be cleaned without the removal of sand. No oil will contact sand dune areas. The barrier features will not be affected by contact from these spills.

No pipeline landfalls, navigation channels, or new infrastructure construction projects are expected as a result of Alternative B. Maintenance dredging of existing navigation channels cannot be attributed to Alternative B because of the small percentage of vessel usage attributable to the Alternative.

No channel deepening projects will occur in an area that could affect barrier landforms.

*Conclusion*

Alternative B is not expected to result in permanent alterations of barrier beach configuration, except in localized areas downdrift from channels that have been dredged and deepened. The contribution to this localized erosion is expected to be less than 1 percent.

#### *(b) Wetlands*

The activities that could affect wetlands under Alternative B include oil spills, pipeline emplacements, dredging of new navigation channels, maintenance dredging and vessel usage of existing navigation channels, and the construction of onshore facilities. Alternative B does not directly affect the severity of impacts expected from activities associated with OCS development under the Base Case scenario, because the deleted offshore sensitive habitats are located at a distance offshore coastal barrier habitats.

No spills greater than or equal to 1,000 bbl or spills greater than 50 bbl and less than 1,000 bbl are assumed to occur and contact WPA coastal wetlands under Alternative B. As in the Base Case, there is a less than 0.5 percent chance of occurrence and contact within 10 days from a spill greater than or equal to 1,000 bbl, and no spills greater than 50 and less than 1,000 bbl are assumed to contact wetlands. Several spills greater than 1 and less than or equal to 50 bbl will occur from onshore sources and contact wetlands. These spills will result in short-term impacts of up to several hectares of WPA wetlands, involving die-back of the above-ground vegetation. No accelerated erosion of wetland margins is expected as a result of the spills.

Oil terminals and barge traffic do not commonly occur in WPA areas that contain extensive seagrass beds; no impacts from oil spills to these resources are therefore assumed to occur.

No pipeline landfalls, navigation channels, or new infrastructure construction projects are expected as a result of Alternative B. Although no new waste disposal sites are projected to be built to accommodate OCS-generated wastes, some seepage from existing sites could occur into nearby wetlands. Maintenance dredging of existing navigation channels cannot be attributed to Alternative B because of the small percentage of vessel usage that can be attributed to the alternative. The deepening of one navigation channel to provide access for deeper draft service vessels is projected to occur. This analysis assumes that the dredged material will be used to enhance or create marsh habitat. Alternative B will result in a reduction in resource development compared with the Base Case scenario. The amount of vessel traffic required under Alternative B for supply vessels, barges, and shuttle tankers will be less than or equal to that required under the Base Case. Impacts of OCS vessel traffic on wetlands along channel margins are expected to be result in less than one hectare of accelerated wetland erosion.

*Conclusion*

Alternative B is expected to result in no permanent alterations of wetland habitats, except for the erosion of less than one ha of wetlands along navigation channel margins. These losses could be offset or even exceeded by wetlands gains from the beneficial disposal of dredged material generated during channel maintenance and deepening operations.

## (2) *Impacts on Sensitive Offshore Resources*

### (a) *Deep-water Benthic Communities*

The sources and severity of impacts associated with this alternative are those sale-related activities discussed for the Base Case. As noted in Section IV.D.2.a.(2)(a) for the Base Case, the only impact-producing factor threatening these communities results from those activities that would physically disturb the bottom, such as the routine operations of anchoring, drilling, and pipeline installation, and the rare seafloor blowout accident. A more detailed examination of this potential impact-producing factor is presented in that section.

As noted in Section IV.D.2.a.(2)(a) above, high-density chemosynthetic communities are found only in water depths greater than 400 m (1,312 ft). Thus, they will be found only in the southeast one-eighth of Subarea W-1 and the southern one-third of W-2; they may be found throughout W-3. Thus, these communities will not be exposed to the full level of the projected impact-producing factors of Table IV-3. None of these excluded blocks are in areas in which chemosynthetic communities may be expected, because the excluded blocks are in much shallower water near the topographic features.

The majority of these deep-water communities are of low density and are widespread throughout the deep-water areas of the Gulf, and disturbance to a small area would not result in a major impact to the ecosystem. For purposes of this analysis, the frequency of such impact is expected to be once every six months to two years, and the severity of such an impact is judged to result in few losses of ecological elements with no alteration of general relationships.

High-density communities are largely protected by the provisions of NTL 88-11. For purposes of this analysis, the frequency of some small percentage of impact is expected to be once every six months to two years, but the severity of such an impact is such that there may be some loss of ecological elements and/or some alteration of general relationships.

*Conclusion*

Alternative B is expected to cause little damage to the physical integrity, species diversity, or biological productivity of either the widespread, low-density chemosynthetic communities or the rare, widely scattered, high-density Bush Hill-type chemosynthetic communities. Recovery from any damage is expected to take less than two years.

### (b) *Topographic Features*

The sources and severity of impacts associated with this alternative are those sale-related activities discussed for the Base Case. As noted in Section IV.D.2.a.(2)(b) for the Base Case, the potential impact-producing factors to the topographic features of the Western Gulf are anchoring and structure emplacement, effluent discharge, blowouts, oil spills, and structure removal. A more detailed examination of these potential impact-producing factors is presented in that section.

Eleven of the 23 topographic features of the Western Gulf are located in Subarea W-1; 12 are in W-2 (in both cases they occupy a very small portion of the entire area). Thus, these communities will not be exposed to the full level of the projected impact-producing factors of Table IV-3. This alternative differs from Alternative A by excluding the 1 unleased block near the topographic features in W-1 and the 87 unleased blocks near the banks in W-2. (These excluded blocks are the blocks that would be subject to the proposed Topographic Features Stipulation under Alternative A. It should be noted that 113 of the total of 200 blocks that would be subject to the stipulation are currently leased; 2 blocks at the Flower Garden Banks are deferred from leasing.) The amounts of wastes discharged in the vicinity of a bank will be some very small fraction of those shown in Table IV-3.

Of the potential impact-producing factors to the topographic features, anchoring, structure emplacement, and structure removal will be eliminated by the adoption of this alternative. Effluent discharge and blowouts will not be a threat because blocks near enough to the banks for these events to have an impact on the biota of the banks will have been excluded from leasing. Thus, the only impact-producing factor remaining, from operations in blocks included in this alternative (i.e., those blocks not excluded by this alternative), is an oil spill.

There is an estimated 6 percent chance of an oil spill greater than or equal to 1,000 bbl occurring in the Western Gulf as a result of this alternative (it will be the same as the Base Case of Alternative A) (Table IV-19), and it is assumed that 8 spills of greater than 1 and less than or equal to 50 bbl will occur each year and that no spills of greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action. In addition, it is assumed there will be 3 spills of diesel oil and other pollutants, the average size of which will be only 34 bbl (Table IV-3) (Section IV.C.1.). No oil spill greater than or equal to 1,000 bbl is assumed to occur during the 35-year life of the proposed action (Section IV.C.1.). In the Western Gulf, the East Flower Garden Bank crests the shallowest at 15 m. Therefore, a surface oil spill would likely have no impact on the biota of the East Flower Garden Bank or the other topographic features, because any oil that might be driven to 15 m or deeper would be well below the concentrations needed to cause an impact. However, spills resulting from this proposal are assumed to be subsurface; such spills are likely to rise to the surface, and any oil remaining at depth will be swept clear of the banks by currents moving around the banks (Rezak et al., 1983). A seafloor oil spill would have to come into contact with a biologically sensitive feature to have an impact. The fact that the topographic features are widely dispersed in the Western Gulf, combined with the probable random nature of spill locations, would serve to limit the extent of damage from any given spill to only one of the sensitive areas. The currents that move around the banks will steer any spilled oil around the banks rather than directly upon them, lessening the severity of impacts.

*Conclusion*

Alternative B is expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 $m^2$ would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks. Selection of Alternative B would preclude oil and gas operations in the unleased blocks affected by the proposed Topographic Features Stipulation.

### *(3) Impacts on Water Quality*

All existing onshore infrastructure and associated coastal activities occurring in support of the proposed action will contribute to the degradation of regional coastal and nearshore water quality to a minor extent because each provides a low measure of continuous contamination and because discharge locations are widespread. The effect of chronic contamination on the Gulf's coastal waters due to the proposed action is considered negligible, with water characteristics rapidly returning to background levels. The OCS-related vessel traffic is likely to impact water quality through routine releases of bilge and ballast waters, chronic fuel and tank spills, trash, and low-level releases of the contaminants in antifouling paints. Given the small concentrations of the releases anticipated, and their continuous and widespread nature, it is assumed that there will be some localized short-term change (up to several weeks) in water quality characteristics from background levels, depending on the length of the affected channel, flushing rates, and other factors. The improper storage and disposal of oilfield wastes and contaminated oilfield equipment would adversely impact surface and ground waters in proximity to disposal facilities, cleaning sites, and scrap yards. Surface and groundwater in proximity to improperly designed and maintained disposal sites and facilities could be adversely impacted with elevated concentrations of arsenic, chromium, zinc, cadmium, mercury, lead, barium, penta-chlorophenol, naphthalene, benzene, toluene, and radium.

Immediate effects would be brought about by increased drilling, construction, and pipelaying activities, causing an increase in water column turbidities (lasting for several hours for mud discharges to several weeks for pipelaying and dredging activities) to the affected offshore waters. The magnitude and extent of turbidity increases would depend on the hydrographic parameters of the area, nature and duration of the activity, and bottom-material size and composition. Offshore Subarea W-1 would receive the greatest portion of program-related pipeline burial activities, whereas offshore Subarea W-3 would receive the largest amounts of program-related operational discharges. Because of the continuous nature of oil and gas activities in the northwestern and north-central Gulf of Mexico, discharges of drilling muds and cuttings and produced water are judged to be of nearly continuous frequency throughout these areas. Proposed produced-water discharges will be rapidly diluted within the immediate vicinity of the discharge source. Significant increases in water concentrations of dissolved and particulate hydrocarbons and trace metals are not expected outside the initial mixing zone or immediate vicinity of the discharge source. Higher concentrations of trace metals, salinity, temperature, organic compounds, and radionuclides, and lower dissolved oxygen may be present near the discharge source. Within the mixing zone of the discharge, long-term effects to water column processes, consisting of localized increases in particulate metal and soluble lower molecular weight hydrocarbon (e.g., benzene, toluene, and xylenes) concentrations, may be implicated. Trace metals and hydrocarbons associated with the discharge may be deposited within sediments near the discharge point. The proposed discharge of drilling fluids and cutting would encounter rapid dispersion in marine waters. Discharge plumes will be diluted to background levels within a period of several hours and/or within several hundred meters of the discharge source. The accumulation of toxic trace metals and hydrocarbons in exposed shelf waters, due to periodic releases of water-based generic muds and cuttings, is unlikely, and the long-term degradation of the water column from such discharges is not a major concerns.

No oil spills greater than or equal to 1,000 bbl and greater than 50 and less than 1,000 bbl are assumed to occur and contact coastal and nearshore waters. Eighteen spills greater than 1 but less than or equal to 50 bbl are assumed to result from OCS sale-related activities both in the coastal zone and from offshore. Of these, fewer than 10, associated with onshore support and vessel activities, are assumed to occur in coastal waters. Program-related spills will introduce oil into nearshore waters, creating elevated hydrocarbon levels (up to 100+ $\mu$g/l) within affected waters. Much of the oil will be dispersed throughout the water column over several days to weeks. In shallow areas, oil may become entrained in suspended particles and bottom sediments. Water uses would be affected for up to several weeks from proposed spills and then only near the source of slick.

*Conclusion*

An identifiable change to the ambient concentration of one or more water quality parameters will be evident up to several hundred to 1,000 meters from the source and for a period lasting up to several weeks in duration in marine and coastal waters. Chronic, low-level pollution related to the proposal will occur throughout the 35-year life of the proposed action.

### *(4) Impacts on Air Quality*

This alternative will offer for lease all those unleased blocks in the proposed action, excluding the 73 blocks near biologically sensitive topographic features in the WPA.

The subsequent analysis is presented to provide insights to any modification in the environmental protection provided under Alternative B, as compared with the estimated impacts of Alternative A. A description of the air quality in the WPA is provided in Section III.A.3., and descriptions of the potential impact-producing factors are provided in Section IV.A. An analysis of the impacts of Alternative A is presented in Section IV.D.2.a.(4). The reader may refer to these sections for more details of the resources, impact-producing factors, and derived impacts.

The size of the area and the number of blocks available for lease under Alternative A is large. Because 73 blocks would be withheld from proposed Sale 141 if this alternative were adopted, it is safe to assume that activities, infrastructure, and other factors described in that analysis will not change appreciably. The reader may consult Table IV-3 for the number of wells and platforms related to Alternative A. It is conceivable, given the small size of the changes produced by Alternative B, that the analyses described in Alternative A will not be changed.

The proposed action projects that 210 exploration and delineation wells and 110 development wells will be drilled, and 10 platforms will be emplaced. The following table estimates emission rates for each subarea during the life of the proposed action.

Total Emissions in WPA Subareas
(tons over the 35-year life of the proposed action)

| Pollutant | W-1 | W-2 | W-3 |
|---|---|---|---|
| $NO_x$ | 2,313.6 | 4,627.2 | 16,195.2 |
| CO | 351.2 | 702.5 | 2,458.7 |
| $SO_x$ | 62.0 | 124.0 | 434.1 |
| THC | 713.2 | 1,426.4 | 4,992.5 |
| TSP | 60.6 | 121.1 | 423.9 |

The discussion of the meteorology and pollutant dispersion presented under Alternative A indicates that the release of pollutants over the Gulf waters occurs relatively close to the surface (30 m) and that prevailing atmospheric conditions will promote vertical and horizontal mixing of the plume, in general. During night and morning hours and in the winter, even though turbulence is available, the mixing height would be low, so that little dilution would occur. During summer, the available turbulent energy and the greater mixing heights will allow greater dispersion and dilution of pollutants. During high-wind conditions, the dispersion will be much larger, reducing the concentrations to even lower levels. The only pollutant that may remain in large concentrations is $NO_X$.

More important are the potential impacts of these emissions on the inshore air quality. It is reasonable to expect that emissions reaching land will be minimal from Subareas W-2 and W-3. Emissions carried inshore from the subarea close to land, W-1, will arrive with small concentrations due to the intensive mixing over the Gulf waters. At the coastline, the impacts then will depend on the level of concentration of the arriving pollutant. Most will have low concentrations when arriving onshore. For $NO_X$, however, the concentrations may not be low. Numerical modeling by MMS of pollutant transport to inshore areas reveals that inert pollutants have low concentrations when reaching inshore.

Oil spills of all categories will produce temporal impacts on the offshore air quality and are limited to the immediate vicinity of the spill. Impacts to inshore areas from these spills are small because of the dispersion of pollutants and the limited input of pollutants to the atmosphere.

Offloading of crude oil from surface vessels at ports is estimated to be nearly 19 percent of the OCS production. The emission rates from these operations are small; thus, these unintentional emissions are estimated to be negligible in the WPA. Emissions from the tugboats in these operations are expected to produce negligible effects on air quality.

Suspended particulate matter is important because of its potential in degrading the visibility in national wildlife parks or recreational parks designated as Type I areas. Particles larger than 10 microns would have very low concentrations because they settle fast. Particles of 10 microns or less remain floating for long periods, but they produce a low impact on the visibility of these areas because of their low concentrations. The selection of Alternative B can diminish impacts on air quality from the above impact-producing factors, but not enough to change the level of the estimated impacts under Alternative A.

*Conclusion*

Emissions of pollutants into the atmosphere from activities for the proposed action are expected to have concentrations that would not change the onshore air quality classifications. Increases in onshore concentrations of air pollutants are estimated to be about 1 $\mu gm^{-3}$ (box model steady concentrations). This concentration will have minimal impacts during winter because onshore winds occur only about 34 percent of the time, and maximum impacts in summer when onshore winds occur 85 percent of the time.

## *(5) Impacts on Marine Mammals*

### *(a) Nonendangered and Nonthreatened Species*

This section discusses the impact of the adoption of Alternative B, which excludes biologically sensitive offshore habitats, on nonendangered and nonthreatened cetaceans, including whales and dolphins. The level of activity associated with the alternative is the same as the summary of infrastructure and activity described for the Base Case in Table IV-3. The sources and severity of impacts for nonendangered and nonthreatened species in Alternative B are the same as those discussed for the Base Case (Section IV.D.2.a.(5)). The impacts include operational discharges, helicopter and vessel traffic, drilling operations, explosive platform removals, seismic surveys, and oil spills. The effects of these activities are estimated to be primarily nonlethal and the probability of an interaction is unlikely. Lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl.

*Conclusion*

The impact of Alternative B on nonendangered and nonthreatened marine mammals is expected to result in sublethal effects that occur periodically and result in short-term physiological or behavioral changes, as well as some degree of avoidance of the impacted area(s).

### *(b) Endangered and Threatened Species*

This section discusses the impact of the adoption of Alternative B, which excludes biologically sensitive offshore habitats, on endangered and threatened cetaceans, including whales and dolphins. The level of activity associated with the alternative is the same as the summary of infrastructure and activity described for the Base Case in Table IV-3. The sources and severity of impacts for endangered and threatened cetaceans in Alternative B are the same as those discussed for the Base Case (Section IV.D.2.a.(5)). The impacts include operational discharges, helicopter and vessel traffic, drilling operations, explosive platform removals, seismic surveys, and oil spills. The effects of these activities are estimated to be primarily nonlethal and the probability of an interaction is unlikely. Lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl.

*Conclusion*

The impact of Alternative B on nonendangered and nonthreatened marine mammals is expected to result in sublethal effects that occur periodically and result in short-term physiological or behavioral changes, as well as some degree of avoidance of the impacted area(s).

### *(6) Impacts on Marine Turtles*

This section discusses the impact of the adoption of Alternative B, which excludes biologically sensitive offshore habitats, on marine turtles. The level of activity associated with the alternative is the same as the summary of infrastructure and activity described for the Base Case in Table IV-3. The sources and severity of impacts for endangered/threatened and nonendangered/nonthreatened species in this alternative are the same as those discussed for the Base Case (Section IV.D.2.a.(6)). The impacts include indirect impacts from anchoring, structure and pipeline placement, dredging, and operational discharges; and the direct impacts of trash and debris, oil spills and oil-spill cleanup, vessel traffic, and the explosive removal of offshore structures. The effects of these activities are estimated to be primarily nonlethal and the probability of an interaction is unlikely. Lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl.

*Conclusion*

The impact of Alternative B on marine turtles is expected to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes.

### *(7) Impacts on Coastal and Marine Birds*

#### *(a) Nonendangered and Nonthreatened Species*

The Gulf of Mexico is populated by migrant and nonmigrant species of coastal and marine birds. This broad category consists of four main groups: seabirds, waterfowl, wading birds, and shorebirds.

The sources and severity of impacts associated with this alternative to coastal and marine birds associated with this alternative are those sale-related activities discussed for the Base Case (Table IV-3). As noted in Section IV.D.2.a.(7) for the Base Case, effects that may result from this alternative include oil spills, disturbance from OCS service-vessel and helicopter traffic near coastal areas, displacement from onshore pipeline landfalls and facility construction near coastal areas, and entanglement and ingestion of offshore oil- and gas-related plastic debris.

It is estimated that the effects from the major impact-producing factors on coastal and marine birds are negligible and of nominal occurrence. As a result, there will no perceivable disturbance to Gulf coastal and marine birds.

*Conclusion*

The impact of Alternative B on nonendangered and nonthreatened coastal and marine birds is expected to result in no discernible decline in a population or species, and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to predisturbance condition in less than one generation.

#### *(b) Endangered and Threatened Species*

This section discusses the impact of the adoption of Alternative B, which excludes biologically sensitive offshore habitats, on endangered and threatened coastal and marine birds, including the piping plover, brown pelican, bald eagle, and Arctic peregrine falcon.

The level of activity associated with the alternative is the same as the summary of infrastructure and activity described for the Base Case in Table IV-3. The sources and severity of impacts in Alternative B for endangered and threatened coastal and marine birds are the same as those discussed for the Base Case (Section IV.D.2.a.(7)). The impacts include oil spills, OCS service-vessel and helicopter traffic, onshore pipeline construction, and entanglement and ingestion of offshore oil- and gas-related plastic debris. The effects of these activities are estimated to be primarily nonlethal and the probability of an interaction is unlikely. Lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl.

*Conclusion*

The impact of Alternative B on endangered and threatened coastal and marine birds is expected to result in no discernible decline in a population or species and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to predisturbance condition in less than one generation.

### *(8) Impacts on Commercial Fisheries*

The sources and severity of impacts to commercial fisheries are the same in this alternative as those discussed for the Base Case (Table IV-3). As noted in Section IV.D.2.a.(8) for the Base Case, effects that may result from this alternative include emplacement of production platforms, underwater OCS obstructions, production platform removals, seismic surveys, oil spills, subsurface blowouts, and OCS discharges of drilling muds.

It is estimated that the effects from the major impact-producing factors on commercial fisheries in the WPA are negligible and of nominal occurrence. As a result, there will be no perceivable disturbance to Gulf commercial fisheries.

*Conclusion*

The impact of Alternative B on commercial fisheries is expected to result in no discernible decrease in a population of commercial importance, its essential habitat, or in commercial fisheries on a local scale. Any affected population is expected to recover to predisturbance condition in less than one generation.

### *(9) Impacts on Recreational Resources and Activities*

### *(a) Beach Use*

The sources and severity of beach use impacts associated with the offering of Alternative B are the same as the sale-related activities discussed for the Base Case. As noted in Section IV.D.2.a.(9)(a) for the Base Case, effects that may result on beach use from this alternative include oil spills and trash and debris.

No oil spills of 1,000 bbl or greater and a few spills greater than 1 and less than or equal to 50 bbl are assumed to occur and contact a major recreational beach in the WPA (Section IV.C.3.). There will also be the intermittent effect of litter or trash associated with sale-related OCS operations. Removing tracts associated with the protected biological features (noted far offshore on Visual No. 2) will have little or no incremental effect on the amount of oil or trash and debris assumed to impact Texas coastal beaches adversely. As in the proposal, a few oil spills greater than 1 and less than or equal to 50 bbl are assumed to affect portions of WPA beaches, however, with little disruption of recreational activities.

*Conclusion*

Alternative B is expected to result in periodic loss of solid-waste items likely to wash up on recreational beaches, which is expected to diminish enjoyment of some beach visits but is unlikely to affect the number or type of visits currently occurring on Texas beaches.

### *(b) Marine Fishing*

The sources and severity of marine fishing impacts associated with the offering of Alternative B are the same as the sale-related activities discussed for the Base Case. As noted in Section IV.D.2.a.(9)(b) for the Base Case, effects that may result on marine fishing from this alternative include platform installations and removals and oil spills. Offshore platforms attract fish and fishermen; explosive removal of platforms will kill or critically injure closely associated sport fish at the time of detonation; and oil spills will tend to discourage fishing.

The platform complex expected to be installed and ultimately removed in coastal Subarea W-1 will most likely be unaffected by this alternative, as all of the tract deletions associated with this alternative are in offshore Subareas W-2 and W-3, which are too far from shore to have much effect on recreational fishing. A few oil spills greater than 1 and less than or equal to 50 bbl being assumed (Section IV.C.1), the impact on marine recreational fishing from this pollution will be short term and minor.

*Conclusion*

One platform complex (2-3 structures) installed as a result of Alternative B within 30 mi of shore is expected to attract fishermen and to improve fishing success in the immediate vicinity of the platform complex for a period of about 20 years.

### *(10) Impacts on Archaeological Resources*

A number of OCS-related factors may cause adverse impacts to archaeological resources. Damage to both historic and prehistoric archaeological resources could be caused by the placement of drilling rigs, production platforms, and pipelines; dredging; and anchoring. These activities could destroy artifacts or disrupt the provenance and stratigraphic context of artifacts, sediments, and paleoindicators, from which the scientific value of the archaeological resource is derived. Oil spills could contaminate site organics and destroy the ability to date prehistoric sites by radiocarbon dating techniques. Ferromagnetic debris associated with OCS oil and gas activities would tend to mask magnetic signatures of significant historic archaeological resources.

### *(a) Historic*

The offering for lease of all WPA blocks, with the exception of the lease blocks near biologically sensitive topographic features, would result in the deletion of six lease blocks considered to have a high probability for the occurrence of historic archaeological resources. Given the small number of lease blocks involved, adoption of the alternative will not change expected impacts from those discussed under the Base Case scenario (Section IV.D.2.a.(10)).

Offshore development could result in an interaction between a drilling rig, a platform, a pipeline, dredging, or anchors and an historic shipwreck. The result would be the loss of archaeological data on ship construction, cargo, the social organization of the vessel's crew, and the concomitant loss of information on maritime culture for the time period from which the ship dates.

Likely locations of archaeological sites on the OCS cannot be delineated without first conducting a remote-sensing survey of the seabed and near-surface sediments. The location of any proposed activity within a lease block that has a high probability for historic shipwrecks requires archaeological clearance prior to operations. If the expanded database containing 159 shipwrecks in the entire Western Gulf OCS is considered, the probability of an OCS activity contacting and damaging a shipwreck is fairly low. However, if an oil and gas structure contacted an historic resource, significant or unique archaeological information could be lost. The frequency of such an occurrence, however, is expected to be low. The limited number of blocks that would be deleted if the alternative were adopted would not change the expected impacts from those found for the Base Case.

The greatest impact to an historic archaeological resource as a result of the proposed action would result from a contact between an OCS offshore activity (platform installation, drilling rig emplacement, dredging and pipeline projects) and an historic shipwreck. Deletion of the blocks near biologically sensitive topographic features would not result in the deletion of any block considered to have a high probability for historic and/or prehistoric archaeological resources.

Because of incomplete knowledge on the location of shipwrecks in the Gulf, an OCS activity could contact a shipwreck. Although this occurrence is not probable, such an event would result in the disturbance or destruction of significant or unique historic archaeological information. Other factors associated with the proposed action are not expected to affect historic archaeological resources.

*Conclusion*

There is a very small possibility of an impact between OCS oil and gas activities and an historic shipwreck or site. Should such an impact occur, significant or unique archaeological information could be lost.

### *(b) Prehistoric*

Prehistoric sites anticipated to occur offshore in WPA waters include all types that occur onshore. The baseline study for the Gulf of Mexico (CEI, 1977) identified distinct, high-probability geomorphic features for the occurrence of prehistoric archaeological sites. Two possible prehistoric sites have been located in the western portion of the CPA as a result of an MMS-funded study (CEI, 1986). These possible sites occurred in association with the ancient Sabine River valley and were identified by coring within Sabine Area, Block 6. While no prehistoric sites have been identified on the Federal OCS in the WPA, artifacts have been discovered at McFaddin Beach, Texas, but these appear to have been transported from areas offshore (CEI, 1977).

Offshore development as a result of the proposed action could result in an interaction that could destroy fragile artifacts or site features and could disturb artifact provenance and site stratigraphy. The limited amount of impact to the seafloor throughout the WPA, coupled with the effectiveness of the archaeological survey and resulting archaeological clearance, is sufficient to assume a low potential for interaction between an impact-producing factor and a prehistoric archaeological site. The adoption of Alternative B will not change expected impacts from those expected under the Base Case.

The survey and clearance provide a significant reduction in the potential for a damaging interaction between an impact-producing factor and a prehistoric site.

*Conclusion*

There is a very small possibility of an impact between oil and gas activities and a prehistoric archaeological site. Should such an impact occur, there would be damage to or loss of significant or unique archaeological information.

## *(11) Impacts on Socioeconomic Conditions*

### *(a) Population, Labor, and Employment*

Resource estimates and associated infrastructure for the proposed action in the Western Gulf, excluding blocks near biologically sensitive topographic features, are not significantly different from those estimated for the proposed action in the Base Case. Estimates include the drilling of 210 exploration and delineation wells, the emplacement of 10 platform complexes, and the drilling of 110 development wells (Table IV-3). The sources and severity of impacts to population, labor, and employment are, therefore, the same as those assessed for Western Gulf Sale 143 in the Base Case. A total of approximately 24,000 person-years of employment (direct, indirect, and induced) are required in the Central and Western Gulf coastal subareas in support of Alternative B throughout its 35-year life. Peak annual changes in the population, labor, and employment of all coastal subareas in the Central and Western Gulf resulting from Alternative B represent less than 1 percent of the levels expected in absence of the proposal. The coastal communities of the Central Gulf are expected to support over 72 percent of the total employment generated by the Western Gulf sale under this alternative. Employment resulting from oil-spill clean-up activities is negligible. It is expected that employment demands in support of this alternative will be met with the existing population and available labor force.

*Conclusion*

The impact of Alternative B in the Western Gulf on the population, labor, and employment of the counties and parishes of the Central and Western Gulf coastal impact area is expected to be less than 1 percent of the levels expected in the absence of the proposal.

### *(b) Public Services and Infrastructure*

Impacts on public services and infrastructure would be related to dramatic increases or decreases in population. No positive net migration into the coastal subareas of the Central and Western Gulf is expected to occur as a result of Alternative B. It is expected that employment will occur from those currently employed in the oil and gas industry as well as the unemployed and underemployed, and new employees already living in the area. In addition, jobs created by the proposal would likely reduce the amount of migration out of the coastal subareas when compared with scenarios without the proposal. It is expected that employees leaving public service and infrastructure-related jobs could be replaced from the existing labor pool.

*Conclusion*

Population and employment impacts that result from the proposed action under Alternative B will not result in disruptions to community infrastructure and public services beyond what is anticipated by in-place planning and development agencies.

### *(c) Social Patterns*

Impacts on social patterns would be related to dramatic changes in population and the disruption of environmental resources, as well as conditions inherent to OCS-related employment (i.e., work scheduling and rate of pay). No positive net migration into coastal subareas of the Central and Western Gulf is expected to occur as a result of the proposal. It is expected that employment will occur from those currently employed in the oil and gas industry, as well as the unemployed and underemployed, and new employees already living in the area. It is expected that jobs created by the proposal would likely reduce the amount of out-migration when compared to scenarios without the proposal. It is expected that minor displacement from traditional occupations will occur as a result of Alternative B. This displacement will be mitigated, to some extent, by the extended work schedule associated with OCS-related employment. The extended work schedule is expected to have some deleterious effects on family life in pertinent, individual cases. Impacts caused by the displacement of traditional occupations and relative wages are expected to occur to a minimal extent.

*Conclusion*

Deleterious impacts on social patterns are expected to occur in some individual cases as a result of the extended work schedule, displacement from traditional occupations, and relative wages.

## c. Impacts from Alternative C - The Proposed Action Excluding the Western Naval Operations Area

*Description of the Alternative*

This alternative would delete about 340 lease blocks (approximately 1.7 million acres) in Western Naval Operations Area located east of Corpus Christi, Texas (Figure I-1). In late 1990, MMS and the Department of Defense (DOD) agreed to the deferral of this area from Western Gulf lease Sale 135 (held in August 1991) and proposed Western Gulf lease Sale 141 (scheduled for August 1992). It was also agreed that the deferral would be subject to a two-year review period, after which a decision would be made to either continue the deferral for another two years or move the area to another acceptable location. Consultation has begun between DOD and MMS and negotiations are continuing regarding this deferral area. Since negotiations regarding this matter are still ongoing, the deletion of this 340-block area is included in this EIS as a separate alternative.

*Effects of the Alternative*

The resource estimates and the projected level of activity (i.e., numbers of wells, platforms, vessel trips, etc.) and amount of spills for the proposed action (Base Case, High Case, and Cumulative Scenario) would remain unchanged as a result of adopting this alternative.

It is expected that the deletion of this area would not change the impacts for the various resources analyzed under Alternative A, except for a potential reduction in impacts to fixed resources (i.e., deep-water benthic communities and archaeological resources) that may occur within the deleted area. Any potential for OCS-related impacts to fixed resources in this area would be eliminated if the area is not available for lease.

### *(1) Impacts on Sensitive Coastal Environments*

### *(a) Coastal Barrier Beaches*

The activities that could affect barrier beaches under Alternative C include oil spills, pipeline emplacements, dredging of new navigation channels, maintenance dredging and vessel usage of existing navigation channels, and the construction of onshore facilities on barrier features. Alternative C does not directly affect the severity of impacts expected from activities associated with OCS development because the deleted offshore sensitive habitats are located at a distance offshore from coastal barriers.

One or two spills greater than 1 and less than 50 bbl will occur inshore and contact the landward side of barrier beaches. These spills will contact about 2 km of coast and will be cleaned without the removal of sand. No oil will contact sand dune areas. The barrier features will not be affected by contact from these spills. No pipeline landfalls, navigation channels, or new infrastructure construction projects are expected as a result of Alternative C. Maintenance dredging of existing navigation channels cannot be attributed to Alternative C because of the small percentage of vessel usage attributable to the alternative. No channel deepening projects will occur in an area that could affect barrier landforms.

*Conclusion*

Alternative C is not expected to result in permanent alterations of barrier beach configuration, except in localized areas downdrift from channels that have been dredged and deepened. The contribution to localized erosion is expected to be less than one percent.

### *(b) Wetlands*

The activities that could affect wetlands under Alternative C include oil spills, pipeline emplacements, dredging of new navigation channels, maintenance dredging and vessel usage of existing navigation channels, and the construction of onshore facilities. Alternative C does not directly affect the severity of impacts expected from activities associated with OCS development under the Base Case scenario because the deleted offshore sensitive habitats are located at a distance offshore from coastal barrier habitats.

Several spills greater than 1 and less than or equal to 50 bbl will occur from onshore sources and contact wetlands. These spills will result in short-term impacts to up to several hectares of WPA wetlands, involving die-back of the above-ground vegetation. No accelerated erosion of wetland margins is expected as a result of the spills. Oil terminals and barge traffic do not commonly occur in WPA areas that contain extensive seagrass beds; no impacts from oil spills to these resources are therefore assumed to occur. No pipeline landfalls, navigation channels, or new infrastructure construction projects are expected as a result of Alternative C. Although no new waste disposal sites are projected to be built to accommodate OCS-generated wastes, some seepage from existing sites could occur into nearby wetlands. Maintenance dredging of existing navigation channels cannot be attributed to Alternative C because of the small percentage of vessel usage that can be attributed to the alternative. The deepening of one navigation channel to provide access for deeper draft service vessels is projected to occur. This analysis assumes that the dredged material will be used to enhance or create marsh habitat. Alternative C will result in a reduction in resource development compared to Alternative A. The amount of vessel traffic required under Alternative C for supply vessels, barges, and shuttle tankers will be less than or equal to that required under the Base Case. Impacts of OCS vessel traffic on wetlands along channel margins are expected to be result in less than 1 ha of accelerated wetland erosion.

*Conclusion*

Alternative C is expected to result in no permanent alterations of wetland habitats, except for the erosion of less than 1 ha of wetlands along navigation channel margins. These losses could be offset or even exceeded by wetlands gains from the beneficial disposal of dredged material generated during channel maintenance and deepening operations.

### ***(2) Impacts on Sensitive Offshore Resources***

### *(a) Deep-water Benthic Communities*

The sources and severity of impacts associated with this alternative are those sale-related activities discussed for Alternative A. As noted in Section IV.D.2.a.(2)(a) for the Base Case analysis, the only impact-producing factor threatening these communities results from those activities that would physically disturb the bottom, such as the routine operations of anchoring, drilling, and pipeline installation, and the rare seafloor blowout accident. A more detailed examination of this potential impact-producing factor is presented in that section.

High-density chemosynthetic communities are found only in water depths greater than 400 m (1,312 ft); thus, they will be found only in the southeast one-eighth of Subarea W-1, the southern one-third of W-2, and throughout W-3. The majority of these communities will not be exposed to the full level of the projected impact-producing factors of Table IV-3. This alternative differs from Alternative A by offering all of the blocks of Alternative A except for approximately 340 blocks that comprise the Western Naval Operations Area (Figure I-1). Of these blocks, all or part of 197 blocks are in water deeper than 400 m, and 6 of these are under active lease. Thus, if Alternative C is adopted, those blocks would not be subject to the potential impacts described for Alternative A (Section IV.D.2.a.(2)(a)). Not leasing these 191 unleased blocks (6% of the 3,104 unleased blocks in the WPA in water deeper than 400 m) will not alter the conclusions reached in the analysis for Alternative A.

The majority of these deep-water communities are of low density and are widespread throughout the deep-water areas of the Gulf, and disturbance to a small area would not result in a major impact to the ecosystem. For purposes of this analysis, the frequency of such impact is expected to be once every six months to two years, and the severity of such an impact is judged to result in few losses of ecological elements with no alteration of general relationships.

High-density communities are largely protected by the provisions of NTL 88-11. For purposes of this analysis, the frequency of some small percentage of impact is expected to be once every six months to two years, but the severity of such an impact is such that there may be some loss of ecological elements and/or some alteration of general relationships.

*Conclusion*

Alternative C is expected to cause little damage to the physical integrity, species diversity, or biological productivity of either the widespread, low-density chemosynthetic communities or the rare, widely scattered high-density Bush Hill-type chemosynthetic communities. Recovery from any damage is expected to take less than 2 years.

### *(b) Topographic Features*

The sources and severity of impacts associated with this alternative are those sale-related activities discussed for the Base Case. As noted in Section IV.D.2.a.(2)(b) for the Base Case, the potential impact-producing factors to the topographic features of the Western Gulf are anchoring and structure emplacement, effluent discharge, blowouts, oil spills, and structure removal. A more detailed examination of these potential impact-producing factors is presented in that section.

Eleven of the 23 topographic features of the Western Gulf are located in Subarea W-1; 12 are in W-2 (in both cases they occupy a very small portion of the entire area); therefore, these communities will not be exposed to the full level of the projected impact-producing factors assumed under Alternative A. This alternative differs from Alternative A by offering all of the blocks of Alternative A except for approximately 340 blocks that comprise the Western Naval Operations Area (Figure I-1). None of the topographic features of the Western Gulf are located within these 340 blocks. Thus, the topographic features of the Western Gulf would be subject to all of the potential impacts described for Alternative A (Section IV.D.2.a.(2)(b)).

*Conclusion*

Alternative C is expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 $m^2$ would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks.

### *(3) Impacts on Water Quality*

All existing onshore infrastructure and associated coastal activities occurring in support of Alternative C will contribute to the degradation of regional coastal and nearshore water quality to a minor extent because each provides a low measure of continuous contamination and because discharge locations are widespread. The OCS-related vessel traffic is likely to impact water quality through routine releases of bilge and ballast waters, chronic fuel and tank spills, trash, and low-level releases of the contaminants in antifouling paints. It is therefore assumed that there will be some localized short-term change (up to several weeks) in water quality characteristics from background levels, depending on the length of the affected channel, flushing rates, etc. The improper storage and disposal of oil-field wastes and NORM-contaminated oil-field equipment would adversely impact surface and groundwaters in proximity to State permitted disposal facilities, cleaning sites, and scrap yards. As a result of site runoff, surface and groundwater in proximity to improperly designed and maintained storage/disposal sites and facilities could be adversely impacted with elevated concentrations of arsenic, chromium, zinc, cadmium, mercury, lead, barium, penta-chlorophenol, naphthalene, benzene, toluene, and radium.

Immediate effects would be brought about by increased drilling, construction, and pipelaying activities, causing an increase in water column turbidities (lasting for several hours for mud discharges to several weeks for pipelaying/dredging activities) to the affected offshore waters. Offshore Subarea W-1 would receive the greatest portion of program-related pipeline burial activities, whereas offshore Subarea W-3 would receive the largest amounts of program-related operational discharges. Proposed produced-water discharges will be rapidly diluted within the immediate vicinity of the discharge source. Significant increases in water concentrations of dissolved and particulate hydrocarbons and trace metals are not expected outside the initial mixing zone or immediate vicinity of the discharge source. Higher concentrations of trace metals, salinity, temperature, organic compounds, and radionuclides, and lower dissolved oxygen may be present near the discharge source. Long-term effects to water column processes, consisting of localized increases in particulate metal and soluble lower molecular weight hydrocarbons (e.g., benzene, toluene, and xylenes) concentrations, may be implicated within the mixing zone of the discharge. Trace metals and hydrocarbons associated with the discharge may be deposited within sediments near the discharge point. The proposed discharge of drilling fluids and cuttings would encounter rapid dispersion in marine waters. Discharge plumes will be diluted to background levels within a period of several hours and/or within several hundred meters of the discharge source. The accumulation of toxic trace metals and hydrocarbons in exposed shelf waters, due to periodic releases of water-based generic muds and cuttings, are unlikely and the long-term degradation of the water column from such discharges are not a major concern.

Eighteen spills greater than 1 but less than or equal to 50 bbl are assumed to result from OCS sale-related activities both in the coastal zone and from offshore. Of these, fewer than 10, associated with onshore support and vessel activities, are assumed to occur in coastal waters. Program-related spills will introduce oil into nearshore waters, creating elevated hydrocarbon levels (up to 100+ $\mu$g/l) within affected waters. After 10 days, much of the oil will be dispersed throughout the water column over a period of weeks. In shallow areas, oil may become entrained in suspended particles and bottom sediments. Water uses would be affected for up to several weeks from proposed spills and then only near the source of the slick.

*Conclusion*

As a result of Alternative C, an identifiable change to the ambient concentration of one or more water quality parameters will be evident up to several hundred to 1,000 m from the source and for a period lasting up to several weeks in duration in marine and coastal waters. Chronic, low-level pollution related to the proposal will occur throughout the life of the proposed action.

### *(4) Impacts on Air Quality*

The size of the area and the number of blocks available for lease under Alternative A is large. Because 340 blocks would be withheld from proposed Sale 143 if this alternative were adopted, it is assumed that activities, infrastructure, and other factors described in that analysis will not change appreciably. The reader may consult Table IV-3 for the number of wells and platforms related to Alternative A. It is conceivable, given the small size of the changes produced by Alternative C, that the analyses described in Alternative A will not be changed.

The only pollutant that may retain large concentrations is $NO_X$. It is expected that, in general, concentrations will be very low for pollutants other than $NO_X$ over the Gulf waters. During stable conditions over the Gulf waters, concentrations can reach moderate values. It is reasonable to expect that emissions reaching land will be minimal from Subareas W-2 and W-3. Emissions carried inshore from the subarea close to land, W-1, will arrive with small concentrations due to the intensive mixing over the Gulf waters. At the coastline, the impacts will depend on how low the concentrations are upon arrival. Numerical modeling by

MMS of pollutant transport to inshore areas reveals that inert pollutants have very low concentrations when reaching inshore areas.

Oil spills of all categories will produce temporal impacts on the offshore air quality and are limited to the immediate vicinity of the spill. Impacts to inshore areas from these spills are small because the dispersion of pollutants and their limited input of pollutants to the atmosphere.

Offloading of crude oil from surface vessels at ports is estimated to be near 19 percent of the OCS production. The emission rates from these operations are small; thus, these unintentional emissions are estimated to be negligible in the WPA. Emissions from tugboats in these operations are expected to produce negligible effects on air quality.

Suspended particulate matter is important because of its potential in degrading the visibility in national wildlife parks or recreational parks designated as Type I areas. Particles larger than 10 microns would have very low concentrations because they settle fast. Particles of 10 microns or less remain floating for long periods, but they have low concentrations. The selection of Alternative C can diminish impacts on air quality from the above impact-producing factors but not enough to change the level of the estimated impacts under Alternative A.

*Conclusion*

Emissions of pollutants into the atmosphere are expected to have concentrations that would not change the onshore air quality classifications. Increases in onshore concentrations of air pollutants are estimated to be about 1 $\mu gm^{-3}$ (box model steady concentrations). This concentration will have minimal impacts during winter because onshore winds occur only about 34 percent of the time, with maximum impacts in summer when onshore winds occur 85 percent of the time.

## *(5) Impacts on Marine Mammals*

### *(a) Nonendangered and Nonthreatened Species*

The level of activity associated with the alternative is the same as the summary of infrastructure and activity described for Alternative A (Table IV-3). The sources and severity of impacts for nonendangered and nonthreatened species in Alternative C are the same as those discussed for Alternative A (Section IV.D.2.a.(5)). The impacts include operational discharges, helicopter and vessel traffic, drilling operations, explosive platform removals, seismic surveys, and oil spills. The effects of these activities are estimated to be primarily nonlethal, and the probability of an interaction is unlikely. Lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl.

*Conclusion*

The impact of Alternative C on the nonendangered and nonthreatened marine mammals is expected to result in sublethal effects that occur periodically and result in short-term physiological or behavioral changes, as well as some degree of avoidance of the impacted area(s).

### *(b) Endangered and Threatened Species*

The level of activity associated with the alternative is the same as the summary of infrastructure and activity described for Alternative A (Table IV-3). The sources and severity of impacts for endangered and threatened species in Alternative C are the same as those discussed for Alternative A (Section IV.D.2.a.(5)). The impacts include operational discharges, helicopter and vessel traffic, drilling operations, explosive platform removals, seismic surveys, and oil spills. The effects of these activities are estimated to be primarily nonlethal, and the probability of an interaction is unlikely. Lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl.

*Conclusion*

The impact of Alternative C on the endangered and threatened marine mammals is expected to result in sublethal effects that occur periodically and result in short-term physiological or behavioral changes, as well as some degree of avoidance of the impacted area(s).

### *(6) Impacts on Marine Turtles*

The level of activity associated with the alternative is the same as the summary of infrastructure and activity described for Alternative A (Table IV-3). The sources and severity of impacts for endangered/threatened and nonendangered/nonthreatened species in this alternative are the same as those discussed for Alternative A (Section IV.D.2.a.(6)). The impacts include indirect impacts from anchoring, structure and pipeline placement, dredging, and operational discharges; and direct impacts from trash and debris, oil spills and oil-spill cleanup, vessel traffic, and the explosive removal of offshore structures. The effects of these activities are estimated to be primarily nonlethal, and the probability of an interaction is unlikely. Lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl.

*Conclusion*

The impact of Alternative C on marine turtles is expected to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes.

### *(7) Impacts on Coastal and Marine Birds*

### *(a) Nonendangered and Nonthreatened Species*

The sources and severity of impacts to coastal and marine birds associated with this alternative are those sale-related activities discussed for Alternative A (Table IV-3). As noted in Section IV.D.2.a.(7) for Alternative A, effects that may result from this alternative include oil spills, disturbance from OCS service-vessel and helicopter traffic near coastal areas, displacement from onshore pipeline landfalls, facility construction near coastal areas, and entanglement in and ingestion of offshore oil- and gas-related plastic debris.

It is estimated that the effects from the major impact-producing factors on coastal and marine birds are negligible and of nominal occurrence. As a result, there will no perceivable disturbance to Gulf coastal and marine birds.

*Conclusion*

The impact of Alternative C on nonendangered and nonthreatened coastal and marine birds is expected to result in no discernible decline in a population or species, and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to pre-disturbance condition in less than one generation.

### *(b) Endangered and Threatened Species*

The level of activity associated with the alternative is the same as the summary of infrastructure and activity described for Alternative A (Table IV-3). The sources and severity of impacts for endangered and threatened coastal and marine birds in Alternative C are the same as those discussed for Alternative A (Section IV.D.2.a.(7)). The impacts include oil spills, OCS service-vessel and helicopter traffic, onshore pipeline construction, and entanglement in and ingestion of offshore oil- and gas-related plastic debris. The effects of these activities are estimated to be primarily nonlethal, and the probability of an interaction is unlikely. Lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl.

*Conclusion*

The impact of Alternative C on endangered and threatened coastal and marine birds is expected to result in no discernible decline in a population or species, and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to pre-disturbance condition in less than one generation.

### *(8) Impacts on Commercial Fisheries*

The sources and severity of impacts to commercial fisheries in this alternative are the same as those discussed for Alternative A (Table IV-3). As noted in Section IV.D.2.a.(8) for Alternative A, effects that may result from this alternative include emplacement of production platforms, underwater OCS obstructions, production platform removals, seismic surveys, oil spills, subsurface blowouts, and OCS discharges of drilling muds.

It is estimated that the effects from the major impact-producing factors on commercial fisheries in the WPA are negligible and of nominal occurrence. As a result, there will be no perceivable disturbance to Gulf commercial fisheries.

*Conclusion*

The impact of Alternative C on commercial fisheries is expected to result in no discernible decrease in a population of commercial importance, in an essential habitat, or in commercial fisheries on a local scale. Any affected population is expected to recover to pre-disturbance conditions in less than one generation.

### *(9) Impacts on Recreational Resources and Activities*

#### *(a) Beach Use*

The sources and severity of beach use impacts associated with the offering of Alternative C are the same as the sale-related activities discussed for Alternative A. As noted in Section IV.D.2.a.(9)(a) for Alternative A, effects that may result on beach use from this alternative include oil spills and trash and debris.

No oil spills greater than or equal to 1,000 bbl and a few spills greater than 1 and less than or equal to 1-50 bbl are assumed to occur and contact a major recreational beach in the WPA (Section IV.C.3.). There will also be the intermittent effect of litter or trash associated with sale-related OCS operations. Removing tracts associated with the protected biological features (noted far offshore on Visual No. 2) will have little or no incremental effect on the amount of oil or trash and debris assumed to impact Texas coastal beaches adversely. As in the proposal, a few oil spills greater than 1 and less than or equal to 50 bbl are assumed to affect portions of WPA beaches; however, there will be little disruption of recreational activities.

*Conclusion*

The periodic loss of solid-waste items likely to wash up on recreational beaches is expected to diminish the enjoyment of some beach sites, but it is unlikely to affect the number or type of visits currently occurring on Texas beaches.

#### *(b) Marine Fishing*

The sources and severity of marine fishing impacts associated with the offering of Alternative C are the same as the sale-related activities discussed for the Alternative A. As noted in Section IV.D.2.a.(9)(b) for Alternative A, effects that may result on marine fishing from this alternative include platform installations and removals and oil spills. Offshore platforms attract fish and fishermen; explosive removal of platforms will kill or critically injure closely associated sport fish at the time of detonation; and oil spills will tend to discourage fishing.

The platform complex expected to be installed and ultimately removed in coastal Subarea W-1 will most likely be unaffected by this alternative, as all of the tract deletions associated with this alternative are in offshore Subareas W-2 and W-3, which are too far from shore to have much effect on recreational fishing. Given that a few oil spills greater than 1 and less than or equal to 50 bbl are assumed (Section IV.C.1), the impact on marine recreational fishing from this pollution will be short term and minor.

*Conclusion*

One new platform complex (2-3 structures) installed as a result of this proposal (within 30 mi of shore) is expected to attract fishermen and to improve fishing success in the immediate vicinity of the platform, lasting for a period of about 20 years.

## *(10) Impacts on Archaeological Resources*

### *(a) Historic*

The offering for lease of all WPA blocks, with the exception of 340 lease blocks offshore Corpus Christi, Texas, would result in the deletion of 12 lease blocks considered to have a high probability for the occurrence of historic archaeological resources. Given the number of lease blocks involved, adoption of the alternative will not change expected impacts from those discussed under Alternative A (Section IV.D.2.a.(10)).

Offshore development could result in an interaction between an historic shipwreck, and a drilling rig, platform, pipeline, dredging, or anchor. The result would be the loss of archaeological data on ship construction, cargo, the social organization of the vessel's crew, and the concomitant loss of information on maritime culture for the time period from which the ship dates. The probability of an OCS activity contacting and damaging a shipwreck is very low. However, if an oil and gas structure contacted an historic resource, significant or unique archaeological information could be lost. The frequency of such an occurrence, however, is expected to be low. The limited number of blocks that would be deleted if the alternative were adopted would not change the expected impacts from those found for Alternative A. The greatest impact to an historic archaeological resource as a result of the proposed action would result from a contact between an OCS offshore activity (platform installation, drilling rig emplacement, dredging and pipeline projects) and an historic shipwreck.

Because of incomplete knowledge on the location of shipwrecks in the Gulf, an OCS activity could contact a shipwreck. Although this occurrence is not probable, such an event would result in the disturbance or destruction of significant or unique historic archaeological information. Other factors associated with the proposed action are not expected to affect historic archaeological resources.

*Conclusion*

There is a very small possibility of an impact between OCS oil and gas activities and an historic shipwreck or site. Should such an impact occur, significant or unique archaeological information could be lost.

### *(b) Prehistoric*

While no prehistoric sites have been identified on the Federal OCS in the WPA, artifacts have been discovered at McFaddin Beach, Texas, but these appear to have been transported from areas offshore (CEI, 1977). Offshore development as a result of the proposed action could result in an interaction that could destroy fragile artifacts or site features and could disturb artifact provenance and site stratigraphy. The limited amount of impact to the seafloor throughout the WPA, coupled with the effectiveness of the archaeological survey and resulting archaeological clearance, is sufficient to assume a low potential for interaction between an impact-producing factor and a prehistoric archaeological site. The adoption of Alternative C will not change expected impacts from those expected under Alternative A, since the area of deferral is outside the prehistoric high-probability area. The survey and clearance provide a significant reduction in the potential for a damaging interaction between an impact-producing factor and a prehistoric site.

*Conclusion*

There is a very small possibility of an impact between oil and gas activities and a prehistoric archaeological site. Should such an impact occur, there would be damage to or loss of significant or unique archaeological information.

### *(11) Impacts on Socioeconomic Conditions*

### *(a) Population, Labor, and Employment*

Resource estimates and associated infrastructure for the proposed action in the Western Gulf, excluding 340 blocks offshore Corpus Christi, Texas, are not significantly different from those estimated for the proposed action in Alternative A. The sources and severity of impacts to population, labor, and employment are, therefore, the same as those assessed for Western Gulf Sale 143 in Alternative A. A total of approximately 24,000 person-years of employment (direct, indirect, and induced) are required in the Central and Western Gulf coastal subareas in support of Alternative C throughout its 35-year life. Peak annual changes in the population, labor, and employment of all coastal subareas in the Central and Western Gulf resulting from Alternative C represent less than 1 percent of the levels expected in absence of the proposal. The coastal communities of the Central Gulf are expected to support over 72 percent of the total employment generated by the Western Gulf sale under this alternative. Employment resulting from oil-spill clean-up activities is negligible. It is expected that employment demands in support of this alternative will be met with the existing population and available labor force.

*Conclusion*

The impact of Alternative C on the population, labor, and employment of the counties and parishes of the Central and Western Gulf coastal impact area is expected to be less than 1 percent of the levels expected in the absence of the proposal.

### *(b) Public Services and Infrastructure*

Impacts on public services and infrastructure would be related to dramatic increases or decreases in population. No positive net migration into the coastal subareas of the Central and Western Gulf is expected to occur as a result of Alternative C. It is expected that employment will occur from those currently employed in the oil and gas industry, as well as the unemployed and underemployed and the new employees already living in the area. In addition, jobs created by the proposal would likely reduce the amount of migration out of the coastal subareas when compared with scenarios without the proposal. It is expected that employees leaving public service and infrastructure-related jobs could be replaced from the existing labor pool.

*Conclusion*

Population and employment impacts that result from the proposed action under Alternative C will not result in disruptions to community infrastructure and public services beyond what is anticipated by in-place planning and development agencies.

### *(c) Social Patterns*

Impacts on social patterns would be related to dramatic changes in population and the disruption of environmental resources, as well as conditions inherent to OCS-related employment (i.e., work scheduling and rate of pay). No positive net migration into coastal subareas of the Central and Western Gulf is expected to occur as a result of the proposal. It is expected that employment will occur from those currently employed in the oil and gas industry, as well as the unemployed and underemployed and the new employees already living in the area. It is expected that jobs created by the proposal would likely reduce the amount of out-migration when compared to scenarios without the proposal. It is expected that minor displacement from traditional occupations will occur as a result of Alternative C. This displacement will be mitigated, to some extent, by the extended work schedule associated with OCS-related employment. The extended work schedule is expected to have some deleterious effects on family life in pertinent, individual cases. Impacts caused by the displacement of traditional occupations and relative wages are expected to occur to a minimal extent.

*Conclusion*

Deleterious impacts on social patterns are expected to occur in some individual cases as a result of the extended work schedule, displacement from traditional occupations, and relative wages.

## d. Impacts from Alternative D - No Action

*Description of the Alternative*

Alternative D is equivalent to cancellation of a sale projected for a specific timeframe. Sales in the Western Gulf are scheduled on an annual basis. By canceling the proposed sale, the opportunity is postponed or foregone for development of the estimated 0.05 BBO and 0.74 tcf of gas that could have resulted from proposed Sale 143 in the Western Gulf.

*Effects of the Alternative*

If Alternative D is selected, all impacts, positive and negative, associated with the proposed action would be canceled. This alternative would, therefore, result in no effect on the sensitive resources and activities discussed in Section IV.D.2.a. The incremental contribution of the proposed action to cumulative effects would also be foregone, but such effects from other activities, including other OCS sales, would remain. One contribution to cumulative effects that could increase is oil-spill risk due to the importation of foreign oil to replace the resources lost through cancellation of the proposed action.

Alternative energy strategies that could provide replacement resources for lost domestic OCS oil and gas production include energy conservation; conventional oil and gas supplies; coal; nuclear power; oil shale; tar sands; hydroelectric power; solar and geothermal energy; and imports of oil, natural gas, and LNG. These are discussed in some detail in Appendix D. A National Energy Strategy is under development by the DOE, and their interim report was published April 2, 1990. The energy equivalents that may be required from several alternative energy sources, should this lease sale be permanently canceled, are shown on Table D-8 and are based on the resources estimated by MMS to be produced as a result of the proposed action. For the purpose of clarity, this table has separately identified each potential alternative source of energy regarding substitution requirements. It is unlikely, however, that there would be a single choice between these alternatives sources, but instead, some combined effort to explore and develop further many or all of these forms as a substitute for OCS oil and gas production.

## e. Impacts of Cumulative Actions

This section analyzes "cumulative" actions, defined as other past, present, and reasonably foreseeable future actions, both Federal and nonfederal (40 CFR 1508.7) that when added with actions resulting from the proposed actions result in an incremental impact to the resources of concern. The time period that these future impacts are examined is limited to the time of the proposed actions (1993-2027), and the resources analyzed are those identified as potentially being impacted from the proposed actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. See Section IV.B. for details regarding the cumulative scenario and assumptions on which the following analyses are based.

### *(1) Impacts on Sensitive Coastal Environments*

### *(a) Coastal Barrier Beaches*

This Cumulative Analysis considers the effects of impact-producing factors related to the proposed action, plus those related to the Central Gulf proposed action, prior and future OCS sales, State oil and gas activities, other governmental and private projects and activities, and pertinent natural processes that may affect barrier features.

Specific impact-producing factors considered in the Cumulative Analysis include sediment reduction, pipeline landfalls, navigation canal and onshore facility construction, oil spills, beach protection and stabilization projects, and recreational activities.

Reductions in sediment supply along the Texas coast will continue to have a significant impact on barrier landforms. Dam construction on coastal rivers upstream has trapped sand-size sediments. The compartmentalization of the coast with groins and jetties has trapped sediment on the updrift sides of the structures. Seawall construction along eroding stretches of islands has reduced the amount of sediment introduced into the littoral system as a result of shore erosion. In addition, the Texas coast has experienced a natural decrease in sediment supply as a result of climatic changes that have occurred during the past few thousand years (Morton, 1982). In addition, the eastern part of the affected area is influenced by the sediment discharge of the Mississippi River, which has decreased by over 50 percent since the 1950's (Turner and Cahoon, 1987).

Oil spill contacts to barrier landforms can occur from a number of sources. The effects of oil spills to barrier features under the Cumulative scenario will be evaluated for OCS Program spills and for imported/onshore crude and petroleum products spills. Spills from offshore and onshore sources will be considered.

No spills greater than 1 and less than or equal to 50 bbl or spills greater than 50 and less than 1,000 bbl are assumed to occur offshore and contact barrier features as a result of OCS Program activities. The offshore occurrence of seven spills greater than or equal to 1,000 bbl is assumed to occur as a result of OCS Program activities. According to Table IV-22, the probability of occurrence and contact within 10 days from these spills ranges from 12 percent along the Chenier Plain coast in Louisiana to less than 0.5 percent along the Padre Island barriers. Spill contacts that occur along the Louisiana coast as a result of OCS Program activities have been discussed and analyzed in Section IV.D.1.a.(1)(a) and will not be covered here. Based on the probabilities in Table IV-22, this analysis assumes no contacts will occur along the Texas coast.

Onshore spills could also occur from OCS operations and contact coastal barriers. These spills could occur as a result of pipeline accidents and barge or shuttle tanker accidents during transit or offloading. Most oil terminals are located on the back side of or inland from barrier islands, so an accident there would either not likely result in contact to a barrier feature or would contact mainly the back side of the island. A barge or shuttle tanker accident in transit could occur as the vessel approached or was travelling through a barrier pass or while the vessel was traveling through the Intracoastal Waterway after entering coastal waters and making the final approach to the terminal. Under this scenario, it is assumed that a spill will contact the lagoonal, rather than the ocean side, of a barrier beach.

This analysis assumes that about six spills greater than 1 and less than or equal to 50 bbl, one spill greater than 50 and less than 1,000 bbl, and one spill greater than or equal to 1,000 bbl will occur onshore as a result of OCS Program activities. The assumption, based on an analysis of historic spill locations, which have been concentrated in the Galveston-Houston area, is assumed that two contacts to barrier landforms will occur, resulting in 10-50 km of back barrier coast contacted. Because of the low-energy environment of this setting, cleanup will be accomplished without erosion or alteration of the island configuration.

Non-OCS spills can occur as a result of import tankers, tidelands oil activities, and petroleum product spills. It is assumed that numerous spills greater than 1 and less than or equal to 50 bbl and greater than 50 and less than 1,000 bbl will occur and contact the ocean and land sides of barrier islands. Most of these spills will result in only small amounts of oiling. Eighty crude oil and product spills greater than or equal to 1,000 bbl, averaging 7,000 bbl each, are assumed to occur during the life of the proposed action from offshore and onshore sources. Numerous contacts to barrier beaches are assumed. Because of the heavy and frequent oilings of beaches in this scenario, it is assumed that cleanup operations will disturb and remove some sand, which could result in short-term (up to two years) adjustments in beach configuration if the sand is not replaced and regraded as a mitigation measure. It is assumed that about 50 km of beach will be contacted by each spill.

As discussed in Section IV.D.1.a.(1)(a), the probability that tide levels could reach or exceed the elevations of sand dune vegetation on barrier beaches ranges from 0 to 16 percent, depending on the particular coastal setting and the elevation of the vegetation. Given the higher frequency of spill occurrence and the heavier oilings from onshore spills greater than or equal to 1,000 bbl, it is assumed that the lower elevations of some sand dune vegetation will be contacted. Considering the results of an investigation of the effects of the disposal of oiled sand on dune vegetation in Texas, which disposal showed no deleterious impacts on existing vegetation or colonization of the sand by new vegetation (Webb, 1988), it is assumed that contacts to small areas of lower elevated sand dunes will not result in destabilization of the sand dune area or the barrier landform.

An area of special concern along the South Texas coast is the Padre Island National Seashore. This area is not assumed to be contacted by an oil spill because of the limited opportunities for a spill to occur near the National Seashore. No oil pipeline landfalls occur in the vicinity of these islands; no oil has been developed in the OCS areas offshore from the seashore. The closest oil port and terminal facilities are near Corpus Christi, located about 20 km to the north of the northern edge of the seashore. Furthermore, a spill that occurs in the Corpus Christi area is assumed to occur within the protected waters of Corpus Christi Bay, and oil is assumed to be introduced into the coastal current system and be carried directly to the Padre Island area.

Pipeline landfalls have been identified as possible causes of impacts to barrier landforms. A recently completed MMS study, *Pipelines, Navigation Channels and Facilities in Sensitive Coastal Habitats: An Analysis of Impacts, Coastal Gulf of Mexico* (Wicker et al., 1989), investigated pipeline emplacement impacts on barrier landforms along the Texas coast. After studying numerous landfalls within the Texas barrier island system and nearby areas of coastal Louisiana, they concluded that the direct and indirect impacts of OCS pipelines were virtually nil. At least part of the reason for this low level of impact was ascribed to a barrier island system with adequate sediment in transport and a relatively stable and firm marsh substrate behind the islands. This analysis assumes that existing pipeline crossings along the Texas and western Louisiana coasts will not result in breachings or accelerated erosion.

The addition of three new pipeline landfalls is estimated to result from future and prior OCS sales in the WPA. Current environmental regulations and pipeline emplacement techniques are sufficient for minimizing impacts from future pipeline projects.

The construction and maintenance of navigation canals through barrier island passes can have impacts on the surrounding landscape. Stabilization of these channels with jetties can interfere with longshore sediment transport, resulting in the accumulation of sediments on the updrift side of the jetty and erosion on the downdrift side. Wicker et al. (1989) have documented this effect at the Matagorda ship channel. Although no new navigation canals are expected to result from the proposed action, the ongoing impact from existing channels is likely to affect barrier landforms. The impact from navigation channels is limited to the immediate area downdrift from the channel jetties. Accelerated erosion immediately downdrift from the channel will be coupled with accretion updrift from the channel jetty. No new navigation canals are expected to be installed during the next 35 years for other purposes. The basis for this assumption is that the large number of existing navigation canals can accommodate future navigation needs.

Section IV.A.3.c.(3)(c) states that a channel in onshore Subarea W-1 (the Corpus Christi, Texas, area) will be deepened to 6.7 m (22 ft) to provide access for larger service vessels that are expected to be used in deep-water operations. Navigable barrier passes in the area exceed this depth. It is assumed that channel deepening will occur in waterways that are located behind barrier islands and provide access to support base locations. Deepening the channel will not affect barrier beaches.

Three new terminals are projected to be constructed along the coast under the Cumulative scenario (Table IV-11). Two of the terminals are assumed to be located in the industrial areas of Matagorda and Mustang Islands, the third on Matagorda Peninsula. No impacts to barrier landforms will result from the construction of these facilities.

Efforts to stabilize the Gulf shoreline have impacted barrier landscapes. Undoubtedly, efforts to stabilize the Texas coast with seawalls, groins, and jetties have contributed to coastal erosion. Although these structures stabilize the immediate areas they are designed to protect, erosion can occur away from the structure. Morton (1982) identifies coastal structures as one of the major causes of coastal erosion along the Texas coast.

The barrier islands in Texas are accessible for recreation because of their proximity to shore, their connection to the mainland in many cases, and the large population that inhabits the coastal counties in Texas. The Texas Open Beaches Act (1959) guarantees the public's right to unimpeded use of the State's beaches. It also provides for means of public acquisition of private beachfront property. Public recreation along the Texas coast is thus encouraged by the State. Recreational use of barrier islands can have impacts on the stability of the landform. Vehicle and pedestrian traffic on sand dunes can weaken the vegetation that binds and stabilizes the dune. Dunes that are affected in this way can be eroded by wind and wave forces. Judd et al. (1988) documented that as much as 18 percent of the total dune area along parts of South Padre Island had experienced damage from vehicular traffic.

*Summary*

Several impact-producing factors may threaten barrier landforms under the Cumulative scenario. The amount of sediment that is delivered to the Texas coast has decreased because of dam construction on coastal rivers, compartmentalization of the coast with groins and jetties, and a natural decrease in sediment supply as a result of climatic changes during the past several thousand years.

Pipeline landfalls have been alleged to be possible sites of accelerated shore erosion and island breaching along the Texas coast. A recently completed, MMS-funded study of pipeline landfall impacts (Wicker et al., 1989), however, documented little to no impacts of pipeline landfalls.

Oil spills from several sources could contact barrier landforms. It is assumed that several spills greater than or equal to 1,000 bbl from both onshore and offshore sources and that several smaller spills will contact coastal barriers. The impacts of the cleanup of these spills along the Texas coast could result in short-term (up to two years) adjustment in beach profiles and configurations as a result of sand removal and disturbance during cleanup operations.

Three new pipeline landfalls are projected for the Western Gulf under the Cumulative scenario. Modern techniques that do not result in noticeable impacts to coastal habitats will be used to install pipelines.

The construction and maintenance of navigation channels through barrier passes can interfere with littoral dynamics and cause localized, accelerated erosion. Wicker et al. (1989) have documented localized accelerated erosion downdrift of jetties installed to stabilize navigation channels. Localized erosion in these settings is expected to continue.

Beach stabilization projects, such as groins, jetties, and seawalls, are expected to cause accelerated coastal erosion. The impacts of fixed structures on the erosion of the barrier coast have not been quantified.

Recreational usage of barrier beaches in the Western Gulf is intense because of the proximity of the beaches to shore, their connection to the mainland, and the large population that inhabits the coastal counties in Texas.

During this century, the annual rate of coastal land loss in Texas has increased from 13 ha at the turn of the century to nearly 65 ha in 1980 (Morton, 1982). According to Wicker et al. (1989), approximately 280 km of the Texas coast are experiencing erosion. The weighted average erosion rate along this stretch of coast is

5.9 m/yr. Another 212 km of coast are experiencing aggradation at an average rate of 2.9 m/yr. The average change over the entire Texas coast has been erosional at a rate of 2.1 m/yr.

The contribution of OCS activities associated with the Cumulative scenario to coastal barrier beach impacts is expected to be very low because oil-spill cleanup operations, pipeline landfalls, and navigation channel deepening and maintenance projects will not result in large amounts of barrier beach changes.

*Conclusion*

Under the Cumulative scenario, the observed erosional trend of barrier features will continue along the Gulf Coast in the area of potential impact. The major causes of the impacts are the reduction in sediment being delivered to the coastal littoral system, sea level rise, the effects of navigational and erosion control structures, and some recreational impacts.

### *(b) Wetlands*

This Cumulative Analysis considers the effects of impact-producing factors related to the proposed action, plus those related to the Central Gulf proposed action, prior and future OCS sales, State oil and gas activities, other governmental and private projects and activities, and pertinent natural processes and events that may occur and adversely affect wetlands. As a result of these activities and processes, several impact-producing factors will contribute to impacts on wetlands during the life of the proposed action.

Oil-spill contacts to coastal wetlands can occur from a number of sources. This analysis considers spills in three size categories: greater than 1 and less than or equal to 50 bbl; greater than 50 and less than 1,000 bbl; and greater than or equal to 1,000 bbl. The effects of oil spills to wetlands under the Cumulative scenario will be evaluated for OCS Program spills and for imported/onshore crude and petroleum products spills. Spills from offshore and onshore sources will be considered.

No spills less than 1,000 bbl are assumed to occur offshore and contact wetlands as a result of OCS Program activities. Seven offshore spills greater than or equal to 1,000 bbl are assumed to occur as a result of OCS Program activities. According to Table IV-22, the probability of occurrence and contact within 10 days from these spills ranges from 12 percent along the Chenier Plain coast in Louisiana to 6 and 9 percent for the Central and East Texas wetlands respectively. Spill contacts that occur along the Louisiana coast as a result of OCS Program activities have been discussed and analyzed in Section IV.D.1.a.(1)(b) and will not be covered here. Based on the low probabilities in Table IV-22, this analysis assumes no contacts will occur along the Texas coast.

Onshore spills could also occur from OCS operations and contact coastal barriers. These spills could occur as a result of pipeline accidents or barge and shuttle tanker accidents during transit or offloading. According to Table IV-13, about two-thirds of the oil transported by pipeline will land in onshore Subarea W-2, and another one-fourth will land in Subarea W-1. The most likely area for pipeline accidents would, therefore, be in Subarea W-2. Further, according to Table IV-13, Subareas W-1 and W-2 are the most likely places for the occurrences of barge and shuttle tanker accidents. This analysis assumes that about six spills greater than 1 and less than or equal to 50 bbl, one spill greater than 50 and less than 1,000 bbl, and one spill greater than or equal to 1,000 bbl will occur onshore as a result of OCS Program activities. Most of these spills will occur in onshore Subarea W-2; the rest will occur in Subarea W-1. Assuming that a few of these spills result in contact to wetlands and that 75 percent of the oil contacts wetlands, a spill averaging 6,000 bbl could result in 32 ha of wetlands vegetation experiencing dieback and plant mortality. Most of the contacted vegetation is assumed to recover within three growing seasons. Some wetlands, particularly along channel margins, where the marsh soil is susceptible to wave attack, will be eroded.

Non-OCS spills can occur as a result of import tankers, tidelands oil activities, and petroleum product spills. It is assumed that numerous category spills less than 1,000 bbl will occur and contact wetlands. Most of these will be spills less than or equal to 1 bbl, resulting in only small amounts of oiling. Eighty crude oil and product spills greater than or equal to 1,000 bbl (7,000-bbl average) are assumed to occur during the life of the proposed action from offshore and onshore sources. Several contacts to wetlands are assumed. A few hundred or more hectares of wetlands are assumed to be affected similarly to the effects described above for the onshore OCS spills.

Under the Cumulative scenario, spills that occur in or near Padre Island and Corpus Christi could potentially contact seagrass beds. Spills in these areas could result from accidents involving import tankers and barges travelling to refineries and oil storage facilities near Corpus Christi. As discussed in the Base Case analysis (Section IV.D.1.a.(1)(b)), oil-spill impacts to seagrasses are usually buffered by the subtidal position of seagrasses, resulting in little direct contact to the seagrass vegetation from a spill. Furthermore, because so much of the seagrass biomass is contained in roots and rhizomes, which are buried in sediment, seagrasses have a high regenerative capacity when their vegetative parts are contacted by oil. Seagrass beds in the area, however, occur at shallow depths, because of which it is assumed that a spill contact will result in some vegetation dieback. Because of the large number of potential spills from barge and tanker accidents in and near Corpus Christi, it is assumed that several contacts to seagrass beds will occur and will result in grass vegetation dieback. The affected vegetation will be replaced, for the most part, with healthy new growth within one growing season. Although no to little direct permanent mortality of grass beds is assumed as a result of oil-spill occurrences, contact of seagrasses with crude and refined oil could be a causative factor in the decline of grass beds and in the observed changes in species composition within beds.

Under the Cumulative scenario, three new terminals are expected to be constructed onshore (Table IV-13). These terminals are expected to be constructed on developed industrial areas of barrier islands and on upland areas of the mainland. No impacts to wetlands are anticipated.

Three new pipelines traversing 120 km of coastal habitat are expected as a result of previous and future OCS leasing during the life of the proposed action. Wicker et al. (1989) observed no significant differences in plant cover and productivity between back-filled pipeline canal rights-of-way and nearby undisturbed wetland areas in the affected area. This analysis assumes impacts of 0.68 ha/km of onshore pipeline. Assuming the pipeline right-of-way is entirely within wetlands, up to 82 ha of wetlands could be affected.

No new navigation channels are projected under the Cumulative scenario (Table IV-13). Some deepening and maintenance dredging of existing channels may occur. Maintenance dredging could harm wetlands if the dredged material is deposited onto wetlands, resulting in burial or impoundment of marsh areas. This document assumes, however, an increasing implementation of dredged material disposal for wetland enhancement and creation during the life of the proposed action. Furthermore, according to Table IV-15, the channels used by vessel traffic associated with OCS program activities in the WPA have only a small percentage of their usage accounted for by OCS activities.

As discussed in Section IV.A.3.c.(3)(c), OCS activities in deep water are requiring larger service vessels for efficient operations. Currently, service bases in Galveston, Texas, and Berwick, Louisiana, are accessible to the larger vessels, and Empire and Cameron, Louisiana, are considered marginally usable. This document assumes that one channel in onshore Subarea W-1 (the Corpus Christi area) will be deepened to 6.7 m (22 ft). Navigable barrier passes in this area exceed this depth. It is assumed that channel deepening will occur in waterways located near support facility locations. As discussed in the analysis of impacts to wetlands in the CPA (Section IV.A.1.a.(1)(b)), the dredged material generated by the deepening project will be used to enhance wetland growth, rather than be disposed of onto spoil banks adjacent to the channel. No impacts to wetlands are therefore expected as a result of the channel deepening project.

Vessel traffic within navigation channels can cause channel bank erosion in wetland areas. An idea of the magnitude of OCS vessel traffic is provided in Tables IV-13 and IV-15, which show projected numbers of barge, service vessel, and shuttle tanker landings and dockings at various ports. Over the 35-year life of the proposed action, about 759 barge trips and 211,000 service vessel trips will occur within navigation channels. Additional vessel usage of navigation channels will be required for pipelaying barges and the movement of platforms to offshore locations. Most of this vessel traffic will use channels within the Texas (onshore Subareas W-1 and W-2) and western Louisiana coastal zone, where the impacts will be assessed. According to Johnson and Gosselink (1982), channels that have high navigational usage in coastal Louisiana widen about 1.5 m/yr more rapidly than channels that have little navigational usage (2.58 m/yr versus 0.95 m/yr). It is assumed that this figure applies to the potential impact area associated with the proposed action, even though most of this area is within the State of Texas. According to Table IV-15, there are 15 channels that are used by OCS vessel traffic related to Sale 143. The OCS usage of these channels will account for about 10 percent of the total channel traffic. Assuming that an average distance along a channel to a service base and other OCS facilities is 10 km in the area and that wetlands fringe the channel over one-half this distance, the estimate of channel erosion impacts is that about 40 ha of wetlands will be eroded along channel banks during the 35-year life of the proposed action. General navigation activity in these channels should result in at least nine times more erosion, based on the 10-percent proportion of the traffic attributed to OCS vessels.

According to Table IV-13, 602,000 bbl of produced sands and 9,322,000 bbl of drilling fluids will be transported to shore for disposal under the High Case scenario. According to USEPA information, sufficient disposal capacity exists at operating disposal sites, and no new disposal sites will be required to accommodate these wastes. Therefore, no wetland areas will be disturbed as a result of the establishment of new disposal sites. Some seepage from waste sites may occur into adjacent wetland areas and result in damage to wetland vegetation.

The WPA nonforested wetland habitat base, 245,700 ha (611,760 ac), is decreasing; however, no composite annual rate of decrease is available. Preliminary examination of available data sources indicates as much as a 35-percent loss of coastal marshes between the mid-1950's and the mid-1970's (Texas Parks and Wildlife Dept., 1989). These estimates, however, are not based on rigorous or controlled analyses of the existing data sources. Areas of most extensive wetland loss occur in the Galveston-Houston area (White et al., 1985) and the Beaumont-Port Arthur area (Gosselink et al., 1979). Observed changes in WPA wetland patterns reflect the effects of submergence on wetland habitats. Wetlands are migrating landward over terrestrial habitat while eroding along their seaward margin in response to a marine transgression. The rate of erosion exceeds the rate at which terrestrial zones are being converted to wetlands, resulting in a net loss of wetland area (White et al., 1985). The rate of wetland loss in Texas has not been quantified, although in some areas of Texas, bay shorelines are eroding by as much as 2.4 m/yr (White et al., 1985). This erosion is the result of natural processes (sea level rise), perhaps exacerbated by localized, human-induced coastal subsidence caused by fluid withdrawals (Ratzlaff, 1980).

The contribution of OCS activities associated with the Cumulative scenario to wetland impacts is expected to be very low because of the small proportion of the total impacts to wetlands that can be attributed to OCS related spills, the small percentage of the vessel usage of navigation channels that can be attributed to OCS activities, the small amount of expected new infrastructure construction in wetland areas, and the dominating importance of sediment deprivation and submergence to the wetlands loss problem.

*Summary*

Several oil spills smaller than 1,000 bbl and greater than or equal to 1,000 bbl from onshore and offshore sources are assumed to contact coastal wetlands in Texas. The combined impacts of these spills are assumed to affect up to a few hundred hectares of wetlands. In the affected areas, the vegetation could be killed back or stressed for up to two years, and accelerated erosion along marsh shorelines could occur where marsh vegetation has been affected by spilled oil. Some seagrass beds in the Corpus Christi area could be contacted by crude and refined oil. These contacts will result in some short-term dieback of the grasses and general weakening of the seagrass communities.

Onshore construction of oil and gas infrastructure is not expected to result in the conversion of wetlands to commercial land. No new navigation channels are expected to be dredged for OCS activities, although some new channels or deepening of existing channels may occur for other navigational purposes. Dredged material from maintenance dredging and channel deepening is expected to be disposed of to enhance or create wetland habitats. About 40 ha of wetlands along navigation channel margins are expected to be eroded as a result of OCS Program activities. A much larger amount of erosion is expected from general navigation activity.

Wetlands along the Texas coast and adjacent areas of Louisiana are eroding as a result of natural processes (e.g., coastal submergence). Although wetland erosion rates have not been quantified, wetland erosion has been commonly observed along the Texas coast.

*Conclusion*

Under the Cumulative scenario, losses of wetlands are expected to continue. The major cause of this loss is expected to be coastal submergence.

## *(2) Impacts on Sensitive Offshore Resources*

### *(a) Deep-water Benthic Communities*

Cumulative factors considered to impact the deep-water benthic communities of the Western Gulf include both oil- and gas-related and non-oil- and gas-related activities. The latter type of impacts includes activities such as fishing, trawling, and anchoring. However, fishing and trawling in the deeper waters of the Central and Western Gulf are minimal and impacts are minimal. Oil- and gas-related activities include pipeline and platform emplacement activities and anchoring, instances of which are expected to be higher than under the Base Case (Section IV.D.2.a.(2)(a)). This analysis considers the effects of these factors related to the proposed action and to prior and future OCS sales.

The greatest potential for adverse impacts to occur to the deep-water benthos stems from pipeline and platform emplacement and associated anchoring activities. The impacts to benthos from these activities are discussed above. As exploration and development continue on the Federal OCS, activities in the Central and Western Gulf regions have moved into the deeper water areas of the Gulf of Mexico. With this trend comes the certainty that increased development will occur in these areas, accompanied by stress to the deep-water benthos from bottom disturbances and disruption of the seafloor from associated activities. The extent of this disturbance shall be determined by the intensity of development in these deep-water regions, as well as the types of structures and mooring systems utilized. For instance, Table IV-8 indicates that in the WPA an estimated 5,280 exploration and delineation wells and 2,050 development wells will be drilled, and 140 platforms will be installed. However, as noted in Section IV.D.2.a.(2)(a) above, NTL 88-11 operates to protect high-density chemosynthetic communities in a high percentage of the cases (but not 100% of the time); for purposes of this analysis, the frequency of impact from bottom disturbance is considered to be once every six months to two years, but the severity of impact is such that the loss of elements and/or relationships will not occur.

*Summary*

The only impact-producing factor threatening the chemosynthetic communities is physical disturbance of the bottom, which would destroy the organisms comprising these communities. Only structure emplacement is considered to be a threat, and then only to the high-density (Bush Hill-type) communities; the widely distributed low-density communities would not be at risk. The provisions of NTL 88-11 (currently in effect), requiring surveys and avoidance prior to drilling, will reduce, but not completely eliminate, the risk.

Activities not related to the OCS oil and gas program include fishing, trawling, and anchoring. Because of the water depths in these areas, these activities are not expected to have any impact on the chemosynthetic communities.

The cumulative impacts are expected to be due entirely to the activities of the proposed action (as analyzed in Section IV.D.2.a.(2)(a)) because activities unrelated to the OCS oil and gas program, such as fishing, trawling, and anchoring, are not expected to have any impact on these chemosynthetic communities.

*Conclusion*

The activities associated with the Cumulative scenario are expected to cause little damage to the physical integrity, species diversity, or biological productivity of either the widespread, low-density chemosynthetic communities or the rarer, widely scattered, high-density Bush Hill-type chemosynthetic communities. Recovery from any damage is expected to take less than two years.

### *(b) Topographic Features*

Oil and gas leasing has been increasing around the topographic features of the Western Gulf, and this trend is expected to continue in the future. Of the 200 blocks in the WPA that are near the topographic features, 113 are under active lease (Appendix A). Many oil and gas operations on the previously leased blocks are subject to the provisions of a biological stipulation. The impact analysis below is presented for the proposed action and does include the Topographic Features Stipulation. These operations are not expected to have an adverse impact on the biota of the topographic features. Thus, the impact from cumulative oil and gas routine operations would be limited to those from the operations conducted as a result of any future OCS sales held without benefit of the stipulation. These impacts are estimated to be very destructive of the reef communities of the banks (Section II.B.1.c.(1)). The impacts from cumulative oil and gas routine operations include those from the operations conducted as a result of the proposed action (as explained in Section IV.D.2.a.(2)(b)). The operations include anchoring and structure emplacement, effluent discharge, blowouts, oil spills, and structure removal, future OCS sales, past sales (which include the biological stipulation of Section II.B.1.c.(1)), hurricanes, the activities of scuba divers, the collapse of the tops of the features due to dissolution of the underlying salt structure, ocean dumping, and the tankering of imported oil.

Anchor damage and damage from structure emplacement are considered to be the most serious threats to coral and coral-community areas (Bright and Rezak, 1978; Rezak and Bright, 1981). The biological stipulation on the existing leases and proposed for leases resulting from this proposed action would prohibit the anchoring of industry-related vessels and the emplacement of structures by the industry in the No Activity Zones; the potential stipulation would not affect other activities such as anchoring, fishing, or recreational scuba diving. No data are available on the extent to which such anchoring may take place; however, all three activities are known to occur in proximity to the topographic features. Nearly all the banks are near established shipping fairways. The banks are apparently well-known fishing areas. Several of the shallower cresting banks are scuba trip destinations. Anchoring at a topographic feature by a vessel involved in any of these activities would cause significant damage to the biota, and although the degree of damage would depend on the size of the anchor and chain, there is the potential for serious anchor damage to the biota of the topographic features. Treasure hunters have destroyed large areas of Bright Bank by using explosives to blast through the coral reef. The impact has been high to Bright Bank (in the Central Gulf) as a result of this blasting activity; however, such blasting is not a common event. All of the impacts described above for the Base Case would also pertain in this case. Thus, for the purpose of this analysis, the frequency of these events is judged to be once or twice each year, and the severity of the impact is considered to be such that there is no loss of elements and/or relationships. Such perturbations would last for periods from 6 months to 2 years at the regional scale and for periods of 2-5 years at the local scale. Recovery of the system to pre-interference conditions is probable.

The routine discharge of drilling muds and cuttings will greatly increase under this scenario. As noted above under the Base Case, most water-based fluids are relatively nontoxic (the more toxic effluents are not allowed to be discharged under the NPDES permit), and their effects are limited to the immediate vicinity of the discharge (NRC, 1983). No effects to the biota of the topographic features are assumed due to toxicity. Small amounts of drilling effluent may reach a bank from wells drilled more than 1,000 m away; however, these amounts from single wells, where measurable, would be extremely small and would have no effect on the biota. Effluents discharged at the water's surface within 1,000 m of a bank could impact the biota of the bank, although the currents at the banks would tend to keep the bank swept clean of fine sediments and would prevent the accumulation of drilling muds at the bank. The muds and cuttings can smother the sessile benthic invertebrates; turbidity from the discharge can reduce light levels to benthic organisms and clog the feeding mechanisms of sessile invertebrates. These conditions can lead to reduced productivity, susceptibility to infection, and mortality. The MMS, as a condition of the operational plan approval, can require the operator of a lease to perform certain measures, such as shunting, that would reduce the impacts to the biota of the banks to very low. The USEPA, through its NPDES permitting procedures, may also require mitigative measures. Current leases contain, and leases resulting from this proposed action near topographic features may contain, at the option of the Secretary, a biological stipulation that protects the biota of the bank from most impacts from oil and gas operations, but leases resulting from future lease sales may not contain this restriction. For purposes of this analysis, it is assumed that such impacts will occur once each year and that the severity of the impacts is judged to be such that there is no loss of elements and/or relationships. Such perturbations would last for short periods at both the regional and local scales. Recovery of the system to pre-interference conditions would be rapid.

There is an estimated 79-percent chance of an oil spill (1,000 bbl or greater) occurring in the Western Gulf as a result of the OCS Program Table IV-19. It is also assumed that 183 spills of greater than 1 and less than 50 bbl will occur each year, and that 7 spills greater than 50 and less than 1,000 bbl will occur during the 35-year life of the proposed action (Section IV.C.1.). It is assumed that 2 oil spills 1,000 bbl or greater will occur on the OCS from OCS oil and gas operations, with an additional 37 spills resulting from import tankering (Section IV.C.1.). Because of the water depths in which topographic features are found, no oil will reach the biota of concern. As discussed for the Base Case, blowouts are rare in the Gulf and, even if one occurred, it is assumed that any oil spilled into the water column from a blowout would reach the biota of a topographic feature. Therefore, it is assumed that no spills of any size will contact the biota of the topographic features.

Many platforms could be removed during the life of this proposal; some may be near topographic features. However, the proposed Topographic Features Stipulation (Section II.B.1.c.(1)), which has been applied in the past to all leases on or near such features and which could be applied to leases resulting from this proposed action, prevents the installation of platforms in the near vicinity of the biota of concern, thus reducing the potential for impact from this factor. Therefore, the impact from this factor would be negligible. See Section IV.A.2.a.(3) for more information regarding structure removals.

Impacts to the topographic features could occur as a result of operational discharges from import and shuttle tankers. Due to the dilution factor and the depths of the banks, this activity is expected to have a very low level of impact on the topographic features. This is also true for the very low level of ocean dumping that occurs in the Gulf (and which is being phased out).

Impacts from natural occurrences such as hurricanes are not expected to result in damage to the biota of the banks. Collapse of the crest of the banks from dissolution of the underlying salt structure is possible, but unlikely and certainly uncontrollable by human activity.

Scuba divers may visit the shallow banks, and their collecting activities may have an adverse impact on the biota of those banks. Other than anchor damage, however, such activities are not expected to have major impacts on the banks.

The other impacts to the biota of the topographic feature described above for the Base Case would also obtain here, but at a greatly increased level.

*Summary*

Those activities causing physical disturbance to the bottom of the topographic features and presenting the greatest threat to the biotic communities of the banks would be prevented by the imposition of the Topographic Features Stipulation.

Non-OCS oil and gas activities are judged to have little, if any, impact on the biota of the topographic features (except for anchoring, described in detail above). These activities include hurricanes, activities of scuba divers, the collapse of the tops of the banks, ocean dumping, and the tankering of imported oil.

Activities resulting from this proposed action, especially bottom-disturbing activities, have a potential for causing low impacts to the biota of the topographic features. While some of the activities are expected to result in lower impacts, those having the greatest impacts are also those most likely to occur.

The cumulative impact to topographic features is expected to be low. The incremental contribution of the proposed action (as analyzed in Section IV.D.2.a.(2)(b)) to the cumulative impact level is very low because of the implementation of the Topographic Features Stipulation, which would limit operational discharges and to the low probability (and thus risks) of accidental OCS-related events such as blowouts and oil spills.

*Conclusion*

The activities assumed for the Cumulative scenario are expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 $m^2$ would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks.

### *(3) Impacts on Water Quality*

*Coastal and Estuarine Waters*

The Cumulative Analysis considers the effects of low-level routine point and nonpoint source discharges, such as industry effluents, both chronic low-level and large accidental hydrocarbon and chemical discharges, and natural seepage entering the coastal or nearshore waters of the northern Gulf of Mexico. These discharges occur from urban and agricultural expansion, municipal and industrial wastes, recreational and commercial boating, maritime commerce, dredging activities, natural events, State oil and gas development activities, and the proposed action plus other OCS oil and gas development activities due to past and future sales. Section IV.B. presents information on major activities occurring in the Gulf and its coastal areas.

Those non-OCS activities that impact coastal and estuarine water quality include nonpoint source contamination, vessel traffic, dredging, and State oil and gas activities (Section IV.D.1.d.(3)). Dredging activities (Section IV.B.) associated with maintenance dredging and deepening of channels, and creation of ports, marinas, and private docks will continue to impact the Gulf's coastal waters. Maintenance dredging is ongoing, especially in major port areas (Houston Ship Channel, Galveston and Corpus Christi Bays, and Sabine Pass) and along the Gulf Intracoastal Waterway (GIWW). Dredging activities are expected to result in localized impacts (primarily elevated water column turbidities) occurring over the duration of the activity (up to several months).

Continued offshore and onshore oil and gas activities will contribute to the cumulative impacts on coastal and nearshore water quality. An unknown number of additional structures and facilities may be constructed as a result of resource development in State waters and coastal areas. The construction and operation of onshore facilities supporting domestic and international oil and gas activities may impact coastal and nearshore water quality by routine point and nonpoint source pollution. Increased effluent discharges from support facilities may contribute to point source pollution within coastal areas. Surface runoff from existing refining and processing facilities is extensive and can adversely impact the surrounding area. Because the majority of the facilities expected to support oil and gas refining and processing activities are located primarily in coastal Texas and Louisiana, impacts of chronic discharges from these sources are expected to be focused there.

Oil-field wastes generated from coastal and offshore oil and gas development activities and disposed of in the Texas and Louisiana coastal zones area may contaminate groundwater and coastal water quality. Produced waters discharged from State oil and gas activities have been substantial and have had adverse effects at many of the discharge sites. Boesch and Rabalais, (1989a) estimated that 823,575 bbl of produced waters from Texas State oil and gas activities were discharged daily into Texas State waters. At present, the State of Texas is examining the issue of produced water discharging into its coastal and nearshore waters. The estimate, based on the Boesch and Rabalais studies, is that elevated levels of salinity (50-150 ppt), dissolved and dispersed petroleum hydrocarbons (10-50 ppm), organic acids, radionuclides, and trace metals may result around sites discharging into coastal and nearshore waters. Concentrations of the organic constituents will depend on the separation and treatment technologies employed. Substantial hydrocarbon contamination of fine-grained sediments may extend out from several hundred meters to over one kilometer from the point of discharge. Concentrations of aromatic hydrocarbons in sediments may exceed background levels by over an order of magnitude.

It is assumed that 37 oil spills greater than or equal to 1,000 bbl will occur from import tankering in the Gulf of Mexico during the life of the proposal. The average size of an import tanker spill is estimated at 30,000 bbl. Eight import spills (approximate size of 7,665 bbl) are assumed to occur in nearshore waters and in port areas. The Houston-Galveston port area is assumed to receive the greatest number of these spills. Another 44 spills (average size of 10,000 bbl) are estimated to occur in the Texas coastal zone from coastwise movement of petroleum products. Most of these spills are assumed to occur in the GIWW. Petroleum hydrocarbons introduced into marine and coastal waters may have varied effects depending on the resource impacted, stage of weathering, and local physical and meteorological conditions. Some crude oil components are highly toxic and may cause damage to marine organisms due to the crude's aromatic content. It is expected that encountered, normal weathering processes will detoxify the oil by breaking down its toxic components. Background levels in the Gulf of Mexico were reported at 0-70 $\mu g/l$. In shallow areas, oil may become entrained in suspended particles and bottom sediments, and subsequently be reintroduced into the water column. The assumption, based on these estimates and the frequent nature of spills over the life of the proposal, is that the effect of hydrocarbon contamination on the Gulf's coastal waters due to the proposed action is considered negligible, with water characteristics rapidly returning to background levels within several days to weeks.

With regard to OCS-related activities, within the Gulf's coastal zone, much of the existing infrastructure supporting offshore OCS oil and gas activities is distributed throughout coastal Texas and Louisiana. About 90 percent of the existing capacity or frequency usage of the oil industry infrastructure will support OCS operations in the future. The addition of three new pipeline landfalls (W-1), 120 km of onshore pipelines (80 km in W-1 and 40 km in W-2), and three new terminals (W-1) is estimated to result from the cumulative OCS activities in the WPA. Both the use of new oil and gas facilities once constructed and the use of the existing facility network would contribute to the number of effluents expected to be discharged into coastal waters from petroleum activities primarily in the Louisiana coastal zone. The construction and operation of onshore facilities supporting OCS activities may impact coastal and nearshore water quality by routine point and nonpoint source pollution. Increased effluent discharges from support facilities may contribute to point source pollution within coastal areas. These effluents are commonly discharged into surface waters after treatment. Surface runoff from existing OCS facilities is extensive and can adversely impact the surrounding area. Runoff from these facilities is likely to contain oil, brine, particulate matter, heavy metals, petroleum products, process chemicals, and soluble inorganic and organic compounds leached from the soil surface. Aside from adding contaminants to coastal waters, runoff from such facilities may alter circulation in wetland areas and affect flushing rates and salinity gradients. Because the majority of the facilities expected to support offshore oil and gas activities are located in Texas and Louisiana, impacts of chronic discharges from these sources are expected to be focused there.

Vessel traffic associated with OCS oil and gas industry activities is expected to be extensive in the Texas and Louisiana coastal areas, especially within the Mississippi Delta area. Approximately 211,000 service vessel trips are estimated to support cumulative OCS activities in the WPA. Waterways along the Texas coast, where projected service vessel traffic will be the greatest, include Houston-Galveston Ship Channel, Sabine Pass, and Aransas Pass. The other navigation channels will have significant but less OCS vessel traffic. Import tankering and barge trips (759 barge vessel trips related to OCS production activities) carrying both domestic and imported crude oil and products between terminals and refineries along the GIWW, adjoining navigation channels, and along coastal nearshore fairways will add to this traffic. Shuttle tankering associated with OCS production in the WPA will result in 960 trips. While inshore, service vessels are estimated to discharge approximately 3,000 liters of bilge water per trip in support of OCS-related activities. An estimated 669 billion liters (5 million liters/day) will be discharged into coastal waters of the WPA from vessels supporting OCS activities. Discharges from service boats and barges, although diluted and discharged slowly over large lengths of channel, will be great enough to result in some water quality degradation in the traversed navigation channels and GIWW. As noted in Alternative A, antifouling paints used on boats and tankers have been shown to have toxic effects on some marine biota. Increased loadings within coastal waters of tributyltin and copper compounds contained in antifouling paints are expected. Ballast and bilge waters from shuttle tankers are assumed to be discharged at onshore reception facilities and are not expected to impact coastal water quality. Operational discharges from shuttle tankering offshore are expected to add to the overall hydrocarbon contamination of nearshore open waters. Tarballs formed from these service vessel discharges will impact the Gulf's coastal beaches. Because no new service base locations are projected for OCS activities, and none is likely for State activities, operational discharges associated with OCS service vessel traffic will not impact coastal water quality. Impacts from such sources are substantial enough to cause low-level effects when discharged into confined waters over a long time period. Impacts to open waters are expected to be negligible.

No new navigation channels are expected to be dredged; however, maintenance dredging of major navigation channels and deepening of some channels to support service vessel traffic are expected to result. Dredging activities are expected to result in localized impacts (primarily elevated water column turbidities) occurring over the duration of the activities (up to several months). Such activities would preclude some recreational and commercial uses within the immediate area. The periods for expected dredging operations will generally allow for the recovery of affected areas between such activities. Impacts from dredging are expected to be somewhat higher near the mouths of major rivers, where sediment inputs are greater. Approximately 120 km of new pipelines are projected to be constructed in association with OCS activities; 98 percent of the oil and all of the gas produced will be transported ashore via the existing pipeline network. Pipelines reduce the need for barge and truck transport of petroleum and the potential for transfer spills. The environmental effects associated with chronic pipeline leakage and malfunction are generally considered small (USDOC, NOAA, 1985). Given this and the small percentage of use of the existing pipeline network in support of the proposed action, impacts from leakage and hydrologic alterations associated with pipelines are considered negligible.

It is assumed that 18 percent of the drilling muds (9.3 MMbbl) associated with sale-related drilling activities and 602,000 MMbbl of produced sand will be brought ashore for disposal. The improper storage and disposal of such oil-field wastes and contaminated oil-field equipment could result in adverse impacts to surface and ground waters in proximity to disposal facilities, cleaning sites, and scrap yards. Many of these wastes may be contaminated by NORM. Improper design and maintenance of such facilities could result in adverse impacts to these waters. The quantities of many wastes attributable to OCS activities, and more specifically the proposed action, are largely unknown, as are the associated environmental consequences and health risks.

Under the Cumulative scenario, two oil spills greater than or equal to 1,000 bbl would occur in the northwestern Gulf offshore Texas. One of these oil spills would originate from a pipeline, whereas the other would originate from a platform. The average size of these spills is 6,500 bbl. It is assumed that as much as 75 percent of the original volume of oil from the spill source would be lost as a result of weathering processes by the time the slick contacts the coast. It should be noted that there could be some effects from residual weathered oil that could reach coastal waters following a spill event, primarily in the form of tar material. Impacts from low-level contamination were discussed earlier. It is further assumed that 7 oil spills greater than 50 and less than 1,000 bbl and 183 oil spills greater than 1 and less than or equal to 50 bbl could occur from OCS pipeline, platform, and transportation sources within the WPA. Of these, it is assumed that few would contact coastal and estuarine waters. An additional 88 spills (less than 50 bbl--average size of 34 bbl) are assumed to occur in the WPA from spills related to the use of diesel and other potential pollutants. The effects of oil spills on coastal and marine waters were discussed previously under import spills.

Petroleum product spills are of great concern because the refined products of crude oil are often more toxic than crude itself. In general, refined oils are considered more toxic than crude due to the higher concentration of aromatic hydrocarbons and their greater ability to dissolve and disperse into the water column as a result of their less viscous nature. Refined oil, such as gasoline and kerosene, is assumed to cause biological damage due to its toxicity over a relatively short period of time. Up to 44 petroleum product spills (average size 10,000 bbl) and another 500 smaller spills (most are less than 1 bbl) will occur in the WPA. Of these, most will occur in Louisiana port areas, along the GIWW, and near the Gulf coastline.

*Summary*

Routine point and nonpoint source discharges from non-OCS activities, such as agriculture, general construction projects, hydromodification, silviculture, septic tank leakage, urban runoff, and especially oil and gas activities will degrade coastal and estuarine waters within the Gulf of Mexico's coastal zone. In addition, maritime activities are expected to contribute to the degradation of waters near ports and major navigation channels. Total hydrocarbon concentrations measured in Gulf of Mexico oyster and sediment samples from the NOAA Status and Trends Program were generally lower than hydrocarbon concentrations at east and west U.S. coast locations, probably because the sites in the Gulf are farther removed from point sources. The following conclusions about hydrocarbon contamination can be made from the study: (a) chronic petroleum contamination is taking place, possibly from oil and gas operations along the Gulf of Mexico coastline, but also due to contamination of the discharge from the Mississippi River; and (b) water quality degradation is not taking place to such an extent to show marked increases over U.S. coastal areas that do not have as many oil operations.

All existing onshore infrastructure and associated coastal activities occurring in support of the proposed action will contribute to the degradation of regional coastal and nearshore water quality to a minor extent because each provides a low measure of continuous contamination and because discharge locations are widespread throughout the Gulf Region. The effect of chronic contamination on the Gulf's coastal waters due to the proposed action is considered negligible, with water characteristics rapidly returning to background levels. The OCS-related vessel traffic is assumed to impact water quality through routine releases of bilge and ballast waters, chronic fuel and tank spills, trash, and low-level releases of the contaminants in antifouling paints. Depending on the length of the affected channel, flushing rates, etc., it is expected that there will be some localized short-term change (up to several weeks) in water quality characteristics from background levels. The improper storage and disposal of oil-field wastes and contaminated oil-field equipment would adversely impact surface and ground waters in proximity to disposal facilities, cleaning sites, and scrap yards. Surface and groundwater in proximity to improperly designed and maintained disposal sites and facilities could be adversely impacted with elevated concentrations of arsenic, chromium, zinc, cadmium, mercury, lead, barium, penta-chlorophenol, naphthalene, benzene, toluene, and radium.

Accidental spills will introduce oil into nearshore waters, creating elevated hydrocarbon levels (up to 100+ $\mu$g/l) within affected waters. Much of the oil would be dispersed throughout the water column over several days to weeks. In shallow areas, oil may become entrained in suspended particles and bottom sediments. Water uses would be affected for up to several weeks from proposed spills and then only near the source of slick. Other spills will occur from import tankering, transporting oil products throughout the Gulf, barging crude oil, etc. Refined oils are considered more toxic than crude due to the higher concentration of aromatic hydrocarbons and their greater ability to dissolve and disperse into the water column as a result of their less viscous nature. Products such as gasoline and kerosene are assumed to cause biological damage due to their toxicity over a relatively short period of time.

*Marine Waters*

This Cumulative Analysis considers the effects of impact-producing factors related to the proposed action, plus those related to tankering and other vessel traffic, the Strategic Petroleum Reserve Program (SPRP), and industrial waste disposal activities that may occur and adversely affect the offshore water quality in the northern Gulf of Mexico. Specific types of impact-producing factors considered in the analysis include well-drilling discharges, pipeline emplacement, hydrocarbon production formation waters, dredging, accidental oil spillage, routine operational discharges, ocean disposal of hazardous material, and industrial waste discharges.

Those non-OCS factors that impact marine water quality include marine transportation, ocean dumping, and the Strategic Petroleum Reserve Program (Section IV.D.1.d.(3)).

Spills from import tankering (average spill size 30,000 bbl) and Gulfwide OCS activities may affect offshore water quality as indicated (see previous discussion under Coastal and Estuarine Waters). It is assumed that 37 oil spills greater than or equal to 1,000 bbl will occur from import tankering in the Gulf of Mexico during the life of the proposal.

With regard to OCS activities, as indicated in the Base Case analyses, immediate effects would be brought about by increased drilling, construction and pipelaying activities, causing an increase in water column turbidities to the affected offshore waters. Pipeline construction activities may result in the resuspension of some 1.2 million yd$^3$ of sediment. Offshore Subarea W-1 will support the greatest portion of program-related pipeline burial activities and associated sediment resuspension, with 701,000 yd$^3$. Pipeline construction activities may result in the resuspension of settled pollutants, toxic heavy metals, and pesticides, if present. Impacts resulting from resuspension of bottom sediments following an explosive structure removal include increased water turbidity and mobilization of sediments containing hydrocarbon extraction waste (drill mud, cuttings, etc.) in the water column. The discharge of 19.7 MMm$^3$ of NPDES-regulated, treated sanitary and domestic wastes from the various rigs and platforms will increase levels of suspended solids, nutrients, chlorine and BOD near the point of discharge. These are considered minor discharges and are quickly diluted. Treated deck drainage and domestic wastes are most often taken ashore for proper disposal at an approved site. Up to 2.4 Bbbl of produced waters are estimated to result from cumulative OCS activities in the WPA. Offshore Subarea W-3 will receive the greatest number of these discharges with 1.54 Bbbl. From the findings of investigators, MMS expects the effects of these discharges on offshore water quality to be limited to an area in proximity to the discharge source.

Some 51.5 MMbbl of drilling muds and 12.7 million $yd^3$ of drill cuttings are estimated to result from drilling activities associated with the cumulative OCS activities in the WPA. As indicated in the Base Case analyses, it is assumed that 18 percent of all muds used (9.3 MMbbl) will be brought ashore for disposal. Drilling muds and cuttings are routinely discharged into offshore waters and are regulated by NPDES permits. As with produced-water discharges, offshore Subarea W-3 would receive the greatest percentage of these potential discharges, with an estimated 28.6 MMbbl of drilling muds and 7.2 million $yd^3$ of cuttings that could be potentially discharged offshore. When discharged into the surrounding offshore waters, drilling muds may create turbidity plumes several hundred meters in length. Studies indicate that these impacts are restricted to an area within 300-500 m of the discharge site. Dilution is extremely rapid in offshore waters. A 1983 NRC study suggests that for routine oil and gas discharges, the various components measured, including turbidity, are at background levels by a distance of 1,000-2,000 m. As in the Alternative A analysis, the natural processes of dispersion, degradation, and sedimentation will result in immeasurably low concentrations of these materials within a few meters to a few kilometers of the discharge site.

It has been recognized that spills of hazardous materials may, in many cases, pose a more serious threat to marine ecosystems than oil spills. Substantial amounts of oil and hazardous materials enter the marine environment as a result of accidental spills. Alternative A analyzes the severity of oil spills to water quality in general. Program-related spills are discussed in the previous section under Coastal and Estuarine Waters. It is assumed that 44 petroleum product spills (10,000 bbl in size) will occur in the WPA from OCS-related activities. As previously noted refined oils are considered more toxic than crude due to the higher concentration of aromatic hydrocarbons and their greater ability to dissolve and disperse into the water column as a result of their less viscous nature. Products such as gasoline and kerosene are assumed to cause biological damage due to their toxicity over a relatively short period of time. Although the focus in the past has been on the cleanup and mitigation of spilled oil, national attention has been shifting toward hazardous materials as the cause for most immediate concern. Much has been learned in the past 10 years about how to respond to oil spills; far less is known for spills of hazardous material. Unlike oil, whose properties are fairly uniform, hazardous materials have a wide variety of physical and chemical forms, complicating and making the response necessary for their cleanup and disposal much more difficult. Methods for the cleanup and mitigation of hazardous materials are not well established.

*Summary*

Those activities that would impact the Gulf's marine waters include marine transportation and OCS oil and gas activities. Vessels range from small recreational craft used primarily in coastal waters to defense-related naval vessels and ships of the merchant marine fleet up to several hundred thousand tons in size. Pollutants from vessel traffic include large amounts of domestic waste products such as sewage, food waste, and trash from the human activities on board. Other problems are related to the movement of crude oil and concern offshore unloading terminals (deep-water ports).

With regard to OCS activities, immediate effects would be brought about by increased drilling, construction and pipelaying activities, causing an increase in water column turbidities (lasting for several weeks) to the affected offshore waters. The magnitude and extent of turbidity increases would depend on the hydrographic parameters of the area, nature and duration of the activity, and bottom-material size and composition. Offshore Texas would receive the greatest portion of program-related pipeline burial activities, whereas offshore Louisiana would receive the largest amounts of program-related operational discharges. Because of the continuous nature of oil and gas activities in the northwestern and north-central Gulf of Mexico, the frequency of drilling mud and cutting and produced-water discharges is judged to occur nearly continuously throughout these areas. Proposed produced water discharges will be rapidly diluted within the immediate vicinity of the discharge source. Significant increases in water concentrations of dissolved and particulate hydrocarbons and trace metals are not expected outside the initial mixing zone or the immediate vicinity of the discharge source. Higher concentrations of trace metals, salinity, temperature, organic compounds, and radionuclides, and lower dissolved oxygen may be present near the discharge source. Within the mixing zone of the discharge, long-term effects to water column processes, consisting of localized increases in particulate metal and soluble lower molecular weight hydrocarbon (e.g., benzene, toluene, and xylenes) concentrations, may be expected. Trace metals and hydrocarbons associated with the discharge may be deposited within sediments near the discharge point. The proposed discharge of drilling fluids and cuttings would encounter rapid dispersion in marine waters. Discharge plumes will be diluted to background levels within a period of several hours and/or within several hundred meters of the discharge source. The accumulation of toxic trace metals and hydrocarbons in exposed shelf waters, due to periodic releases of water-based generic muds and cuttings, is unlikely, and the long-term degradation of the water column from such discharges is not a major concern. No effects to water uses from routine activities and discharges are expected.

Program-related and nonrelated crude oil spills will introduce oil into offshore waters and create elevated hydrocarbon levels (up to 100+ $\mu$g/l) within affected waters. Much of the oil will be dispersed throughout the water column over several days to weeks. Little effect to water use is expected from these spills, and then only in an area near the source and slick. Other spills will occur from import tankering (including oil from the TransAlaskan Pipeline), transporting oil products throughout the Gulf, barging crude oil, etc. Refined oils are considered more toxic than crude due to the higher concentration of aromatic hydrocarbons and their greater ability to dissolve and disperse into the water column as a result of their less viscous nature. Products such as gasoline and kerosene are assumed to cause biological damage due to their toxicity over a relatively short period of time.

*Conclusion*

Cumulative demands resulting from the proposal are expected to result in significant changes to the ambient concentration of one or more water quality parameters, up to several hundred meters from the source of activities and for a period lasting up to several weeks or months in duration. In marine waters and well-flushed coastal water bodies, this change will be less noticeable due to rapid dilution and dispersion of contaminants. Chronic, low-level pollution related to the proposal will occur throughout the 35-year life of the proposal. Overall cumulative impacts, which include the effects of non-OCS-related factors (routine point and nonpoint source discharges from agriculture, general construction projects, hydromodification, silviculture, septic tank leakage, urban runoff and State oil and gas activities) and OCS activities will significantly degrade water quality, primarily within the Gulf of Mexico's coastal zone in highly urbanized and industrialized coastal areas. Maritime activities are expected to contribute to water quality degradation near ports and major navigation channels. In restricted or poorly flushed coastal waterbodies, localized increases in pollutant concentrations (nutrients, organic matter, trace metals, organotins, hydrocarbons, etc.) may be severe and persist for months or longer. Low dissolved oxygen levels will result in localized hypoxia in the coastal and nearshore waters. As indicated above, water quality degradation will be less noticeable in marine waters and well-flushed coastal water bodies due to rapid dilution and dispersion of contaminants. Chronic, low-level pollution will continue to persist in marine and coastal waters.

### *(4) Impacts on Air Quality*

The Cumulative Analysis considers the impacts from the following factors and/or activities: the proposed action, past and future OCS sales, power generation, industrial activities, and transport in the WPA.

The scenario discussed in Section IV.A. (Table IV-8) for the Cumulative Case establishes that 5,280 exploration and delineation wells and 2,050 development wells would be drilled, and 140 platform complexes would be emplaced. The sale area has been subdivided into three offshore subareas: W-1, W-2, and W-3 (Figure IV-1). This discussion analyzes the potential degrading effects of OCS-related activities on air quality in each subarea. Table IV-8 presents for the Cumulative scenario the numbers of exploration, delineation, and development wells; platforms installed; and service vessel and helicopter trips for each subarea. The following table shows total emissions from wells, platforms, vessels, and other OCS-related activities in the WPA for the Cumulative Case. Observe that $NO_x$ is the most emitted pollutant, while $SO_x$ is the least emitted. More important is that this information shows that wells and vessels contribute mostly $NO_x$; platforms contribute mostly $NO_x$, CO, and VOC. These emissions were calculated by adding the emissions from wells and platform complexes over time. Emissions of vessels were calculated using the total number of service vessel trips presented in Table IV-8.

Total OCS Emissions in the WPA
(tons over the 35-year life of the proposed action--Cumulative Case)

| Activity | $NO_x$ | CO | $SO_x$ | THC | TSP |
|---|---|---|---|---|---|
| Service Vessels | 71,114.8 | 8,331.2 | 1,123.6 | 3,618.9 | 5,017.1 |
| LTO Helicopters | 512.9 | 414.2 | 78.9 | 21.4 | 19.7 |
| Cruise Helicopters | 1,656.9 | 4,734.0 | 355.1 | 385.9 | 473.4 |
| Blowouts without Fire | 0.0 | 0.0 | 0.0 | 24.2 | 0.0 |
| Spills without Fire | 0.0 | 0.0 | 0.0 | 510.0 | 0.0 |
| Barge Loading | 0.0 | 0.0 | 0.0 | 299.8 | 0.0 |
| Tanker Loading | 0.0 | 0.0 | 0.0 | 3,298.2 | 0.0 |
| Transit Loss | 0.0 | 0.0 | 0.0 | 2,835.8 | 0.0 |
| Tanker Exhaust | 2,193.3 | 239.8 | 2,724.5 | 3.6 | 788.2 |
| Tug Exhaust | 1,372.0 | 136.7 | 17.7 | 61.8 | 82.3 |
| Exploratory Wells | 50,815.9 | 13,557.9 | 5,938.2 | 1,471.4 | 5,097.3 |
| Development Wells | 14,678.0 | 3,915.5 | 1,722.0 | 74 430.5 | 1,476.0 |
| Platforms | 212,752.8 | 27,713.7 | 372.2 | 80,635.2 | 521.0 |
| Totals | 355,096.6 | 59,043.0 | 12,332.2 | 93,596.7 | 13,475.0 |

Total emissions for each subarea in the WPA during the Cumulative Case are presented below. Observe that Subareas W-1 and W-2, which are closest to land, generate the largest emissions, while Subarea W-3 generates the smallest amounts of all pollutant emissions.

Total Emissions in WPA Subareas
(tons over the 35-year life of the proposed action--Cumulative Case)

| Pollutant | W-1 | W-2 | W-3 |
|---|---|---|---|
| $NO_x$ | 146,431.6 | 142,770.8 | 65,894.2 |
| CO | 24,347.6 | 23,738.9 | 10,956.4 |
| $SO_x$ | 5,085.4 | 4,958.3 | 2,288.4 |
| THC | 38,596.6 | 37,631.7 | 17,368.5 |
| TSP | 5,556.7 | 5,417.8 | 2,500.5 |

The total pollutant emissions per year are not uniform. During the early years of the OCS program activities, emissions would be large and decrease over time as reserves and production decrease. After a maximum, emissions would decrease rapidly as platforms, wells, and service vessel trips decrease to a minimum.

The following table presents peak emissions of primary pollutants from OCS programmatic activities in tons per year. It is very important to note that well drilling activities and platform peak emissions are not necessarily simultaneous. However, it is assumed that peak emissions from service vessels and other activities and well and platform peak emissions occur simultaneously. In this analysis the aggregate peak emissions, which are generally larger than average emissions, will be employed. Use of peak emissions results in conservative impact level estimates from the OCS program activities.

Mean and Peak Emissions in the WPA
(tons/year)

| Pollutant | Wells | Platforms | Vessels | Others | Mean | Aggregate |
|---|---|---|---|---|---|---|
| $NO_x$ | 4,438.95 | 8,306.56 | 2,195.71 | 0.00 | 10,145.60 | 13,304.61 |
| CO | 1,184.30 | 1,082.03 | 395.88 | 0.00 | 1,686.94 | 2,419.68 |
| $SO_x$ | 519.05 | 14.53 | 122.85 | 0.00 | 352.35 | 628.75 |
| THC | 128.80 | 3,148.26 | 116.90 | 244.51 | 2,719.61 | 3,567.41 |
| TSP | 445.45 | 20.34 | 182.31 | 0.00 | 385.00 | 623.01 |

The mean emissions were computed by dividing the total emissions by the 35-year life of the proposed action. Peak emissions from wells and platforms are obtained from their temporal distribution. Platforms and wells have the greatest peak emissions, while vessels and other OCS-related activities have smaller emissions. This phenomenon is contrary to the emission rates, where wells have greater rates than platforms.

The effects of the pollutants considered in this analysis were described in the Base Case analysis and will not be repeated here. The reader may consult that section.

Because the meteorological conditions described in the Base Case will not change for this analysis, neither will they be repeated. The only changes that occur in the Cumulative Case are those related to infrastructures and resources. These changes are reflected in an increase of emissions for all analyzed pollutants. A comparison of Cumulative Case emissions per year with those of the Base Case shows that these Cumulative emissions are 10-15 times greater.

To estimate the potential impact of offshore emissions on offshore and onshore air quality, a steady state box model was employed (Lyons and Scott, 1990). The model is an expression of mass conservation and assumes that pollutants are vertically dispersed and sources uniformly distributed. For the purpose of these air quality analyses, an assumption of uniform distribution of average size sources throughout the planning areas at this early stage is a reasonable approach. Predominance of unstable atmospheric conditions over the sea, as discussed in Section III.A.2., ensures that pollutants are dispersed homogeneously. The model was applied to $NO_x$ emissions because these are the largest emissions. Because VOC emissions are not inert, the box model cannot be used to assess their impacts on air quality. Concentrations for other pollutants can be estimated by multiplying the $NO_x$ concentrations by the ratio of the pollutant emissions over the $NO_x$ emissions. Concentrations of primary pollutants other than $NO_x$ would be smaller by more than 75 percent. Impacts from VOC and CO will be estimated by comparing the offshore and onshore emission rates.

The box model was applied to the following conditions: onshore and offshore winds with speeds ranging from 1 to 7 $m/s^{-1}$, a mean mixing height of 900 m, and a low mixing height of 300 m. During offshore wind conditions, impacts to the onshore air quality from offshore WPA emissions are very low because the pollutants are transported offshore. Conditions of onshore winds indicate that concentrations reaching land from Subarea W-1 varied between 2.42 and 0.26 $\mu gm^{-3}$ for speeds from 1 to 7 $ms^{-1}$ and a mixing height of 900 m; for a 300-m mixing height, concentrations varied from 7.26 to 0.77 $\mu gm^{-3}$ under the same wind speeds. Concentrations for pollutants other than VOC would be smaller, as indicated above. Impacts to air quality from $NO_x$ are low because the only ambient concentration near the coastal area is well below the national standard, and the OCS contributions will not exceed it. Impacts from CO, $SO_x$, and TSP are low because the concentrations arriving onshore do not exceed national standards when these contributions are added to the existing ambient concentrations presented in Section III.A.3. for Texas. The MMS regulations (30 CFR 250.44) do not establish annual significance levels for CO and VOC. For these pollutants, a comparison of emission rates will be used to assess impacts. Formulas to compute the emission rates in tons/yr for CO are $3,400 \cdot D^{2/3}$ and $33.3 \cdot D$ for VOC. In these formulas, D represents distance in statute miles from the shoreline to the source. The CO exempt emission level in Subarea W-1 is 15,781.4 tons/yr, which is greater than peak emissions from the whole WPA. Therefore, CO impacts on air quality will be low. The exemption emission level of VOC in Subarea W-1 is 333 tons/yr, while the platform emission level is estimated at 30.7 tons/yr. Therefore, VOC impacts to air quality would be low.

Transport of pollutants toward onshore areas has a maximum frequency of 85 percent during summer and only 34 percent during winter. Thus, the box model results are very conservative estimates of pollutant contributions to the onshore air quality status. The modeling effort does not consider removal processes such as rain, which in the WPA has a high frequency (Section III.A.2.) and would reduce impact levels to onshore air quality.

The MMS has also studied the impacts of offshore emissions using the OCD Model (USDOI, MMS, 1986a). The study was conducted off the Galveston, Brazos, and High Island Areas, Texas, using 250 offshore sources and employing a 300-m mixing height, which coincides with the lower mixing height employed in the box model. The model run in this study represents an aggregation of all sources. The annual arithmetic mean varied between 0.82 and 1.83 $\mu gm^{-3}$, which is below the national standard of 100 $\mu gm^{-3}$. All other inert pollutants would have lower concentrations.

A recent dispersion analysis of $NO_x$ emissions from 47 OCS sources, which included 31 existing sources and 16 proposed platforms, along the Texas offshore area was completed (USDOI, MMS, 1991c). Annual average concentrations peaked around 0.08 $\mu gm^{-3}$ and the highest 1-hour concentration never exceeded 2.31 $\mu gm^{-3}$. These results indicate that OCS contributions to onshore air quality problems are small. Therefore, it is reasonable to assume that mean hourly concentrations derived from emissions associated with OCS program activities (2.42 $\mu gm^{-3}$) and spread over 145.3 billion square meters would have a moderate effect.

Oil-spill effects on air quality are examined below. It is assumed that oil spills in the category greater than and equal to 50 bbl, or less than 50 bbl, as well as greater than 50 bbl and less than 1,000 bbl, would have low impacts on air quality because their input of pollutants (it is assumed that 50% of the spill evaporates in three days) would be very small. Information from OCS accidents indicates emissions of fewer than 100 tons/hr by the second hour. For spills greater than or equal to 1,000 bbl, emissions are about 285 tons/hr or smaller. If the dispersion of emissions is taken into account, effects on offshore air quality would be temporary.

Nearly 12 percent of OCS crude-oil production is offloaded from surface vessels at ports. The unintentional emissions from these offloading operations are estimated to be 3,598 tons, which represent less than 1.1 percent of the total VOC emissions and are considered negligible in the WPA. Towboat emissions in these operations are expected to produce negligible effects on air quality.

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 used in this analysis represents the equivalent diameter, which is the diameter of a sphere that will 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 less than 2 $\mu m$ and a third peak with a diameter larger than 2 $\mu m$. Particles with diameters of 2 $\mu m$ or larger settle very close to the source (residence time of approximately ½ day, Lyons and Scott, 1990), so their impact on these areas would be low. For particles smaller than 2 $\mu m$, which do not settle fast, wind transport determines their impacts. Results from the box model indicate that the largest concentration for TSP will be 0.34 $\mu gm^{-3}$, which is less than the allowable annual increase level of 5 $\mu gm^{-3}$. Besides, Section III.A.3. indicates that in the coastal areas the suspended particulate matter is around 50 $\mu gm^{-3}$ and the national standard is 150 $\mu gm^{-3}$, making the OCS contribution unimportant. Therefore, suspended matter would have a small effect on the visibility of PSD Class I areas.

Ozone is of great concern because of its environmental considerations. In the WPA five counties have nonattainment status for this pollutant (Section III.A.3.). Ozone measurements (Texas Air Control Board, 1989) in 1988 were discussed in Section III.A.3. and details will not be repeated here. Concentrations at three coastal sites indicate that the national standard was exceeded in two (Houston and the Beaumont-Port Arthur-Brazoria area), and the third was a border case (Corpus Christi). However, impacts from OCS activities cannot be assessed because ozone is not emitted but formed by photochemical processes, which were not modeled in this analysis.

The amount of power generation is very difficult to predict because it depends on many nonquantifiable factors. Therefore, different sets of assumptions result in different estimates. The envelope of predictions shows that energy consumption should increase up to the year 2010; after this, predictions show more variation but generally indicate an increase of energy consumption. Because energy production is the largest single pollutant generator, it is safe to assume that emissions must also increase (USDOE, 1990). However, advances in control technology and the use of alternative energy sources can change the correlation between energy production and emissions. The available information (USDOE, 1990) indicates that $SO_x$ emissions from energy generation decreased 16.4 percent between 1970 and 1987. Other pollutants that showed a decrease over the 1970-1987 period are particulate matter and $NO_x$. Although CO and VOC increased over the same period, the overall amount of emitted pollutants decreased.

Emissions of the primary pollutants related to industrial activities decreased over the 1970-1987 period. The reduction in the total amount of pollutants was 51 percent (Godish, 1991). The projected increase in employment (Section III.C.2.) can be interpreted as an increase of industrial activities. However, if the decreasing trend of emissions holds during the next 35 years, it is safe to assume that industrial emissions would not increase; or, at worst, they would remain at the present levels.

Transportation-related emissions are an important consideration in regard to inshore air quality because vehicles constitute the second largest emitters of $SO_2$ and $NO_x$ and the largest source of carbon monoxide (USDOE, 1990). Emissions of particulate matter and $SO_x$ increased, while $NO_x$ emissions remained the same over the 1970-1987 period. Emissions of CO and hydrocarbons decreased over the same period. The overall emissions showed a reduction of almost 44 percent during the 1970-1987 period (Godish, 1991). Vehicular use is population-dependent and the demographic trends through most of the 1980's have shown a population decrease in most Gulf Coast States. A recent projection for MMS (Section III.C.2.) indicates that this trend will be reversed, and population will increase. Thus, vehicular use will increase, but as the consequence of advances in fuel efficiency, alternative gasoline developments, and better emission controls, emissions will probably decrease or, at worse, remain at the same level.

Blowouts are accidents related to OCS activities and are defined as an uncontrolled flow of fluids from a wellhead or wellbore. In the Gulf of Mexico OCS there have been 116 blowouts over a period of 19 years (1971-1989) (Section IV.A.4.b.(4)). This represents an average of about 5 blowouts per year, but the number of wells drilled is a better indicator. The estimated number of blowouts, at a rate of 7 blowouts per 1,000 wells drilled, is 74 blowouts during the Cumulative Scenario in the WPA. 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.

Because of technological advances the duration of blowouts has decreased, and about 61 percent of recent blowouts last 1 day or less, 19 percent last between 2 and 3 days, 7 percent last between 4 and 7 days, and 13 percent last more than 7 days (Fleury, 1983). Further, most blowouts occurred without fire (MMS Database). The amount of oil released during these accidents has been small. The total emission of THC is 1,614 tons over the Cumulative scenario. It must be remembered that these are conservative estimates and that the total amount of THC may be less; the VOC will also be less because it is a fraction of the THC.

State oil and gas production occurs in State waters off Texas. These platforms also release air pollutant emissions that cause impacts to the onshore air quality. The latest information that MMS has regarding the Texas oil and gas industry indicates that about 86 production platforms and about 15 drilling rigs exist in State waters. Assuming that these facilities are similar to those used in the OCS offshore waters, an estimate of their emissions can be made. The 86 platforms represent about 18 percent of the platforms available in the OCS Program for the WPA. The $NO_x$ emissions that these facilities will contribute to the onshore areas is estimated as 2,359 tons during the peak year and also decreasing in time. Thus, the total concentrations arriving onshore from OCS and State activities are about 20 percent underestimated because they do not include the State emissions. However, MMS still needs better information regarding these activities to make any assessment of these activities.

*Summary*

The scenario discussed in Section IV.A. (Table IV-13) for the Cumulative Case establishes that 5,280 exploration and delineation wells and 2,050 development wells would be drilled and that 140 platform complexes would be emplaced. This is in addition to the 1,106 platforms that were considered as sources in this analysis. These latter sources exist as a result of past sales. It is also assumed that power generation, transportation, and industry will cause enough emissions to keep the present impact at their actual levels. Maintenance of the present impact levels is due to the continuation of actual trends in energy consumption or technological developments in fuel and motor efficiency.

The incremental contribution of the proposed action (as analyzed in Section IV.D.2.a.(4)) to the cumulative impacts is low because of the prevailing atmospheric conditions and mixing heights affecting the transport and dispersion of emissions, and the concentrations of pollutants reaching the onshore areas.

*Conclusion*

Emissions of pollutants into the atmosphere from activities assumed for the OCS Program within the WPA are expected to have concentrations that would not change the onshore air quality classifications. Increases in onshore concentrations of air pollutants from the proposed action are estimated to be about 1 $\mu gm^{-3}$ (box model steady concentrations). This concentration will have minimal impacts during winter, because onshore winds occur only about 34 percent of the time, and maximum impacts in summer, when onshore winds occur 85 percent of the time.

### *(5) Impacts on Marine Mammals*

### *(a) Nonendangered and Nonthreatened Species*

This Cumulative Analysis considers the effects of impact-producing factors related to the Western Gulf proposed action, prior and future OCS sales, State oil and gas activity, commercial fishing, removal of live specimens for public display, and pathogens that may occur and adversely affect nonendangered and nonthreatened cetaceans in the same general area that may be affected by OCS oil and gas activity located in the WPA.

Sections providing supportive material for the nonendangered and nonthreatened cetacean analysis include III.B.3. (description of cetaceans), IV.A.2.a.(1) (seismic operations), IV.A.2.a.(3) (structure removal), IV.A.2.c. (support activities), IV.A.2.d.(5) (offshore discharges), IV.C.1. and 3. (oil spills), and IV.C.5. (oil-spill response activities).

An estimated 5.2 MM bbl of drilling muds, 1.3 MMbbl of drill cuttings, and 2.5 Bbbl of produced waters are assumed to be generated offshore as a result of the proposed action plus prior and future OCS sales. These effluents are routinely discharged into offshore marine waters and are regulated by the U.S. Environmental Protection Agency's NPDES permits. An unknown but expected substantial amount would also be discharged into nearshore waters from State oil and gas activities. It is expected that nonendangered cetaceans will periodically interact with these discharges. Direct effects to cetaceans are expected to be sublethal, and effects to cetacean food sources are not expected due to the rapid offshore dilution and dispersion of operational discharges. It is expected that operational discharges will periodically contact and affect nonendangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis, averaging about 135,000 trips per year. The FAA Advisory Circular 91-36C encourages the use of fixed-wing aircraft above an elevation of 152 m and helicopters above 300 m. It is expected that at these elevations no cetaceans will be affected by OCS helicopter traffic. It is expected that helicopter traffic will rarely disturb and affect nonendangered cetaceans because of special prohibitions and adherence to the general, FAA-recommended minimum ceiling of 300 m.

It is assumed that, during the peak year, 12,000 OCS-related oil/gas service-vessel trips, 33 shuttle tanker trips, and 26 barge traffic trips will occur as a result of the proposed action, plus prior and future OCS sales in the WPA (Table IV-8). Noise from service-vessel traffic may elicit a startle reaction from cetaceans or mask their sound reception. This effect is sublethal and, at worst, of a short-term, temporary nature. Service vessels could collide with and directly impact cetaceans, but due to dolphin maneuverability and echo-location, encounters of this type are extremely rare. Cetaceans can avoid service vessels, and operators can avoid cetaceans. It is expected that service-vessel traffic will rarely contact and affect nonendangered cetaceans.

It is assumed that, during the peak year, 385 exploration and delineation wells and 100 development wells will be drilled as a result of the proposed action, plus prior and future OCS sales in the WPA (Table IV-8), and will produce sounds at intensities and frequencies that could be heard by cetaceans. It is estimated that noise from drilling activities will last no longer than two months at each location. However, the decibel level of these sounds dissipates to the tolerance of most cetaceans within 15 m of the source. Odontocetes communicate at higher frequencies than the dominant sounds generated by drilling platforms. Sound levels in this range are not likely to be generated by drilling operations (Gales, 1982). The effects on cetaceans from platform noise are expected to be sublethal. It is expected that drilling noise will rarely disturb and affect nonendangered cetaceans.

Explosive platform removals can temporarily interfere with communication, disturb behavior, permanently reduce hearing sensitivity, or cause hemorrhaging in cetaceans. It is estimated that 231 production platforms will be removed by explosives from the WPA as a result of the proposed action, plus prior and future OCS sales. It is assumed that these removals will occur during the last 12 years of the life of the proposed action, with no more than 12 in any given year. It is expected that structure removals will cause sublethal effects on cetaceans. No mortalities are expected because of the MMS guidelines for explosive removals (USDOI, MMS, 1990a, Appendix B). It is expected that structure removals will periodically disturb and affect nonendangered cetaceans.

Seismic surveys use airguns to generate pulses. It is assumed that only this method will be used in seismic surveys as a result of the proposed action, plus prior and future OCS sales. It is expected that effects on cetaceans from seismic surveys are primarily sublethal, constituting short-term avoidance behavior.

Oil spills can adversely affect cetaceans, causing skin and eye irritation, asphyxiation from inhalation of toxic fumes, food reduction or contamination, oil ingestion, and displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from oil spills greater than or equal to 1,000 bbl, the effects would primarily be sublethal; few mortalities are assumed. The effects of oil spills less than 1,000 bbl are assumed to be solely sublethal due to the inconsiderable area affected and their rapid dispersion. It is assumed that the extent and severity of effects from oil spills of any size will be lessened by improved coastal oil-spill contingency planning (Section IV.C.5.) and by active avoidance of oil spills by cetaceans.

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring as a result of the proposed action, plus prior and future OCS sales in the WPA. It is assumed that 5 offshore spills greater than 1 and less than or equal to 50 bbl will occur each year and that none will contact land. It is assumed that 1 spill greater than 50 and less than 1,000 bbl will occur every 5 years and that none will contact land. No spills less than 1,000 bbl are assumed to occur and contact nearshore areas. Although an interaction with spills less than 1,000 bbl is assumed, only sublethal effects are assumed. It is estimated that spills less than 1,000 bbl will periodically contact and affect nonendangered cetaceans.

It is assumed that 39 crude oil spills greater than or equal to 1,000 bbl will occur as a result of import tankering and the proposed action, plus prior and future OCS sales in the Gulf of Mexico (Table IV-22). Section IV.C.1. identifies the assumed risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting areas within 10 days where cetaceans have been surveyed. There is a 71 percent probability from import tankering and a 30 percent probability from the OCS program that an oil spill will occur and contact cetacean habitats at or beyond the shelf break of the WPA. There is a 22 percent probability that an oil spill greater than or equal to 1,000 bbl will occur and contact coastal areas of Texas where cetaceans have been sighted. Although an interaction with spills grater than or equal to 1,000 bbl is assumed, primarily sublethal effects are assumed with infrequent mortalities. It is assumed that an oil spill greater than or equal to 1,000 bbl will periodically contact and affect nonendangered cetaceans in the WPA.

Commercial fishing equipment entangles and drowns cetaceans during routine activities or during accidental "ghost" fishing by lost or discarded gear (Tucker & Associates, Inc., 1990). Although the extent of incidental take and death during "ghost" fishing is largely undocumented, it has been noted as an activity of concern by the NMFS and the Marine Mammal Commission. It is expected that both routine commercial and accidental "ghost" fishing will cause few mortalities of cetaceans. It is expected that commercial fishing equipment will periodically contact and affect nonendangered cetaceans in the WPA.

Nonendangered and nonthreatened cetaceans are captured and removed for public display and research. These activities are concentrated on bottlenose dolphins, and not all endeavors are successful. Dolphins occasionally elude capture or escape during acquisition. Catch quotas are set by the NMFS to ensure a sustainable yield, and capture is occasionally banned if populations are considered depleted. It is assumed that bottlenose dolphins will be captured and removed from the WPA. The effects on those dolphins that elude or escape capture are expected to be sublethal. It is expected that live capture and removal will rarely contact and affect nonendangered cetaceans in the WPA.

Epidemic die-offs or mass strandings occur in several species of nonendangered cetaceans. The causes are difficult to diagnose, as has been the case with abnormal bottlenose dolphin mortality in the Gulf in 1989-1990 and along the Atlantic Seaboard in 1988 (USDOC, NMFS, 1990b). Naturally occurring and anthropogenic toxins have been the hypothesized cause. Sources include algal blooms, oil spills, ocean dumping, industrial and municipal effluents, and agricultural runoff. These concentrations are not widespread, and mortalities occur in localized populations. It is expected that toxins will periodically contact and affect nonendangered cetaceans in the WPA.

*Summary*

Activities resulting from the Cumulative scenario have a potential to affect nonendangered cetaceans detrimentally. These cetaceans could be impacted by operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills, commercial fishing, capture and removal, and pathogens. The effects of the majority of these activities are estimated to be sublethal. Lethal effects are assumed only from oil spills greater than or equal to 1,000 bbl, commercial fishing, and pathogens. Oil spills of any size as a result of import tankering, the proposed action, and prior and future OCS sales are estimated to be infrequent events that will periodically contact nonendangered and nonthreatened cetaceans.

The incremental contribution of the proposed action (as analyzed in Section IV.D.2.a.(5)(a)) to the cumulative impact is inconsequential because the effects of sale-specific operational discharges, helicopter and service-vessel traffic, and seismic activity are estimated to be sublethal. No mortalities are expected from explosive platform removal because of MMS guidelines. It is assumed that there will be no interaction between sale-related oil spills and nonendangered and nonthreatened cetaceans.

*Conclusion*

The impact of the Cumulative Case scenario on nonendangered and nonthreatened cetaceans within the potentially affected area is assumed to result in a decline in species numbers or temporary displacement from their current distribution, a decline or displacement that will last more than one generation.

## *(b) Endangered and Threatened Species*

This Cumulative Analysis considers the effects of activities related to the Western Gulf proposed action, prior and future OCS sales, State oil and gas operations, migration, and recreational whale-watching on the blue, sei, humpback, fin, and sperm whale. The sperm whale is the species most seen in the Gulf of Mexico.

The major impact-producing factors are described in the preceding section (Section IV.D.2.e.(5)(a), nonendangered and nonthreatened species). Sections providing supportive material for the endangered cetacean analysis include III.B.3. (description of cetaceans), IV.A.2.a.(1) (seismic operations), IV.A.2.a.(3) (structure removal), IV.A.2.c. (support activities), IV.A.2.d.(5) (offshore discharges and noise emissions), IV.C.3. (oil spills), and IV.C.5. (oil-spill response activities).

An estimated 5.2 MMbbl of drilling muds, 1.3 MMbbl of drill cuttings, and 2.5 Bbbl of produced waters are assumed to be discharged annually as a result of the proposed action plus prior and future OCS sales. These effluents are routinely discharged into offshore marine waters and are regulated by the U.S. Environmental Protection Agency's NPDES permits. An unknown but expected substantial amount would also be discharged into nearshore waters from State oil and gas activities. It is estimated that endangered cetaceans will periodically interact with these discharges. Direct effects to cetaceans are expected to be sublethal and effects to cetacean food sources are not expected due to the rapid offshore dilution and dispersion of operational discharges. It is expected that operational discharges will periodically contact and affect endangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis, averaging about 133,000 trips per year. The FAA Advisory Circular 91-36C encourages the use of fixed-wing aircraft above an elevation of 152 m and helicopters above 300 m. It is estimated that at these elevations no cetaceans will be affected by OCS helicopter traffic. It is expected that helicopter traffic will rarely disturb and affect endangered cetaceans because of special prohibitions and adherence to the general, FAA-recommended minimum ceiling of 300 m.

It is assumed that, during the peak year, 12,000 OCS-related oil/gas service-vessel trips, 33 shuttle tanker trips, and 26 barge traffic trips will occur as a result of the proposed action, plus prior and future OCS sales in the WPA (Table IV-8). Noise from service vessel traffic may elicit a startle reaction from cetaceans or mask their sound reception. This effect is sublethal and, at worst, of a short-term, temporary nature. Service vessels could collide with and directly impact cetaceans, but due to dolphin maneuverability and echo-location, encounters of this type are extremely rare. Cetaceans can avoid service vessels and operators can avoid cetaceans. It is expected that service vessel traffic will rarely contact and affect endangered cetaceans.

It is assumed that, during the peak year, 385 exploration and delineation wells and 100 development wells will be drilled as a result of the proposed action, plus prior and future OCS sales in the WPA (Table IV-8), and will produce sounds at intensities and frequencies that could be heard by cetaceans. It is estimated that noise from drilling activities will last no longer than two months at each location. However, the decibel level of these sounds dissipates to the tolerance of most cetaceans within 15 m of the source. Odontocetes communicate at higher frequencies than the dominant sounds generated by drilling platforms. Sound levels in this range are not likely to be generated by drilling operations (Gales, 1982). The effects on cetaceans from platform noise is expected to be sublethal. It is expected that drilling noise will rarely disturb and affect endangered cetaceans.

Explosive platform removals can temporarily interfere with communication, disturb behavior, permanently reduce hearing sensitivity, or cause hemorrhaging in cetaceans. It is assumed that 231 production platforms will be removed by explosives from the WPA as a result of the proposed action plus, prior and future OCS sales. It is assumed that these removals will occur during the last 12 years of the life of the proposed action and that no more than 12 are likely to occur in any single year. It is expected that structure removals will cause sublethal effects on cetaceans. No mortalities are expected because of the MMS guidelines for explosive removals (USDOI, MMS, 1990a, Appendix B). It is expected that structure removals will periodically disturb and affect endangered cetaceans.

Seismic surveys use airguns to generate pulses. It is assumed that only these methods will be used in seismic surveys as a result of the proposed action, plus prior and future OCS sales (Section IV.A.2.). It is expected that effects on cetaceans from seismic surveys are primarily sublethal constituting short-term avoidance behavior.

Oil spills can adversely affect cetaceans, causing skin and eye irritation, asphyxiation from inhalation of toxic fumes, food reduction or contamination, oil ingestion, and displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from oil spills greater than or equal to 1,000 bbl, the effects would primarily be sublethal, few mortalities are assumed. The effects of oil spills less than 1,000 bbl are assumed to be solely sublethal due to the inconsiderable area affected and their rapid dispersion. It is assumed that the extent and severity of effects from oil spills of any size will be lessened by improved coastal oil-spill contingency planning (Section IV.C.5.) and by active avoidance of oil spills by cetaceans.

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring as a result of the proposed action, plus prior and future OCS sales in the WPA. It is assumed that 5 offshore spills greater than

1 and less than or equal to 50 bbl will occur each year and that none will contact land. It is assumed that 1 spill greater than 50 and less than 1,000 bbl will occur every 5 years and that none will contact land. Although an interaction with spills less than 1,000 bbl is assumed, only sublethal effects are assumed. It is expected that spills less than 1,000 bbl will periodically contact and affect endangered cetaceans.

It is assumed that 39 crude oil spills greater than or equal to 1,000 bbl will occur as a result of import tankering and the proposed action, plus prior and future OCS sales in the Gulf of Mexico (Table IV-22). Section IV.C.3. identifies the assumed risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting areas within 10 days where cetaceans have been surveyed. There is a 71 percent probability from import tankering and a 30 percent probability from the OCS Program that an oil spill greater than or equal to 1,000 bbl will occur and contact cetacean habitats at or beyond the shelf break of the WPA. There is a 22 percent probability that an oil spill greater than or equal to will occur and contact coastal areas of Texas where cetaceans have been sighted. Although an interaction with spills greater than or equal to 1,000 bbl is assumed, primarily sublethal effects are expected, with infrequent mortalities. It is expected that an oil spill greater than 1,000 bbl will periodically contact and affect endangered cetaceans in the WPA.

It is assumed that the migratory behavior of the great whales exposes them to potential adverse impacts generated from all Gulf of Mexico and Atlantic OCS planning areas, as well as routine activities and accidental events originating from Western America, North America, Europe, and the Caribbean. The incremental contribution of each impact cannot be determined nor its effect estimated because of the multitude of sources.

Recreational whale-watching is an applicable impact-producing factor only to large cetaceans and great whales. Although whale-watching vessels have the potential to displace or collide with whales, no incidents of this nature have been reported. These activities are not popular in the Gulf; however, it is assumed that they regularly occur on the Eastern Seaboard. It is assumed that these activities cause sublethal effects. It is estimated that recreational whale-watching activities rarely contact and affect great whales that migrate to the WPA.

*Summary*

Activities resulting from the Cumulative scenario have a potential to affect endangered and threatened cetaceans detrimentally. These cetaceans could be impacted by operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills, oil-spill response operations, natural and anthropogenic activities contacted during migration, and recreational whale-watching. The effects of the majority of these activities are estimated to be sublethal. Lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl. Oil spills of any size as a result of import tankering, the proposed action, and prior and future OCS sales are estimated to be infrequent events that will periodically contact endangered cetaceans.

The incremental contribution of the proposed action (as analyzed in Section IV.D.2.a.(5)(b)) to the cumulative impact is inconsequential because the effects of sale-specific operational discharges, helicopter and service-vessel traffic, and seismic activity are estimated to be sublethal. No mortalities are assumed from explosive platform removal because of MMS guidelines. It is assumed that there will be no interaction between sale-related oil spills and endangered and threatened cetaceans.

*Conclusion*

The impact of the Cumulative Case scenario on endangered and threatened cetaceans within the potentially affected area is assumed to result in a decline in species numbers or temporary displacement from their current distribution, a decline or displacement that will last more than one generation.

### *(6) Impacts on Marine Turtles*

This Cumulative Analysis considers the effects of impact-producing factors related to the Western Gulf proposed action, prior and future OCS sales, State oil and gas activity, migration, dredge-and-fill operations, natural catastrophe, pollution, commercial fishing, hopper dredge operation, recreational boat traffic, and human consumption on the loggerhead, Kemp's ridley, hawksbill, green, and leatherback marine turtles.

The effects from the major impact-producing factors are discussed in detail in Section IV.D.2.a.(6), and described below. Sections providing supportive material for the marine turtle analysis include III.A.2. (meteorological conditions), III.B.4. (description of marine turtles), IV.A.2.a.(3) (structure removal), IV.A.2.c. (support activities), IV.A.2.d.(5) (offshore discharges), IV.B.1.c. (other major coastal/onshore activities), IV.C.1. and 3. (oil spills), and IV.C.5. (oil-spill response activities).

Anchoring, structure installation, pipeline placement, dredging, and operational discharges as a result of the proposed action, plus prior and future OCS sales, may adversely affect marine turtle habitat through destruction of nearshore wetland areas and live-bottom communities. The impact to such habitats under the Cumulative Case scenario from the above activities is analyzed in detail in Sections IV.D.1.d.a.(1) and (2).

To summarize the effects on wetlands and estuaries, it is assumed that 500 ha of coastal areas will be affected by oil spills as a result of the proposed action, prior and future OCS sales, and State oil and gas activities. An estimated dieback of up to 50 ha of wetlands, mainly along the Texas and Louisiana coasts, will occur for several growing seasons from contact with spilled oil. Up to 80 ha of wetlands could be eroded as a result of maintenance dredging and deepening of navigation channels in coastal Texas. Three new pipeline landfalls will affect a total of 16 ha of wetlands in Matagorda, Calhoun, and Nueces Counties in Texas. The main causes of wetland and estuary loss within the Gulf of Mexico are sediment deprivation and rapid coastal submergence.

To summarize the effects on nesting beaches, it is assumed that minor changes in beach profiles will occur as a result of oil-spill cleanup operations that remove some sand from the littoral zone. Prespill configurations are assumed to be reestablished within 2-4 months. Recreational use of accessible beaches near large population centers, such as in Texas, will result in damage to beach features. The main causes of nesting beach loss within the Gulf of Mexico are the reduction in sediment being delivered to the coastal littoral system, rapid rate of relative sea level rise, and continued coastal urbanization. To summarize the effects on seafloor habitats, little or no damage is expected to the physical integrity, species diversity, or biological productivity of topographic features. Small areas of 5-10 $m^2$ would be affected for less than two years, probably on the order of four weeks. However, damage is expected to one or more components of physical integrity, species diversity, or biological productivity in the regionally common habitats or the communities of live-bottom areas. Fewer than five live-bottom areas of 5-10 $m^2$ would be affected for 10 years. Offshore operational discharges are not lethal to marine turtles and are diluted and dispersed rapidly within 1 km of the discharge point to the extent that adverse effects to marine turtle food sources do not occur (API, 1989; NRC, 1983). It is expected that effects on marine turtles from anchoring, structure installation, pipeline emplacement, and dredging will be indistinguishable from the long-term (25-50 years) natural variability within populations of marine turtles. It is expected that marine turtles will avoid 5-10 $m^2$ of topographic feature areas for up to a month and that this avoidance of impoverished foraging areas will have no effect on marine turtles. It is expected that marine turtles will avoid 5-10 $m^2$ of live-bottom areas for up to 10 years and that this avoidance of impoverished foraging areas will have no effect on marine turtles. The suspended particulate matter in operational discharges offshore is expected to cause sublethal effects by inhibition of the ability of marine turtles to locate their prey visually within 1 km of the discharge point for the short time period (less than one hour) spent traversing the plume.

Sublethal effects on marine turtles or their habitats are expected from these impact-producing factors. The expectation is that anchoring, structure installation, pipeline placement, dredging, and operational discharges will periodically contact marine turtles or their habitats.

Marine turtles can become entangled in or ingest trash and debris, which may result in injury or mortality. It is assumed that some OCS-related trash and debris will be accidentally lost into the Gulf of Mexico and available for interaction with marine turtles. Although mortalities could occur, primarily sublethal effects are expected. It is expected that OCS oil- and gas-related trash and debris will rarely interact with and affect marine turtles.

Explosive platform removals can cause capillary damage, disorientation, loss of motor control, and fatal injuries in marine turtles. It is assumed that 231 production platforms will be removed by explosives from the WPA as a result of the proposed action, plus prior and future OCS sales. It is assumed that these removals will occur during the last 12 years of the life of the proposed action with no more than 12 in any single year and that some of the platform removals will occur beyond the continental shelf. As benthic feeders, Gulf of Mexico hard-shell marine turtles do not use habitats beyond the shelf break. Although the pelagic life stages of all marine turtles use these habitats, there is no correlation between marine turtles and the presence of offshore structures beyond the shelf break. It is expected that structure removals will cause sublethal effects on marine turtles. No mortalities are expected because of the MMS guidelines for explosive removals (USDOI, MMS, 1990a, Appendix B) and because the removals occur away from preferred offshore habitats. It is expected that structure removals will rarely disturb and affect marine turtles.

It is assumed that, during the peak year of the proposed action, 12,000 OCS-related oil and gas service-vessel trips, 33 shuttle tanker trips, and 26 barge trips will occur in the WPA as a result of the proposed action, plus prior and future OCS sales (Table IV-8). Noise from service-vessel traffic may elicit a startle reaction from marine turtles. This effect is sublethal and, at worst, of a short-term, temporary nature (NRC, 1990). Collision between service vessels and surfaced marine turtles would likely cause fatal injuries. It is assumed that service-vessel traffic and marine turtles will infrequently be in close proximity. Although a low percentage of stranded marine turtles have shown indications of vessel collision, it cannot be determined what types of vessel were involved and whether these injuries occurred before or after death. Marine turtles are known to spend 4 percent or less of their time at the surface and to sound when large vessels approach. In addition, marine vessel operators can avoid marine turtles. It is expected that service-vessel traffic will rarely contact and affect marine turtles.

Oil spills and oil-spill response activities can adversely affect marine turtles by toxic external contact, toxic ingestion or blockage of the digestive tract, asphyxiation, entrapment in tar or oil slicks, habitat destruction, and displacement from preferred habitats. Oil-spill response activities, such as vehicular and vessel traffic, are assumed to contact marine turtle habitat, such as shallow areas of turtle grass beds and live-bottom communities, in the event of contact with an oil spill greater than or equal to 1,000 bbl. Sublethal effects are assumed due to the particular consideration these areas receive during oil-spill cleanup to minimize adverse effects from traffic during cleanup activities and to maximize protection efforts to prevent contact of these areas with spilled oil. It is assumed that oil-spill response activities will rarely contact and affect marine turtle habitat.

In the event that oiling of marine turtles should occur from oil spills greater than or equal to 1,000 bbl, the effects would primarily be sublethal; few mortalities are assumed. The effects of oil spills less than 1,000 bbl are assumed to be solely sublethal due to the inconsiderable area affected and their rapid dispersion. It is assumed that the extent and severity of effects from oil spills of any size will be lessened by improved coastal oil spill contingency planning (Section IV.C.5.).

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring as a result of the proposed action plus, prior and future OCS sales in the WPA. It is assumed that 5 offshore spills greater than 1 and less than or equal to 50 bbl will occur each year and that none will contact land. It is assumed that 1 spill greater than 50 and less than 1,000 bbl will occur every 5 years and that none will contact land. No spills less than 1,00 bbl are assumed to occur and contact nearshore areas. Although an interaction with spills less than 1,000 bbl is assumed, only sublethal effects are assumed. It is estimated that spills less than 1,000 bbl will periodically contact and affect marine turtles.

It is assumed that 39 crude oil spills greater than or equal to 1,000 bbl will occur as a result of import tankering and the proposed action, plus prior and future OCS sales in the Gulf of Mexico (Table IV-22). Section IV.C.1. identifies the assumed risk of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting marine turtle habitat within 10 days. There is a 22 percent probability from import tankering and an 8 percent probability from the OCS program that an oil spill greater than or equal to 1,000 bbl will occur and contact marine turtle habitats in nearshore areas of the WPA. There is an 85 percent probability that an oil spill greater than or equal to 1,000 bbl will occur and contact within 10 days pelagic turtle habitat beyond the shelf break of the WPA. Although an interaction with spills greater than or equal to 1,000 bbl is expected, primarily sublethal effects are assumed with infrequent mortalities. It is estimated that an oil spill greater than or equal to 1,000 bbl will periodically contact and affect nonendangered cetaceans in the WPA.

Non-OCS operations, such as dredge and fill operations, pollution, and natural catastrophes, can cause the loss of marine turtles habitats, e.g., nesting beaches, nearshore wetland areas, and live-bottom communities.

Non-OCS operations such as commercial fishing, hopper dredge activities, nearshore boat traffic, human consumption, and loss of anthropogenic debris can directly impact marine turtles.

Dredge-and-fill activities occur throughout the nearshore areas of the United States. They range in scope from propeller dredging by recreational boats to large-scale navigation dredging and fill for land reclamation. Pollution resulting in loss of turtle grass beds includes the alteration of salinity, as in Florida Bay, as well as man-induced increases in turbidity, witnessed in Tampa Bay. Disturbances to nesting beaches occur from a variety of sources, including construction, vehicle traffic, and deprivation of sand. Natural catastrophes, including storms, floods, droughts, and hurricanes, can result in substantial damage to sea turtle habitat. Sublethal effects on marine turtles are expected from these activities. It is expected that dredge-and-fill activities, pollution, and natural catastrophes will periodically contact and affect marine turtle habitats.

Drowning that results from forced submergence in commercial fishing trawls has a substantial effect on marine turtle populations in the Gulf of Mexico. Shrimp trawling in the southeastern United States has received extensive scrutiny because of its incidental catch of marine turtles. The National Research Council (1990) has identified shrimp trawling as the greatest cause of human-induced mortality in marine turtles. The use of turtle excluder devices is legislatively mandated in order to decrease losses. Dismemberment of turtles by hopper dredging has resulted in turtle mortalities. Specific dredging projects include the Canaveral Ship Channel in Florida, the King's Bay Submarine Channel in Georgia, and channel dredging of ports throughout the Gulf. Data from the Sea Turtle Stranding Network indicate a large number of marine turtles are hit by boats. In the Eastern Gulf, the incidence of stranded marine turtles exhibiting indications of vessel collision has been related to the volume of recreational boat traffic. However, the number of mortalities caused by collisions is unknown. The human consumption of turtle eggs, meat, or by-products occurs worldwide (Mack and Duplaix, 1979; Cato et al., 1978). Human use is probably substantial, but the frequently illegal nature of the activity generates unreliable estimates of mortality. In addition to the incremental amount of trash and debris generated by the proposed action, plus prior and future OCS sales, trash and debris that could affect marine turtles find their way into the Gulf of Mexico from both commercial and recreational endeavors in the Gulf of Mexico, South and Central America, and North Africa. The volume of marine debris from these sources is unknown (USDOC, NMFS, 1989b; Heneman and the Center for Environmental Education, 1988). Both mortalities and sublethal effects on marine turtles are expected from these activities. It is expected that hopper dredge activities, nearshore boat traffic, human consumption, and loss of anthropogenic debris will periodically contact and affect marine turtles.

It is assumed that the migratory behavior of marine turtles exposes them to potential adverse impacts generated from all Gulf of Mexico and Atlantic OCS planning areas, as well as routine and accidental events originating from Central America, North America, Europe, and the Caribbean. The incremental contribution of each impact cannot be determined, nor its effect estimated, because of the multitude of sources.

*Summary*

Activities resulting from the Cumulative scenario have a potential to affect marine turtles detrimentally. Those activities include anchoring, structure installation, pipeline placement, dredging, operational discharges, loss of trash and debris, explosive platform removals, vessel traffic, oil-spill response operations, oil spills, dredge-and-fill operations, pollution, natural catastrophes, commercial fishing, hopper dredge operations, recreational boat traffic, human consumption, and natural and anthropogenic activities contacted during migration. The effects of the majority of these activities are estimated to be sublethal. Lethal effects are expected from ingestion of trash and debris, oil spills greater than or equal to 1,000 bbl, commercial fishing, hopper dredge operations, and human consumption. Oil spills of any size as a result of import tankering, the proposed action, and prior and future OCS sales are estimated to be infrequent events that will periodically contact endangered cetaceans.

The incremental contribution of the proposed action (as analyzed in Section IV.D.2.a.(6)) to the cumulative impact is inconsequential because the effects of sale-specific anchoring, structure installation, pipeline placement, dredging, operational discharges, service-vessel traffic, and trash and debris are estimated to be sublethal. No mortalities are expected from explosive platform removal because of MMS guidelines. It is expected that there will be no interaction between sale-related oil spills and endangered and threatened marine turtles.

*Conclusion*

The impact of the Cumulative Case scenario on marine turtles within the potentially affected area is expected to result in a decline in species numbers or a temporary displacement from their current distribution, a decline or displacement that will last more than one generation.

### *(7) Impacts on Coastal and Marine Birds*

### *(a) Nonendangered and Nonthreatened Species*

The Gulf of Mexico is populated by migrant and nonmigrant species of coastal and marine birds. This broad category consists of four main groups: seabirds, waterfowl, wading birds, and shorebirds.

This Cumulative Analysis considers the status of populations and migratory habits of coastal and marine birds, and the effects of impact-producing factors related to the proposed action, plus those related to prior and future OCS sales; State oil and gas activity; crude oil imports by tanker; and other commercial, military, recreational offshore and coastal activities that may occur and adversely affect those populations. Specific types of impact-producing factors considered in the analysis include habitat loss and degradation, oil spills, vessel traffic, pipeline landfalls and coastal construction, dredging, fishing gear, plastic debris, and water contamination.

See Section III.B.5.a. for a fully detailed discussion of coastal and marine birds in the Gulf of Mexico. The four major types of coastal and marine birds have experienced decreases in population (National Geographic Society, 1983a; Spendelow and Patton, 1988).

Nonmigrant populations of coastal birds that nest in the WPA are believed to be in decline due to habitat loss from urbanization of coastal wetlands and water management practices (Section III.B.1.b.) (National Geographic Society, 1983a; Texas Parks and Wildlife Dept., written comm., 1989). Overwintering migrant waterfowl in the WPA are believed to be in decline due to loss and degradation of their nesting habitat in the north-central United States and south-central Canada from encroaching agriculture and drought (Ducks Unlimited, 1989). Should habitat loss cease, the population will return to its pre-impact level within one to two generations. However, the assumed continual loss of crucial habitat will have a deleterious impact on coastal and marine birds during several or all lifestages of migratory and resident species, respectively.

Many coastal and marine bird populations in the Gulf of Mexico are overwintering migrants or migrants passing through to wintering grounds outside the country. Waterfowl journey to Gulf feeding grounds using specific flight corridors that run the length of the continental U.S. These corridors terminate in distinct localities along the Gulf Coast. Some waterfowl exhibit a limited degree of coastal movement within their terminal locality, but do not cross planning areas (Bellrose, 1968).

Resident wading bird populations are augmented during the winter by migrants from as far away as southern Canada. The Mississippi Delta divides migrating wading birds into distinct east-west groups in the Gulf. Migrating adults of each group terminate and remain in distinct localities along the Gulf Coast, while juveniles usually continue migration outside the country. Migration by Eastern Gulf juveniles begins in southern Florida and terminates in the Caribbean or on the Yucatan Peninsula. Juvenile migration in the Western Gulf begins and continues southwestward along the Gulf Coast, terminating in Mexico and Central America (Byrd, 1978; Ogden, 1978; Ryder, 1978).

Resident shorebird and seabird populations are augmented during the winter by migrants from as far away as the North American Arctic Circle. Some species overwinter in discrete localities within a single planning area of the Gulf of Mexico Region, while other species are split into distinct groups east or west of the Mississippi Delta. A few species of shorebirds may continue migration. Those in the Western Gulf continue along the coast into Mexico and Central America. Those in the Eastern Gulf continue to the Caribbean. Those that remain on the Western or Eastern Gulf Coast exhibit a limited degree of coastal movement within their terminal locality, but do not cross planning areas (Clapp, 1982a and b; Fritts et al., 1983; National Geographic Society, 1983b).

Discernible effects to regional populations or subpopulations of these migrating costal and marine birds as a result of OCS oil and gas activities are not expected because these species have a large areal distribution and do not migrate through more than one planning area.

Section IV.C.1. estimates the mean number of offshore spills less than 1,000 bbl occurring from the proposed action in the WPA. Five offshore spills and one onshore spill greater than 1 and less than 50 bbl are assumed to occur each year; a few will contact the coastline. It is assumed that one offshore spill greater than 50 and less than 1,000 bbl will occur every 5 years and that it will not contact the coastline. It is assumed that one onshore spill greater than 50 and less than 1,000 bbl will occur every 10 years. For the purpose of this analysis, it is estimated that spills less than 1,000 bbl will seldom contact and affect coastal and marine birds.

It is assumed that 39 crude oil spills greater than or equal to 1,000 bbl will occur as a result of import tankering and the proposed action, plus prior and future OCS sales in the Gulf of Mexico (Table IV-22). Section IV.C.1. identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl resulting from the proposed action, prior and future OCS leasing, and import and OCS shuttle tankering occurring and contacting, within 10 days, the Gulf of Mexico coastline at 73 percent for imports and 85 percent for the OCS. In the WPA, OCS spills have a higher probability of occurrence and contact within 10 days with coastal Galveston, Chambers, and Cameron Counties (Table IV-22); imported oil in the WPA has the highest probability (23%) of an occurrence and contact within 10 days with the same counties.

For purposes of this analysis, it is estimated that oil spills greater than or equal to 1,000 bbl will often contact and affect Western Gulf inshore habitats or the coastline. Therefore, this analysis expects noticeable interaction between coastal and marine birds and oil spills.

The OCS-related helicopter traffic could disturb feeding, resting, or breeding behavior of birds, or cause abandonment of preferred habitat. This impact-producing factor could contribute to population losses by displacement of birds to areas where they may experience increased environmental or physiological stress. It is assumed that air traffic will adhere to the FAA Advisory Circular 91-36C prohibition of flights below a ceiling of 300 m over national wildlife refuges and national park lands. At this elevation, it is assumed that birds will not be disturbed.

It is assumed that, during the peak year, 12,000 OCS-related oil and gas service-vessel trips, 33 shuttle tanker trips, and 26 barge traffic trips will occur as a result of the proposed action, plus prior and future OCS sales in the WPA (Table IV-8). Noise from service-vessel traffic may elicit a startle reaction from cetaceans or mask their sound reception. This effect is sublethal and, at worst, of a short-term, temporary nature. Service vessels could collide with and directly impact coastal and marine birds, because dolphin maneuverability and echo-location encounters of this type are extremely rare. The OCS-related vessel traffic represents a meager amount of the total annual vessel traffic in the Gulf of Mexico and occurs in and out of existing port areas. Coastal and marine birds can avoid service vessels, and operators can avoid coastal and marine birds. It is estimated that service-vessel traffic will rarely contact and affect nonendangered coastal and marine birds.

The frequency and severity of cumulative impacts will moderately increase as a result of OCS-related onshore construction of 3 pipeline landfalls, 120 km of onshore pipeline, and 3 marine terminals (Table IV-13). An unknown but substantial amount of coastal construction is possible due to further urbanization. Coastal development falls under the jurisdiction of individual states.

Entanglement in commercial and recreational fishing gear and plastic debris causes injuries and death of birds. Coastal storms and hurricanes cause flooding and destruction of nesting areas, resulting in coastal and marine bird losses. High levels of oil and organic chemical contamination in the river runoff into the northern Gulf of Mexico could cause direct mortality or indirect food loss to avian species. Collision with power lines and supporting towers causes additional bird mortality (Avery et al., 1980).

*Summary*

Habitat loss results in the decline of populations of coastal and marine birds. In the Western Gulf coastal zone, habitat loss of nonmigrating birds occurs from urbanization of coastal wetlands and water management practices. In the north-central United States and south-central Canada, habitat loss of migrating birds occurs from encroaching agriculture and drought.

The OCS-related helicopter and service-vessel traffic results in displacement of birds from nesting and feeding habitats. At worst, the effect of vessel or air traffic during any time of year is of a very short-term nature. The FAA Advisory Circular 91-36C prohibits flight elevation below 300 m during the time of year of greatest concentration of coastal and marine birds (mid-October to mid-April). Pipeline landfalls and coastal facility construction result in possible desertion of birds from feeding and breeding habitats. Entanglement or ingestion of commercial fishing and recreational fishing plastic debris may injure or kill coastal and marine birds. Oil spills pose the greatest threat to coastal and marine birds by direct oiling, food source contamination, or breeding habitat pollution. It follows that activities have the potential to affect coastal and marine birds adversely.

The incremental contribution of the proposed action (as analyzed in Section IV.D.2.a.(7)(a)) to the cumulative impact is negligible because the effects of sale-specific helicopter and service-vessel traffic and trash and debris are estimated to be sublethal. No sale-specific pipeline landfalls and coastal facility construction are estimated to occur or to interact with coastal and marine birds. It is assumed that there will be no interaction between sale-related oil spills and nonendangered and nonthreatened coastal and marine birds.

*Conclusion*

The cumulative effect on coastal and marine birds within the potentially affected area is expected to result in a discernible decline in a local coastal or marine bird population or species, resulting in a change in distribution or abundance. Recruitment will return the population or affected species to its pre-impact level and/or condition within one to two generations. It is doubtful that this impact will affect regional populations.

### *(b) Endangered and Threatened Species*

This Cumulative Analysis considers the effects of impact-producing factors related to the Western Gulf proposed action, prior and future OCS sales, State oil and gas operations, migration, and habitat loss and degradation on endangered and threatened birds, including the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover. Specific types of impact-producing factors considered in the analysis include migratory behavior, helicopter and service-vessel traffic, pipeline landfalls and coastal construction, fishing equipment, plastic debris, coastal dredge-and-fill operations, and land use changes.

The effects from the major impact-producing factors are discussed in detail in Section IV.D.2.a.(7)(b) and are described below. Sections providing supportive material for the endangered and threatened bird analysis include III.B.5.(b) (description of endangered and threatened birds), IV.A.2.c. (support activities), IV.A.2.d.(5) (offshore discharges), IV.B.1.c. (onshore infrastructure, activities, and impacts), IV.C.3. (oil spills), and IV.C.5. (oil-spill response activities).

Endangered birds that nest in the WPA, such as some piping plovers, bald eagles, and brown pelicans, are believed to be in decline due to habitat loss from urbanization of coastal wetlands and water management practices (Section III.B.1.) (National Geographic Society, 1983a; Texas Parks and Wildlife Dept., written comm., 1989). Overwintering migrant, endangered birds, such as the Arctic peregrine falcon and some piping plovers, are believed to be in decline due to loss and degradation of their breeding habitat in far northern latitudes of the North American continent (National Geographic Society, 1983a). It is expected that habitat loss will periodically affect endangered birds.

As previously described (Section III.B.5.b.), some piping plovers and the Arctic peregrine falcons are overwintering migrants and/or migrants passing through to wintering grounds outside the country. These birds use specific flight corridors that run the length of the continental U.S. These corridors terminate in distinct localities along the Gulf Coast. Most piping plovers and Arctic peregrine falcons overwinter in discrete localities within a single planning area of the Gulf of Mexico Region. A few of these endangered birds may continue migration. Those in the Western Gulf continue along the coast into Mexico and Central America. Those in the Eastern Gulf continue to the Caribbean. Those that remain on the Western or Eastern Gulf coast exhibit a limited degree of coastal movement within their terminal locality, but do not cross planning areas (Clapp, 1982a and b; Fritts et al., 1983). Discernible effects to these endangered birds as a result of OCS oil and gas activities are not expected because these species have a large areal distribution and do not migrate through more than one planning area.

It is assumed that helicopter traffic will occur on a regular basis, averaging about 135,000 trips per year. The FAA Advisory Circular 91-36C prohibits the use of fixed-wing aircraft lower than an elevation of 152 m and helicopters lower than 300 m during the period of October 15 through April 15 in the vicinity of numerous national wildlife refuges in the Gulf of Mexico to prevent disturbances to the birds (Biological Opinion - Section 7 Consultation Proposed Exploration Plans for OCS in the Gulf of Mexico; FWS/OES 375.0). The majority of these wildlife refuges provide important critical habitats (feeding, resting, or breeding areas) for endangered and threatened species. Although interactions may occur and be disruptive, effects are expected to be sublethal and, at worst, of a temporary nature. It is expected that helicopter traffic near critical feeding, resting, or breeding areas will rarely disturb the brown pelican, Arctic peregrine falcon, bald eagle, or piping plover because of special prohibitions and adherence to the general, FAA-recommended minimum ceiling of 300 m.

It is assumed that, during the peak year, 12,000 OCS-related oil and vessel trips, 33 shuttle tanker trips, and 26 barge traffic trips will occur as a result of the proposed action plus prior and future OCS sales in the WPA (Table IV-8). Most of the OCS-related oil and gas traffic occurs in and out of existing port areas that are well away from critical feeding, resting, or breeding habitats of the Arctic peregrine falcon, bald eagle, or piping plover. Some OCS-related service vessel traffic occurs in the vicinity of Cameron, Intracoastal City, Morgan City, and Venice, Louisiana, within several miles of critical habitats for feeding, resting, or breeding areas of the brown pelican. Although incidents may occur and be disruptive, effects are expected to be sublethal and, at worst, of a temporary nature. It is expected that service-vessel traffic will rarely disturb the brown pelican.

Disturbance of brown pelican and piping plover critical feeding, resting, or breeding habitats from pipeline landfalls and onshore construction could result in a reduction or desertion of birds that use the habitats. It is assumed that three new OCS oil- and gas-related pipeline landfalls and three new coastal facilities will be constructed as a result of the proposed action, plus prior and future OCS sales (Table IV-13). Sublethal effects are expected from these activities. It is expected that pipeline landfalls and onshore construction will infrequently interact with critical feeding, resting, or breeding habitats of the brown pelican, Arctic peregrine falcon, or piping plover.

The brown pelican, Arctic peregrine falcon, bald eagle, and piping plover can become entangled in or ingest trash and debris. Interaction with plastic materials can be especially injurious. 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), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. It is assumed that little trash and debris will be lost into the Gulf of Mexico as a result of the proposed action, plus prior and future OCS sales. However, it is expected that some trash and debris will be lost or discarded into the Gulf from non-OCS commercial and recreational endeavors, which are not as highly regulated. Although interactions may occur, effects are expected to be sublethal. It is expected that the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover will periodically become entangled in or ingest trash and debris.

When an oil spill occurs, many factors interact to delimit the severity of effects and extent of damage to threatened and endangered birds. Determining factors include geographic location, oil type, oil dosage, impact area, oceanographic conditions, meteorological conditions, and season (NRC, 1985; USDOI, MMS, 1987b). The direct effect of oiling on birds occurs through the matting of feathers and subsequent loss of body insulation and water-repellency, the ingestion of oil, the depression of egg-laying activity, and the reduction of hatching success (Holmes and Cronshaw, 1977; Ainley et al., 1981; Peakall et al., 1981). Transfer of oil from adults to eggs and young during nesting results in significant mortality for new eggs and deformities in hatchlings from eggs further along in incubation (Clapp et al., 1982a). Indirect effects of oil spills include contamination, displacement, and reduction of food sources. Food contamination may cause less severe, sublethal effects decreasing survival and fecundity, affecting behavior, and decreasing survival of young. Less severe, sublethal effects are defined as those that impair the ability of an organism to function effectively without causing direct mortality (NRC, 1985). In the event that oiling of the brown pelican, Arctic peregrine falcon, bald eagle, or piping plover should occur from oil spills less than 1,000 bbl, the effects would primarily be sublethal; few mortalities are assumed. The effects of oil spills less than 1,000 bbl are assumed to be solely sublethal due to the inconsiderable area affected. In the event that oil spills of any size should occur in critical habitats for feeding, resting, or breeding, such as inshore, intertidal, and nearshore areas, sublethal effects are assumed. It is assumed that the extent and severity of effects from oil spills of any size will be lessened by improved coastal oil-spill contingency planning and response, deterrence of birds away from the immediate area of an oil spill, and increased percentage of survival from rehabilitation efforts (Section IV.C.5.).

Section IV.C.1. estimates the mean number of spills less than 1,000 bbl occurring as a result of the proposed action plus prior and future OCS sales in the WPA. It is assumed that five offshore spills and one onshore spill greater than one and less than or equal to 50 bbl will occur each year; few will contact coastal areas. It is assumed that one offshore spill greater than 50 and less than 1,000 bbl will occur every five years and that it will not contact coastal areas. It is assumed that 1 onshore spill greater than 50 and less than 1,000 bbl will occur every 10 years. Although an interaction with spills less than 1,000 bbl is assumed, only sublethal effects are assumed. It is assumed that spills less than 1,000 bbl will periodically contact and affect the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover.

It is assumed that 39 crude oil spills greater than or equal to 1,000 bbl will occur as a result of import tankering and the proposed action, plus prior and future OCS sales in the Gulf of Mexico (Table IV-22). Section IV.C.1. identifies the estimated risk of one or more oil spills greater than or 1,000 bbl occurring and contacting critical habitats within 10 days for feeding, resting, or breeding of the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover in the WPA. The highest probability of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting a coastal bay in the Western Gulf within 10 days is 22 percent (Galveston Bay). The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days Texas coastal marshes is 27 percent. Although an interaction with spills greater than or equal to 1,000 bbl is expected, primarily sublethal effects are assumed with infrequent mortalities. It is assumed that an oil spill greater than or equal to 1,000 bbl will periodically contact and affect the brown pelican, Arctic peregrine falcon, bald eagle, and piping plover in the WPA.

Some critical feeding habitats of the brown pelican, Arctic peregrine falcon, and piping plover occur nearshore. The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days nearshore areas (coastline) along the Western Gulf is 85 percent. Although an incident is expected, sublethal effects are assumed. It is assumed that an oil spill greater than or equal to 1,000 bbl will periodically contact and affect nearshore areas (coastline) critical to the feeding of the brown pelican, Arctic peregrine falcon, and piping plover.

*Summary*

The brown pelican, Arctic peregrine falcon, bald eagle, and piping plover may be impacted by helicopter and service-vessel traffic, onshore pipeline landfalls, entanglement in and ingestion of offshore oil- and gas-related plastic debris, and oil spills. The effects of these activities are estimated to be sublethal. Lethal effects are assumed only from oil spills greater than or equal to 1,000 bbl. Oil spills of any size are estimated to be infrequent events that will periodically contact threatened and endangered birds or their critical feeding, resting, or breeding habitats.

The incremental contribution of the proposed action (as analyzed in Section IV.D.2.a.(7)(b)) to the cumulative impact is inconsequential because the effects of sale-specific helicopter and service-vessel traffic, trash and debris, and onshore pipeline landfalls are estimated to be sublethal. It is assumed that there will be no interaction between sale-related oil spills and endangered and threatened coastal and marine birds.

*Conclusion*

The impact of the Cumulative Case scenario on endangered and threatened birds within the potentially affected area is assumed to result in a decline in species numbers or a temporary displacement from their current distribution, a decline or displacement that will last more than one generation.

### *(8) Impacts on Commercial Fisheries*

This Cumulative Analysis considers the status of commercial fishery stocks, the effects of impact-producing factors related to the Western Gulf proposed action, prior and future OCS sales, State oil and gas activity, crude oil imports by tanker, and offshore recreational fishing that may occur and adversely affect the commercial fishing industry in the same general area that may be affected by OCS oil and gas activity located in the WPA. Specific types of impact-producing factors considered in the analysis include commercial fishing techniques or practices, loss of wetlands, structure removal, and construction of offshore oil and gas platforms.

Sections providing supportive material for the commercial fisheries analysis include Sections III.B.6. (description of fish resources), III.C.3. (commercial fishing stocks and activities), IV.A.2.d.(3) (use conflicts), IV.A.2.b.(1) (pipelines), IV.A.2.a.(3) (structure removal), IV.A.2.a.(1) (seismic operations), IV.C.3. (oil spills), IV.A.2.d.(8) (subsurface blowouts), IV.B.1.b.(4)(e) (offshore discharges), and IV.B.1.c. (onshore discharges). Competition between large numbers of commercial fishermen, between commercial operations employing different fishing methods, and between commercial and recreational fishermen for a given fishery resource, as well as natural phenomena such as weather, hypoxia, and red tides, may reduce standing populations. Fishing techniques such as trawling, gill netting, or purse seining, when practiced nonselectively, may reduce the standing stocks of the desired target species as well as significantly impact species other than the target. Space-use conflicts can result from different forms of commercial operations and between commercial and recreational fisheries. Finally, hurricanes may impact commercial fisheries by destroying oyster reefs, damaging gear and shore facilities, and changing physical characteristics of inshore and offshore ecosystems. The availability and price of fuel can also affect commercial fishing operations in the Gulf of Mexico.

The majority of commercial species harvested from the Gulf of Mexico are believed to be in serious decline from overfishing. Continued fishing at the present levels may result in rapid declines in commercial landings and eventual failure of certain fisheries. Commercial landings of traditional fisheries, such as shrimp and red snapper, have declined over the past decade despite increases in fishing effort. Commercial landings of recent fisheries, such as shark, black drum, and tuna, have increased exponentially over the past five years, and those fisheries are thought to be in danger of collapse (Angelovic, written comm., 1989; USDOC, NMFS, 1989a). It is expected that overfishing will adversely affect commercial fishery resources. The severity of the effects of overfishing on the commercial fishing resources could be prominent, involving a decline in populations of commercial importance that will recover to pre-impact level within two to three generations.

Because approximately 92 percent of commercially important species are estuarine dependent, the degradation of inshore water quality and the loss of Gulf wetlands as nursery areas are considered significant threats to the commercial fishing industry (Angelovic, written comm., 1989; Christmas et al., 1988; USEPA, 1989). Loss of wetland nursery areas in the WPA is believed to be the result of urbanization of coastal wetlands and water management practices (Texas Parks and Wildlife Dept., written comm., 1989). It is expected that wetlands loss and water quality degradation will adversely affect commercial fishery resources. The severity of the effects of wetlands loss and water quality degradation on commercial fishing resources could be considerable, involving a decline in populations of commercial importance that will recover to pre-impact level within two to three generations.

Those species of commercial importance that are not estuarine dependent, such as mackerel, cobia, and crevalle, are considered coastal pelagics. Populations of these species exhibit some degree of coastal movement. These species range throughout the Gulf, move seasonally, and are more abundant in the WPA during the summer (Gulf of Mexico Fishery Management Council, 1985). In general, the coastal movements of these species are restricted to one or two planning areas within the Gulf of Mexico Region and are not truly migratory, as is the case with salmon. The coastal movements of these species are related to reproductive activity, seasonal changes in water temperature, or other oceanographic conditions. Discernible effects to regional populations or subpopulations of these species as a result of OCS oil and gas activities are not expected, because pelagic species are distributed and spawn over a large geographic area and depth range.

Structure removals result in artificial habitat loss and cause fish kills when explosives are used. Table IV-8 assumes that 231 structure removals by explosives will occur in the WPA under the cumulative scenario during the 35-year life of the proposed action. It is assumed that no more than 12 removals will occur in the WPA during this time in any single year. For the purpose of this analysis, it is estimated that structure removals may have a minor effect on Western Gulf fisheries because removals will be unusual events killing only those fish proximate to the removal site.

The 140 additional platform complexes resulting from the proposed action, plus prior and future OCS sales in the WPA (Table IV-8), are estimated to reduce trawling area by about 1,602 ha (3,957 ac) during the peak year. This represents an inconsequential amount of the total trawling area in the WPA. It is expected that platform emplacement will rarely affect trawling activity.

Oil spills that contact coastal bays, estuaries, and waters of the OCS during the time when high concentrations of pelagic eggs and larvae are present have the greatest potential to damage commercial fishery resources.

Section IV.C.1. estimates the mean number of offshore spills less than 1,000 bbl occurring from the proposed action, plus prior and future OCS sales in the Gulf of Mexico. Although spills greater than 1 and less than 50 bbl may occur each year, none is assumed to occur in proximity to coastal environments. It is assumed that oil spills, plus prior and future OCS sales in the Gulf of Mexico, will not affect coastal bays and marshes essential to the well-being of the commercial fishery resources in the WPA.

Section IV.C.1. estimates the mean number of spills greater than or equal to 1,000 bbl occurring from cumulative activity in the WPA. It is assumed that 2 crude oil spills greater than or equal to 1,000 bbl from OCS platforms and pipelines and 37 spills from import tankering will occur in the Gulf of Mexico over the 35-year life of the proposed action. Section IV.C.3. identifies the estimated risk of one or more oil spills greater than or equal to 1,000 bbl, resulting from cumulative activity (the proposed action, prior and future OCS leasing, import tankering, and OCS shuttle tankering), occurring and contacting, within 10 days, coastal bays and marshes essential to the well-being of commercial fishery resources in the WPA.

The estimated mean number of spills greater than or equal to 1,000 bbl to occur and contact within 10 days nearshore areas (coastline) in the Cumulative Case in the Gulf is two. The estimated mean number of spills greater than or equal to 1,000 bbl to occur and contact within 10 days Texas coastal marshes is less than 1 (Table IV-22). Galveston County, Texas, is the land segment with the highest probability (22% from imports) of occurrence and contact by one or more spills greater than or equal to 1,000 bbl. Galveston Bay is the coastal inshore bay with the highest probability (22% from imports) of being contacted by one or more spills greater than or equal to 1,000 bbl. The highest estimated probability of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days the Texas coastal marshes is 27 percent for east Texas coastal marshes from import tankers.

Oil spills greater than or equal to 1,000 bbl originating in port from the tankering of imported oil include those that may occur and contact bays and estuaries. The highest estimated probability of one or more oil spills greater than or equal to 1,000 bbl originating from tankering of imported oil occurring and contacting within 10 days a Western Gulf bay or estuary is 98 percent (Houston). The estimated number of spills greater than or equal to 1,000 bbl from tankering of imported oil occurring and contacting within 10 days a Western Gulf bay or estuary in the next 35 years is eight. There are no offshore ports in the Western Gulf. The closest offshore port is the Louisiana Offshore Oil Port (LOOP). The highest estimated probability of one or more oil spills from tankering of imported oil occurring and contacting within 10 days OCS waters from LOOP is 97 percent. The estimated number of spills greater than or equal to 1,000 bbl from tankering of imported oil occurring and contacting within 10 days OCS waters from LOOP is eight (Section IV.C.3.).

It is assumed that the interaction of oil spills greater than or equal to 1,000 bbl, either assumed to occur and contact or assumed to occur, as a result of cumulative activity, with commercial fishery resources in the Western Gulf will have a considerable effect on the commercial fishing industry. It is estimated that oil spills will regularly contact and affect Western Gulf coastal bays, estuaries, or coastal areas. As a singular example, the highest estimated probability of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting within 10 days Gulf menhaden during their winter spawning in coastal waters of the WPA is 31 percent from platforms, pipelines, or shuttle tankers. Therefore, this analysis expects noticeable interaction between commercial fishery resources and oil spills greater than or equal to 1,000 bbl.

*Summary*

Several impact-producing factors may threaten the commercial fishing industry.

Habitat loss results in the decline of commercial populations, essential habitats, and commercial fishing activity. In the Western Gulf coastal zone, habitat loss of nonmigrating birds occurs from urbanization of coastal wetlands and water management practices.

Overfishing results in rapid declines in commercial populations and landings and in the eventual failure and loss of both traditional and recent fisheries. The majority of commercial species harvested from the Gulf of Mexico are believed at present to be in a seriously depleted condition due to overfishing.

Structure removals result in habitat loss and cause fish kills in the vicinity of the removal.

Oil spills pose the greatest threat to the commercial fishing industry by direct contact with eggs, larvae, juveniles, or massed spawning adult finfish or shellfish; by contamination of essential estuarine nursery habitat; or by deterrence of commercial fishing activity.

It follows that activities have the potential to affect the commercial fishing industry detrimentally.

The incremental contribution of the proposed action (as analyzed in Section IV.D.1.a.(9)) to the cumulative impact is inconsequential because the effects of sale-specific underwater OCS obstructions, subsurface blowouts, operational discharges, explosive structure removal, space-use conflict, and seismic surveys are expected to be negligible. It is estimated that there will be no interaction between sale-related oil spills and areas essential to commercial fisheries.

*Conclusion*

The cumulative effect of the above-listed, impact-producing factors on the commercial fishing industry within the potentially affected area is expected to result in a discernible decline in populations of commercial importance, in the quality of essential habitats, or in commercial fishing activity. Recruitment will return any affected population, habitat, or activity to pre-impact level and/or condition within two to three generations.

### *(9) Impacts on Recreational Resources and Activities*

### *(a) Beach Use*

This Cumulative Analysis considers the effects of impact-producing factors related to the proposed action (Section IV.D.2.a.(9)(a)), plus those related to prior and future OCS sales, State offshore oil and gas activity, tankering of crude oil imports, merchant shipping, commercial and recreational fishing, defense operations, recreational use of beaches, and other offshore and coastal activity that results in debris, litter, trash, and pollution, which may occur and adversely effect major recreational beaches. Specific impact-producing factors analyzed include oil spills and trash and debris. Other factors such as commercial, industrial, and residential land developments, civil works projects, and natural phenomena have affected, and will continue to affect, beach-associated characteristics, such as barrier island stabilization (Section IV.D.2.a.(1)(a) and air quality (Section IV.D.2.a.(4); ultimately, these factors may also affect the recreational use of beaches.

A mean number of two oil spills greater than or equal to 1,000 bbl (Table IV-19), and a few spills each year greater than 1 and less than or equal to 50 bbl are assumed to occur and contact land as a result of Federal OCS activity and crude-oil import tankering (Section IV.C.4.). Estimates of one or more spills greater than or equal to 1,000 bbl occurring and contacting within 10 days major recreational beaches in Texas (Galveston/Bolivar Peninsula) and Louisiana (Cameron beaches) are presented in Table IV-22. Spills of 1,000 bbl (Section IV.C.1.) are assumed to result in short-term disturbances, causing temporary loss or displacement of water-related, nearshore recreational activity on specific beaches directly or indirectly impacted. Furthermore, over the next 35 years 16 spills greater than or equal to 1,000 bbl (Section IV.C.1.) involving tankers carrying imported petroleum liquids could adversely impact beaches in the vicinity of major inshore Gulf of Mexico ports from Mobile to Corpus Christi. It is important to realize, especially in the cumulative impact context, that of all chronic hydrocarbon pollution existing in the Gulf, less than 1 percent is directly related to Gulf of Mexico oil and gas leasing and production (Section IV.C.4.). In terms of effects, chronic natural and human-induced hydrocarbon pollution can manifest itself on beaches as tarballs, which would adversely impact beach users, recreational developments, and personal property.

Continued and expanded oil and gas operations in the WPA have contributed to the already serious problem of debris and trash on coastal beaches. Trash and debris detract from the aesthetic quality of beaches, can be hazardous to beach recreational activity, and can increase the cost of beach maintenance programs. Other factors, such as merchant shipping, naval operations, offshore commercial and recreational fishing, natural phenomena, recreational use of beaches, State oil and gas activity, tankering, pipelines, operational discharges, condominiums, coastal activity in Mexico and Cuba, and other offshore and coastal activities, contribute to flotsam, jetsam, pollution, and litter existing on Gulf of Mexico recreational beaches. Trash and debris are a recognized problem affecting enjoyment and maintenance of recreational beaches in the WPA. It has been estimated that OCS oil and gas operations are contributing 10-12 percent of the trash and debris affecting Texas and Louisiana recreational beaches (USEPA, 1990; Parker, personal comm., 1990).

A recent report resulting from a detailed marine debris monitoring program at coastal national parks (Cole et al., 1990) indicates plastics compose a preponderance of litter and debris items at Padre Island National Seashore, and plastic pellets used in plastics manufacturing composed the most numerous item within the plastics category (73%). Although microplastics have little effect on recreational beach use, large plastic items, drums, and broken glass, which are also recorded, can adversely impact beach use. Items known to be associated with the oil and gas industry have been frequently identified with the beach litter removed from Texas and Louisiana beaches; however, some of these items, such as computer write-protection rings, have noticeably declined in the past few years. Regulatory, administrative, and volunteer programs involving government, industry, and private citizens, and environmental, school, and civic groups are monitoring and reducing the gravity of the beach litter problem Gulfwide.

*Summary*

For purposes of this analysis, one or two oil spills greater than or equal to 1,000 bbl that are assumed to preclude short-term recreational use of some Texas beaches at the park or community levels for the next 35 years. However, smaller annual spills throughout the planning area are assumed to preclude short-term use of the small segments of recreational beaches adversely impacted, but will have little effect on local recreational use or tourism. Frequent impacts from man-induced debris and litter derived from both offshore and onshore sources are assumed to diminish the tourist potential of beaches in the WPA and to degrade chronically the ambience of shorefront recreational beaches, thereby affecting the enjoyment of recreational beaches throughout the planning area. However, pollution and debris associated with the proposed sale will contribute minimally to this impact.

A ton or more per mile of trash and debris has been removed from some Texas recreational beaches cleaned each fall since 1986. Sale-specific operational activities are not assumed to cause beach or park closures or to generate the need for excessive beach maintenance. Accidental loss of solid waste from offshore activities generated by this sale is assumed to impact Texas beaches; however, this incremental litter is unlikely to be perceptible by beach users or administrators because it will constitute only a very small percentage of the existing trash and litter found on Texas beaches. Improved offshore waste management practices, implementation of recently imposed MARPOL regulations, and participation and support by most marine user groups and public agencies in implementing the Gulf of Mexico Program's Marine Debris Action Plan should gradually improve the recreation quality of Texas beaches.

*Conclusion*

Although trash and accidental oil spills will continue to affect the ambience of Texas recreational beaches adversely, the level of chronic pollution should decline during the life of the proposed action. Beach use at the regional level is unlikely to change from existing patterns; however, closure of specific beaches or parks directly impacted by one or two oil spills greater than or equal to 1,000 bbl is assumed during cleanup operations.

### *(b) Marine Fishing*

This Cumulative Analysis considers the effects of impact-producing factors related to the proposed action (Section IV.D.2.a.(9)(b), plus those related to prior and future OCS sales; State offshore oil and gas activity; tankering of crude oil imports; other marine vessel traffic and port congestion; and other commercial, military, and recreational offshore activities that might affect offshore marine recreational fishing.

Activity related to OCS oil and gas development is projected to add 140 offshore platform complexes in the WPA over the next 35 years (Table IV-8). Of these, 15 new platforms are projected for the W-1 coastal subarea. Platforms here will be those closest to shore and assumed to affect offshore fishing because they function as accessible, high profile, *de facto* artificial reefs. These structures would add to the existing 380 OCS petroleum structures currently in the WPA and several permitted artificial reefs also in the planning area. Studies and observations have shown that, where oil and gas structures are accessible, they are significant attractants of offshore fishermen and they enhance fishing success. Conversely, anthropogenic pollution and activity (oil and chemical spills, competition between commercial and recreational fishermen and among recreational fishermen, coastal modifications brought on by industrial development and population increases in the coastal zone) and inevitable natural forces, such as subsidence, erosion, anoxia, floods, and freezes, will affect long-term sociological and ecological changes. These pollution events, fishing activities, and changes will directly and indirectly stress fishery resources important to marine recreational fishing and could lead to the increase of restrictive regulations affecting fishing enjoyment and participation. Should there be a sustained, declining trend in offshore fishing trips, the recreational fishing support industry is likely to suffer as well.

The two offshore oil spills greater than or equal to 1,000 bbl (Table IV-19) from either platforms, pipelines, or tankers and eight inshore tanker spills from Houston to Corpus Christi assumed to occur over the next 35 years will cause temporary disinterest in recreational fishing within the area of visible oil slicks, but should not affect the level of recreational fishing within the planning area.

Offshore oil and gas activity (platforms) has had a major impact on recreational fishing in the WPA in that it has helped to focus the location of offshore fishing and enhanced fishing success. A continuation of oil and gas development as a result of continued Federal and State offshore lease sales is expected to help maintain recreational fishing levels in offshore areas of the WPA over the next 35 years. Because of the expected increase in the structure removal rate in the Federal waters of the Gulf of Mexico (currently around 100 per year off Louisiana and Texas), and greater interest in artificial reef development Gulfwide, more interest in the use of obsolete oil and gas structures as dedicated reefs in the marine environment is likely. The National Fishing Enhancement Act of 1984 and management measures adopted by NMFS through the planning efforts of the Gulf of Mexico Fishery Management Council will also affect the future of offshore fishing in the WPA.

*Summary*

Both anthropogenic and natural events (fishing, degradation and loss of wetlands, environmental change brought on by extreme weather conditions, and the degradation of coastal and offshore water quality from all types of pollution) will adversely affect marine recreational fishing.

The incremental contribution of the proposed action (as analyzed in Section IV.D.2.a.(9)(b)) to the cumulative impact is minimal because sale-specific activity will generate only a few offshore platforms readily accessible to marine recreational fishermen.

*Conclusion*

Continued offshore oil and gas development over the next 35 years will continue to support, maintain, and facilitate offshore recreational fishing in the WPA and extend the time offshore oil and gas structures are a focus of offshore fishing activity.

### *(10) Impacts on Archaeological Resources*

#### *(a) Historic*

The following analysis considers not only the effects of the impact-producing factors related to the proposed action, but OCS activities in the Central Gulf, as well as prior and future OCS sales. Specific types of impact-producing factors considered in this analysis include drilling rig and platform emplacement, pipeline emplacement, anchoring, oil spills, dredging, new onshore facilities, and ferromagnetic debris associated with OCS hydrocarbon activities. Included also in this analysis are trawling, sport diving, commercial treasure hunting, and tropical storms. A discussion of each impact-producing factor is presented in Section IV.D.1.d.(11).

Future OCS exploration and development activities in the WPA are expected to result in the drilling of 5,280 exploration and delineation wells and 2,050 development wells, the installation of 140 platforms, and the laying of 3,510 km of offshore pipelines (Table IV-8). The archaeological surveys are expected to reduce the potential for an interaction between an impact-producing activity and an historic resource by 95 percent in those WPA areas that have a thin Holocene sediment veneer (eastern part of the WPA). Archaeological surveys are estimated to be 90 percent effective in those WPA areas that have a thick blanket of unconsolidated Holocene sediments (western portion of WPA). Archaeological surveys were first required in 1974; therefore, it is assumed that the major impacts to historic resources resulted from development prior to 1974. The potential of an interaction between rig or platform emplacement and an historic shipwreck is diminished by the survey, but still exists. Such an interaction could result in the loss of significant or unique historic information.

The placement of 3,510 km of pipelines in the WPA is projected. According to Table IV-8, there are currently 4,654 km of pipelines on the Western Planning Area OCS. While the archaeological survey minimizes the chances of impacting an historic shipwreck, there remains a possibility that a wreck could be impacted by pipeline emplacement. Should such an impact occur, significant or unique historic archaeological information could be lost.

The setting of anchors for drilling rigs, platforms, and pipeline lay barges, and anchoring associated with oil and gas vessel trips to the OCS have the potential to impact historic wrecks. The archaeological surveys serve to minimize the chance of impacting historic wrecks; however, these surveys are not seen as infallible, and the chance of an impact from future activities exists. A total of about 212,000 shuttle tanker, barge, and service vessel trips are projected for the WPA (Table IV-13). Impacts from anchoring on an historic shipwreck may have occurred. There is also a potential for future impacts from anchoring on an historic shipwreck. Such an interaction could result in the loss of significant or unique information.

Oil spills have the potential to impact coastal historic sites directly or indirectly by physical impacts caused by oil spill cleanup operations. According to Table IV-22, there is an estimated 85 percent probability of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting the WPA coastal area within 10 days. There is up to a 73 percent probability that an imported oil spill greater than or equal to 1,000 bbl will occur and contact the WPA coastal area within 10 days. However, the impacts caused by oil spills to coastal historic archaeological resources are generally short term and reversible.

Most channel dredging occurs at the entrances to bays, harbors, and ports. These areas have a high probability for historic shipwrecks, and the greatest concentrations of historic wrecks are likely associated with these features (Garrison et al., 1989). It is assumed that significant or unique archaeological information has been lost as a result of past channel dredging activities. In many areas, COE requires remote-sensing surveys prior to dredging activities to minimize such impacts (Espey, Huston, & Associates, 1990).

Past, present, and future OCS oil and gas exploration and development will result in the deposition of several tens of thousands of tons of ferromagnetic debris on the seafloor. This modern marine debris will tend to mask the magnetic signatures of historic shipwrecks, particularly in areas that were developed prior to requiring archaeological surveys in the WPA (offshore Subareas W-1 and W-2). Such masking of the signatures characteristic of historic shipwrecks may have resulted in OCS activities impacting a shipwreck containing significant or unique historic information. Potential impacts caused by the masking of magnetic signatures could result in the damage to or loss of significant or unique historic archaeological information.

Trawling activity in the WPA would only affect the uppermost portion of the sediment column (Garrison et al., 1989). On many wrecks, this zone would already be disturbed by natural factors and would contain only artifacts of low specific gravity that have lost all original contact. According to Table IV-13, 3 terminals (each requiring 7-24 ha of land), 3 pipeline landfalls, and 120 km of onshore pipelines will be necessary to support total Western Planning Area OCS program activities. Investigations prior to construction can determine if historic archaeological resources exist at the sites.

Because MMS does not have jurisdiction over pipelines in State waters, the archaeological resource protection requirements of the National Historic Preservation Act (NHPA) are not within MMS's jurisdiction. However, other Federal agencies, such as the COE, which lets permits associated with pipelines in State waters, are responsible for the protection of archaeological resources under the NHPA. Therefore, the impacts that might occur to archaeological resources by pipeline construction within State waters should be mitigated under the requirements of the NHPA.

Sport diving and commercial treasure hunting are significant factors in the loss of historic data from wreck sites. While commercial treasure hunters generally impact wrecks with intrinsic monetary value, sport divers may collect souvenirs from all types of wrecks. Since the extent of these activities is unknown, the impact cannot be quantified. It is assumed that some of the data lost have been significant or unique.

About one-third of the coast in the Western Gulf was hit with 16-20 tropical cyclones between the years 1901 and 1955 (DeWald, 1982). The other two-thirds had a slightly lower incidence of cyclones (11-15). Shipwrecks in shallow waters are exposed to a greatly intensified longshore current during tropical storms (Clausen and Arnold, 1975). Under such conditions, it is highly likely that artifacts of low specific gravities (e.g., ceramics and glass) would be dispersed. Some of the original information contained in the site would be lost in this process, but a significant amount of information would also remain. Overall, a significant loss of data from historic sites has probably occurred, and will continue to occur, in the Western Gulf from the effects of tropical storms. Some of the data lost have most likely been significant or unique.

*Summary*

Several impact-producing factors may threaten historic archaeological resources of the Western Gulf. An impact could result from a contact between an OCS activity (pipeline and platform installations, drilling rig emplacement and operation, dredging, and anchoring activities) and an historic shipwreck located on the continental shelf. The archaeological surveys and resulting archaeological analysis and clearance that are required prior to an operator beginning oil and gas activities in a lease block are estimated to be 90 percent effective at identifying possible historic shipwrecks in areas of the WPA with a high probability for the presence of historic period shipwrecks and a thick blanket of unconsolidated sediments (western part of the WPA). Development of the WPA prior to requiring archaeological surveys has possibly impacted wrecks containing significant or unique historic information.

The loss of tons of ferromagnetic debris associated with oil and gas exploration and development could result in the masking of historic shipwrecks. It is expected that dredging, sport diving, commercial treasure hunting, and tropical storms have impacted and will continue to impact historic period shipwrecks. Such impact will likely result in the loss of significant or unique archaeological information.

Onshore development as a result of the proposed action could result in the direct physical contact between an historic site and new facility construction and pipeline trenching. It is assumed that archaeological investigations prior to construction will serve to mitigate these potential impacts. While the likelihood of an oil spill occurring and contacting within 10 days the WPA coastline is high, assumed effects on historic coastal resources are temporary and reversible. Loss of significant or unique historic archaeological information from commercial fisheries (trawling) is not expected.

The effects of the various impact-producing factors discussed in this analysis have likely resulted in the loss of significant or unique historic archaeological information. In the case of factors related to OCS Program activities, it is reasonable to assume that most impacts would have occurred prior to 1974 (the date of initial archaeological survey and clearance requirements). The incremental contribution of the proposed action is expected to be very small due to the efficacy of the required remote-sensing survey and archaeological report. However, there is a possibility of an interaction between bottom-disturbing activity (rig emplacement, pipeline trenching, and anchoring) and an historic shipwreck.

*Conclusion*

The total of OCS program and non-program-related impact-producing factors have likely resulted and may yet result in the loss of significant or unique historic archaeological information.

### *(b) Prehistoric*

Future OCS exploration and development activities in the WPA are expected to result in the drilling of 5,280 exploration and delineation wells and 2,050 development wells, the installation of 140 platforms, and the laying of 3,510 km of offshore pipelines (Table IV-8). The archaeological surveys are expected to reduce the potential for an interaction between an impact-producing activity and a prehistoric resource by 90 percent. Because archaeological surveys were first required in 1974, it is assumed that the major impacts to historic resources resulted from development prior to 1974. The potential of an interaction between rig or platform emplacement and a prehistoric site is diminished by the survey, but still exists. Such an interaction could result in the loss of significant or unique prehistoric information.

The placement of 3,510 km of pipelines in the WPA is projected. According to Table IV-8, there are currently 4,654 km of pipelines on the Western Planning Area OCS. While the archaeological survey minimizes the chances of impacting a prehistoric site, there remains a possibility that a site could be impacted by pipeline emplacement. Should such an impact occur, significant or unique prehistoric archaeological information could be lost.

The setting of anchors for drilling rigs, platforms, and pipeline lay barges, and anchoring associated with oil and gas vessel trips to the OCS have the potential to impact shallow, emplaced prehistoric sites. The archaeological surveys serve to minimize the chance of impacting these sites; however, these surveys are not seen as infallible, and the chance of an impact from future activities exists. A total of about 212,000 shuttle tanker, barge, and service vessel trips are projected for the WPA (Table IV-13). Impacts from anchoring on a prehistoric site may have occurred. There is also a potential for future impacts from anchoring on a prehistoric site. Such an interaction could result in the loss of significant or unique information.

Oil spills have the potential to impact coastal prehistoric sites directly, or indirectly by physical impacts caused by oil spill cleanup operations. According to Table IV-22, there is an estimated 85 percent probability of an oil spill greater than or equal to 1,000 bbl occurring and contacting the WPA coastal area within 10 days. There is an estimated 73 percent probability that an oil spill greater than or equal to 1,000 bbl will occur and contact the WPA coastal area within 10 days. The impacts caused by oil spills to coastal prehistoric archaeological resources can severely distort information relating to the age of the site. Contamination of the site organics by modern hydrocarbons can render dating by C-14 methods useless. This loss might be ameliorated by artifact seriation or other relative dating techniques. Coastal prehistoric sites might also suffer direct impact from beach cleanup operations. Interaction between oil-spill cleanup equipment and a site could destroy fragile artifacts or disturb site context, possibly resulting in the loss of information on the prehistory of North America and the Gulf Coast Region. Some coastal sites may contain significant or unique information.

Most channel dredging occurs at the entrances to bays, harbors, and ports. Bay and river margins have a high probability for prehistoric sites. It is assumed that significant or unique archaeological information has been lost as a result of past channel dredging activities. In many areas, COE requires surveys prior to dredging activities to minimize such impacts.

Trawling activity in the WPA would only affect the uppermost portion of the sediment column (Garrison et al., 1989). This zone would already be disturbed by natural factors and site context to this depth would presumably be disturbed.

Investigations prior to construction can determine if prehistoric archaeological resources exist at the sites. According to Table IV-13, 3 terminals (each requiring 7-24 ha of land), 3 pipeline landfalls, and 120 km of onshore pipelines will be necessary to support total Western Planning Area OCS program activities.

Because MMS does not have jurisdiction over pipelines in State waters, the archaeological resource protection requirements of the NHPA are not within MMS's jurisdiction. However, other Federal agencies, such as the COE, which lets permits associated with pipelines in State waters, are responsible for the protection of archaeological resources under the NHPA. Therefore, the impacts that might occur to archaeological resources by pipeline construction within State waters should be mitigated under the requirements of the NHPA.

About one-third of the coast in the Western Gulf was hit with 16-20 tropical cyclones between the years 1901-1955 (DeWald, 1982). The other two-thirds had a slightly lower incidence of cyclones (11-15). Prehistoric sites in shallow waters or on coastal beaches are exposed to the destructive effects of wave action and scouring currents. Under such conditions, it is highly likely that artifacts would be dispersed and the site context disturbed. Some of the original information contained in the site would be lost in this process. Overall, a significant loss of data from prehistoric sites has probably occurred, and will continue to occur, in the Western Gulf from the effects of tropical storms. Some of the data lost have most likely been significant or unique.

*Summary*

Several impact-producing factors may threaten prehistoric archaeological resources of the Western Gulf. An impact could result from a contact between an OCS activity (pipeline and platform installations, drilling rig emplacement and operation, dredging, and anchoring activities) and a prehistoric archaeological site located on the continental shelf. The archaeological surveys and resulting archaeological analysis and clearance that are required prior to an operator beginning oil and gas activities in a lease block are estimated to be 90 percent effective at identifying possible prehistoric sites in the WPA. Development of the WPA prior to requiring archaeological surveys has possibly impacted sites containing significant or unique prehistoric information.

Expected effects from dredging and tropical storms are estimated to result in damage to or loss of significant or unique archaeological information. The likelihood of an oil spill occurring and contacting within 10 days the WPA coastline is high. Such contact could result in loss of significant or unique information relating to the dating of a prehistoric site. Onshore development as a result of the proposed action could result in the direct physical contact between a prehistoric site and new facility construction and pipeline trenching. It is assumed that archaeological investigations prior to construction will serve to mitigate these potential impacts. Loss of significant or unique historic archaeological information from commercial fisheries (trawling) is not expected.

The effects of the various impact-producing factors discussed in this analysis have likely resulted in the loss of significant or unique prehistoric archaeological information. In the case of factors related to OCS Program activities, it is reasonable to assume that most impacts would have occurred prior to 1974 (the date of initial archaeological survey and clearance requirements). The incremental contribution of the proposed action is expected to be very small due to the efficacy of the required remote-sensing survey and archaeological report. However, there is a possibility of an interaction between bottom-disturbing activity (rig emplacement, pipeline trenching, and anchoring) and a prehistoric archaeological site.

*Conclusion*

The total of OCS program and non-program-related impact-producing factors have likely resulted in and may yet result in the loss of significant or unique prehistoric archaeological information.

### *(11) Impacts on Socioeconomic Conditions*

#### *(a) Population, Labor, and Employment*

The Cumulative Analysis will focus on the direct, indirect, and induced impacts of the OCS oil and gas industry on the population, labor, and employment of the counties in the Western Gulf coastal impact area as a result of prior sales, the proposed sales, and future sales in the Gulf of Mexico. Considered also are employment impacts associated with the clean-up of oil spilled during import tankering operations. There would also be other economic impacts, both direct and indirect, associated with the OCS program resulting from its effect on other industries, such as commercial fishing, tourism, and recreational fishing. The direct benefit or loss in these industries is addressed in the sections of this EIS related specifically to those topics. The OCS program's indirect and induced effect on these associated industries is much more difficult to quantify. Nevertheless, it will generally constitute a fraction of the magnitude of the direct impact. Also discussed in the Cumulative Analysis are projected changes in the industrial composition of the regional economy.

Section III.C.1. provides an historical perspective of the oil and gas industry, as well as a brief description of recent events that have significantly affected the level of OCS activity in the Gulf of Mexico. A detailed discussion of historical trends in population, labor, and employment within the coastal impact area of the Western Gulf can be found in Section III.C.2. That section also includes a listing of counties in the Western Gulf coastal impact area, as well as current statistics and future projections of population, labor, and employment levels for coastal subareas in the region. These projections will serve as a baseline against which impacts will be measured. The methodology developed to quantify these impacts takes into account changes in OCS-related employment, along with population and labor impacts resulting from these employment changes within each individual coastal subarea. For a detailed description of the methodology used in this analysis, see Section IV.D.2.a.(11).

Baseline employment projections for the coastal impact area of the Western Gulf can be found in Figure IV-11. Baseline employment projections, excluding jobs generated in the WPA by the OCS program during the 35-year life of the proposed action, are also displayed on this figure. The difference between these two sets of projections accounts for OCS program employment impacts to the counties of the Western Gulf resulting from prior sales, proposed sales, and future sales in the Central, Western, and Eastern Gulf of Mexico. Sales in the Central Gulf can, and do, result in employment impacts to the Western Gulf. The methodology discussion in Section IV.D.2.a.(11) provides an in-depth treatment of the development of these projections.

A total of approximately 277,300 person-years of employment (direct, indirect, and induced) are required in the Western Gulf coastal subareas in support of the OCS Program in the Gulf of Mexico during the 35-year life of the proposed action. Peak-year impacts occur in 2000, with approximately 11,050 workers involved in primary, secondary, and tertiary industries. After this initial peak-year employment, impacts decline through the year 2027, reflecting the declining level of OCS-related oil and gas activity projected for the Western Gulf. Direct employment in the primary oil and gas extraction industry (SIC 13) accounts for 45 percent of the total employment impacts projected for the coastal subareas of the Western Gulf over the life of the proposed action. Of these total direct employment impacts, exploratory and development activities collectively account for almost 38 percent. Exploratory activities peak in the year 2000, contributing almost 46 percent of the direct employment peak. Development operations peak five years later, in the year 2005. Production operations peak in 1993, the first year of the life of the proposed actions. The main contributor to the overall total employment impact is also production operations. Employment in oil and gas production activities and workover operations account for approximately 62 percent of total direct employment impact due to activities in the Western Gulf. Indirect and induced employment impacts in secondary and tertiary industries amount to approximately 30 percent and 25 percent, respectively, of the total employment impact over the life of the proposed action in the Western Gulf.

Table IV-31 displays the cumulative model projections of total OCS-related employment impacts (direct, indirect, and induced) for each coastal subarea throughout the life of the proposed action. Table IV-32

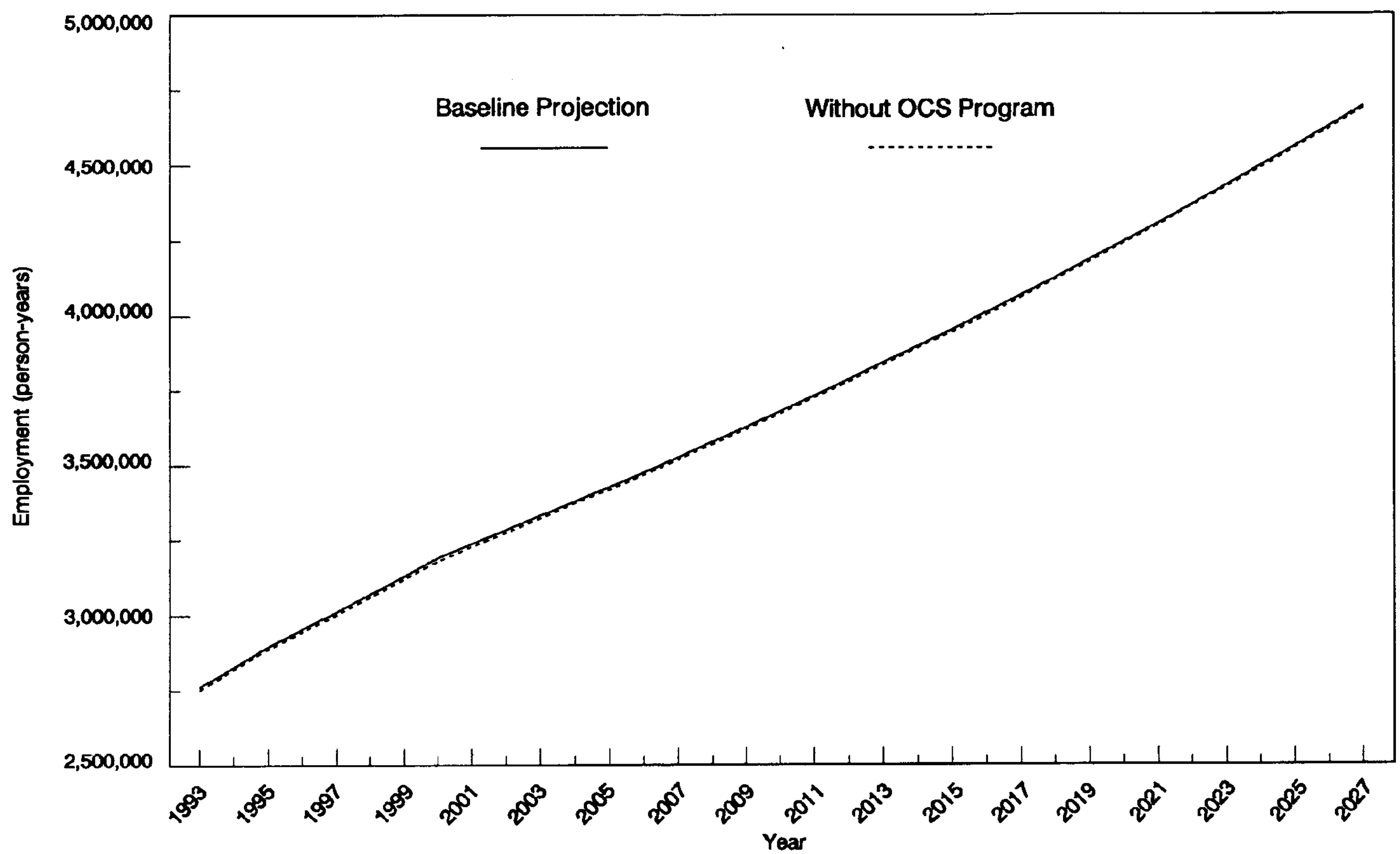



Figure IV-11. Employment Impacts from the OCS Program (Western Planning Area) (USDOI, MMS, Gulf of Mexico OCS Region estimates, 1991).

provides estimates of annual impacts to the population and employment of each coastal subarea as a percent of levels expected in absence of the OCS program. These impact estimates represent changes in the new share of the existing population and employment, changes that will be dependent on the OCS oil and gas industry for support as a result of prior sales, the proposed sales, and future sales in the Gulf of Mexico. The Cumulative scenario's population and employment impact projections presented in this document are higher than those estimated for recent past EIS's. The current analysis incorporates the benefit of improved information on employment levels associated with existing offshore structures and workover operations. These data improvements account for the larger impact projections.

The greatest contributor to the overall employment impact in the Western Gulf is coastal Subarea W-2, which accounts for about 84 percent of the total planning area impact expected for the Cumulative Case. Coastal Subarea W-1 contributes the remaining 16 percent. Peak-year impacts of 0.4 and 0.3 percent occur in both coastal Subareas W-1 and W-2, respectively, during most of the first 10 years of the life of the proposed action.

All coastal subareas of the Western Gulf are projected to experience peak-year employment impacts of less than 1 percent due to activity resulting from prior sales, the proposed sales, and future sales in the Gulf of Mexico. New OCS development will allow the continuation of some opportunities in the oil and gas industry for currently employed workers or future entrants into the labor force already living in the area. After their peak in the year 2000, the level of OCS-related employment projected for the Western Gulf will continue to diminish as existing hydrocarbon resources become depleted. Continued leasing in the OCS will only partially offset the decline in available oil- and gas-related employment in the counties of the WPA.

Employment impacts resulting from oil-spill clean-up activities, because of their highly unpredictable nature, were handled apart from the population and employment model. The level of employment associated with any given clean-up operation is dependent on numerous variables which, in themselves, are also difficult to predict. Nevertheless, the most labor-intensive clean-up operations are those from spills that contact the coastline, particularly recreational beaches. For the purpose of this analysis, it is assumed that only those spills contacting land will involve significant manpower requirements in their clean-up efforts.

Section IV.C.1. presents estimates of the mean number of offshore spills assumed to occur as a result of the Cumulative Case in the Gulf. The estimated probability that one or more offshore spills greater than or equal to 1,000 bbl from import tankering will occur and contact land segments of the Western Gulf within 10 days of the accident can be found in Table IV-22. The highest probability that an offshore spill of this size resulting from the OCS program will occur and contact a WPA land segment within 10 days is 8 percent for Galveston and Chambers Counties (Land Segment 10) in coastal Subarea W-2. Calhoun County (Land Segment 7) in coastal Subarea W-1 carries the second highest probability of occurrence and contact within 10 days, with a probability of 3 percent. Based on these low probabilities, the assumption is that no offshore spill of this size category will occur and contact land somewhere in the WPA as a direct result of the OCS program.

The highest probability that an offshore spill greater than or equal to 1,000 bbl will occur from accidents involving import tankering and contact a WPA land segment within 10 days is 22 percent for Galveston and Chambers Counties (Land Segment 10) in coastal Subarea W-2. All remaining counties have a probability of occurrence and contact within 10 days of less than 10 percent. Aransas County (Land Segment 6), in coastal Subarea W-1, has the second highest probability of occurrence and contact within 10 days, 9 percent. Based on these probabilities, the assumption is that one offshore spill of approximately 22,728 bbl will occur from import tankering operations and contact a land segment somewhere in the WPA. An MMS study of oil slick sizes and length of affected coastline provides statistics that lead to the assumption that, on average, a spill of this size would affect approximately 50 km of coastline (USDOI, MMS, 1985c). Based on employment statistics from recent spill clean-up operations along the coast, the assumption is also made that, for every kilometer of coastline subjected to heavy oiling, approximately 100 temporary workers would be employed for a maximum of 6 weeks. Thus, an estimated 5,000 workers would spend approximately 6 weeks employed in operations supporting the clean-up of one OCS-related spill greater than or equal to 1,000 bbl that is assumed to contact the Western Gulf coast. This estimate is equivalent to 580 person-years of employment over the life of the proposed action. Assuming the spill occurred at the height of employment impacts to coastal Subarea W-2, total impacts would still be less than 1 percent of the employment levels assumed that year in absence of the OCS program in coastal Subarea W-2.

No offshore spills of the size category greater than 50 bbl and less than 1,000 bbl are assumed to occur and contact the Western Gulf coastline. One-hundred and eighty three spills of the size category greater than 1 bbl and less than or equal to 50 bbl are assumed to occur each year in the WPA over the life of the proposed action. Of these spills, only a few are assumed to contact land (Section IV.C.1.). Furthermore, employment impacts resulting from the cleanup of spills this small is assumed to be negligible.

In addition to the spills referenced in Table IV-22, a number of crude oil and petroleum product spills of less than 1,000 bbl and greater than and equal to 1,000 bbl are assumed to occur, primarily in the coastal zone. Estimates regarding the size, source, and potential location of these spills can be found in Section IV.C.1. The level of clean-up action associated with spills of this type will vary.

Employment levels in the impact area of the Western Gulf are expected to increase approximately 77 percent from the year 1990 over the life of the proposed action (Section III.C.2.). Projected changes in the industrial composition of the regional economy are considerable (USDOC, Bureau of Economic Analysis, 1990). The mining sector will sustain a significant reduction in employment levels. By the year 2020, mining employment in the State of Texas is projected to decrease by about 16 percent from 1988 levels. The sector of highest growth in Texas through the year 2020 will very likely be the service industry, which includes establishments primarily engaged in providing a wide variety of services for individuals, business, government, and other organizations. Included in this sector are establishments highly dependent on the tourist industry, such as hotels and other lodging places, recreational camps and parks, amusement services, museums, art galleries, zoological gardens, automotive rental agencies, business advertising, and other miscellaneous personal services. By the year 2020, the service industry is expected to grow by about 40 percent from employment levels experienced in 1988. Retail trade, finance, insurance and real estate, and transportation and public utilities are also projected to exhibit considerable growth over this time period.

Population in the impact area of the Western Gulf is expected to increase approximately 52 percent from the year 1990 over the life of the proposed action (Section III.C.2.). Population impacts from activities associated with the OCS Program are expected to be relatively low in the Western Gulf. Peak-year population impacts for coastal Subareas W-1 and W-2 are estimated to be 0.4 and 0.3 percent, respectively.

*Summary*

From a cumulative standpoint, the OCS program has had a much lower impact on the coastal subareas of the Western Gulf than on those of the Central Gulf. Peak annual changes in the population, labor, and employment of all coastal subareas in the Western Gulf represent less than 1 percent of the levels expected in absence of the OCS program in the Gulf of Mexico. As much as 13 percent of activity in offshore Subarea W-1, 47 percent of activity in offshore Subarea W-2, and 83 percent of activity in offshore Subarea W-3 is supported by the coastal subareas of the Central Gulf (coastal Subareas C-1 and C-2). It appears that the growth in employment to levels expected in the year 2000 will represent the peak impact of the OCS program over the life of the proposed action. Employment needs in support of OCS oil and gas activity are likely to be met with the existing population and available labor force. Future OCS leasing is expected to offset only partially the declining level of activity already taking place in the oil and gas industry offshore. Similar declining trends are projected for oil and gas production in State waters.

In light of the past and projected decline in oil and gas activities in the Western Gulf, there have been numerous and significant efforts to diversify the State's economy. A diversified economy will provide the coastal communities the opportunity to achieve net economic growth in spite of the downturn in the oil and gas industry. The service industry, in particular, is projected to experience significant growth in the region over the life of the proposed action.

The cumulative impact from prior sales, the proposed actions, and future sales on the population, labor, and employment of the counties of the Western Gulf coastal impact area is approximately 277,300 person-years of employment over the life of the proposed action. The incremental contribution of the proposed action (as analyzed in Section IV.D.2.a.(11)(a)) to the cumulative impact level is minimal because peak annual changes in the population, labor, and employment of all coastal subareas in the Central and Western Gulf resulting from the proposed action in the Western Gulf represent less than 1 percent of the levels expected in absence of the proposal.

*Conclusion*

The Cumulative Analysis impact from prior sales, the proposed actions, and future sales on the population, labor, and employment of the counties of the coastal impact area is approximately 277,300 person-years of employment over the life of the proposed action. Employment needs in support of OCS oil and gas activity are likely to be met with the existing population and the available labor force.

## *(b) Public Services and Infrastructure*

The Cumulative Analysis considers the effects of OCS-related, impact-producing factors from the Central, Western, and Eastern Gulf of Mexico, as well as the effects of prior, current, and future OCS sales and the effects of non-OCS-related impact-producing factors. Impact-producing factors considered in the analysis include work force fluctuations, net migration, relative income, oil and gas activity from State waters, wetlands loss, and tropical storms. Unexpected events (such as the 1973 Arab Oil Embargo) may influence oil and gas activity within the Gulf of Mexico Region. These events cannot be projected and will not be considered in this analysis.

Public services and infrastructure, as used in this analysis, include commonly provided public, semipublic, and private services and facilities, such as education, police and fire protection, sewage treatment, solid-waste disposal, water supply, recreation, transportation, health care, other utilities, and housing. Changes in OCS activities as well as changes caused by non-OCS-related, impact-producing factors, could result in changes in demands for and usage of public services and infrastructure. Adverse effects could arise if the amount or rate of increase or decrease in the usage significantly exceeded or fell far below the capability of a local area to provide a satisfactory level of service. In addition, a natural disaster, such as a hurricane, could significantly damage infrastructure and create a greater need for service than would be locally available.

Section III.C.1. provides an historical perspective of the oil and gas industry, as well as a brief description of recent events that have significantly affected the level of OCS activity in the Gulf of Mexico. Discussions of population, labor, and employment; public services; and social patterns are presented in Section III.C.2.

As shown in Table IV-35, approximately 277,303 person-years of employment (direct, indirect, and induced) are required in the coastal subareas of the Western Gulf to support OCS-related activities during the 35-year life of the proposed action. Peak-year impacts occur in 2000, with 11,041 workers involved in primary, secondary, and tertiary industries. A breakdown of total employment projections for the life of the proposed action by coastal subarea reveals total employment of 16 percent in Subarea W-1 and 84 percent in Subarea W-2. Examination of Table IV-34 reveals that the impact to employment is 0.4 percent in coastal Subareas W-1 and 0.3 percent in coastal Subarea W-2 during the peak year (2000) of the life of the proposed action. It is expected that the level of OCS-related employment projected for the WPA will diminish as existing hydrocarbon resources become depleted. It is assumed that continued leasing in the OCS will only partially offset the decline in available OCS-related oil and gas employment.

Fluctuations in the work force as a result of changing levels of OCS-related oil and gas activity could impact public services and infrastructure during the life of the proposed action. As mentioned above, following the peak year (2000), total employment in the WPA is expected to decline. Projected changes in the industrial composition of the regional economy over the life of the proposed action reveal a decrease in mining employment in Texas of about 16 percent from 1988 levels (USDOC, Bureau of Economic Analysis, 1990). The highest growth industry in the WPA is expected to be the service industry. It is assumed for the purpose of analysis that the jobs created in the service sector will be lower paying than jobs in OCS-related activities. This development could result in a lower tax base, making financing for new infrastructure needed in response to normal growth problematic. However, the more diversified economy is expected to buffer the effects of the decline in OCS-related employment.

Peak-year cumulative impacts are expected to be maintained from 1993 to 2002. Following this period, total OCS-related oil and gas employment in the WPA is expected to decline. As mentioned above, projected levels of mining employment in Texas are expected to drop by 16 percent by 2020. Expected growth in the service industry will most likely provide employment for some of the work force; however, it is assumed that a small amount of out-migration will occur among those persons seeking pay comparable to that of OCS-related employment. It is expected that the diversified economy of the WPA will provide the opportunity for coastal communities to achieve net economic growth despite the projected downturn in OCS-related activities. Out-migration as a direct result of lower employment in the OCS oil and gas industry is not expected to occur in large amounts.

The relatively high wages paid to OCS-related oil and gas industry personnel in the cumulative case will serve to increase the tax base in the coastal parishes and counties beyond what could be expected if there were no OCS activities. As OCS-related employment decreases through time, it is assumed that taxes originating from OCS-related wages and expenditures will decrease. Consequently, maintenance of existing infrastructure and creation of new infrastructure may become problematic.

Oil and gas activity within State waters requires similar public services and infrastructure as do OCS-related oil and gas activities. Further, it is assumed that oil and gas employment from activities within State waters will decline at the same rate, if not faster, than that from Federal OCS waters. Infrastructure needs in support of oil and gas activities in State waters would diminish as employment associated with State-regulated activities declines. Impacts to public services would include increased numbers of individuals requiring assistance. In addition, maintenance of the existing infrastructure and the creation of new infrastructure may become difficult to support at different levels of oil and gas employment.

About one-third of the WPA coast was hit with 16-20 tropical cyclones between the years 1901 and 1955 (DeWald, 1982). The other two-thirds had a slightly lower incidence of cyclones (11-15). Experience with Hurricanes Carla and Beulah has indicated that major hurricanes can have a devastating effect on both public services and community infrastructure. Assuming that several major storms will impact the Western Gulf coastal subareas during the life of the proposed action necessitates an assessment of very high local impact where these storms hit.

Coastal erosion and submergence appear to be the greatest factors in the loss of wetlands. Continuance of these processes will likely result in some impact to community infrastructure, primarily roads and bridges in proximity to coastal wetlands.

*Summary*

Several impact-producing factors will contribute to the impacts expected to occur to public services and community infrastructure during the life of the proposed action.

Declining levels of OCS-related employment are expected to occur during the life of the proposed action. The diversified economic base of the WPA is expected to buffer the effects of the declining growth in the OCS-related oil and gas industry. Economic growth is expected to occur in the service industry.

It is assumed that a small amount of out-migration will coincide with declining levels of OCS-related employment. Oil and gas activity within State waters is assumed to decline over the life of the proposed action. Impacts to public services would occur as persons formerly employed required assistance. Impacts to community infrastructure would occur as the need for the infrastructure diminished and funding for maintenance and replacement declined.

Tropical storm activity has occurred in the past and will occur in the future. It is assumed that several major storms will strike the WPA coastal counties during the life of the proposed action. Experience has indicated that these storms could have a major short-term (1-3 years) impact on public services and community infrastructure.

Community infrastructure in the coastal parishes and counties is linked to the region's physiography. Continued coastal erosion and coastal submergence are expected to require expanded maintenance of roads, bridges, and railroads.

*Conclusion*

The cumulative impact on public services and community infrastructure is not expected to result in long-term (greater than 3 years) disruptions in delivery of public services or maintenance of community infrastructure because of the diversified local economy and the small percentage of impact of the OCS Program on local employees and demographies.

### *(c) Social Patterns*

The Cumulative Analysis considers the effects of OCS-related, impact-producing factors from the Central, Western, and Eastern Gulf of Mexico, as well as the effects of prior, current, and future OCS sales. The analysis also considers the effects of certain non-OCS-related, impact-producing factors. Unexpected events (such as the 1973 Arab Oil Embargo) may influence oil and gas activity within the Gulf of Mexico Region. These events cannot be projected and cannot be presumed for this analysis.

Social patterns, as used in this analysis, will include traditional occupations, folkways, social structure, language, family life, and other forms of cultural adaptation to the natural and human environment. It should be noted that impacts not treated in the present analysis (such as technological improvements in communications and transportation) have caused, and will continue to cause, changes within the analysis area. For the purpose of the current analysis, impact-producing factors to social patterns will include work force fluctuations, net migration (both in-migration and out-migration), work scheduling, displacement from traditional occupations (primarily resulting from wetlands loss), relative income, oil and gas activity within State waters, and tropical storms. Adverse effects could arise if disruption of social patterns occurred and resulted in changes in traditional occupations, disruption in the viability of extant subcultures, and detrimental effects on family life. As mentioned in Section III.C.2.c., it may be argued that employment in the oil and gas industry could be perceived as a traditional occupation. For the purpose of this analysis, such employment will not be considered as a traditional occupation.

Section III.C.1. provides an historical perspective of the oil and gas industry, as well as a brief description of recent events that have significantly affected the level of OCS activity in the Gulf of Mexico. Discussions of population, labor, and employment; public services; and social patterns are presented in Section III.C.2.

As stated in Section IV.D.2.d.(11)(a), approximately 277,300 person-years of employment (direct, indirect, and induced) are required in the Western Gulf coastal subareas to support OCS-related activities during the 35-year life of the proposed action. Peak-year impacts occur in the year 2000, with approximately 11,050 workers involved in primary, secondary, and tertiary industries. A breakdown of total employment projections for the life of the proposed action by coastal subarea reveals total employment of 16 percent in Subarea W-1 and 84 percent in Subarea W-2. An examination of Table IV-34 reveals that the impact to employment ranges from 0.4 percent in Subarea W-1 and 0.3 percent in W-2 in the peak year 2000 to 0.2 and 0.1 percent, respectively, in 2027. Population impacts closely track employment impacts. It is expected that the level of OCS-related employment projected for the WPA will diminish as existing hydrocarbon resources become depleted. It is assumed that continued leasing in the OCS will only partially offset the decline in available OCS-related oil and gas employment.

Fluctuations in the work force as a result of changing levels of OCS-related oil and gas activity could impact social patterns and infrastructure during the life of the proposed action. As mentioned above, total employment in the WPA is expected to decline after the peak year (2000). Projected changes in the industrial composition of the regional economy over the life of the proposed action reveal a decrease in mining employment in Texas of about 16 percent from 1988 levels (USDOC, Bureau of Economic Analysis, 1990). The highest growth industry in the WPA is expected to be the service industry. It is assumed for the purpose of analysis that the jobs created in the service sector will be lower paying than jobs in OCS-related activities. The quality of family life, in some individual cases, could be adversely affected from the stress resulting from decreased family income and loss of security resulting from layoffs in the OCS oil and gas industry. However, the more diversified economy in the WPA is expected to buffer the effects of the decline in OCS-related employment.

Peak-year cumulative impacts are expected to occur in the year 2000. Following the peak year, total employment in the WPA is expected to decline in OCS-related oil and gas employment. As mentioned above, projected levels of mining employment in Texas are expected to drop by 16 percent by 2020. Expected growth in the service industry will most likely provide employment for some of the work force; however, it is assumed that a small amount of out-migration will occur among those persons seeking pay comparable to that of OCS-related employment. It is expected that the diversified economy of the WPA will provide the opportunity for coastal communities to achieve net economic growth despite the projected downturn in OCS-related activities. Out-migration as a direct result of lower employment in the OCS oil and gas industry is not expected to occur in large amounts.

Distance to the site and the type of transportation needed for personnel in OCS-related oil and gas activities results in the normal work schedule occurring as a large block of time on duty (or at site) followed by a large block of time off duty. The schedules may range from 7 days on followed by 7 days off to a 30 day on/30 day off schedule. It has been argued that this type of schedule has allowed for participation in, and continuance of, traditional occupations (Hallowell, 1979; Laska, personal comm., 1991). It is expected that stress will be placed on family life in response to the regular absences of a parent (usually the father). In some cases, it is expected that adaptation to changing family roles will occur. In other cases, it is expected that adaptation will not occur and that there will be deleterious impacts to family life. In the peak year of 2000, approximately 11,050 workers are projected to be involved in primary, secondary, and tertiary industries. Employment in oil and gas production activities and workover operations is projected to account for about 62 percent of this total. Of those persons employed in OCS-related oil and gas activities and working the extended schedule, it is expected that some families will not adapt to these conditions and that deleterious impacts to family life will occur.

The relatively high wages paid to OCS-related oil and gas industry personnel in the cumulative case may result in the voluntary shift of persons engaged in traditional occupations to more lucrative positions within the oil and gas industry. Dependency on these relatively high wages may have a deleterious impact on family life, particularly in view of the projected decline in OCS-related oil and gas activity over the life of the proposed action. Some individual cases of serious impairment of family life are expected to occur in association with those persons who, laid off from OCS-related oil and gas activities, cannot find jobs at comparable pay.

Oil and gas activity within State waters is assumed to result in adverse effects as do OCS-related oil and gas activity. It is assumed the oil and gas employment from activities within State waters will decline at the same rate, if not faster, than that from Federal OCS waters. As employment from these activities decline through time, it is expected that the diversified economy of the WPA will absorb most of these personnel. It is expected that some of those former OCS personnel will engage in full-time participation in traditional occupations. Serious impacts to family life would be expected in some individual cases involving the layoff of personnel working for oil and gas industries associated with State jurisdiction.

About one-third of the WPA coast was hit with 16-20 tropical cyclones between the years 1901-1955 (DeWald, 1982). The other two-thirds had a slightly lower incidence of cyclones (11-15). Experience with hurricanes in the historical record (such as the 1900 hurricane that destroyed Galveston) and more recent storms such as Hurricanes Carla and Beulah has indicated that major hurricanes can have a devastating effect on both the natural and human environment. Temporary disruption of traditional occupations and severe impairment of family life, in some individual cases, can result from the effects of tropical storms. It is assumed that several major storms will impact the Western Gulf coastal subareas during the life of the proposed action.

Displacement from traditional occupations could originate from destruction of a resource base, space-use conflict, and voluntary shifts from traditional occupations to employment in OCS-related activities. Adverse effects resulting from the displacement from traditional occupations could include a diminishment in the number of participants in traditional occupations, the loss of traditional knowledge and cultural heritage, and deleterious impacts to family life. The existence of the Fisherman's Contingency Fund mitigates, to some extent, space-use conflicts associated with commercial fishing. A total of 1,640 claims was filed as of 1990; of these, 407 originated in the Western Gulf of Mexico. Section IV.D.1.d.(1)(b) states that the expected cumulative impact to coastal wetlands is expected to be moderate. Coastal erosion and submergence appear to be the greatest factors in the loss of wetlands. Continuance of these processes will likely result in some impact to traditional occupations in the WPA over the life of the proposed action, resulting in the serious impairment of family life in some individual cases.

*Summary*

Several impact-producing factors will contribute to impacts on social patterns during the life of the proposed action.

Declining levels in OCS-related employment are expected to occur during the life of the proposed action. Economic growth is expected to occur in the service industry. The diversified economic base of the WPA is expected to buffer the effects of declining growth in the OCS-related oil and gas industry to some extent. However some deleterious impact to family life is expected to occur in individual cases.

It is assumed that a small amount of out-migration will coincide with declining levels of OCS-related employment. Given the low percentage of projected impacts on total population and employment from OCS-related activities and the diversified economic base of the WPA, minimal impacts from migration on social patterns is expected.

Adverse effects from relative wages are expected to be greatest among families who have grown dependent upon the relatively high level of wage paid to persons employed by OCS-related industries. Serious impairment of family life is expected to occur in some individual cases.

Oil and gas activity within State waters is assumed to decline over the life of the proposed action. Impact-producing factors are expected to parallel those found for activity in Federal OCS waters. The level of impact is also expected to parallel that for OCS-related activities.

It is assumed that several tropical storms will make contact with the WPA coastal subareas during the life of the proposed action. Experience has shown that these storms can have a devastating, but temporary, impact on traditional occupations. Serious impairment of family life is expected to occur in some individual cases.

Displacement from traditional occupations could occur as a result of the destruction of the resource base (primarily loss of wetlands), space-use conflicts, and voluntary shifts from traditional occupations to OCS-related employment. The loss of wetlands under the cumulative case is expected to be a few hundred hectares. This loss, through time, is expected to have some deleterious impacts on family life in some individual cases.

The incremental contribution of the proposed action (as analyzed for the Base Case in Section IV.D.2.a.(11)(c)) to the cumulative impact level is minimal because there are no expected dramatic short-term increases or decreases in population of the coastal parishes and counties. In addition, minimal net migration into the coastal subareas is expected, and jobs created by the proposed action will reduce out-migration. The extended work schedules and relatively high wages associated with OCS-related employment will cause minor displacement from traditional occupations.

*Conclusion*

Under the Cumulative scenario, it is expected that some displacement from traditional occupations will occur. Deleterious impacts to family life are also expected to occur in some individual cases.

## f. Coastal Zone Management Plans and Land Use

Coastal management policies apply to Sale 143 and to all subsequent activities that affect uses or resources of the coastal zone. Section III.C.6. contains an overview of State Coastal Zone Management Plans.

The following assessment focuses on the hypothetical direct and indirect effects of postlease activities (the Base Case scenario of the EIS). Changes made by the lessees as they explore, develop, and produce petroleum products from leases offered in Sale 143 would affect the applicability of this assessment. The MMS is generally prohibited from issuing drilling permits until after the consistency certification review is completed and affirmed by a State. Additional information on the Base Case scenario can be found in Section IV.A.

### *(1) Louisiana*

The sale analysis area adjacent to the submerged lands of the State of Louisiana is the Central Planning Area, made up of Central Coastal Subareas C-1, C-2, and C-3, which extend offshore from the State 3-mi line. Twenty-one coastal parishes of Louisiana are involved.

Appendix C2 of the Louisiana Coastal Zone Management Plan (LCZMP) outlines the rules and procedures for the State's local coastal management programs. Under the LCZMP, parishes are authorized, though not required, to develop local coastal management programs. Approval of these programs gives the parishes greater authority in regulating coastal development projects that entail uses of local concern. Priorities, objectives, and policies of use of local land use plans must be consistent with the policies and objectives of Act 361 and the State guidelines, except for a variance adopted in Section IV.D. of Appendix C2. The Secretaries of the Departments of Natural Resources and Wildlife and Fisheries may jointly rule on an inconsistent local program based on local environmental conditions or user practices.

State and Federal agencies first review parish programs before they are adopted. According to NOAA, the State of Louisiana has seven approved local coastal management programs (Lafourche, Jefferson, Calcasieu, Orleans, Cameron, St. Bernard, and St. James Parishes). Two others, St. Charles and St. Tammany, are pending NOAA approval. The parish police jury often serves as the permitting agency for projects limited to local concern. Parish level programs function in an advisory capacity to Louisiana's CZM agency, the Coastal Management Division. The energy facility planning process is comprehensively outlined in Appendix E of the LCZMP. Conflicts with local land use plans or ordinances are not expected to occur as a result of Sale 143, as existing onshore infrastructure is expected to be sufficient.

There is currently considerable local concern in the State of Louisiana about OCS waste onshore disposal practices. If OCS drilling and production wastes cannot meet the U.S. Environmental Protection Agency's NPDES effluent limitations or if these limitations require zero offshore discharge, offshore operational wastes must be transported to shore for onshore disposal.

New proposed effluent limitations and the changes to current disposal practices are discussed in Section IV.A.2.d.(5). It is expected that OCS waste resulting from Sale 143 leases would be properly disposed of in approved landfills onshore. Onshore disposal of offshore waste products would be in accordance with USEPA's proposed effluent regulations (40 CFR 435), which list preferred options for each type of waste.

Issues identified in LCZMP include the following: general coastal use guidelines; levees; linear facilities (pipelines); dredged spoil deposition; shoreline modifications, surface alteration, hydrologic and sediment transport modifications; waste disposal; uses that result in the alteration of waters draining into coastal waters; oil, gas, and other mineral activities; and air and water quality.

Assumptions fully discussed in Sections IV.A. and IV.C. indicate that proposed Sale 143 will generate the impacting factors discussed below. These factors will affect coastal issues identified in the LCZMP.

*Coastal Use Guidelines*

*Guidelines Applicable to All Uses (1.1 through 1.10)*

General guidelines provide basic policy direction for the use of subsequent guidelines. Guidelines 1.1 through 1.3 apply to the determination of consistency for this proposal. Guideline 1.2, consistency with incorporated air and water quality statutes and standards, is also addressed later in this discussion. Guidelines 1.4 and 1.5, regarding taking of property or violations of the terms of a grant of lands or water bottoms, are not applicable because no such activities are included or will result from this lease sale.

Guideline 1.6 lists the general factors that the permitting authority will use in evaluating whether a proposed use is consistent with other guidelines. Nineteen factors are listed. Examples are as follows:

"a) type, nature and location of use."

"b) elevation, soil and water conditions and flood and storm hazard characteristics of site."

"g) economic need for use and extent of impacts of use on economy of locality."

"j) existence of necessary infrastructure to support the use and public costs resulting from use."

"l) proximity to and extent of impacts on important natural features such as beaches, barrier islands, tidal passes . . . ."

"m) extent to which regional, state and national interests are served . . . ."

"p) proximity to and extent of impacts on public lands or historic, recreational or cultural resources."

Additionally, six of the factors deal with effects of the use. Much of the information cited above concerns activities for which specific information is not available at the lease sale stage.

Guideline 1.7 lists 21 categories of adverse effects that potential land and water uses in the coastal zone should avoid creating, to the maximum extent possible.

As previously indicated, no new support facilities are expected in Louisiana's coastal zone as a result of this lease sale (EIS Base Case scenario). Transportation of equipment and materials to support offshore operations is expected to use existing navigation channels through coastal areas. These operations would have only minor incremental effects relative to existing facilities.

The primary factor of concern for sensitive coastal habitats is contact by accidental oil spills. An oil-spill risk analysis, detailed information concerning oil spills and spill containment and cleanup methods, is included in Section IV.C. Predictive results of a computer model run for the EIS analysis, described below and used throughout the rest of this document, assume that no efforts are made to contain or clean up spills or otherwise protect sensitive resources from spill contact.

The mean number of spills over 1,000 bbl estimated to occur in the Central Gulf from Sale 142 is 0.18. This EIS indicates that the sale could result in an approximate 2 percent probability of accidental spills occurring and contacting within 10 days the coast of Louisiana within 10 days. Further, oil spills greater than or equal to 1,000 bbl that may occur as a result of an accident during exploration or development activities are not assumed to contact coastal habitats proximal to the sale area.

There is no direct relationship between offshore oil and gas activities and wetlands destruction. Therefore, it is impossible to determine direct wetland impacts from a specific offshore activity. Offshore activities would be located away from coastal wetlands. The MMS has no jurisdictional or permitting involvement in any possible coastal wetlands mitigation activities in the State of Louisiana. Coastal zone impacts are documented by the State in its Coastal Use Permitting Process.

Many researchers believe that restoring sediment to the wetlands would solve much of the land loss problem and even result in a significant wetlands gain (Cleveland et al., 1981). The MMS has funded a study to determine the effects of pipeline and navigation channels on barrier beach erosion along the Gulf Coast from Texas to the Florida panhandle (Wicker et al., 1989). This study showed zero-to-minimal impacts from OCS activities on the Louisiana barrier coast. The MMS is funding additional research to evaluate the effects of backfilling OCS channels to restore living resources and enhance fisheries habitat. The MMS has also funded a major study of the effects of marsh management practices on wetlands (Cahoon and Groat, 1990).

No new nearshore pipelines are expected to be emplaced nor are new channels expected to be dredged. Maintenance dredging in existing navigation channels in Louisiana could adversely affect wetlands if the dredged material is disposed of in continuous spoil banks. New OCS-related pipeline and navigation channel projects in coastal Louisiana will occur much more infrequently than in the past because the network currently in place is adequate to accommodate oil and gas production from future resource development. One channel in the Port Fourchon area will be deepened to accommodate larger vessels. The potential contribution of support activities during exploration and/or production on these offshore leases, as compared to all navigation use of channels, is likely to be very small and will be subject to later State consistency certification review.

Offshore structures enhance long-term biological productivity due to creation of reef habitat. The State of Louisiana has been a leader in establishment of an artificial reef program, recognizing the value of offshore platforms to the commercial and recreational fishing industries.

The northern Gulf coastal zone is one of the major recreational regions of the United States, particularly in connection with marine fishing and beach-related activities. Marine debris lost from operations associated with drilling and production offshore may occur from time-to-time; however, the effect of intermittent washup of debris on the recreational use of Louisiana beaches should be low. The regulations at 30 CFR 250.40 require that offshore operators handle, control, mark, and dispose of containers, equipment, and solid waste through stringent marking, equipment handling, and storage requirements. The MMS inspectors check for compliance with regulations during daily offshore inspections. Failure to comply with regulations leads to official warnings to take corrective action or, if warranted, to cease operations.

Deliberate disposal of any solid waste or garbage items anywhere in the marine environment is strictly prohibited under existing MMS, EPA, and Coast Guard regulations. Because of increased concern with the prevalence and effects of persistent marine debris both offshore and on coastal beaches, MMS issued a special advisory (Notice to Lessees No. 86-11) in 1986 strongly encouraging the oil and gas industry to take special educational, operational, and awareness measures designed to reduce or eliminate their contributions to marine debris in the Gulf of Mexico. Annex V of the International Convention for the Prevention of Pollution from Ships, also known as the MARPOL Protocol, prohibits the dumping of all plastic wastes, including plastic packaging materials and fishing gear, from all ships at sea. The MMS has established a policy that requires submission, for approval, of detailed plans for the disposal of all produced solids accumulated as a result of OCS activities (LTL dated November 20, 1990).

From information collected at beach cleanups and during marine debris surveys, it has been estimated that existing offshore oil and gas operations are responsible for 10-15 percent of the trash and debris adversely affecting the Gulf's shorefront recreational beaches in the CPA. Recent Federal regulations (33 CFR 151) stemming from MARPOL Annex V, as well as periodic MMS directives and information seminars on the debris issue, should lead to better waste handling and less accidental loss of materials and personal items into the marine environment from offshore oil and gas operations. Additionally, industry education and training emphasis on waste management, along with voluntary stewardship commitments by several major oil companies (the adoption of about 30 mi of Louisiana Gulf beaches and the reduction and recycling of waste materials generated offshore), will also be reflected in a positive way on Louisiana's beaches.

Activities on these offshore leases are not expected to have a significant effect on coastal fishery resources. In addition, the effects on fishery resources beyond the coastal zone are likely to be minimal. State review of consistency certifications of exploration and development and production plans will enable more detailed review of site-specific proposed activities as they relate to fisheries and fishing practices. Federal provisions concerning fisheries include the Fishermen's Contingency Fund, which requires payment to fishermen for documented damages, and 30 CFR 250.40, which requires the charting of subsea obstructions and the marking of equipment to establish liability for fisheries losses.

Biological stipulations proposed for the sale (Section II) contain special provisions for the regulation of discharges and siting of facilities within offshore areas recognized as areas of exceptional biological productivity. These stipulations will help to protect fisheries resources. Studies of mud (NRC, 1983; Zingula, 1975; Menzie, 1983) and cutting discharges from offshore oil and gas operations show rapid dispersal by ocean currents with no long-term, significant biological effects.

An archaeological resource stipulation has been proposed that will require surveys for investigation and avoidance or protection of cultural resources on the OCS. The State Office of Historic Preservation will have opportunities to consult with MMS on protection of onshore historic resources, if development is proposed on any lease.

In addition, the lease sale may create new jobs and may generate other economic opportunities to the benefit of Louisiana and the Nation. An MMS-funded study (Laska, in progress) evaluates the effect of the downturn in the oil industry on the Gulf economy and investigates alternate uses of existing OCS infrastructure for economic development opportunities. Any change of existing social patterns in coastal Louisiana as a result of activities on these offshore leases is highly unlikely. The sale will result only in a continuation of existing facilities without notable alteration of social patterns because of currently unemployed and underemployed resources in the coastal zone. Jobs created as a result of the sale would likely reduce the amount of out-migration when compared to scenarios without the proposal. Economic considerations are also evaluated in the Secretarial Issue Document and the Decision Memorandum for this sale.

The cumulative effects of the proposed actions that relate to the LCZMP are addressed in Section IV.B. This evaluation meets the criteria of "cumulative" as used in Guideline 1.7 of the LCZMP because it projects all of the reasonably foreseeable effects of the sales including exploratory drilling, platform installation, support vessel traffic, etc. A separate Cumulative Analysis required under NEPA considers a much broader scope of effects, including proposed Sale 143; subsequent OCS oil and gas sales that are considered reasonably foreseeable; prior OCS oil and gas sales; State oil and gas activity; crude oil imports by tankering; and all other major non-OCS activities and occurrences that may occur and affect a resource in question.

The proposed lease stipulations, MMS rules and regulations (including requirements for oil-spill contingency planning, use of blowout preventers, Best Available and Safest Technology, crew training, and other environmental safeguards), compliance with National Pollutant Discharge Elimination System (NPDES) permits and standards, and other available Federal regulatory mechanisms will effectively mitigate the possible effects of oil and gas activities. Should new onshore facilities be needed for development of these leases, they will be subject to State regulations and separate permits, including State consistency certification review.

Guideline 1.8 defines "to the maximum extent possible," a phrase that modifies many of the guidelines. A use or activity will be consistent, although not fully complying with a standard, if it meets several criteria relating to public benefit, or lacks feasible alternatives, or serves important local, State or national interests, or is dependent on water. Federal regulations at 15 CFR 930.32 also define the term "maximum extent practicable" and recognize there will be circumstances where full consistency with a State program is not possible.

Federal offshore oil and gas leasing serves an important national interest because future energy production resulting from OCS development will help to reduce the Nation's reliance on foreign imports. The LCZMP, through this policy, recognizes the relative importance of a national interest criterion in this guideline to the extent that, even if a use or activity does not fully comply with a standard, it is consistent "to the maximum extent possible."

Guideline 1.9 requires that uses be, to the maximum extent practicable, designed and carried out to permit multiple uses and to avoid use conflict. This lease sale, as pointed out earlier, may eventually result in an outcome that allows for multiple use and avoids use conflict. Offshore conflicts would be limited in scope because certain multiple-use areas are off limits to oil and gas activities (e.g., shipping fairways and selected military warning areas). Other multiple uses, such as boating and fishing, would result in only limited conflicts because of the small areal extent of space used by oil and gas operations.

*Guidelines for Levees (2.1 through 2.6)*

The guidelines for levees apply to those constructed in the coastal zone. No levee construction activities are expected to occur in Louisiana as a result of this lease sale. If any such activities were to be proposed in Louisiana, the State would have opportunities to review such proposals through consistency certifications of Corps of Engineers permits.

*Guidelines for Linear Facilities (3.1 through 3.16)*

Guidelines for linear facilities contain standards for State permitting of siting and installation of pipelines located in onshore or nearshore coastal areas. Most of the production from this lease sale is projected to be sent through existing trunklines for transportation to existing onshore processing facilities in the central and western Gulf coastal areas. No new pipeline landfalls or onshore pipeline projects are anticipated. There may be a small contribution (less than 5%) of barge and tanker operations transporting oil to offloading facilities located at onshore terminals in Louisiana. Any new pipeline construction crossing submerged State lands must be consistent with applicable State regulatory policies to ensure safety in construction and operation.

The Gulf Regional Technical Working Group (RTWG), which is an advisory committee, develops transportation plans for OCS areas. One of the purposes of this coordinated planning effort is to establish corridors for consolidating multiple pipelines, an effort aimed at minimizing seafloor obstructions and adverse environmental effects. These and other efforts of RTWG, which include representatives from the State of Louisiana, help to ensure effective coordination on postlease pipeline-related activities.

*Guidelines for Dredged Spoil Deposition (4.1 through 4.7)*

Guidelines apply to disposal of dredged material in the coastal zone. No new trunklines are expected from projected production on these offshore leases. No dredging solely related to activities taking place on Sale 143 leases is projected to occur. Maintenance dredging of existing canals through barrier passes to accommodate vessel traffic to support the proposed action could alter littoral dynamics in the vicinity of the channel and could affect erosion and deposition patterns. Field studies, however, have not substantiated that dredging has resulted in coastal barrier erosion. In fact, the disposal of dredged material into the coastal, littoral transport system can be used to nourish sediment-starved and eroding coastal barriers. One canal in the Port Fourchon area may be deepened. Should any future exploration or development of Sale 143 leases involve disposal of dredged material, the State will have an opportunity to review such activities in its consistency certification process.

*Guidelines for Shoreline Modifications (5.1 through 5.9)*

These guidelines apply to shoreline modification and protection structures and to harbor structures. No such activities or facilities are expected to result from exploration or development activities on Sale 143 leases. Given the availability of existing harbor space, no new shoreline modifications are likely to be needed. If unforeseen postlease support facilities are proposed, the State will have opportunities to conduct consistency certification reviews.

*Guidelines for Surface Alteration (6.1 through 6.14)*

Guidelines for surface alterations contain two general guidelines (6.1 and 6.5) regarding development in the coastal zone.

Guideline 6.1 encourages industrial, commercial, and other development in suitable areas of the coastal zone. Suitable areas are defined as (a) to the maximum extent practicable, lands 5 ft or more above sea level or fast lands; or (b) those lands where suitable foundation conditions and minimum flood and storm damage risk are already developed or where development would not unreasonably endanger public safety; (c) areas having adequate infrastructure; or (d) having a tradition of similar use. Guideline 6.5 states that coastal water-dependent uses shall be given special consideration in permitting because of the reduced choice of alternatives. Most major postlease activities or facilities in the coastal zone are coastal water-dependent and industrial in nature. The consistency certifications contained in exploration and development and production plans will enable the State to review these activities for consistency.

Other surface alteration guidelines (6.2, 6.4, 6.6 through 6.10, and 6.12 through 6.14) are similar in scope to guidelines affecting pipeline siting and construction. They address siting, construction techniques, design characteristics aimed at avoiding natural features, and alteration of critical and biological resources.

As indicated earlier, no new support facilities are hypothesized to occur in Louisiana's coastal zone. However, should they be needed, the State will have opportunities to conduct consistency certification reviews and issue separate permits.

*Guidelines for Hydrologic and Sediment Transport Modifications (7.1 through 7.9)*

Hydrologic and sediment transport modification guidelines apply to water control structures and marsh-building schemes in the coastal zone. Although these guidelines are not applicable to this lease sale *per se*, because no such structures or activities are included or are likely to result, should a lessee propose development activities involving such modifications, he must obtain an affirmative State consistency certification review and other State permits.

*Guidelines for the Disposal of Wastes (8.1 through 8.9)*

The guidelines for waste disposal apply to the location and operation of waste disposal facilities in the coastal zone and the generation, transportation, treatment, storage, and disposal of hazardous wastes. The requirements and standards in NPDES permits (40 CFR 122) and the regulatory requirements of MMS (30 30 CFR 250.42) protect the quality of offshore waters. A variety of solid wastes are brought onshore for disposal at nonhazardous oilfield waste (NOW) sites and landfills. Oil and gas waste are exempt from Federal hazardous waste regulations. Because of recent State regulations (LAC 33:IX.708, effective March 20, 1991), impacts from OCS produced waters should be minimized (Section IV.A.3.c.(4)(a)). Current levels of routine point source and nonpoint source discharges are expected to continue because no new infrastructure is projected (Section IV.A.), and no new sources are expected from this proposal.

The oil and gas industry is the dominant supporter and participant in the Louisiana beach adoption and cleanup program. Over three-fourths of Louisiana's adopted beaches and cleanup volunteers are directly associated with the oil companies (Amoco, Chevron, Conoco, CNG, Exxon, Fina, Kerr-McGee, Koch, LL&E, Mobil, Shell, and Texaco). Furthermore, a special subcommittee of the Offshore Operators (Waste Handling & Recycling) has been established to develop and to encourage industrywide strategies and procedures that will reduce and improve the handling of waste materials generated offshore. For example, many offshore oil and gas operators have eliminated the use of styrofoam drinking containers and food packaging materials and have increased the use of bulk containers and compactors. Some companies are testing and implementing comprehensive recycling projects for reusable waste generated offshore. Several ongoing surveys supported and conducted by government, industry, academia, and environmental groups will help monitor industry's record in handling, controlling, and disposing of solid waste and other items associated with offshore operations. The MMS has taken a leading role in establishing the Take Pride Gulf Wide campaign working through the Gulf of Mexico Program, in which all Gulf user groups are encouraged through education and participation in stewardship projects to become part of the solution instead of the problem.

*Guidelines for Uses that Result in the Alteration of Waters Draining into Coastal Waters (9.1 through 9.3)*

The guidelines apply to water management programs and are not applicable to this lease sale because no such programs are included in or will result from this lease sale.

*Guidelines for Oil, Gas, and Other Mineral Activities (10.1 through 10.14)*

The guidelines for oil, gas, and other mineral activities address surveying, drilling, or refining activities in the coastal zone and are not applicable to exploration, development, and production activities on the OCS that may occur on Sale 143 leases.

However, some of the guidelines (10.3, 10.4, 10.9 through 10.12, and 10.14) could be applicable to the extent that these are defined as associated exploration, development, or production facilities or activities. Those guidelines that would apply to onshore facility development (10.3, 10.4, 10.9 and 10.10) are modified by the terms "to the maximum extent practicable" or "best practical techniques." The applicable requirement is for exploration and production facilities to be "designed and constructed using best practical techniques to minimize adverse environmental impacts" to the coastal zone.

The EIS analysis indicates that projected adverse impacts of hypothetical, future offshore exploration, development, and production operations on the Louisiana coastal zone are likely to be of a very low level. Further, all OCS exploration, development, and production activities and/or associated facilities will be subject to State consistency certification review if and when they are proposed.

Guideline 10.11 establishes an absolute requirement for environmental protection and emergency or contingency plans for all mineral operations in the coastal zone. Sale 143, however, will not result in any oil, gas, or other mineral operations in the State's coastal area, nor is there any expectation of new or expanded shore bases or refining facilities. Existing Federal regulations (30 CFR 250.33, 250.34, and 250.42) establish similar but more site-specific requirements for approval of such operations on OCS leases. An oil-spill contingency plan (OSCP) is one such requirement. The OSCP's must be submitted for approval with, or prior to, an exploration or development plan. The OSCP, outlining the availability of spill containment and cleanup equipment and trained personnel, is reviewed and updated annually. It must ensure that full response capability could be committed during an oil-spill emergency. This commitment would include specifications for appropriate equipment and materials, their availability, and the time needed for deployment. The plan must also include provisions for varying degrees of response effort, depending on the severity of a spill.

All OCS exploration or development and production plans will be subject to State consistency certification review and must describe how the operator proposes to comply with the environmental protection requirements of pertinent Federal statutory and regulatory requirements.

Guideline 10.12 prohibits the use of chemical agents on coastal zone oil spills without prior approval of the On-Scene Coordinator, in consultation with Louisiana and the USEPA, pursuant to the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR 112). This guideline duplicates similar Federal requirements.

Finally, Guidelines 10.13 and 10.14 address the restoration of mineral exploration or production sites and the avoidance of creating underwater obstructions in the coastal zone. No mineral exploration or production activities will be proposed in the coastal zone. However, on the OCS, offshore sites are subject to the Site Clearance requirements of MMS under NTL 90-01. Requirements established under this NTL ensure that any object (e.g., wellheads, platforms, etc.) installed on an OCS lease is properly removed and the site cleared so as not to conflict with other uses of the OCS.

*State Air and Water Quality Regulatory Provisions*

*Air Quality (Louisiana R.S. 30:1068, 1081-1087)*

State policy on air quality incorporated into the LCZMP is applicable to State onshore areas.

Section 5(a)(8) of the OCSLA grants DOI exclusive authority and responsibility to prescribe regulations requiring offshore sources of air emissions to be consistent with national ambient air quality standards to the extent offshore activities significantly affect the onshore air quality. Thus, the Department's regulations are the applicable air pollution control requirements of the LCZMP under Section 307(f) of CZMA for OCS emissions.

Oil and gas development and production activities on the OCS are required to meet Department air quality regulations (30 CFR 250.44, 250.45, and 250.46). These regulations require offshore lessees to determine through modeling whether their air emissions would result in onshore pollutant concentrations above Department-specified significance levels. If these levels are projected to be exceeded in an area where concentrations already exceed air quality standards, the lessee will be required to control fully or offset its emissions so that there would be no effect onshore. If the significance levels are exceeded in areas at present in compliance with standards, the lessee will be required to employ best available control technology (BACT). If predicted onshore concentrations still exceed a standard for the prevention of significant deterioration, measures beyond BACT will be required.

Because of trends in leasing farther offshore, the levels of activity adjacent to Louisiana parishes are not expected to be large as a result of this sale. This trend toward development farther offshore will result in greater dispersion of emissions, i.e., a very low level of impact.

Section 328 of the Clean Air Act (42 U.S.C. 7401-7642, as amended) directed the Department of the Interior to conduct a research study examining the impacts from activities on the OCS adjacent to Texas, Louisiana, Mississippi, and Alabama on areas that fail to meet the Federal air quality standards for ozone (40 CFR 50). The MMS has been consulting with USEPA, the States, and others to design a study that will start in 1992. The study will have the following components: (a) a characterization of meteorological regimes associated with ozone episodes in nonattainment areas; (b) an evaluation of meteorological and air quality data from ozone modeling; (c) application of photochemical modeling to estimate impacts from OCS activities on ozone nonattainment areas; (d) a limited field program to collect meteorological data in offshore and coastal areas for future modeling applications; and (e) a set of recommendations for future monitoring and modeling activities.

In addition to the air quality study being planned in the Gulf of Mexico, MMS and USEPA have been consulting on the possibility of conducting a preliminary ozone study using the ROM model. A complete set of results and impact assessment will be made when the 3-year study is completed. The EIS (Sections IV.D.1.a.(4) and IV.D.2.a.(4)) reflects MMS's needs and commitment to gather information on ozone formation and dispersion from OCS emissions.

This EIS analysis (Section IV.A.2.d.(6)) indicates that offshore air emissions are not likely to cause degradation of onshore air quality and are not likely to have any significant effect on nonattainment or Prevention of Significant Deterioration Class I areas. Actual measures ordered by MMS will be determined after reviewing additional site-specific studies submitted by lessees, along with their exploration and development and production plans for approval.

*Water Quality (Louisiana R.S. 30:1068, 1091-1096; 38:216)*

The Federal Water Pollution Control Act (FWPCA) (33 U.S.C. 1251 et. seq., as amended) vests exclusive regulatory authority over discharges on the high seas to USEPA. Under Section 307(f) of CZMA, the applicable water pollution control requirements are those promulgated pursuant to the FWPCA. Inasmuch as Louisiana does not have USEPA approval to administer NPDES permits for coastal waters pursuant to that Act, USEPA's own regulations are the applicable water pollution control requirement of the LCZMP.

All OCS exploratory operations involving discharges will be conducted in compliance with NPDES permits (40 CFR 122) issued by the USEPA. Operational discharges (drilling muds and cuttings, produced waters, deck drainage, and sanitary and domestic wastes) may degrade water quality somewhat, changing measures from background levels, but with little effect to benthic and pelagic organisms in the water column, and then only very close to the source. (No oil-based drilling muds are allowed to be discharged into Federal waters.) The MMS established a policy that requires the submission, for approval, of detailed plans for the disposal of all produced solids accumulated as a result of OCS activities (LTL dated November 20, 1990). The impact to marine waters from oil and gas discharge activities on these offshore leases is considered to be low.

The NCP requires that the U.S. Coast Guard's OSC obtain the concurrence of the USEPA representative to the RRT and, as appropriate, the concurrence of the RRT representatives from the states having jurisdiction over the navigable waters threatened by the release or discharge; and that, when practicable, the OSC consult with the DOC and DOI natural resource trustees prior to authorizing the use of a chemical agent. Approved chemical agents must be listed on the NCP Product Schedule. The OSC is not required to obtain the aforementioned concurrence when, in the judgment of the OSC, the use of a chemical agent is necessary to prevent or reduce substantially a hazard to human life. Consistent with this, a Memorandum of Understanding, dated August 16, 1971, between the Department of the Interior and the Department of Transportation allows MMS the authority to grant OCS operators approval to use chemical agents within a 500-m radius of the source of pollution to abate the source of pollution only when such agents are deemed necessary as a measure for the safety of personnel and operations.

Several activities may adversely affect marine water quality on the OCS and, thus, potentially the coastal waters. Drilling operations, platform and pipeline installation, and platform removal operations may resuspend bottom sediments. Some water quality parameters may change from background levels with little effect to the benthic and pelagic life nearby, and then only very close to the source. The impact from these activities to marine water quality above the OCS is considered to be low.

Existing onshore infrastructure and associated coastal activities in support of oil and gas activities on these leases have the potential to contribute to a low extent to the degradation of regional coastal and nearshore water quality. The barge trips and service-vessel trips expected to occur in Louisiana (Base Case) may further impact water quality by routine release of bilge and ballast waters (estimated at 2,000 liters per day from service vessels) and low-level antifouling paints. Each activity provides only a small measure of continuous contamination. Discharge locations are widespread. Negligible saltwater intrusion could occur from maintenance dredging or deepening of existing navigation channels for large vessel requirements. Such dredging is likely to result in short-term, low-level impacts to the surrounding waters. All dredging would be pursuant to COE permits (33 CFR 330) or conducted by the Corps itself, and would be subject to consistency determination from that agency.

No new service bases are expected to be constructed in Louisiana to support activities from Sale 143 leases. Therefore, no additional point or nonpoint sources of pollution are likely to result. Environmental impacts associated with normal service base use include runoff and spillage of fuels and chemicals from the facility, discharges from supply and crew boats, channel bank erosion from vessel traffic, and disturbance of bottom sediments from maintenance dredging. All new onshore facilities must be proposed in exploration or development and production plans, which the State will review for consistency certification. Separate State permits will also be necessary.

Accidental oil spills on the OCS may degrade water quality somewhat, changing measurements from background levels, but with little effect to the pelagic and benthic organisms in the water column and then only in a very limited area close to the source. Accidental oil spills may contribute to a local, low-level impact near some terminals and service bases where the spills have a more probable occurrence; regionally, adverse impacts from such accidental oil spills are assumed to be very low.

In both offshore and coastal areas, authorities cited above are sufficient to ensure that future operations related to the proposed lease sale will not adversely affect water quality.

### *(2) Texas*

The Sale 143 analysis area closest to the submerged lands of the State of Texas includes Western offshore Subareas W-1, W-2, and W-3, which extend offshore from the State's 3-marine league line.

The Texas Legislature has distributed authority for coastal resource management among 14 State agencies (Appendix III, Coastal Responsibilities of Texas State Agencies, Texas Coastal Management Plan, January 1991). Conflicts with local land use goals or planning are not expected to occur as a result of Sale 143, as existing onshore infrastructure is expected to be sufficient.

The Texas Coastal Management Plan (TCMP) (State-approved plan) includes the following coastal resource issues: coastal erosion/dune protection, beach access, wetlands loss and degradation, oil spills, marine debris, freshwater inflow, nonpoint-source pollution, and hazardous waste generation and disposal.

Based on assumptions fully discussed in Sections IV.A. and IV.C., the impacting factors generated by the proposed sale are discussed below. These factors will affect coastal issues identified in the TCMP.

#### *Coastal Erosion/Dune Protection and Beach Access*

No new support facilities, pipeline landfalls, or onshore pipeline projects are anticipated in Texas as the result of activities on offshore leases (Base Case). Several deep-water pipelines will be constructed on Matagorda Island along the Texas coast and towed into deep-water areas off Texas and Louisiana. No new channels are expected to be dredged. One channel in the Corpus Christi area (coastal Subarea W-1) will be deepened to 6.7 m (22 ft) to accommodate larger vessels. Transportation of equipment and materials to support offshore operations is expected to use existing navigation channels through coastal areas (Brazos Santiago Pass, Port Mansfield Cut, Matagorda Ship Channel, Yarborough Pass, Aransas Pass, Corpus Christi Ship Channel, Freeport Harbor Channel, Houston/Texas City/Galveston Ship Channels, and Sabine Pass Ship Channel). These operations would have only minor incremental effects relative to existing facilities. If any hypothesized, postlease onshore development were to occur in Texas, it would be subject to control by applicable State regulations. The Texas General Land Office is responsible for technical assistance and compliance under the Dune Protection Act and for implementation of the Texas Coastal Preserve Program with the Texas Parks and Wildlife Department. The Texas Attorney General's Office protects the public's beach access rights and can bring suit on behalf of other State agencies to enforce State laws.

#### *Wetlands Loss and Degradation*

Wetlands and submersed grassbeds are essential to the biological productivity of the Texas coastal zone. Given the availability of existing harbor space, no new shoreline modifications are likely to be needed. Additionally, no pipelines are proposed to cross Texas lands. If any new onshore facilities are proposed for development of offshore leases, potential effects to wetlands and submersed grassbeds in the State's coastal zone will be subject to State regulatory review. The TCMP identifies the Texas Parks and Wildlife Department as the State agency that would monitor and enforce a policy of no net loss of wetlands. The Texas Water Commission and the General Land Office would also coordinate with them in this effort.

Coastal zone biological resources may be affected by oil spills associated with offshore operations. Prevention and containment and cleanup of oil spills are addressed through various Federal mitigation and regulation measures (30 CFR 250.42). Such measures include MMS requirements for an oil-spill contingency plan, prevention, and response; the platform verification program; and the general OCSLA requirement to apply the best available and safest technologies (BAST). The MMS requires that oil-spill contingency plans ensure that a full-response capability exists for containment in the event of an oil spill, including specification of appropriate equipment and materials, their availability and deployment time, and provisions for varying degrees of response effort, depending on the severity of the spill. The USEPA's development and implementation of the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR 112) and correlative regional plans are designed to provide a coordinated and integrated response by Federal and State agencies to protect the environment from the damaging effects of accidental oil spills and pollution discharges.

Maintenance dredging in existing navigation channels in Texas could adversely affect wetlands if the dredged material were disposed of in continuous spoil banks. The potential contribution of support activities during exploration and/or production on these offshore leases, as compared with all navigation use of channels, is likely to be very small and will be subject to later State regulatory review. The Texas Department of Highways and Public Transportation is responsible for acquiring easements and rights-of-way from the General Land Office for channel expansion, relocation, or alteration.

*Oil Spills*

The primary factor of concern for sensitive coastal habitats is contact by accidental oil spills. An oil-spill risk analysis, detailed information concerning oil spills and spill containment and cleanup methods, are included in Section IV.C. Predictive results of a computer model run for the EIS analysis assume that no efforts are made to contain or clean up spills or otherwise protect sensitive resources from spill contact.

The mean number of spills over 1,000 bbl estimated to occur in the Western Gulf from proposed Sale 143 is 0.07. The EIS indicates that the sale could result in an approximate 0.05 percent probability of accidental spills occurring and contacting the coast of Texas within 10 days.

An OSCP must be submitted for approval to MMS with, or prior to, an exploration or development plan (30 CFR 250.33, 250.34, and 250.42). This OSCP, outlining the availability of spill containment and cleanup equipment and trained personnel, is reviewed and updated annually. It must ensure that full-response capability could be committed during an oil-spill emergency. This commitment would include specification for appropriate equipment and materials, their availability, and the time needed for deployment. The plan must also include provisions for varying degrees of response effort, depending on the severity of a spill.

*Marine Debris*

The State of Texas Gulf coastal zone is one of the major recreational regions of the United States, particularly in connection with marine fishing and beach-related activities. As indicated in Section IV.A.1., onshore support is expected to be provided from existing facilities. Marine debris lost from OCS operations associated with drilling and production throughout the 35-year life of the lease may occur from time to time, but the effect of intermittent washup of debris on the recreational use of Texas beaches should be low. The regulations at 30 CFR 250.40 require that offshore operators handle, control, mark, and dispose of containers, equipment, and solid waste through stringent marking, equipment handling, and storage requirements. The MMS inspectors check for compliance with regulations during daily offshore inspections. Failure to comply with regulations leads to official warnings to take corrective action or, if warranted, to cease operations.

Deliberate disposal of any solid waste or garbage items anywhere in the marine environment is strictly prohibited under existing MMS, USEPA, and Coast Guard regulations. Because of increased concern with the prevalence and effects of persistent marine debris both offshore and on coastal beaches, MMS issued a special advisory (NTL 86-11) in 1986 strongly encouraging the oil and gas industry to take special educational, operational, and awareness measures designed to reduce or eliminate their contributions to marine debris in the Gulf of Mexico. Annex V of the International Convention for the Prevention of Pollution from Ships, also known as the MARPOL Protocol, prohibits the dumping of all plastic wastes, including plastic packaging materials and fishing gear, from all ships at sea. The MMS has established a policy that requires the submission, for approval, of detailed plans for the disposal of all produced solids accumulated as a result of OCS activities (LTL dated November 20, 1990).

From information collected at beach cleanups and during marine debris surveys, it has been estimated that existing offshore oil and gas operations are responsible for 10-15 percent of the trash and debris adversely affecting the Gulf's shorefront recreational beaches in the WPA. Recent Federal regulations (30 CFR 151) stemming from MARPOL Annex V, as well as periodic MMS directives and information seminars on the debris issue, should lead to better waste handling and less accidental loss of materials and personal items into the marine environment from offshore oil and gas operations. Additionally, industry education and training emphasis on waste management along, with voluntary stewardship commitments by several major oil companies (the adoption of about 30 mi of Louisiana Gulf beaches and the reduction and recycling of waste materials generated offshore), will also be reflected in a positive way on Texas' beaches.

*Freshwater Inflow, Nonpoint Source Pollution, and Hazardous Waste Generation and Disposal*

Potable water will be needed for domestic uses of personnel living on offshore platforms. However, the EIS estimates that no new service bases are likely to be constructed. The quantity of freshwater needed for offshore operations on these leases is likely to be insignificant in an area such as coastal Texas. The Texas Water Commission has the responsibility of overseeing surface water rights.

The quality of nearshore and offshore waters is protected through standards and requirements for NPDES permits (40 CFR 122), as mandated in the Federal Water Pollution Control Act (33 U.S.C. 1251 et. seq., as amended). Marine water quality is protected through regulatory requirements, monitoring, and enforcement actions of MMS and USEPA. Discharges in coastal areas are also subject to regulation by the Texas Water Commission and Texas Water Development Board.

No onshore water quality degradation is likely to occur in Texas as a result of activities on offshore leases, because no new service bases are likely to be constructed in Texas (Base Case). Therefore, no additional point source and nonpoint sources of pollution are likely to result. In the unlikely event of any such occurrence, numerous Federal and State water pollution control regulations for mitigating any potential adverse effects exist.

Operational discharges (drilling muds and cuttings, produced waters, deck drainage, and sanitary and domestic wastes) may degrade water quality somewhat, changing measurements from background levels, but with little effect to benthic and pelagic organisms in the water column, and then only very close to the source. (No oil-based drilling muds are allowed to be discharged into Federal waters.) The impact to marine waters from oil and gas discharge activities on these offshore leases is considered to be low.

The NCP requires that the U.S. Coast Guard's OSC obtain the concurrence of the USEPA representative to the RRT and, as appropriate, the concurrence of the RRT representatives from the states having jurisdiction over the navigable waters threatened by the release or discharge; and that, when practicable, the OSC consult with the DOC and DOI natural resource trustees prior to authorizing the use of a chemical agent. Approved chemical agents must be listed on the NCP Product Schedule. The OSC is not required to obtain the aforementioned concurrence when, in the judgment of the OSC, the use of a chemical agent is necessary to prevent or reduce substantially a hazard to human life. Consistent with this, a Memorandum of Understanding, dated August 16, 1971, between the Department of the Interior and the Department of Transportation allows MMS the authority to grant OCS operators approval to use chemical agents within a 500-m radius of the source of pollution to abate the source of pollution only when such agents are deemed necessary as a measure for the safety of personnel and operations.

Several activities may adversely affect marine water quality on the OCS and, thus, potentially the coastal waters. Drilling operations, platform and pipeline installation, and platform removal operations may resuspend bottom sediments. Some measures of water quality parameters may change from background levels with little effect to the benthic and pelagic life nearby, and then only very close to the source. The impact from these activities to marine water quality above the OCS is considered to be low.

Existing onshore infrastructure and associated coastal activities in support of oil and gas activities on these leases have the potential to contribute to a low extent to the degradation of regional coastal and nearshore water quality. The barge trips and service-vessel trips expected to occur in Texas (Base Case) may further impact water quality by the routine release of bilge and ballast waters (estimated at 2,000 liters per day from service vessels) and low-level antifouling paints. Each activity provides only a small measure of continuous contamination. Discharge locations are widespread. Negligible saltwater intrusion could occur from maintenance dredging of existing navigation channels. Such dredging is likely to result in short-term, low-level impacts to the surrounding waters.

The MMS has established a policy that requires the submission, for approval, of detailed plans for the disposal of all produced solids accumulated as a result of OCS activities (LTL dated November 20, 1990). The USEPA's development and implementation of the National Oil and Hazardous Substances Pollution Contingency Plan and correlative regional plans are designed to provide a coordinated and integrated response by Federal and State agencies to protect the environment from the damaging effects of pollution discharges. Deliberate disposal of any solid waste or garbage items anywhere in the marine environment is strictly prohibited under existing MMS, USEPA, and Coast Guard regulations. The Texas Department of Health regulates programs to protect and promote public health, including those addressing the issue of solid waste. The Texas Water Commission regulates hazardous and industrial solid waste management.

In both offshore and coastal areas, authorities cited above are sufficient to ensure that future operations related to the proposed lease sales will not adversely affect water quality.

# E. ANALYSIS OF A LARGE OIL SPILL

The MMS has evaluated the consequences of a large oil spill that could be associated with proposed Sales 142 and 143. Included here is an analysis of the potential effects of a hypothetical large spill that occurs under unfavorable conditions. The analysis that follows assumes that a spill of 100,000 bbl occurs and contacts the Gulf of Mexico shoreline. The spill occurs as a result of an accident involving a shuttle tanker transporting oil produced as a result of either of the proposed actions. Although this section considers the impacts of a 100,000-bbl spill, the probability of occurrence of a spill of this magnitude resulting from the proposed actions for Sales 142 and 143 is extremely low.

## 1. Background

As oil and gas exploration and production extends farther offshore into deeper water tracts, the use of shuttle tankers to bring oil to shore for processing, rather than the installation of pipelines in deep water, may occur. The EIS estimates that less than 1 percent of the oil produced under the Base Case for proposed Sale 142 and 19 percent of the oil produced under the Base Case for proposed Sale 143 will be transported by shuttle tanker into Gulf Coast terminals.

In the early stages of scenario development, the MMS Gulf of Mexico OCS Region considered different cases of tanker, pipeline, and platform spills for several places along the coast and at all seasons of the year. From these possibilities, the scenario that was selected for analysis here was a winter spill at the entrance to the Port Arthur ship channel.

## 2. Scenario to be Analyzed

### a. Assumptions About the Occurrence of the Spill

It is assumed in this scenario that approximately 100,000 bbl of Louisiana crude oil are spilled within 24 hours during the winter from a shuttle tanker accident that occurs four miles from the coastline at the entrance to the Port Arthur, Texas, ship channel. Average climatological conditions for this part of the Gulf are assumed at the time of the spill. Winds are blowing from the east at 11 kn, surface drift currents are moving west to northwest at 0.75 kn, and the surface water temperature is 61°F. Severe storm conditions are not assumed because, historically, such conditions have dispersed spilled oil, and no surface slick remains after the passage of the storm. The spill is assumed to occur in 33 ft of water. Tankers transporting crude oil produced as a result of proposed Sales 142 and 143 could be expected to move through this area enroute to terminals at Port Arthur, Texas.

The leading edge of the oil is assumed to rapidly wash ashore and contact the shoreline in approximately four hours. Offshore cleanup efforts are assumed to be ineffective at containing a significant amount of the spilled oil, and dispersant use is not approved because of the proximity of the sensitive resources. Beach removal of oil is assumed to be effective, and the majority of the oil will be cleaned from major recreational beaches after six weeks.

## b. Assumptions About the Offshore and Shoreline Zone of Contact

It is assumed that 10 percent of the spilled oil will not move directly to shore but will remain in the nearshore waters, moving with coastal current patterns. By the end of three days, the remaining oil slick is assumed to have been carried onto and along the coast by tidal and longshore currents. The oil is assumed to be stranded along 80 mi of coastline from about nine miles west of the Sabine River in Jefferson County, Texas, to San Luis Pass at the south end of Galveston Island in Galveston County, Texas. The primary area of potential contact includes a 4 by 80 mi area offshore, the 80-mi stretch of shoreline, and on land, to the extent of the maximum inland movement of the oil. Both the slick moving towards shore and the offshore slick would appear as a series of windrows. Oil slicks do not remain intact as discrete entities; therefore, it is assumed that they would be smeared or streaked over the primary area of contact.

## c. Assumptions About the Onshore Zone of Contact

With the exception of barrier passes at the entrance to Bolivar Roads and San Luis Pass at either end of Galveston Island, the entire stretch of coastline within the primary area is fronted by barrier island or chenier ridge beaches. The stranded oil would be deposited on the foreshore areas and lower berms of these beaches for a distance of 100 ft back from the normal low tide line. It is assumed that no stranded oil will move across barrier beaches into back barrier marshes. Any oil that reaches the passes between the two barrier islands, within the primary area of contact, is expected to be transported through these two barrier passes on incoming tides into the back barrier estuarine environment. It is assumed that 5 percent (1,750 bbl) of the oil that reaches the coast will be transported into Galveston Bay, and 1 percent (350 bbl) will be transported into San Luis Pass, based on the percentage of the shoreline that these passes occupy. In addition, it is assumed that 50 bbl of oil will be transported through Rollover Pass, a small breach in Bolivar Peninsula.

The oil that is transported into Galveston Bay is assumed to spread for six miles along the back sides of the barrier islands along either side of the barrier pass and for six miles along the mainland shore. The oil that is transported into San Luis Pass is assumed to spread for one mile on either side of the pass along the back side of the barrier. Discontinuous wetland areas occur in these settings. Twenty percent of the oil that is transported into the estuary is assumed to move 30 ft back onto these wetlands. Oil deposited in wetlands could accumulate in clumps of marsh vegetation or in protected pools or embayments, resulting in isolated thick layers of oil on such marsh surfaces and in sediments. The rest of the estuarine shoreline consists of bluffs cut into Pleistocene terraces, developed land, and scattered tidal flats. Here, oil will pile up along the shore or will coat the surface of tidal flats. The small amount of oil that is assumed to be transported through Rollover Pass will be deposited onto back barrier wetland areas within a few hundred yards on either side of the pass.

There is some smearing of the oil along the coast, or breakup and reemergence of the weathered oil farther up or down the coast over time. All of the oil that contacts recreational beaches is cleaned up to the extent that oil is not visible and that remnant oil will not interfere with the recreational use of the beach. Onshore efforts to contain or intercept the oil as it reaches the shoreline are ineffective.

### d. Assumptions About the Fate of the Spilled Oil

Thirty-three percent of the oil would be lost from the slick surface as a result of weathering by four hours, the time assumed for the leading edge of the oil to first contact land. About one-half of the amount lost is due to evaporation. In three days, it is assumed that the slick contains 35,000 bbl of oil with evaporation accounting for 40 percent of the loss of slick volume. This assumption is based on conditions that allow the slick to spread over a large surface area. By the end of 10 days, approximately 50 percent of the oil could be lost due to evaporation and a total of 67 percent of the oil could have weathered from the slick surface.

Of the 10 percent of the spilled oil that remains offshore, 60 percent would be lost as a result of weathering after 24 hours. The remaining offshore oil slick would cover less than one square mile of sea surface by 24 hours.

## 3. Effects of a Large Oil Spill

Resources assessed under the proposed actions are analyzed below with the exception of the sensitive offshore habitats and communities category (Section IV.D.1.a.(2)). These resources will not be contacted by oil spills because of their water depths.

### a. Impacts on Sensitive Coastal Habitats

*Coastal Barriers*

The primary threat to a barrier landform from a large oil spill is the potential for the removal of large quantities of sand in association with cleanup operations. The configuration of a barrier landform is determined by the balance between the sand supply reaching the beach and the erosional processes that are acting to remove the sand. On a sand-deficient beach, if the sand supply is depleted as a result of cleanup operations, the beach could migrate and/or erode in adjustment to the new balance between erosional forces and sand supply. Erosion and migration will cause loss of beach and island area and possible damage to fixed structures on or near the beach (buildings, roads, power lines, etc.)

The length of coast that could be contacted by the spill includes accreting and eroding segments. The Galveston Island shore face is a stable or accreting segment. Cleanup efforts along the Galveston Island shoreline would not have a large impact on beach and island morphology. After the tanker *Alvenus* spill (about 67,000 bbl of oil), for example, 90,000 $yd^3$ of sand were removed from the beaches along middle and western Galveston Island. This amount of sand removal was considered equivalent to the amount that would be removed by a minor storm. By comparison, Hurricane Alicia, a major Gulf hurricane, removed 900,000 $yd^3$ of sand from Galveston beach. As a result of the cleanup and the associated sand removal, the beach profile changed slightly, but this change was undetectable after a few spring tides.

Along the remaining sections of the coast that could be contacted by the spill, beaches are undergoing varying rates of erosion. Removal of sand from these areas as a result of cleanup operations could alter the cross-sectional and plan configurations of the coastline as a result of beach adjustments to a lowered sand supply. Techniques that do not remove large quantities of sand could be used to clean the beach. These cleanup approaches would probably be more expensive than simply scraping the oiled sand off the beach, but they would result in reduced impacts to the beach.

Impacts to coastal barriers as a result of contact from the large spill would be short-term changes in beach profile where sand had been scraped away and not replaced during cleanup operations. No long-term impacts will occur at Galveston Island. Elsewhere, some accelerated erosion of the barrier shoreline may occur where large quantities of sand were removed from the beach and not replaced. The use of cleanup methods that do not remove sand from the beach will lower erosional impacts.

*Wetlands*

Along the coastal area affected by the spill, wetlands occur either in back barrier estuarine settings (Galveston County) or directly behind mainland barrier beaches (Jefferson and Chambers Counties). The continuous length of barrier beach along the coast in Jefferson and Chambers Counties will prevent the spilled oil that is moved onto the beach from being deposited in the wetlands. In Galveston County, oil will be transported through barrier passes at Bolivar Roads (the entrance to Galveston harbor) and at San Luis Pass at the southern end of Galveston Island. There is also a small cut through Bolivar Peninsula that will allow a small quantity of oil to move into the estuary. The total amount of oil that will be transported onto wetland areas through these three passes is approximately 2,150 bbl. About five miles of marsh shoreline will be contacted by the oil. If this oil were spread evenly over the contacted marsh area, the concentration of oil on the marsh surface will be approximately 0.017 gallons/square foot. This concentration is below the amount (0.35 gallons/square foot) that was shown to have a detrimental effect on the vigor and survival of *Spartina alterniflora* vegetation in Galveston Bay, Texas, when varying concentrations of oil were applied to the marsh (Alexander and Webb, 1985).

Although it is likely that the oil will be spread across a large expanse of wetlands with the tides, this spreading will not be completely uniform. Lower elevation and protected wetland areas will likely accumulate greater concentrations of oil. Alexander and Webb (1987) have reported that areas of a *Spartina alterniflora* marsh, which had become heavily oiled (5-50 parts of oil per 1,000 parts of marsh soil) after a spill in Galveston Bay, showed significantly reduced growth for 18 months after the spill. Accelerated erosion of marsh shorelines that had received heavy oiling was apparent by 16 months and continued through 32 months. Other areas that had received lighter concentrations of oil were not affected by the spill.

The results of the 1987 Alexander and Webb study provide a realistic scenario for assessing impacts from the occurrence of the very large oil spill in the WPA. Investigations that use *Spartina alterniflora* as the test species are useful for the analysis of the impacts of the spill being considered because this grass dominates the vegetation of saline marshes, which will characterize much of the coastal fringe 30 ft back from the shoreline. Furthermore, the Alexander and Webb spill occurred in the same coastal region of Texas and involved a spill with dimensions of the same order of magnitude as the one being considered (160 bbl spilled along four miles of coast).

Based on the results of this study, most of the wetland areas contacted by the spill will be unaffected by the oil because the oil on the marsh will have been spread out to a low concentration. Some areas, probably close to the shore, will receive heavier concentrations of oil, resulting in reduced plant vigor and dieback during the following two growing seasons and in accelerated marsh shoreline erosion because of the greater susceptibility of the shoreline to wave attack after the marsh grass roots have died.

The affects of the spilled oil on coastal wetlands are expected to persist for 1-3 years, except in areas where the marsh shoreline has eroded. In these cases, the loss of wetland areas will be permanent. However, only a small percentage of the total wetland acreage in an area contacted by the large spill will be destroyed or altered as a result of the spill.

## b. Impacts on Water Quality

The effect of oil spills on water quality is determined by the amount of oil that resides within the contacted water body. Significant degradation of offshore water quality is directly proportional to the areal coverage of the surface slick, the concentration of oil transported into the water column, and the residence time of the oil in the water column. The slick itself, defined as the oil spread on the water surface, is a short-lived phenomena and is only important in determining water quality impacts because of its contribution of hydrocarbons into the water column. The concentration of oil in the surface slick of the 100,000-bbl spill averages 0.0024 gallons/square foot of surface water (NRC, 1985) by the third day of the spill incident.

Major weathering processes removing oil from the surface of the water include spreading, evaporation, dissolution, dispersion (often called vertical transport), photochemical oxidation, adsorption to suspended particulate matter, and microbial degradation. Section IV.C.2. describes these processes in more detail. Oil spilled from a subsurface source, such as the tanker spill being considered here, will form a subsurface plume. This plume, although poorly understood, is assumed to rapidly rise to the sea surface to form a surface slick that moves with the currents and winds. Spilled oil can be mixed into the water column primarily through three mechanisms. First, oil in the surface slick can be dispersed back into the water due to wave action. Second, dissolution of the lower molecular weight hydrocarbons would occur from the surface slick and subsurface plume. Dissolution does not play a significant role in the mixing of oil into the water column, usually resulting in less than a 1 percent loss from the total slick hydrocarbon concentration. Third, turbulence in the water, caused by the rapidly rising subsurface plume, would result in the greatest dispersion of water droplets into the surrounding water column during the spill incident.

Such weathering processes, which remove oil from the water surface, would be slowed during winter because the processes are temperature dependent. During winter, the average coastal water surface temperature is 61°F.

*Offshore*

The oil spill is assumed to occur from a grounded tanker, four miles from the coastline near the entrance to the Port Arthur ship channel. It is assumed that the oil is released from the bottom of the grounded tanker's hull. Oil spilled at the seafloor would form a subsurface plume that rapidly rises to the sea surface to form surface slicks. Two primary slicks are assumed to be formed at the surface of the water over the discharge site. The majority of the floating oil is assumed to be pushed directly toward land. This primary slick becomes stranded along the shoreline within the surf zone in the first three days following the accident. Because of shifting winds, however, it is not expected that all of the oil would move directly toward the shoreline. Ten percent of the oil would move as a separate discreet slick, moving westward within nearshore waters.

As described above, oil would become incorporated into the water column in two ways: (1) at the subsurface discharge point, due to turbulence from the rising oil and (2) under the floating surface slicks, due to dispersion and dissolution processes. Concentrations of hydrocarbons in the water column surrounding the discharge point decrease with distance away from the spill, and will likely decrease tenfold seven miles on either side of the plume (USDOI, MMS, 1987e). It is assumed that the majority of the oil dispersed into the water column would occupy the top 20 ft of the water column similar to conditions recorded during the *Ixtoc* spill (Fiest and Boehm, 1980). Therefore, the major volume of water affected by the primary slick moving landward would be 4 mi (distance from shore) by 14 mi (7 mi on each side of the plume) by 20 ft (water depth affected).

The surface slick, formed from the 10 percent of the oil remaining offshore, would persist for approximately 4.5 days before disappearing from the water surface due to weathering processes. It would cover a maximum area of 1 $mi^2$ before breaking up. The volume of water affected by this slick would be 1 $mi^2$ by 20 ft.

Calculations of the maximum amount of oil within the water column were then made for the affected areas. Approximately 9,000 bbl of oil would be contained in the water column after three days under the major surface slick heading towards shore, and about 2,600 bbl of oil would be contained under the offshore slick after four days. Given all of the above, maximum hydrocarbon loadings of the affected waters would be 30,000 ppb. This figure is very high when compared to the average reported concentrations of oil in pristine waters of less than 1 ppb (Fiest and Boehm, 1980).

It is assumed that the contaminated water would mix with surrounding water and would become diluted. After several weeks, enough mixing would take place so that, within the primary area of contact, hydrocarbon quantities would approach background levels.

In conclusion, hydrocarbon concentrations would increase in the primary area of contact by several orders of magnitude. This condition would persist for days to weeks. Effects on regional water quality conditions would not be considered significant due to the relatively small areal extent of impact.

*Coastal and Nearshore*

It is assumed that the slick will spread out along the shore, contacting 80 mi of west Texas chenier ridge beaches and barrier islands by the end of three days. Nearshore coastal water quality adjacent to the contaminated 80 mi would be affected by the oil due to backwashing of the oil into the surf zone. Oil returning to the surf would likely be trapped by longshore currents and, therefore, would remain within nearshore waters. Surf conditions would accelerate the amount of hydrocarbons dispersed into the shallow water column. Therefore, in nearshore waters contacting the beaches, it is expected that hydrocarbon concentrations would be significantly higher than background levels. Waters containing significantly higher levels of hydrocarbons than background levels are assumed to be contaminated and of poor water quality. This contamination would continue until the source of the contamination, the oil on the beaches, is removed. Cleanup of beaches is assumed to be completed in about six weeks. Prior to this time, it is assumed that the longshore currents would continually be carrying some contaminated water westward beyond the primary area of contact. The contaminated water that remains after the beaches are cleaned would mix with surrounding water as it moves westward with nearshore currents and become diluted to background levels within several weeks. It is therefore expected that the 100,000-bbl spill would significantly alter the water quality of Texas nearshore waters for several weeks.

It is assumed that 2,100 bbl of the oil would reach the back bay area behind Galveston Island through the Bolivar Roads and San Luis Pass inlets. Another 50 bbl of oil would enter the back barrier area through the Rollover inlet, a small channel through Bolivar Peninsula. Of the 2,150 bbl of oil that enter the inland coastal waters, 430 bbl are assumed to reach coastal wetlands along a total of five miles of bay shoreline. The oil will move back 30 ft into wetland waters. The majority of the oil covering wetlands would weather, and quantities of hydrocarbons would likely return to background levels within several months after the spill occurred. The colder weather occurring in the winter would impede weathering processes so that the oil may remain above ambient conditions until warmer weather returns. Some of the oil, however, could be pushed into clumps of marsh vegetation or into protected pools or embayments, resulting in a thick layer of oil on these water bodies or marsh surfaces. Dissipating factors reducing the concentrations of oil would operate slower due to the low energy of the isolated water bodies, due to the thickness of the oil on the marsh surface, and due to the cold weather. These isolated pools of oil would weather more slowly and may release oil into the surrounding water bodies for a much longer time period. Past studies (discussed in Section IV.D.1.a.(1)(b)) documented that this type of dense oiling has occurred, releasing oil from oiled sediments and vegetation for over one year from the time of the spill. Given the above, a large spill entering the inland estuarine environment of Galveston Bay would result in impacts in a few, scattered wetland and pond areas because of thick accumulations of oil. It is expected that the remaining bay environment, based on this scenario, would also experience impacts.

### c. Impacts on Air Quality

Evaporation of total hydrocarbons from the large oil spill results in emissions into the atmosphere of the Port Arthur and Galveston area. These emissions would discharge a number of volatile organic compounds (VOC), which are a constituent in the formation of photochemical oxidants ($O_x$), in particular ozone.

Emissions of hydrocarbons and VOC would occur at a variable rate. The greatest rate of evaporation would occur during the first hour and would decrease continuously afterwards. It is assumed that 17 percent of the original spilled oil would evaporate during the first four hours, 40 percent (23 percent more) by the third day, 42 percent in five days, and 50 percent by the 10th day.

The duration and magnitude of the concentrations depend on air and water temperature, wind speed and direction, and the amount of sun irradiance occurring during the spill. The spill scenario assumes an easterly wind with a mean speed of 3 $ms^{-1}$ and water temperature of 16°C, which represent seasonal average wind and sea surface conditions for the area. Heat flux peaks during this time, which is indicative of strong vertical mixing.

By the end of the first 4 hours, a total of 2,499 tons would have evaporated into the atmosphere. This estimate was calculated by expressing the amount of spilled crude oil in tons and multiplying by the preceding evaporation rates. By the third day, evaporated oil would amount to 5,879 tons, and by the end of the tenth day, approximately 7,349 tons. During winter, potentially very stable atmospheric and low mixing heights conditions can occur, causing high short-term (24 hours) air quality impacts in localized areas. The addition of these emissions under normal climatic conditions could increase ozone levels in the coastal environment.

However, long-term impacts of the large crude oil spill on the coastal air quality will be lower because the increase of pollutants represents about 21 tons a year of hydrocarbons.

## d. Impacts on Endangered and Threatened Species

The following threatened and endangered species and their habitats between San Luis Pass and Sea Rim State Park, Texas, could be impacted by a 100,000-bbl spill or its subsequent containment/cleanup operations because they are located within the area of potential impact: piping plover, eskimo curlew, bald eagle, Arctic peregrine falcon, brown pelican, and the Kemp's ridley, green, loggerhead, and hawksbill turtles. If these animals or their habitat were contacted by spilled oil or were in proximity to the resultant containment/cleanup operations, the impacts could include mortality or displacement of food, displacement from critical habitats, mortality or disfunction from ingestion or contact, reduced reproductive capacity, and debilitating or terminal stress. These impacts could be acute as well as long term and could impact all life stages from prenatal to adult. Protected species, which occur in or on the Gulf Coast but do not inhabit areas that occur in the area of potential impact, include the jaguarundi, ocelot, Mississippi sandhill crane, Alabama beach mouse, Choctawatchee beach mouse, and Perdido Key beach mouse, whooping crane, leatherback sea turtle, and the great whales (blue, sei, right, fin, and sperm). The marine species occur farther offshore than the spill will contact, and the terrestrial species occur inland of the landward extent of the spill.

*Piping Plover*

The piping plover migrates to and congregates along the sandy shores of the central and western Gulf Coast during the winter. Based on the scenario, the spill and cleanup/containment operations would contact piping plover habitat in Bolivar Flats and San Luis Pass, Texas. The spill, occurring during the winter, could contact the piping plover and its habitat because the bird's primary congregating, feeding, resting, and roosting areas are within the area of impact (i.e., 10 m of the mean low tide on Gulf Coast sandy shores). Impacts to the birds from such a contact are discussed in the first paragraph of this section. A significant portion of the population is assumed to be in the area of impact because the fourth largest piping plover aggregation, which was observed in a 1987-1988 survey, was located at Bolivar Flats, with a smaller aggregation at San Luis Pass. It is likely that a portion of the local population could die or be reproductively disabled as a result of contact; such mortality has been documented. A local population decline could occur, and this decline would take more than three generations to recover. Such losses would eliminate the piping plover from up to 80 mi of its wintering range and could reduce the gene pool of the species to a point that could impair its ability to recover.

*Arctic Peregrine Falcon*

The Arctic peregrine falcon migrates through and concentrates along the coast of the western and central Gulf of Mexico during the spring, fall, and winter. The greatest threat to peregrine falcons from the spill is the external oiling and toxic ingestion of oil during and after the capture of oiled prey. Based on the scenario, the spill and cleanup/containment operations would contact Arctic peregrine habitat in coastal Texas between San Luis Pass and Sea Rim State Park. A spill occurring during the winter could contact Arctic peregrine falcons and their habitat because the birds' primary feeding areas are within the area of impact (i.e., 10 m of the mean low tide on the central and western Gulf Coast). Impacts to the birds from such a contact are discussed in the first paragraph of this section. A significant portion of the population may be in the area of impact because the North American Arctic peregrine population concentrates in a coastal corridor from Louisiana through Mexico during its spring, fall, and winter migration. A significant portion of the species or its habitat may come in contact with oil or cleanup/containment operations because the peregrine's prey inhabit the area of potential impact. It is likely that a significant portion of the population could be reproductively disabled with some mortalities as a result of contact; such mortality has been documented. A population decline could occur and this decline could take more than three generations to recover. Such losses would be acute, as in the case of birds starving because of their inability to fly after being oiled, or long term, where oil ingestion results in infertile or thin-shelled eggs.

*Brown Pelican*

The brown pelican is protected in Louisiana and Texas because of population declines in these states. The protected population nests in lower Laguna Madre, Corpus Christi Bay, and Aransas Bay in Texas, and Barataria Bay and Mississippi Sound in Louisiana. The majority of the species occurs in a healthy, unprotected population along the Gulf Coast of Florida. Based on the scenario, the spill and cleanup/containment operations could contact brown pelicans and their habitat in Galveston Bay. The spill, occurring during the winter, could contact the brown pelican and its habitat because the bird's primary congregating, feeding, resting, and roosting areas are in the area of impact (i.e., in coastal waters or within 10 m of the mean low tide). Impacts to the birds from such a contact are discussed in the first paragraph of this section. A significant portion of the protected brown pelican population is not assumed to be in the area of impact because no nesting rookeries exist in the Galveston Bay area. A significant portion of the protected population or its habitat will therefore not come in contact with oil or cleanup/containment operations. However, that portion of the population that occurs in the Galveston Bay area is at risk because the bird's primary habitat is within the area of potential impact. The portion of the population in Galveston Bay could die or become reproductively disabled as a result of contact; such mortality has been documented. A local population decline could occur and this decline could take one generation to recover.

*Bald Eagle*

The bald eagle is endangered throughout most of the Nation. They occur throughout the continental United States and Alaska including the Gulf of Mexico coast. They build nests near water and hatch eggs from November to April. Eagles feed primarily on fish, shorebirds and waterfowl, of ten preferring carrion over predation. Based on the scenario, the spill and cleanup/containment operations could contact bald eagle habitat between Sea Rim State Park and San Luis Pass, Texas. The spill, occurring during the winter, could contact the bald eagle and its habitat because the bird's primary feeding areas are in the area of impact (i.e., in coastal waters or 10 m of the mean low tide). Impacts to the birds from such a contact are discussed in the first paragraph of this section. A significant portion of the local population will not be in the area of impact because no nests are reported for the area of primary impact. A significant portion of the species or its habitat will not come in contact with oil or cleanup/containment operations because of the small number of eagles in the area of potential impact. A small portion of the population could die or be reproductively disabled as a result of contact; such mortality has been documented. Birds from the interior would recolonize coastal areas within a generation if coastal birds were extirpated by a spill. Such losses would be acute, as in the case of a birds starving because of their inability to fly after being oiled, or long term, where oil ingestion results in infertile or thin-shelled eggs.

*Sea Turtles*

Five species of sea turtles occur in the northern Gulf of Mexico. The loggerhead and Kemp's ridley sea turtles are the only species that nest in the central and western Gulf of Mexico. For the purposes of discussion, this analysis will concentrate on these two species because more is known about their distribution and abundance in the Gulf of Mexico. Based on the scenario, the spill and cleanup/containment operations would contact sea turtle habitat between Sea Rim State Park and San Luis Pass, Texas. The spill, occurring during the winter, could contact sea turtles and their habitat because their primary feeding areas are in the area of impact (i.e., in coastal waters and on land within 10 m of the mean low tide). Impacts to the turtles from such a contact are discussed in the first paragraph of this section. Although little is known about the distribution and abundance of sea turtles, for the sake of analysis this discussion assumes that a significant portion of the sea turtle populations do not occur in the area of impact because so few sightings have been reported in the area. The exception is the Kemp's ridley turtle, which periodically strands in large numbers along this portion of the coast. Although mortality from contact and ingestion of oil has been documented, a significant portion of the population will not be affected, except in the case of the Kemp's ridley. A population decline could occur and this decline could take one generation to recover for loggerhead, hawksbill, and green turtles. The

Kemp's ridley could sustain a population decline as large as 5 percent, which could last as long as two to three generations.

## e. Impacts on Marine Mammals

More than twenty species of nonendangered marine mammals occur in the northern Gulf of Mexico. Eight species have been observed with regularity, the bottlenose dolphin being the most common. The bottlenose dolphin is the only species that would be contacted by the spill because they occur nearshore within the primary area of potential contact in the spill scenario. All other species will not contact or be impacted by the spill or its cleanup operations because they occur outside the primary area of impact. Contact with bottlenose dolphins will result in dysfunction as a result of skin irritation, displacement from preferred habitats, ingestion, and loss of food sources. The impact on dolphins would be greatest in those populations that have high accumulations of toxic metabolites and during periods of poor water quality (i.e., red tide).

## f. Impacts on Coastal and Marine Birds

The back barrier estuarine environment, barrier islands, beaches, and nearshore waters of Chambers, Jefferson, and Galveston Counties in Texas are populated by both migrant and resident species of waterfowl, wading birds, and shorebirds. Refer to Section IV.D.1.a.(7) for a detailed discussion of the effects of oil on coastal and marine birds.

A very large spill 4 mi off Port Arthur, Texas, will contact barrier islands and beaches on the Texas coast. Most of the oil (90 percent) will come ashore. The oil will wash ashore 100 ft back from the normal low tide line. Approximately 1,750 bbl of the oil will be transported through Bolivar Roads Pass into Galveston Bay and the back barrier estuarine environment, spreading six miles across from and six miles both east and west of the Pass. Approximately 50 bbl of the oil will be transported through Rollover Pass into the back barrier estuarine environment, spreading a few hundred feet across from and a few hundred feet both east and west of the Pass. Approximately 350 bbl of the oil will be transported through San Luis Pass into Redfish Cove and the back barrier estuarine environment, spreading one mile across from and one mile both east and west of the Pass.

The majority of the waterfowl population (e.g., ducks and geese) are overwintering migrants. The occurrence of a very large spill during the winter would contact those duck species of the central flyway that migrate to the back barrier estuarine environment, barrier islands, beaches, and nearshore waters found in Chambers, Jefferson, and Galveston Counties. These ducks (e.g., lesser scaup, mergansers, and fulvous whistlers) are gregarious and feed on marine fish and shellfish while in coastal areas.

Wading birds (e.g., herons, egrets, and ibis) are both overwintering migrants and residents of the Texas coast and would be vulnerable to contact from a large spill. Major wading bird habitats include the protected bays, back barrier estuarine environment, barrier islands, and open beaches found in Chambers, Jefferson, and Galveston Counties. Under the spill scenario, wading birds that occupy the foreshore area of the islands and the oiled areas of the back barrier estuarine environment near the barrier passes would be contacted by oil.

Shorebirds (e.g., gulls, terns, sandpipers, and shearwaters) are both overwintering migrants and residents of the Texas coast and would be vulnerable to contact from a large spill. Shorebirds are closely associated with the marine environment. Major shorebird habitats include the back barrier estuarine environment, barrier islands, open beaches, and nearshore waters found in Chambers, Jefferson, and Galveston Counties. Under the spill scenario, birds roosting in the nearshore part of the primary area of potential contact (80 mi along the coast by 4 mi offshore) would be contacted by oil. In addition, shorebirds that occupy the foreshore area of the islands and the oiled areas of the back barrier estuarine environment near the barrier passes would be contacted by oil. Shorebirds nest on the barrier islands of Chambers, Jefferson, and Galveston Counties, between the dunes and the normal low tide line. Under the spill scenario, these nesting sites would be contacted and contaminated by oil. However, beach cleanup operations would be completed within six weeks of the spill before shorebird nesting activities take place on these beaches in the spring. Therefore, it is expected that shorebird nesting sites would not be impacted from a large oil spill.

It is expected that contact between the spilled oil and birds associated with the coastal area in the settings described above would result in both lethal and sublethal impacts on the contacted birds. It is expected that no more than 1,000 birds associated with the coastal area will be contacted by the spilled oil. Direct contact between partially weathered oil and adult birds would result in lethal impacts, whether or not the birds were completely oiled, due to ingestion and toxic poisoning, drowning, or hypothermia. Direct contact between heavily weathered oil and adult birds would result in sublethal impacts including decreased survival and fecundity and modifications of normal behavior. Any oil remaining in the protected bays and back barrier estuarine environments found in Chambers, Jefferson, and Galveston Counties would exist as probable contaminated areas or sources of contaminated food for several months. Adults of both resident and migrant birds associated with the coastal area would be susceptible to sublethal impacts from feeding in these contaminated areas or on contaminated food. Within the limited geographical area affected, both migrant and resident coastal bird populations would decline and change their distribution and/or abundance for one to two generations or for two to three years.

## g. Impacts on Commercial Fisheries

Commercial fisheries in the Gulf of Mexico are dominated by estuarine-dependent species. The back barrier estuarine environment, nearshore waters, and passes of Chambers, Jefferson, and Galveston Counties in Texas serve as nursery grounds and immigration routes for eggs, larvae, and/or juveniles of commercial finfish and shellfish that are spawned offshore. Refer to Section IV.D.1.a.(9) for a detailed discussion of the effects of oil on finfish and shellfish.

A very large spill 4 mi off Port Arthur, Texas, will contact barrier islands and beaches on the Texas coast. Most of the oil (90%) will come ashore. The oil will wash ashore 100 ft back from the normal low tide line. Approximately 1,750 bbl of the oil will be transported through Bolivar Roads Pass into Galveston Bay and the back barrier estuarine environment, spreading 6 mi across from and 6 mi both east and west of the Pass. Approximately 50 bbl of the oil will be transported through Rollover Pass into the back barrier estuarine environment, spreading a few hundred feet across from and a few hundred feet both east and west of the Pass. Approximately 350 bbl of the oil will be transported through San Luis Pass into Redfish Cove and the back barrier estuarine environment, spreading one mile across from and one mile both east and west of the Pass.

Important commercial fisheries species in Chambers, Jefferson, and Galveston Counties that could be contacted by a very large oil spill include brown shrimp, blue crab, American oyster, flounder, and several species of sciaenids. All stages of larval shrimp are distributed within the upper portion of the water column while nearshore. Postlarval shrimp become benthic after entering nursery grounds. Young blue crabs are distributed within the upper portion of the water column while nearshore. Blue crabs become benthic after entering nursery grounds, but retain the ability to swim for short distances especially with tidal currents. Oyster larvae remain within back barrier environments and once settled as adults do not change location. Except for flounder, young finfish are distributed within the upper portion of the water column while nearshore. Juvenile finfish remain pelagic in back barrier estuarine environments, but occupy shallow water areas along with young flounder.

The greatest potential for damage to commercial fisheries would occur when oil contacts nearshore waters and back barrier estuarine environments during the time when high concentrations of planktonic larvae, or developing young, are present. Young finfish and shellfish (e.g., shrimp, blue crabs, and sciaenids) would be vulnerable to contact from a very large spill. Under the spill scenario, young finfish and shellfish would be contacted by oil as they migrate from nearshore waters through the primary area of potential contact (80 mi along the coast by 4 mi offshore) into back barrier estuarine environments found in Chambers, Jefferson, and Galveston Counties. Under the spill scenario, all life stages of oysters that occupy the oiled areas of the back barrier estuarine environment near the passes would be contacted by oil.

It is expected that contact between the spilled oil and important commercial fish and shellfish species in the settings described above would result in both lethal and sublethal impacts on the contacted species. Direct contact between partially weathered oil and the eggs, larvae, or juvenile stages of finfish or shellfish would result in lethal impacts, due to ingestion and toxic poisoning and/or uptake of dissolved oil through the epithelium or gills and toxic poisoning. Direct contact between heavily weathered oil and juvenile fish and shellfish would result in sublethal impacts including decreased resistance to disease and reduced growth rates. Any oil remaining in the protected bays and back barrier estuarine environments found in Chambers, Jefferson, and Galveston Counties would exist as probable contaminated areas or sources of contaminated food for several months. Juvenile finfish and shellfish would be susceptible to sublethal impacts from feeding in these contaminated areas or on contaminated food. In addition, low concentrations of the spilled oil could taint the flesh of adult oysters rendering them unmarketable.

Fishermen tend to fish within a limited, traditional area. This area may be only hours from their home port. Fishermen are reluctant and often unable to switch gear type or to change target species. Within the limited geographical area affected, commercial fisheries would be depressed with local fishermen out of work and secondary employment affected for one to two years after the spill.

## h. Impacts on Recreational Resources and Activities

A large oil spill affecting up to 80 mi of north Texas coastline between the Sabine River and San Luis Pass would have short-term adverse impacts on several designated park areas and general-use beach areas, extending the entire length between Sabine Pass and Galveston Island. Sea Rim State Park, a 5.2-mi stretch of designated beach park in Jefferson County, would likely receive the initial oiling from an assumed spill off Port Arthur. About 5-10 percent of annual visitations occur during the winter season and consist mainly of recreational vehicle campers traveling the Gulf Coast. The attention associated with a major winter spill could even attract more winter leisure travelers to the park than normal. Within the next two days, intermittent oiling of the extensive dispersed use recreational beaches fronting on Jefferson and Chambers Counties would be adversely affected also. By the third day, the 9 mi of Gulf recreational beaches associated with the City of Galveston Island, Galveston Island State Park's 1.5 mi of beachfront, and Seawolf Park are likely to be impacted by residual oil from an assumed spill off the Port Arthur ship channel. Although beach use, particularly swimming and sunbathing, declines appreciably after Labor Day, residual use of coastal beach parks, pier, jetty, and surf fishing continues through the fall and winter months, especially in Galveston County. Very little recreation activity is focused on beach activities in Galveston County during the winter months, but publicity associated with a very large spill event, which pollutes the city's major natural recreational amenity, is likely to result in some cancellations of discretionary leisure travel planned to the city of Galveston and may discourage attendance at Sea Wolf Park.

In general, the socioeconomic impact of a large oil spill on beach communities is unlikely to be severe during the off season but would preclude or detract from public use and enjoyment of directly impacted beaches for several days on up to six weeks, depending on current, tides, weather, access, and cleanup effectiveness. Cleanup of beaches extensively affected by crude oil is labor intensive and can result in beach closures and sand displacement, removal, and disposal problems. As noted from the large spills and accidents that have impacted major Gulf of Mexico beaches with oil in the past, recreational use and enjoyment of coastal beaches and shoreline fishing platforms return to normal after evidence of the spill was gone.

# SECTION V

# CONSULTATION AND COORDINATION

V

# V. CONSULTATION AND COORDINATION

## A. DEVELOPMENT OF THE PROPOSED ACTIONS

The draft 5-Year OCS Oil and Gas Leasing Program Schedule for 1992 to 1997 (tentatively scheduled for completion in mid 1992) authorizes proposed lease Sale 142 covering the Central Gulf of Mexico, to be held in March 1993, and proposed lease Sale 143 covering the Western Gulf of Mexico, to be held in August 1993.

The Area Identification process was initiated on June 13, 1991, with the *Federal Register* publication of the Call for Information (Call) and the Notice of Intent to Prepare an EIS (NOI). The Call covered all unleased blocks in the CPA and WPA, with the exception of two highly sensitive blocks in the WPA: Blocks A-375 and A-398 in the High Island Area, East Addition, South Extension (East and West Flower Garden Banks, respectively).

In late 1990, MMS and the Department of Defense (DOD) agreed to the deferral of the Western Naval Operations Area from proposed Western Gulf lease Sales 135 and 141 scheduled for August 1991 and August 1992. The deferral area, containing 340 lease blocks and approximately 1.7 million acres, is located east of Corpus Christi, Texas (Figure I-1). It was also agreed that the deferral would be subject to a two-year review period, after which a decision would be made to either continue the deferral for an additional two years or move the area to another acceptable location.

Consultation has begun between DOD and MMS to review the two-year deferral. Comments received from industry concerning this deferral have been relayed to the appropriate parties at DOD. On August 7, 1991, a meeting was held between MMS, DOD, and industry representatives at the Gulf of Mexico Regional Office to discuss the current and planned operational conditions in the deferral area and to allow industry to further express their concerns. Industry representatives requested MMS and DOD to consider adjusting the configuration and location of the carrier operations area to accommodate industry interest in the area to the maximum extent possible within the constraints posed by DOD. The MMS committed to establishing a process by which companies can identify areas of interest in or near the Corpus Christi carrier operations area for subsequent evaluation by DOD and MMS.

## B. DEVELOPMENT OF THE DRAFT EIS

In accordance with NEPA requirements and CEQ regulations, MMS followed scoping procedures for contacting and coordinating with Federal, State, and local governments; academic institutions; public interest groups; and concerned individuals throughout the development of this document. The scoping process utilized in determining the issues and concerns for the proposed 1993 Gulf of Mexico sales is discussed in Section I.B.2. At the time of the Call/NOI, the scoping process for the proposed sales was officially initiated. Federal, State, and local governments, along with other interested parties, were requested to send written comments to the Region on the scope of the EIS. These comments are summarized below.

## C. RESPONSES TO THE CALL FOR INFORMATION AND THE NOTICE OF INTENT TO PREPARE AN EIS

There were 10 responses to the Call/NOI--5 from industry, 3 from Federal agencies, 1 from the State of Alabama, and 1 from an environmental organization. These comments were considered in the identification of the area to be offered for lease in proposed Sales 142 and 143 and in the development of the issues, alternatives, and mitigating measures addressed in the Draft EIS.

Industry responses were received from the following companies:

Mobil Exploration and Producing U.S., Inc.

Shell Offshore, Inc.
Chevron U.S.A., Inc.
Unocal
Pogo Producing Company

Industry interest and comments as submitted by the companies indicate the following:

- A general support for the continuation of areawide leasing for the 1993 sales in the Central and Western Gulf of Mexico.

- One company stated it could also support a slower paced leasing alternative for tracts in water depths greater than 5,000 ft.

- Support was expressed for the annual offering of the CPA and WPA.

- Two companies opposed the deferral of acreage for naval operations in the Western Gulf.

- One company recommended MMS remain flexible regarding the naval operations area and refrain from making this a permanent deferral.

- One company expressed support for the current minimum bid requirement and recommended a fixed 10-year term for leases in all water depths greater than 400 m.

- One company supported the continuation of all current lease terms.

- One company suggested including the entire OCS off Alabama in the CPA (except any acreage subject to existing moratoria).

- Two companies identified and prioritized specific areas of interest for leasing in the Central and Western Gulf OCS.

The Department of the Navy expressed concern for the provision of safe and adequate sea room for training carrier operations in the Western Gulf. They are currently working with MMS on the development of an appropriate deferral configuration for consideration in the presale process for Sale 143.

The State of Alabama expressed support for the centralization of gas cleansing and processing facilities in southern Alabama but maintained that the affected coastal communities should share in the financial benefits resulting from this OCS production. The States of Louisiana, Texas, and Mississippi did not respond to the Call.

Several commentors expressed concerns of an environmental nature. These commentors were the U.S. Fish and Wildlife Service (FWS), the U.S. Environmental Protection Agency (USEPA), the State of Alabama, and Project ReefKeeper (an environmental group). When submitting their comments on the Call/NOI, the USEPA also attached a copy of their comments on the Draft EIS for proposed lease Sales 139 and 141 (1992 lease sales), and these are also included in the summary list presented below. Project Reefkeeper, in their response to the Call/NOI, attached a copy of their comments on proposed lease Sales 131 and 135, and these are also included in the summary list presented below.

Environmental comments and concerns received in response to the Call/NOI include the following.

*U.S. Fish and Wildlife Service*

- The FWS noted that their Panama City Field Office continues to provide biological information to the MMS Gulf of Mexico OCS Office as it becomes available and continues to work cooperatively with the office on a regular basis to identify and assist in resolving resource issues.

*U.S. Environmental Protection Agency*

- The MMS should undertake a comprehensive ozone study.

- The MMS should provide an interim ozone air quality analysis in the next draft EIS.

- The USEPA is concerned about the beach litter problem in the Gulf of Mexico.

- Industry should be more diligent in securing operational debris to reduce the problem of marine debris.

- The USEPA objects to unrestricted leasing without inclusion of protective stipulations to protect biologically sensitive habitats including topographic features and pinnacles.

- The USEPA is concerned about the discharge of produced waters into coastal water bodies and about impacts to estuarine animals.

*State of Alabama*

The State of Alabama supports the existing Live Bottom Stipulation applied to the pinnacle trend areas in the Main Pass and Viosca Knoll Areas.

*Project ReefKeeper*

- The Pinnacle Trend and other shelf-edge coral banks should be safeguarded by deleting them from lease sales.

- Project ReefKeeper requests deletion of all Gulf coral habitat areas.

- They are concerned about impacts to the Flower Garden Bank and 19 other shelf-edge banks off Texas and Louisiana.

- They are concerned about the impacts of anchoring, discharge of drilling muds and cuttings, and explosive structure removals on shelf-edge banks.

- They are concerned about the impacts of oil from a pipeline break or subsurface blowout.

- They are concerned about the long recovery period for damaged coral ecosystems.

# D. DISTRIBUTION OF THE DRAFT EIS FOR REVIEW AND COMMENT

The following public and private agencies and groups will be provided the opportunity to review and comment on this Draft EIS.

*Federal Agencies*

Congress
- Congressional Budget Office
  - House Committee on Merchant Marine and Fisheries
    - Subcommittee on Panama Canal and OCS
  - Senate Committee on Energy and Natural Resources
    - Subcommittee on Energy and Mineral Resources

Department of Commerce
- National Marine Fisheries Service
- National Oceanic and Atmospheric Administration
  - Office of Ecology and Environmental Conservation
  - Office of Ocean and Coastal Management

Department of Defense
- Department of the Air Force
- Department of the Army
  - Corps of Engineers
- Department of the Navy

Department of Energy

Department of the Interior
- Bureau of Mines
- Fish and Wildlife Service
- Geological Survey
- Minerals Management Service
- National Park Service
  - Gulf Island National Seashore
  - Office of Environmental Project Review
  - Padre Island National Seashore

Department of State

Department of Transportation
- Coast Guard
- Office of Pipeline Safety Regulations

Environmental Protection Agency

Marine Mammal Commission

Nuclear Regulatory Commission

*State and Local Agencies*

Alabama
- Governor's Office
- Alabama Department of Environmental Management
- Alabama Department of Conservation and Natural Resources
- Alabama Geological Survey
- Alabama Highway Department

Alabama Historical Commission and State Historic Preservation Officer
Alabama State Clearinghouse
Alabama State Oil and Gas Board
Dauphin Island Marine Laboratory
State Docks Department

Mississippi
Governor's Office
Bureau of Marine Resources
Mississippi Department of Archives and History
Mississippi Department of Natural Resources
Mississippi Department of Wildlife Conservation
Mississippi State Clearinghouse
State Oil and Gas Board

Louisiana
Governor's Office
Department of Culture, Recreation, and Tourism
Department of Environmental Quality
Department of Natural Resources
Department of Transportation and Development
Department of Urban and Community Affairs
Department of Wildlife and Fisheries
Louisiana Geological Survey
Louisiana State Archaeologist

Florida
Governor's Office
Executive Office of the Governor
Florida Department of Community Affairs
Florida Department of Environmental Regulation
Florida Department of Labor and Employment Security
Florida Department of Natural Resources
Florida Department of State
Florida Game and Freshwater Fish Commission
Florida State Clearinghouse
Florida State Historic Preservation Officer

Texas
Governor's Office
Bureau of Economic Geology
Texas A&M University
Texas Air Control Board
Texas Department of Highways and Public Transportation
Texas Employment Commission
Texas General Land Office
Texas Historical Commission
Texas Parks and Wildlife Department
Texas Railroad Commission
Texas State Clearinghouse
Texas Water Commission

Texas Water Development Board
The Attorney General of Texas

*Other*

Alaska Department of Game and Fish

*Libraries*

Alabama
- Auburn University Library
- City of Mobile Public Library
- City of Montgomery Public Library
- Dauphin Island Sea Lab Library
- Gulf Shores Public Library
- University of Alabama at Huntsville Library

Florida
- Charlotte Glades Regional Library
- Collier County Public Library
- Florida A&M University, Coleman Memorial Library
- Florida Atlantic University Library
- Lee County Library
- Leon County Public Library
- Marathon Public Library
- Northwest Regional Library System
- St. Petersburg Public Library
- Tampa-Hillsborough County Public Library
- University of Florida Library
- University of Miami Library
- University of South Florida Library
- West Florida Regional Library

Louisiana
- Calcasieu Parish Library
- Howard Tilton Memorial Library, Tulane University
- Lafayette Public Library
- Louisiana State University Library
- Louisiana Tech University Library
- New Orleans Public Library
- Nicholls State University Library

Mississippi
- Gunter Library
- Harrison County Public Library
- Jackson George Regional Library System

Texas
- Abilene Christian University, Margaret and Herman Brown Library
- Austin Public Library
- Baylor University Library
- Brazoria County Library

Dallas Public Library
East Texas State University Library
Houston Public Library
Lamar University Library
La Ratama Library
Rosenburg Library (Galveston)
Stephen F. Austin State University, Steen Library
Texas A&M University Library
Texas Southmost University Library
Texas State Library at Austin
Texas Technical University Law Library
University of Houston Library
University of Texas at Arlington Library
University of Texas at Dallas Library
University of Texas at El Paso Library
University of Texas Library
University of Texas at San Antonio Library

*Academic Institutions*

Colorado State University
Florida Institute of Oceanography
Florida Sea Grant
Gulf Coast Research Lab
Louisiana State University
Louisiana Universities Marine Consortium Council
Mississippi Sea Grant Advisory Service
Oregon State University
Swarthmore College
State University System of Florida
Texas A&M University
University of Wisconsin
Woods Hole Oceanographic Institute

*Industrial Firms*

Amoco Production Company
Atlantic Richfield Company
Chevron U.S.A. Inc.
Conoco Inc.
EP Operating Company
ERT Houston
Exxon Corporation
Florida Petroleum Council
The Louisiana Land and Exploration Company
MAR, Inc.
Pennzoil Exploration and Production Company
Placid Oil Company
Rowan Companies, Inc.
Shell Offshore Inc.
Texaco Inc.
TXP Operating Company

Unocal Exploration Corporation
Walter Oil & Gas Corporation

*Groups and Individuals*

Apalachee Audubon Society
Audubon Society, Mississippi Coast
Audubon Society, Mobile Bay, Alabama
Audubon Society, New Orleans, Louisiana
Audubon Society, Sanibel, Florida
Audubon Society, Southwest Florida
Audubon Society, Venice, Florida
Center for Environmental Health
Coastal Conservation Association
Concerned Shrimpers of America
Environmental Confederation of Southwest Florida
Environmental Information Center (Florida)
Fisheries Association, Mississippi Coast
Florida Conservation News
Florida Public Interest Research Group
Florida Wildlife Federation
Ft. Myers Beach Chamber of Commerce
Fowl River Protective Association, Inc.
Greenpeace
Gulf of Mexico Fishery Management Council
HEART
Izaak Walton League of America
League of Women Voters
Louisiana Environmental Professionals Association
Louisiana Nature Center
Louisiana Wildlife Biologist Association
Louisiana Wildlife Federation
LUMCON
Lyle St. Amant Marine Lab
MANASOTA 88
Mississippi Coast Fisheries Association
Mississippi Sea Grant Advisory Service
Mississippi Wildlife Federation
Natural Resources Defense Council, Inc.
Organized Florida Fishermen
Oystershell Alliance
Petroleum Information Corporation
Sarasota Audubon Society
Save Our Wetlands
Sierra Club, Florida Chapter
Sierra Club, Houston Chapter
Sierra Club, Lone Star Chapter
Sierra Club, Long Beach, Mississippi
Sierra Club, New Orleans Chapter
Southwest Culture Resources Center
Tampa Audubon Society
Texas Water Conservation Association

# SECTION VI

# BIBLIOGRAPHY AND SPECIAL REFERENCES

VI

# VI. BIBLIOGRAPHY AND SPECIAL REFERENCES

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Contact: Librarian
Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394
(504) 736-2522 or FTS 686-2522

# SECTION VII
# PREPARERS

VII

# VII. PREPARERS

Joseph A. Christopher, Chief, Environmental Assessment Section
Mary R. Bartz, Coastal Unit Chief, Supervisory Environmental Protection Specialist
Dennis L. Chew, Offshore Unit Chief, Supervisory Environmental Protection Specialist, Coordinator

Darice K. Breeding, Environmental Protection Specialist
Patricia R. Bryars, Statistical Assistant
Ann Scarborough Bull, Biologist
Linda Castaño-Velez, Economist
Elmo J. Cooper, Visual Information Specialist
T. Gerald Crawford, Supervisory Petroleum Engineer
Janet K. Diaz, Secretary
Michael E. Dorner, Jr., Regional Editor
Norman L. Froomer, Physical Scientist
Gary D. Goeke, Supervisor, Information Management Team
John R. Greene, Archaeologist
Charles W. Hill, Jr., Natural Resource Specialist
Bonnie Laborde Johnson, Physical Scientist
Alexis Lugo-Fernández, Physical Oceanographer
Anne M. Maranto, Clerk-Typist
Deborah H. Miller, Technical Publications Editor
Gail B. Rainey, Natural Resource Specialist
Villere C. Reggio, Jr., Outdoor Recreation Planner
John L. Rodi, Economist
R. Mark Rouse, Environmental Protection Specialist
Gary J. Rutherford, Geologist
Joseph C. Souhlas, Visual Information Specialist
Wilfred W. Times, Visual Information Specialist
Darcel D.Waguespack, Cartographic Technician

# SECTION VIII
# GLOSSARY

VIII

# VIII. GLOSSARY

**Acute** -- Sudden, short term, severe, critical, crucial, intense, but usually of short duration.

**Aliphatic** -- Of or pertaining to organic compounds characterized by a chain of carbon atoms; subgroups of such compounds are alkanes, alkenes, and alkynes, and their cyclic analogs.

**Analysis area** -- An OCS subplanning area or other OCS area plus the adjacent coastal subarea.

**Anoxia** -- Absence of oxygen.

**Anthropogenic** -- Coming from human sources, relating to the effect of humankind on nature.

**Anticline** -- An upfold or arch of stratified rock in which the beds or layers bend downward in opposite directions from the crest or axis of the fold.

**Aphotic zone** -- Zone where the levels of light entering through the surface are not sufficient for photosynthesis or for animal response.

**API gravity** -- A standard adopted by the American Petroleum Institute for expressing the specific weight of oil, also known as the Baume gravity. The API gravity equals [(141.5/specific gravity at 60°F) - 131.5].

**Areas of high marine productivity** -- Areas such as open bays, estuaries, and sounds that are used by finfish and shellfish as nursery and/or spawning grounds and may contain oyster reefs; nearshore Gulf areas that are important harvest grounds for menhaden and industrial bottomfish and/or finfish and shellfish spawning grounds; and coral areas in the vicinity of the Florida Keys.

**Aromatic** -- Applied to a class of organic compounds containing benzene rings or benzenoid structures.

**Asphaltene** -- Any of the dark, solid constituents of crude oils that are soluble in carbon disulfide but insoluble in paraffin napthas.

**Attainment area** -- An area that is shown by monitored data or that is calculated by air quality modeling no to exceed any primary or 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.

**Base Case** -- An estimate of the resources expected to be leased, developed, and produced, assuming that hydrocarbons exist in the area (i.e., a conditional estimate), and an estimate of the exploration, development, production, and transportation activities appropriate to that level of resources.

**Basin** -- A depression of the earth in which sedimentary materials accumulate or have accumulated, usually characterized by continuous deposition over a long period of time; a broad area of earth beneath which the strata dip, usually from the sides toward the center.

**Biological opinion** -- An appraisal from either FWS or NMFS evaluating the impact of a proposed activity on endangered and threatened species.

**Block** -- A geographical area, as portrayed on an official MMS protraction diagram or leasing map, that contains approximately nine square miles (2,331 ha or 5,760 ac).

**Blowout** -- An uncontrollable flow of fluids from a wellhead or wellbore. Unless otherwise specified, a flow of fluids from a flowline is not considered a blowout as long as the wellhead control valves can be automatically or manually activated. If the wellhead control valves become inoperative, the flow is classified as a blowout.

**Blowout preventer (BOP)** -- A stack or an assembly of heavy-duty valves attached to the top of the casing to control well pressure.

**Bunker fuel** -- Heavy residual fuel oil used in ship boilers and in large heating and generating plants.

**Caprock** -- A disk-like plate over all or part of the top of most salt domes in the Gulf Coast States, composed of anhydrite, gypsum, limestone, and occasionally sulfur. Caprock may also be a comparatively impervious stratum immediately overlying an oil- or gas-bearing rock in an anticline.

**Centistoke** -- A derived unit of viscosity in customary use as a measure of a fluid's resistance to flow or change of form by internal forces of friction.

**Central Planning Area (CPA)** -- The sale area south from territorial sea at approximately 87°45'W. longitude to approximately 29°N. latitude, thence west to approximately 87°55'W. longitude, thence south to approximately 26°N. latitude, thence west to approximately 91°55'W. longitude, except that between approximately 88°23'W. longitude and 91°0'W. longitude the boundary is the U.S.-Mexico provisional maritime boundary; thence north to approximately 27°55'N. latitude, thence generally west to approximately 93°25'W. longitude, thence northwest to the juncture of the territorial sea at approximately 93°50'W. longitude, thence east along the territorial sea to the point of origin.

**Cetacean** -- A marine mammal such as whales, dolphins, porpoises, and related forms.

**Coastal subareas** -- Discrete analysis areas (consisting of several counties/parishes) within the larger offshore coastal areas.

**Coastal waters** -- Inshore waters within the geographical areas defined by each State's Coastal Zone Management Program.

**Coastal wetlands** -- Forested and nonforested habitats, mangroves, and all marsh islands that are exposed to the Gulf of Mexico waters. Acreage and shoreline distances for these categories can be found on Visual No. 14 of Final EIS 94/98/102. Included in forested wetlands are hardwood hammocks, cypress-tupelo gum swamps, and fluvial vegetation/bottomland hardwoods. Nonforested wetlands include fresh, brackish, and salt marshes. These areas directly contribute to the high biological productivity of coastal water by input of detritus and nutrients, by providing nursery and feeding areas for shellfish and finfish, by serving as habitat for many birds and other animals, and by providing waterfowl hunting and fur trapping.

**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 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.

**Coelobite** -- Organisms that live in the cavities of reefs--cryptic organisms. They are normally small and encrusting and include foraminifers.

**Commingling** -- The intentional mixing of petroleum products having similar specifications.

**Completion** -- Conversion of a development well or an exploratory well into a production well of oil and/or gas.

**Condensate** -- Liquid hydrocarbons produced with natural gas; they are separated from the gas by cooling and various other means. Condensate generally has an API gravity of 50°-120° and is water-white, straw, or bluish in color.

**Conditional resources** -- Assessment of oil or gas resources under the assumption that economically recoverable resources exist within the area of interest.

**Continental margin** -- The ocean floor that lies between the shoreline and the abyssal ocean floor. It includes the provinces of the continental shelf, continental slope, and continental rise.

**Continental shelf** -- The continental margin province that lies between the shoreline and the abrupt change in slope called the shelf edge, which generally occurs around a water depth of 200 m. The shelf is characterized by a gentle slope (ca. 0.1°).

**Continental slope** -- The continental margin province that lies between the continental shelf and continental rise, characterized by a steep slope (ca. 3°-6°) and located around depths of 3,000-4,000 m.

**Contingency plan** -- A plan for possible offshore emergencies prepared and submitted by the oil or gas operator as part of the Plan of Development and Production.

**Critical habitat** -- Specific areas essential to the conservation of a protected species and that may require special management considerations or protection.

**Crude oil** -- An oily, flammable bituminous liquid that occurs in many places in the upper strata of the earth, either in seepages or in reservoirs; essentially a complex mixture of hydrocarbons of different types with small amounts of other substances; as distinguished from refined oil manufactured from it.

**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. Deferred areas could receive environmental description in the EIS but are not assessed as alternatives.

**Deletion alternative** -- An option available to the Secretary of the Interior to alter the proposed action in Alternative A by deleting areas/blocks from the sale. This action would normally take place after completed analysis is available in the Final EIS.

**Delineation well** -- A well that is drilled for the purpose of delineating a discovered oil or gas reservoir, thereby enabling the lessee to determine whether to proceed with development and production.

**Designated environmental preservation areas** -- Gulf of Mexico shorefront areas that have been established for the quality and significance of their natural environments. They have been legislatively, administratively, or privately protected from the developmental influences of humans and are managed solely for the preservation, understanding, and appreciation of their natural attributes. Included are National Parks and Preserves, National and State Wilderness Areas, National Marine and Estuarine Sanctuaries, National Landmarks, Wildlife Sanctuaries, Florida Aquatic Preserves, and Environmentally Endangered Lands.

**Detritivores** -- Animals whose diet consists of detritus and the microbial fauna attached to detrital particles.

**Detritus** -- Particulate organic matter originating primarily from the physical breakdown of dead animal and plant tissue (may also include the breakdown of inorganic material).

**Development** -- Activities that take place following discovery of minerals in paying quantities, including geophysical activity, drilling, platform construction, and operation of all onshore support facilities, and that are for the purpose of ultimately producing the minerals discovered.

**Development/Production Plan (DPP)** -- A plan describing the specific work to be performed, including all development and production activities that the lessee(s) propose(s) to undertake during the time period covered by the plan and all actions to be undertaken up to and including the commencement of sustained production. The plan also includes descriptions of facilities and operations to be used, well locations, current geological and geophysical information, environmental safeguards, safety standards and features, time schedules, and other relevant information. Under 30 CFR 250.34-2, all lease operators are required to formulate and obtain approval of such plans by the Director of the Minerals Management Service before development and production activities commence.

**Development/production service base** -- A service base that is used in support of offshore development and production activity.

**Development well** -- A well drilled to a known producing formation in a previously discovered field; distinguished from a wildcat or exploratory well and from an offset well.

**Diapir** -- A piercing fold; an anticlinal fold in which a mobile core, such as salt, has broken through the more brittle overlying rocks.

**Discharge** -- Something that is emitted; flow rate of a fluid at a given instant expressed as volume per unit of time.

**Discovery** -- The initial find of significant quantities of fluid hydrocarbons on a given field on a given lease.

**Dispersion** -- A distribution of finely divided particles in a medium.

**Dome** -- A roughly symmetrical upfold, the beds dipping in all directions, more or less equally, from a point; any structural deformation characterized by local uplift approximately circular in outline, for example, the salt domes of Louisiana and Texas.

**Drilling mud** -- A special mixture of clay, water or refined oil, and chemical additives pumped downhole through the drill pipe and drill bit. The mud cools the rapidly rotating bit, lubricates the drill pipe as it turns in the well bore, 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 control downhole pressures that may be encountered (drilling fluid).

**Drill ship** -- A self-propelled, self-contained vessel equipped with a derrick amidship for drilling wells in deepwater.

**Eastern Planning Area (EPA)** -- The sale are south from territorial sea at approximately 87°45'W. longitude to approximately 29°N. latitude, thence west to approximately 87°55'W. longitude, thence south to approximately 26°N. latitude, thence east to approximately 85°55'W. longitude, thence south to the limit of U.S. jurisdiction, thence southeast to approximately 83°55'W. longitude at 24°N. latitude, thence east to 83°W. longitude, thence north to the limits of the territorial sea, thence east to approximately 82°25'W. longitude, thence north and east along the territorial sea abutting the Florida Keys, thence north and east to approximately 81°55'W. longitude, thence North to the limits of the territorial sea, thence North and West along the territorial sea to the point of origin.

**Economically recoverable resource estimate** -- 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.

**Emission offset** -- Emission reductions obtained from facilities, either onshore or offshore, other than the facility or facilities covered by the proposed Exploration Plan or Development and Production Plan.

**Endangered and threatened species** -- Those species identified in 43 FR 238 (December 11, 1978) and subsequent publications.

**Environmental impact statement (EIS)** -- A statement required by the National Environmental Policy Act of 1969 (NEPA) or similar State law in relation to any major action significantly affecting the environment; an NEPA document.

**Essential habitat** -- Specific areas crucial to the conservation of a species and that may necessitate special considerations.

**Estuary** -- Semienclosed coastal body of water that has a free connection with the open sea and within which seawater is measurably diluted with fresh water.

**Eutrophic(ation)** -- An enrichment of nutrients in the water column by natural or artificial methods with an increase of respiration, which may create an oxygen deficiency.

**Exclusive Economic Zone (EEZ)** -- The maritime region adjacent to the territorial sea, extending 200 nautical miles from the baseline of the territorial sea, in which the United States has exclusive rights and jurisdiction over living and nonliving natural resources.

**Exploration** -- The process of searching for minerals. Exploration activities include: (1) geophysical surveys, where magnetic, gravity, seismic, or other systems are used to detect or infer the presence of such minerals, and (2) any drilling, except development drilling, whether on or off known geological structures. Exploration also includes the drilling of a well in which a discovery of oil or natural gas in paying quantities is made and the drilling, after such a discovery, of any additional well that is needed to delineate a reservoir and to enable the lessee to determine whether to proceed with development and production.

**Exploration Plan (EP)** -- A plan based on available relevant information about a leased area that identified, to the maximum extent possible, the potential hydrocarbon accumulations and the wells that the lessee(s) propose(s) to drill to evaluate the accumulations within the entire area of the lease(s) covered by the plan. Under 30 CFR 250.34-1, lease operators are required to formulate and obtain approval of such plans by the Director of Minerals Management Service before significant exploration activities may commence.

**Exploratory well** -- A well drilled in unproven or semi-proven territory for the purpose of ascertaining the presence underground of a commercial petroleum or natural gas deposit.

**Exposed coastline** -- Shoreline areas that can be directly impacted by activities in OCS waters.

**Fault** -- A fracture in the earth's crust accompanied by a displacement of one side of the fracture with respect to the other.

**Field** -- An area within which hydrocarbons have been concentrated and trapped in economically producible quantities in one or more structural or stratigraphically related reservoirs.

**Florida hammocks** -- Areas of higher elevation than their surroundings and characterized by hardwood and/or palm vegetation.

**Frasch technique** -- Technique used for mining sulphur whereby heated seawater injected into the mineral-bearing formation results in melting of the elemental sulphur. Air pumped to the level of the molten sulphur lifts the sulphur to the surface.

**Fugitive emissions** -- Emission into the atmosphere that could not reasonably pass through a stack, chimney, vent, or other functionally equivalent opening.

**Gathering lines** -- Pipelines and flowlines used to bring oil from production leases by separate lines to a central point in the production complex or to a trunk pipeline.

**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.

**Geologic hazard** -- A naturally occurring or manmade geologic condition or phenomenon that presents a risk or is a potential danger to life and property. Examples include subsidence and marine slides.

**Geomorphology** -- The science of surface landforms and their interpretation on the basis of geology and climate.

**Geophysical** -- Of or relating to the physics of the earth, especially the measurement and interpretation of geophysical properties of the rocks in an area.

**Geophysical survey** -- The exploration of an area during which geophysical properties and relationships unique to the area are measured by one or more geophysical methods.

**Habitat** -- A specific type of place that is occupied by an organism, a population, or a community.

**Herbivores** -- Animals whose diet consists of plant material.

**High Case** -- An estimate of a significantly higher level of resource recovery and attendant exploration and development activity, which could result from leasing more acreage than may occur in the Base Case or which could result from the discoveries of larger oil and gas accumulations than estimated under the Base Case assumptions.

**High density offshore shellfish areas** -- Nearshore areas known to have the highest concentrations of commercially important shrimp, spiny lobster, and stone crab.

**Hydrocarbon** -- 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 dissovled oxygen in waters, usually resulting in decreased metabolism.

**Incidental take** -- Takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant.

**Industry infrastructure** -- The facilities associated with oil and gas development, e.g., refineries, gas processing plants, etc.

**Interaction** -- An event during which a resource comes in contact with and is affected by an impact- producing factor.

**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 at which a marine pipeline comes to shore.

**Landfill** -- Location where disposal of solid waste occurs by burying in layers of earth in low ground.

**Land segment** -- A subarea, usually consisting of one or more counties or parishes, within the coastal subarea.

**Land use** -- The function for which people employ an area of land.

**Lay barge** -- A shallow-draft, barge-like vessel used in the construction and laying of underwater pipelines.

**Lease** -- Any form of 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** -- For oil and gas leases, a period of either 5 years or up to 10 years (when a longer period is necessary to encourage exploration and development in areas because of unusually deep water or other adverse conditions (see primary term)).

**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.

**Major shorefront recreational beaches** -- Those frequently visited sandy areas along the shorefront exposed to the Gulf of Mexico that support a multiplicity of recreational activity, most of which is focused at the land-water interface. Included are National Seashores and other selected areas in the National Parks System, State Park and Recreational Areas, county and local parks, urban beachfronts, and private resort areas.

**Marshes** -- Persistent, emergent nonforested wetlands characterized by vegetation consisting predominantly of cordgrasses, rushes, and cattails.

**Military warning area** -- An established area within which the public is warned that 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.

**Nearshore waters** -- Offshore, open waters that extend from the shoreline out to the limit of the territorial seas (12 nautical miles).

**Nepheloid** -- A layer of water near the bottom that contains significant amounts of suspended sediment causing an increase of turbidity.

**Nonattainment area** -- Any area that is shown by monitored data or that is calculated by air quality modeling to exceed any primary or secondary ambient air quality standards established by the USEPA.

**OCS program activities** -- All oil and gas activities occurring Gulfwide during the life of the proposals as a result of past, proposed, and future sales in the OCS.

**Offloading** -- Another name for unloading; offloading refers more specifically to liquid cargo, crude oil, and refined products.

**Offshore marine recreational fishing** -- Hook-and-line sport fishing for fun, food, and occasional incidental profit, inclusive of spearfishing, from a boat seaward of the beach in the Gulf of Mexico.

**Operational discharge** -- A release of oil that is part of the routine operations of a function.

**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 plant or animal organisms.

**Outer Continental Shelf (OCS)** -- All submerged lands that comprise the continental margin adjacent to the United States and seaward of State offshore lands.

**Penaeids** -- Chiefly warm water and tropical prawns belonging to the family Penaeidae.

**Plankton** -- Passively floating or weakly motile aquatic plants and animals.

**Platform** -- A steel or concrete structure from which offshore development wells are drilled.

**Poisson process** -- A process that occurs as discrete and independent trials with a low probability of success (p) in each trial but with a large number of trials (N) such that the product $Np = a$ has a moderate size. The probability of having successes is given by

$$P(n) = \frac{a^n e^{-a}}{n!}; \quad n = 0, 1, 2, 3, \ldots$$

The area under the curve P(n) is mostly concentrated around the integers near $n = a$. It can also be shown that if in N trials the total observed number of successes is T than $a \sim T/N$.

**Porous** -- Containing void spaces that may be occupied by fluids.

**Potable** -- Suitable for drinking.

**Primary production** -- Organic material produced by photosynthetic or chemosynthetic autotrophs organisms.

**Primary term** -- The initial period of oil and gas leases, normally 5, 8, or 10 years (see lease term).

**Production** -- Activities that take place after the successful completion of any means for the removal of minerals, including such removal, field operations, transfer of minerals to shore, operation monitoring, maintenance, and workover drilling.

**Production curve** -- A curve plotted to show the relation between quantities produced during definite consecutive time intervals.

**Production schedule** -- A percentage distribution intended to show quantities of oil or gas produced over a consecutive time interval.

**Production well** -- A well that is drilled for the purpose of producing oil or gas reserves. It is sometimes termed development well.

**Province** -- An area throughout which geological conditions have been similar or that is characterized by particular structural, petrographic, or physiographic features.

**Recoverable reserves** -- The portion of the identified oil or gas resource that can be economically extracted under current technological constraints.

**Recoverable resource estimate** -- An assessment of oil and gas 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.

**Refining** -- Fractional distillation, usually followed by other processing (for example, cracking).

**Relief** -- The elevations or inequalities of a land surface.

**Reserves** -- Identified oil or gas resources.

**Reservoir** -- An accumulation of hydrocarbons that is separated from any other such accumulation.

**Rig** -- A structure used for drilling an oil or gas well.

**Right-of-way** -- A legal right of passage, an easement; the specific area or route for which permission has been granted to place a pipeline and ancillary facilities and for normal maintenance thereafter.

**Risked, economically recoverable resource estimate** -- An assessment of oil or gas resources that has been modified to take into account: (1) physical and technological constraints on production; (2) the influence of the costs of exploration and development and market price on industry investment in OCS exploration and production; (3) and the uncertainty of the estimate and to account for the possibility that economically recoverable resources may not be found within the area of interest.

**Rookery** -- The nesting or breeding grounds of gregarious (i.e., social) birds or mammals; also a colony of such birds or mammals.

**Royalty** -- A share of the minerals produced from a lease paid in either money or in kind to the Treasury Department by the lessee.

**Saltwater intrusion** -- Phenomenon occurring when a body of saltwater; because of its greater density, invades a body of freshwater, occurs in either surface or groundwater sources.

**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. As such, this habitat type is especially sensitive to oil-spill impacts.

**Sediment** -- Material deposited (as by water, wind, or glacier) or a mass of deposited material.

**Sedimentary rocks** -- Rock formed of mechanical, chemical, or organic sediment.

**Seeps--petroleum** -- Gas or oil that reaches the surface along bedding planes, fractures, unconformities, or fault planes through connected porous rocks.

**Seismic** -- Pertaining to, characteristic of, or produced by earthquakes or earth vibration; having to do with elastic waves in the earth.

**Sensitive coastal habitats** -- Coastal habitats susceptible to damage from oil- and gas-related OCS activities.

**Sensitive offshore area** -- An area containing species, populations, communities, or assemblages of living resources, to which normal oil and gas exploration and development activities may cause irreparable damage, including interference with established ecological relationships.

**Shunting** -- A method used in offshore oil and gas drilling activities where expended drilling cuttings and fluids are discharged near the ocean seafloor.

**Single point mooring (SPM)** -- Offshore anchoring and loading or unloading point connected to shore by an undersea pipeline.

**Sour oil** -- Crude oil containing significant quantities of hydrogen sulfur gas.

**Stratigraphic trap** -- A geologic feature that includes a reservoir, capable of holding oil or gas, that is formed from a change in the character or extent of the reservoir rock. Such a trap is harder to identify because it is not dependent on structural closure and is thus not readily revealed by geological or geophysical surveys.

**Subplanning area** -- A discrete subarea within the larger offshore planning area.

**Subsea completion** -- A self-contained unit to carry men from a tender to the ocean bottom and enable them to install, repair, or adjust wellhead connections in a dry, normal atmosphere.

**Subsea complex** -- A development well in which the assembly of valves, pipes, and fittings used to control the flow of oil or gas is located on or near the ocean floor.

**Subsidence** -- A sinking of a part of the earth's crust.

**Summary report** -- A document prepared by the Department of the Interior pursuant to 30 CFR 252.4 that is intended to inform affected State and local governments as to current OCS reserve estimates, projections of magnitude and timing of development, transportation planning, and general location and nature of nearshore and onshore facilities.

**Supply boat** -- A vessel that ferries food, water, fuel, and drilling supplies and equipment to a rig and returns to land with refuse that cannot be disposed of at sea.

**Sweet crude** -- Crude oil containing very little sulfur or sulfur compounds and having a good odor.

**Sweet gas** -- Natural gas free of significant amounts of hydrogen sulfide ($H_2S$) when produced.

**Taking** -- To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct (including, but not inclusive of actions that induce stress, adversely impact critical habitat, or result in adverse secondary or cumulative impacts).

**Total suspended solids** -- The total content of suspended and dissolved solids in water.

**Trunk line** -- A pipeline for the transportation of oil and or gas from producing areas to refineries or terminals.

**Turbidities** -- High-density currents carrying nearshore deposits consisting of coarse, unsorted clastic deposits alternating with uniform fine-grain deposits out into the ocean.

**Turbidity** -- Reduced water clarity resulting from the presence of suspended matter.

**Undiscovered resources** -- Quantities of oil and gas estimated to exist outside known fields.

**Unit** -- Administrative consolidation of OCS leases held by one or more companies, but explored, developed, and/or produced as one lease by one operator for purposes of conservation, eliminating unnecessary operations and/or maximizing resources recovered.

**Vascular plants** -- Plants containing food- and water-conducting structures; higher plants that reproduce by seeds.

**Volatile organic compound (VOC)** -- Any organic compound that is emitted to the atmosphere as a vapor.

**Water test areas** -- Areas established within the Eastern Gulf where research, development, and the testing of military planes, ships, and weaponry take place.

**Weathering** -- The aging of oil due to its exposure to the atmosphere, causing marked alterations in its physical and chemical makeup.

**Western Planning Area (WPA)** -- The sale area east from the territorial sea along the U.S.-Mexico provisional maritime boundary to approximately 25°45'N. latitude, thence along approximately 26°N. latitude to approximately 91°55'W. longitude, thence north to approximately 27°55'N. latitude, thence generally west to approximately 93°25'W. longitude, thence northwest to the juncture of the territorial sea at approximately 93°50'W. longitude, thence along the territorial sea to the point of origin.

**Wetlands** -- Areas periodically inundated or saturated by surface or groundwater and that support vegetation typically adapted for life in saturated soil conditions.

# SECTION IX
# APPENDICES

IX

# Appendix A

# Blocks Affected by the Topographic Features Stipulations in the Central and Western Gulf of Mexico

**Central Gulf of Mexico**

A total of 167 blocks in the Central Gulf would be affected by the topographic features stipulation, 105 of which are currently leased. The blocks affected, leasing status, and affected bank follow (as of January 31, 1992).

West Cameron, South Addition

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| 569 | 9427 | 29 Fathom |
| 570 | 5188 | 29 Fathom |
| 589 | 5352 | 29 Fathom |
| 590 | 9430 | 29 Fathom |
| 591 | | 29 Fathom |
| 592 | | 29 Fathom |
| 611 | | 29 Fathom |
| 612 | 2557 | 29 Fathom and MacNeil |
| 613 | 3286 | MacNeil |
| 614 | | MacNeil |
| 633 | 2238 | MacNeil |
| 634 | 10603 | Rankin |
| 635 | 12811 | Rankin |
| 636 | | Bright |
| 637 | | Bright |
| 638 | 2026 | Bright |
| 645 | 3973 | Geyer |
| 646 | | Geyer |
| 648 | 4268 | Bright |
| 649 | | Bright |
| 650 | | Bright |
| 651 | | Bright |
| 652 | | Rankin and Bright |
| 653 | 12812 | Rankin |
| 654 | | Rankin |
| 655 | | Rankin and Bright |
| 656 | 11819 | Bright |
| 657 | 11820 | Bright |
| 658 | | Bright |
| 659 | | Bright |
| 660 | 11821 | Bright |
| 661 | | Bright |
| 662 | | Bright and Rankin |
| 663 | 12813 | Rankin |

East Cameron, South Addition

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| 361 | 10639 | McGrail |
| 362 | 11853 | McGrail |

East Cameron, South Addition (continued)

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| 363 | 11854 | McGrail |
| 377 | | McGrail |
| 378 | 12856 | McGrail |
| 379 | 9486 | McGrail |

Vermilion, South Addition

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| 284 | 9508 | Sonnier |
| 285 | | Sonnier |
| 286 | 11883 | Sonnier |
| 297 | 11885 | Sonnier |
| 298 | 11886 | Sonnier |
| 299 | 8674 | Sonnier |
| 300 | 11887 | Sonnier |
| 303 | | Sonnier |
| 304 | 11889 | Sonnier |
| 305 | 11890 | Sonnier |
| 306 | 11891 | Sonnier |
| 317 | 11894 | Sonnier |
| 318 | 4427 | Sonnier |
| 319 | | Sonnier |
| 320 | 2087 | Sonnier |
| 361 | | Bouma |
| 362 | 10687 | Bouma |
| 363 | 9522 | Bouma |
| 369 | 2274 | Bouma |
| 370 | 2275 | Bouma |
| 371 | 9524 | Bouma |
| 372 | | Bouma |
| 382 | | Bouma and Rezak |
| 383 | | Bouma and Rezak |
| 384 | | Bouma |
| 385 | 12880 | Bouma |
| 386 | 2278 | Bouma |
| 387 | | McGrail |
| 388 | | McGrail |
| 389 | | McGrail |
| 390 | | McGrail |
| 391 | 9528 | McGrail and Bouma |
| 392 | | Bouma |
| 393 | 8677 | Bouma and Rezak |
| 394 | 11900 | Bouma and Rezak |
| 395 | 11901 | Rezak |
| 396 | | Rezak |
| 403 | | Rezak |
| 404 | 8678 | Rezak |

Vermilion, South Addition (continued)

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| 405 | | Rezak |
| 406 | | Rezak and Bouma |
| 407 | 11902 | Bouma |
| 408 | 9532 | McGrail |
| 409 | 9533 | McGrail |
| 410 | 11903 | McGrail |
| 411 | 10693 | Sidner and Rezak |
| 412 | 6685 | Sidner and Rezak |

South Marsh Island, South Addition

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| 161 | 4809 | Alderdice |
| 162 | | Alderdice |
| 163 | | Alderdice |
| 169 | 9554 | Alderdice |
| 170 | | Alderdice |
| 171 | 11921 | Alderdice |
| 172 | 11922 | Alderdice |
| 173 | 2887 | Alderdice |
| 176 | 5221 | Alderdice |
| 177 | | Alderdice |
| 178 | 9555 | Alderdice |
| 179 | 9556 | Alderdice |
| 180 | 9557 | Alderdice |
| 185 | 9559 | Alderdice and Parker |
| 186 | 9560 | Alderdice and Parker |
| 187 | | Alderdice and Parker |
| 188 | | Alderdice and Parker |
| 193 | | Parker |
| 194 | 11926 | Parker |
| 195 | 11927 | Parker |
| 196 | 9562 | Parker |
| 197 | 11928 | Parker |
| 200 | | Parker |
| 201 | | Parker |
| 202 | | Parker |
| 203 | | Parker |
| 204 | | Parker |

Eugene Island, South Addition

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| 335 | 12927 | Fishnet |
| 355 | | Fishnet |
| 356 | | Fishnet |

Eugene Island, South Addition (continued)

| Block | OCS-G No. (if leased) | Block |
|---|---|---|
| 381 | 8703 | Jakkula |
| 382 | 9603 | Jakkula |
| 383 | 10756 | Jakkula |
| 390 | 11970 | Jakkula |
| 391 | 11971 | Jakkula |
| 397 | 11973 | Jakkula |

Ship Shoal, South Addition

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| 325 | 10800 | Ewing |
| 326 | 12956 | Ewing |
| 327 | 12005 | Ewing |
| 328 | 12006 | Ewing |
| 329 | 10801 | Ewing |
| 334 | 10804 | Ewing |
| 335 | 12957 | Ewing |
| 336 | | Ewing |
| 337 | 9633 | Ewing |
| 338 | | Ewing |
| 339 | 12007 | Ewing |
| 348 | 10807 | Ewing |
| 349 | 12008 | Ewing |
| 350 | 8716 | Ewing |
| 351 | 12959 | Ewing |
| 352 | 10808 | Ewing |
| 353 | | Ewing |
| 356 | 5206 | Ewing |
| 357 | 12960 | Ewing |
| 358 | 12009 | Ewing |
| 359 | 12010 | Ewing |

South Timbalier, South Addition

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| 314 | | Diaphus |
| 315 | 8728 | Diaphus |
| 316 | 10862 | Diaphus |
| 317 | | Diaphus |

West Delta, South Addition

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| 147 | 10887 | Sackett |

West Delta, South Addition (continued)

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| 148 | 12074 | Sackett |

Green Canyon

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| 4 | 12180 | Jakkula |
| 5 | 12181 | Jakkula |
| 6 | 6987 | Jakkula |
| 7 | 13152 | Jakkula |
| 49 | | Jakkula |
| 50 | 7989 | Jakkula |
| 90 | 11020 | Sweet |

Ewing Bank

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| 903 | 5803 | Ewing |
| 932 | | Jakkula |
| 933 | | Jakkula |
| 944 | 5809 | Ewing |
| 945 | | Ewing |
| 947 | 5803 | Ewing |
| 975 | | Jakkula |
| 976 | | Jakkula |
| 977 | | Jakkula |

Mississippi Canyon

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| 316 | | Sackett |

### Western Gulf of Mexico

A total of 200 blocks in the Western Gulf would be affected by the topographic features stipulation, 113 of which are currently leased. The blocks affected, leasing status, and the affected bank follow (as of January 31, 1992).

North Padre Island, East Addition

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| A-30 | 8965 | Dream |
| A-31 | 8966 | Dream |
| A-40 | 8967 | Dream |
| A-41 | 8968 | Dream |
| A-72 | 11213 | Blackfish Ridge |
| A-83 | 12408 | Mysterious |
| A-84 | 12409 | Mysterious |

Mustang Island

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| A-3 | 11240 | North Hospital |
| A-4 | | North Hospital and Hospital |
| A-9 | | Southern |
| A-16 | 3011 | Southern |

Mustang Island, East Addition

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| A-54 | 10176 | Small and Big Dunn Bars |
| A-61 | 13282 | Baker |
| A-62 | | Baker |
| A-86 | 12427 | Baker and South Baker |
| A-87 | | Baker and South Baker |
| A-95 | | South Baker |
| A-117 | 10184 | Aransas and North Hospital |
| A-118 | 10185 | Aransas |
| A-136 | | Aransas, Hospital, and North Hospital |
| A-137 | | Hospital |

High Island, South Addition

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| A-446 | 2359 | Claypile |
| A-447 | 2360 | Claypile |
| A-448 | 2361 | Claypile |
| A-463 | | Claypile |

High Island, South Addition (continued)

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| A-464 | | Claypile |
| A-465 | 9123 | Claypile |
| A-486 | 6227 | Stetson |
| A-487 | | Stetson |
| A-488 | 13337 | Stetson |
| A-501 | 12580 | Stetson |
| A-502 | | Stetson |
| A-503 | 11387 | Stetson |
| A-512 | 13338 | Stetson |
| A-513 | | Stetson |
| A-514 | | Stetson |
| A-527 | 9129 | Stetson |
| A-528 | | Stetson |
| A-529 | 9130 | Stetson |
| A-534 | | 32 Fathom |
| A-535 | 13340 | 32 Fathom |
| A-573 | 2393 | West Flower Garden |
| A-578 | | Applebaum |
| A-579 | | Applebaum |
| A-580 | | Applebaum |
| A-589 | 12586 | Applebaum |
| A-590 | 10304 | Applebaum |
| A-591 | | Applebaum |
| A-596 | 2722 | West Flower Garden |

High Island, East Addition, South Extension

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| A-311 | | 29 Fathom |
| A-312 | 2409 | 29 Fathom |
| A-327 | 2418 | 29 Fathom |
| A-328 | | 29 Fathom |
| A-329 | 11403 | 29 Fathom |
| A-330 | 2421 | 29 Fathom |
| A-331 | | 29 Fathom |
| A-332 | 2422 | 29 Fathom |
| A-340 | 2426 | Coffee Lump |
| A-346 | | MacNeil |
| A-347 | 9151 | MacNeil |
| A-348 | 9152 | MacNeil |
| A-349 | 2743 | MacNeil |
| A-350 | 2428 | MacNeil |
| A-351 | 2429 | MacNeil and East Flower Garden |
| A-352 | 9153 | East Flower Garden and MacNeil |

High Island, East Addition, South Extension (continued)

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| A-353 | | East Flower Garden |
| A-354 | 9154 | East Flower Garden |
| A-355 | 2745 | East Flower Garden |
| A-358 | | Coffee Lump |
| A-359 | | Coffee Lump |
| A-360 | | Coffee Lump |
| A-361 | 9155 | Coffee Lump and West Flower Garden |
| A-362 | | West Flower Garden |
| A-363 | 9156 | West Flower Garden |
| A-364 | | East and West Flower Garden |
| A-365 | 2750 | East Flower Garden |
| A-366 | | East Flower Garden |
| A-367 | | East Flower Garden |
| A-368 | 2433 | East Flower Garden, Rankin, and MacNeil |
| A-369 | 2751 | MacNeil and Rankin |
| A-370 | 2434 | MacNeil and Rankin |
| A-371 | 9157 | Rankin |
| A-372 | 9158 | Rankin and MacNeil |
| A-373 | 7367 | East Flower Garden, Rankin, and MacNeil |
| A-374 | 11405 | East Flower Garden |
| A-375 | | East Flower Garden |
| A-376 | 2754 | East Flower Garden |
| A-377 | 11406 | East and West Flower Garden |
| A-378 | | West Flower Garden |
| A-379 | | West Flower Garden |
| A-380 | | West Flower Garden |
| A-381 | | West Flower Garden |
| A-382 | 2757 | West Flower Garden |
| A-383 | 11407 | West Flower Garden |
| A-384 | 3316 | West Flower Garden |
| A-385 | 10311 | West Flower Garden |
| A-386 | 9159 | East and West Flower Garden |
| A-387 | | East Flower Garden |
| A-388 | 12592 | East Flower Garden |
| A-389 | 2759 | East Flower Garden |
| A-390 | 9161 | East Flower Garden and Rankin |
| A-391 | 9162 | Rankin |
| A-392 | 12593 | Rankin |
| A-393 | 12594 | Rankin |
| A-394 | | East Flower Garden |
| A-395 | 13346 | East Flower Garden |

High Island, East Addition, South Extension (continued)

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| A-396 | 12595 | East and West Flower Garden |
| A-397 | | West Flower Garden |
| A-398 | | West Flower Garden |
| A-399 | 13347 | West Flower Garden |
| A-400 | | West Flower Garden |
| A-401 | 13348 | West Flower Garden |
| A-402 | | West Flower Garden |
| A-403 | 13349 | East Flower Garden |

East Breaks

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| 121 | | Applebaum |
| 122 | 12596 | Applebaum |
| 123 | | Applebaum |
| 124 | | Applebaum |
| 165 | 6280 | Applebaum |
| 166 | 11413 | Applebaum |
| 167 | 13351 | Applebaum |
| 168 | 12598 | Applebaum |
| 173 | 12600 | West Flower Garden |
| 217 | | West Flower Garden |

Garden Banks

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| 26 | 9197 | McGrail |
| 27 | | McGrail |
| 28 | | McGrail |
| 29 | | McGrail |
| 30 | | Rezak and Sidner |
| 31 | | Rezak and Sidner |
| 33 | | Rezak and Sidner |
| 61 | | Geyer |
| 62 | | Geyer |
| 63 | | Geyer |
| 70 | 9200 | McGrail |
| 71 | 9201 | McGrail |
| 72 | 13363 | McGrail |
| 73 | 13364 | McGrail |
| 74 | | Sidner |
| 75 | | Sidner |
| 76 | | Sidner |
| 77 | | Sidner |
| 81 | | Parker |
| 82 | | Parker |

Garden Banks (continued)

| Block | OCS-G No. (if leased) | Bank |
|---|---|---|
| 83 | 11450 | Parker |
| 84 | 11451 | Parker |
| 85 | 10327 | Parker |
| 95 | | East Flower Garden |
| 96 | | East Flower Garden |
| 97 | 9204 | East Flower Garden and Rankin |
| 98 | 9204 | Rankin |
| 102 | 10328 | Bright |
| 103 | 12630 | Bright |
| 104 | | Geyer |
| 105 | 10329 | Geyer |
| 106 | 10330 | Geyer |
| 107 | | Geyer |
| 108 | | Geyer and Elvers |
| 109 | | Elvers |
| 110 | | Elvers |
| 119 | | Sidner |
| 120 | 12632 | Sidner |
| 121 | 10331 | Sidner |
| 126 | 11453 | Parker |
| 127 | 11454 | Parker |
| 128 | 11455 | Parker |
| 133 | | West Flower Garden |
| 134 | 13366 | West Flower Garden |
| 135 | | West Flower Garden |
| 136 | | West Flower Garden |
| 138 | | East Flower Garden |
| 139 | | East Flower Garden |
| 140 | | East Flower Garden |
| 141 | 9210 | Rankin |
| 142 | 8217 | Rankin |
| 144 | 11456 | Bright |
| 145 | 11457 | Bright |
| 146 | | Bright |
| 148 | | Geyer |
| 149 | | Geyer |
| 150 | | Geyer |
| 151 | 11459 | Geyer |
| 152 | 10333 | Geyer and Elvers |
| 153 | | Elvers |
| 154 | 9212 | Elvers |
| 155 | | Elvers |
| 177 | | West Flower Garden |
| 178 | | West Flower Garden |
| 179 | 11464 | West Flower Garden |
| 180 | | West Flower Garden |
| 192 | 3301 | Geyer |

Garden Banks (continued)

| Block | OCS-G No. (if leased) | Bank |
| --- | --- | --- |
| 193 | 4130 | Geyer |
| 194 | | Geyer |
| 195 | 10336 | Geyer |
| 196 | 11468 | Geyer and Elvers |
| 197 | | Elvers |
| 198 | 10338 | Elvers |
| 237 | 2812 | Geyer |
| 238 | | Geyer |
| 239 | 11475 | Geyer |

# Appendix B

# Biological Opinions

## APPENDIX B

## BIOLOGICAL OPINIONS

In compliance with Section 7(a)(2) of the Endangered Species Act of 1973 (16 U.S.C. 1531-1543), as amended, MMS initiated endangered species consultation with the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) for proposed Gulf of Mexico Oil and Gas Lease Sales 142 and 143. A copy of this Draft EIS has been officially transmitted to the appropriate FWS and NMFS offices as an attachment to the letters requesting initiation of consultation. This Draft EIS will be used as the primary information base for the consultations. The MMS, Gulf of Mexico Regional Office continually consults and coordinates with the appropriate FWS and NMFS field offices regarding endangered species that may be affected by oil and gas operations. There have been no known significant changes to the endangered species situation in the Gulf; thus, the Biological Opinions resulting from this consultation are not expected to change significantly from the most recent Opinions for Sales 139 and 141, which were published in the Final EIS for those sales (USDOI, MMS, 1991a). These Opinions are republished here for information purposes. The Biological Opinions for proposed Sales 142 and 143 will be published in the Final EIS for these sales, along with any changes to the EIS that may result from the consultations.

For more information, see Section I.B.4.c. and the appropriate parts of Sections III.B. and IV.D.

# National Marine Fisheries Service

# Biological Opinion

# Gulf of Mexico

# Sales 139 and 141

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
1335 East-West Highway
Silver Spring, MD 20910
THE DIRECTOR

FEB 08 1991

Mr. James W. Workman
Deputy Associate Director
for Offshore Leasing
U.S. Department of Interior
Minerals Management Service
Washington, D.C. 20240

Dear Mr. Workman:

This is in response to Minerals Management Service's (MMS) request for an Endangered Species Act (ESA) Section 7 Consultation on proposed Gulf of Mexico (GOM) oil and gas lease sale 139 in the central GOM, and an unnumbered western GOM offering. Lease sale 139 is comprised of blocks in the central GOM planning area, and the unnumbered offering encompasses blocks in the western GOM planning area. These areas constitute approximately 84 million acres offshore Texas, Louisiana, Mississippi, and Alabama. Documents provided with your letter indicate that the proposed action may adversely affect sea turtles.

The proposed lease sales are a reoffering of unleased blocks in the central and western GOM. The National Marine Fisheries Service (NMFS) consulted with MMS on oil and gas lease sales 113/115/116, and issued a Biological Opinion on November 2, 1987 (enclosed). This opinion considered all phases of exploration, development, and production activities that have occurred or are proposed in the GOM. In the November 2, 1987, opinion, NMFS concluded that these activities were not likely to jeopardize the continued existence of any endangered and threatened species under our jurisdiction. Opinions issued for lease sales 123 and 125 on May 22, 1989, and lease sales 131/135/137 on April 9, 1990, (enclosed) were also for reofferings of lease sales 113/115/116.

Since issuance of our November 2, 1987, opinion, MMS and NMFS have conducted cooperative research activities to better assess potential interactions between sea turtles and listed cetaceans and oil and gas activities. Data collected thus far have provided important information regarding the frequency and location of sea turtle and marine mammal/platform associations. MMS recently funded additional cooperative research to conduct radio, sonic and satellite turtle tracking experiments in the vicinity of the Chandeleur Islands, Louisiana, where turtle occurrence was found to be correlated with presence of structures. This study should provide important information on turtle habitat utilization and movements within an area of high platform concentrations.

THE ASSISTANT ADMINISTRATOR
FOR FISHERIES

MMS has also cooperated with NMFS in conducting exploratory aerial surveys of deep water areas in the north-central GOM. Areas studied included underwater canyons, a cliff and a seamount with depths ranging from 200-1800m. Over 2900 dolphins and whales were counted in 113 sightings. The endangered sperm whale was the most commonly sighted species. NMFS conducted a pilot vessel survey in 1990 to evaluate the feasibility of using vessel surveys to determine marine mammal abundance and trends in the deeper waters of the GOM. Sighting rates from the research vessel were comparable to those observed in research cruises in Pacific waters, indicating that vessel surveys are a viable means of assessing cetacean populations in deep waters of the GOM. NMFS intends to continue vessel surveys on a regular basis to further assess deepwater cetacean and turtle populations.

Both of these efforts suggest that cetaceans may be relatively abundant in deeper offshore waters of the GOM. If these preliminary findings prove correct, the potential impacts of oil and gas activities to cetaceans will be of increasing concern as the industry expands further offshore. Additional information on these populations will be needed, at some point, to satisfy Section 7 information requirements.

Because no "new" information that might alter our previous opinion has become available, and because the areas and species impacted by the proposed activity remain unchanged, the conclusions of our November 2, 1987, opinion are valid and are applicable to proposed lease sale 139 and the unnumbered lease sale in the western GOM.

This concludes consultation responsibilities under Section 7 of the ESA. However, consultation should be reinitiated if new information reveals impacts of the identified activity that may affect listed species or their critical habitat, a new species is listed, the identified activity is subsequently modified or critical habitat determined that may be affected by the proposed activity.

I look forward to your continued cooperation in future consultations, and in developing the needed information.

Sincerely,

Michael F. Tillman
(for) William W. Fox, Jr.

Enclosures

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, Maryland 20910

Mr. Barry Williamson
Director
Minerals Management Service
U.S. Department of Interior
Washington, D.C. 20240

Dear Mr. Williamson:

This responds to Minerals Management Service's (MMS) request for an Endangered Species Act Section 7 Consultation on proposed Gulf of Mexico (GMX) oil and gas Lease Sales 123 and 125, scheduled for March 1990 and August 1990, respectively. Lease Sale 123 is comprised of blocks in the central GMX planning area, and Sale 125 encompasses blocks in the western GMX planning area. Excerpts from the Draft Environmental Impact Statement provided with your letter indicate that the proposed action may adversely affect sea turtles.

The National Marine Fisheries Service (NOAA Fisheries) has reviewed the information provided with your letter and concludes that the proposed lease sales are a reoffering of unleased blocks addressed in our November 2, 1987, Biological Opinion on oil and gas Lease Sales 113/115/116. The 1987 opinion considered all phases of exploration, development, and production activities that have occurred or are proposed in the GMX. In the November 2 opinion, NOAA Fisheries concluded that these activities were not likely to jeopardize the continued existence of any endangered or threatened species under our jurisdiction.

Since there is no new information that might alter our previous opinion, and because the areas and species impacted by the proposed activity remain unchanged, the conclusions of the November 2, 1987, opinion are valid and are applicable to proposed Lease Sales 123 and 125.

No records of sea turtle take in the course of oil and gas exploration activities have been reported. However, there is a growing body of evidence that oil and gas related activities (i.e. exposure to oil spills, vessel collisions, disorientation by vessel/platform lights, etc.) may adversely affect sea turtles. These potential impacts were discussed in the November 2, 1987, opinion. NOAA Fisheries does not anticipate any sea turtle take as a result of leasing and exploration activities associated with Lease Sales 123 and 125. However, as a condition of this statement, if a sea turtle is

cc: F/CU(2), F/PR2(2), GCF

F/PR2:RZiobro:427-2322:5/11/89:dat (f) (123-125Z.MMS)

injured or killed during any phase of the proposed activity, the incident must be reported to NOAA Fisheries Southeast Regional Director as soon as possible. NOAA Fisheries will cooperate with MMS in a review of the incident to determine the need for developing appropriate mitigation measures.

This concludes consultation responsibilities under Section 7 of the ESA. However, consultation should be reinitiated if new information reveals impacts of the identified activity that may affect listed species or their critical habitat, a new species is listed, the identified activity is subsequently modified or critical habitat determined that may be affected by the proposed activity.

NOAA Fisheries is looking forward to participating in MMS' Protected Species Workshop scheduled for August 1-3, 1989, in New Orleans, Louisiana, which should prove useful in identifying and prioritizing research projects that have direct application to our Section 7 information needs.

I look forward to your continued cooperation in future consultations, and in developing needed information.

Sincerely,

James W. Brennan
Assistant Administrator
for Fisheries

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, Maryland 20910

APR ? 1990

Mr. Barry Williamson
Director
U.S. Department of Interior
Minerals Management Service
Washington, D.C. 20235

Dear Mr. Williamson:

This responds to Minerals Management Service's (MMS) request for an Endangered Species Act Section 7 Consultation on proposed Gulf of Mexico (GOM) oil and gas Lease Sales 131, 135, and 137. Lease Sale 131 is comprised of blocks in the central GOM planning area, Lease Sale 135 encompasses blocks in the western GOM planning area, and Lease Sale 137 includes blocks in the eastern GOM planning area. Documents provided with your letter indicate that the proposed action may adversely affect sea turtles.

The National Marine Fisheries Service (NMFS) has reviewed the information provided and concludes that the proposed lease sales are a reoffering of unleased blocks addressed in our November 2, 1987, Biological Opinion on oil and gas Lease Sales 113/115/116 (enclosed). The 1987 opinion considered all phases of exploration, development, and production activities that have occurred or are proposed in the GOM. In the November 2 opinion, NMFS concluded that these activities were not likely to jeopardize the continued existence of any endangered and threatened species under our jurisdiction.

Since issuance of our November 2, 1987, opinion, MMS and NMFS have conducted cooperative research activities to better assess potential interactions between sea turtles and listed cetaceans and oil and gas activities. Data collected thus far have provided important information regarding the frequency and location of turtle and marine mammal/platform associations. While the data remain inconclusive, turtle occurrence was found to be correlated with presence of structures in one of five areas studied, while correlations were not observed in the remaining four study areas. These preliminary data suggest that it may be possible to identify areas and times of potential "high risk" to listed species, while potential risks to endangered and threatened species may be minimal in other areas and times.

In addition to the cooperative research efforts described above, MMS recently sponsored a workshop on sea turtles and marine mammals. The purpose of the workshop was to identify information gaps in our knowledge of listed species in the Gulf of Mexico, and to develop a prioritized list of research objectives. NMFS believes that the workshop results adequately reflect information needs for future Section 7 Lease Sale Consultations in the Gulf of Mexico, and we hope that MMS will continue to support studies directed toward providing this information.

Because no "new" information that might alter our previous opinion has become available, and because the areas and species impacted by the proposed activity remain unchanged, the conclusions of our November 2, 1987, opinion are valid and are applicable to proposed Lease Sales 131, 135, and 137.

This concludes consultation responsibilities under Section 7 of the Endangered Species Act. However, consultation should be reinitiated if new information reveals impacts of the identified activity that may affect listed species or their critical habitat, a new species is listed, the identified activity is subsequently modified or critical habitat determined that may be affected by the proposed activity.

I look forward to your continued cooperation in future consultations and in developing the needed information.

Sincerely,

William W. Fox, Jr.
Assistant Administrator
for Fisheries

Enclosure

cc: F/CU(2), GCF - Gleaves, F/SER23 - T. Henwood,
F/PR2 - Ziobro, F/PR2 - Holman

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Washington, D.C. 20235

NOV 2 1987

Mr. William D. Bettenberg
Director
Minerals Management Service
U.S. Department of the Interior
Washington, D.C. 20240

Dear Mr. Bettenberg:

This responds to your January 12, 1987, request for an Endangered Species Act Section 7 Consultation on proposed oil and gas lease sales 113/115/116 in the Gulf of Mexico Outer Continental Shelf (OCS) Oil and Gas leasing planning area. These sales are tentatively scheduled for March, August and November, 1988. The Draft Environmental Impact Statement received in May 1987 indicates that the proposed action may adversely affect sea turtles.

Enclosed is the Biological Opinion prepared by the National Marine Fisheries Service (NMFS) concerning the proposed activities. At the request of MMS, this opinion addresses all phases of OCS exploration, development, and production activities that have occurred or are proposed in the GOM. NMFS concludes that these actions are not likely to jeopardize the continued existence of any endangered or threatened species under our jurisdiction. In formulating this opinion NMFS used the best available information, including scientific and commercial data and past records of oil and gas lease sales.

While NMFS has concluded that the proposed activities are not likely to jeopardize endangered and threatened species, we believe that at some point the additive effects of oil and gas activities and all other activities in the GOM may constitute a jeopardy situation. To determine when this point may be reached, additional research is needed to quantify all sources of mortality and to determine existing population levels.

With regard to the issue of rig removals using explosives, NMFS had hoped that sufficient data would be available to enable us to render an opinion on the effects of Gulfwide abandonment activities on endangered and threatened marine species. However, few removals have occurred and we still have little data from which to draw conclusions about the potential impacts associated with various types of explosives or removal techniques. Therefore, we believe that consultations on all platform removals using explosive means should be continued on a case-by-case basis until additional data are available to allow a more complete assessment of the effects of such actions on listed species.

I look forward to your continued cooperation in future consultations.

Sincerely,

William E. Evans
Assistant Administrator
for Fisheries

Enclosure

Endangered Species Act - Section 7 Consultation

BIOLOGICAL OPINION

Agency: Minerals Management Service (MMS), U.S. Department of Interior (DOI).

Activity: Outer Continental Shelf (OCS) Oil and Gas Lease Sales in the Eastern, Central and Western Gulf of Mexico (GOM).

Consultation Conducted By: National Marine Fisheries Service, Southeast Regional Office

Date Issued: NOV - 2 1987

Background:

In accordance with Section 7(a) of the Endangered Species Act, MMS in a letter dated January 12, 1987, requested formal consultation on proposed Oil and Gas Lease Sales 113/115/116 in Federal waters of the Eastern, Central and Western Gulf of Mexico (GOM) OCS Oil and Gas Leasing Planning Areas. This consultation was to consider the effects of leasing and exploration associated with these sales as well as all OCS oil and gas development, production and abandonment activities that have occurred and are proposed in the GOM through the year 2023.

On March 29, 1979, the National Marine Fisheries Service (NMFS) issued a biological opinion for a regionwide consultation on the OCS oil and gas leasing program in the Gulf of Mexico. This opinion addressed, in general terms, the effects of the MMS GOM leasing programs on endangered and threatened species under the jurisdiction of the NMFS. Several consultations on specific OCS lease sales in the GOM have been conducted since the March 1979 opinion. These consultations resulted in the determination that the lease sales did not substantively modify the earlier lease sale proposals covered by the NMFS regionwide biological opinion. At the time of these previous consultations, no significant new information was available to alter the conclusions reached in the NMFS 1979 opinion, nor had additional species been listed as endangered or threatened, or critical habitat designated, that would be affected by the proposed actions.

On December 30, 1985, MMS sought from NMFS concurrence on its determination that reinitiation of formal Section 7 consultation was not needed for OCS Lease Sale 110 and 112 in the GOM. The NMFS responded in a March 10, 1986, letter that new information relative to the potential impacts of oil on sea turtles may be available. In a July 24, 1986, letter the MMS reinitiated formal consultation for OCS Lease Sales 110 and 112 on the basis of the availability of new information and the need to update and revise the earlier 1979 biological opinion.

In the biological opinion on proposed OCS Lease Sales 110 and 112, NMFS only addressed the leasing and exploration phases. The development, production, and abandonment phases were not considered. In a letter of September 9, 1986, MMS stated their intent to request formal consultation on the effects of all OCS development, production, and abandonment activities that have occurred and are proposed in the GOM. MMS initiated formal consultation for these components of OCS-related activities on January 12, 1987 in conjunction with upcoming Lease Sales 113/115/116. However, in view of the scant information available on which to base an assessment of impacts of all abandonment activities on endangered and threatened species in the GOM, NMFS determined that consultations for future abandonment activities should continue to be conducted on a case-by-case basis until sufficient data are available to allow a more complete assessment of impacts associated with platform removal using explosives.

This biological opinion responds to the MMS January 12, 1987, letter. It is based on the best scientific and commercial data available and incorporates information from: (1) the 1979 NMFS biological opinion; (2) the DEIS prepared by MMS for the proposed oil and gas Lease Sales; (3) the scientific literature; and (4) other pertinent and available information. The conclusions offered in this opinion are based on current information on the distributions and abundance of threatened and endangered species, probable effects of all OCS oil and gas development, production and abandonment scenarios, and potential effect to listed species.

Proposed Activity

This consultation addresses the potential effects of OCS oil and gas exploration, production and development activities associated with past, present and proposed future lease offerings through 2023 in the Eastern, Central and Western Gulf of Mexico with the exception of administratively deferred areas as identified in the DEIS (MMS 1987).

Central Gulf of Mexico Lease Sale 113

The proposed action will offer for lease all unleased acreage in the Central Planning Area (CPA) which amounts to approximately 34.5 million acres or 6,341 blocks. This area is located from 3 to 220 miles offshore in water depths ranging from 4 m to 3,200 m. MMS has provided a mean-case scenario resource estimate of 0.220 billion barrels of oil and 1.840 tcf of gas during the period of 1990-2011. MMS estimates that the sale will result in the drilling of 281 exploration and delineation wells, installation of 30 production platforms, drilling of 345 development wells and the emplacement of 150 miles of pipeline. Based on this development scenario, MMS estimates the probability of one or more large oil spills (more than 1,000 bbls) to be 41%, medium spills (50-999 bbls) to be 95%, and small spills (1-49 bbls) to be 99+%.

MMS also provided a cumulative mean-case scenario resource estimate for the Central GOM of 3.02 billion bbls of oil and 24.16 tcf of gas to be developed during the period of 1988-2023. MMS estimates that subsequent to the proposed sale, 2,560 exploration and delineation wells will be drilled, 330 production platforms constructed, 4,430 development wells will be drilled and 2,400 miles of pipelines emplaced. These will be in addition to the existing offshore infrastructure of 3,655 platforms and 15,000 miles of pipelines. Estimates of the probability of large, medium and small oil spills all exceed 99+%.

Western Gulf of Mexico Lease Sale 115

The proposed action for Sale 115 will offer for lease all unleased acreage in the Western Planning Area with the exception of administratively deferred areas. Areas available for leasing are approximately 29.0 million acres or 5,244 blocks located from 9-222 miles offshore in water depths ranging from 8m to over 3,000m. Excluded from the offering are Blocks A-375 (East Flower Garden Bank) and A-398 (West Flower Garden Bank) in the High Island area.

MMS has provided a mean-case scenario resource estimate of 0.110 billion barrels of oil and 1.610 tcf of gas during the period of 1990-2011. MMS estimates that the sale will result in the drilling of 187 exploration and delineation wells, installation of 20 production platforms, drilling of 230 development wells and the emplacement of 120 miles of pipeline. Based on this development scenario, MMS estimates the probability of one or more large oil spills (more than 1,000 bbls) to be 22%, medium spills (50-999 bbls) to be 79%, and small spills (1-49 bbls) to be 99+%.

The cumulative mean-case scenario resource estimate for the Western GOM is 1.75 billion bbls of oil and 24.33 tcf of gas to be developed during the period of 1988-2023. MMS estimates that subsequent to the proposed sale, 1,780 exploration and delineation wells will be drilled, 220 production platforms constructed, 3,400 development wells will be drilled and 1,780 miles of pipelines emplaced. These will be in addition to the existing offshore infrastructure of 365 platforms and 2,000 miles of pipelines. Estimates of the probability of large, medium or small oil spills all exceed 99+%.

Eastern Gulf of Mexico Lease Sale 116

The proposed action for Sale 116 will offer for lease all unleased acreage in the Eastern Planning Area with the exception of administratively deferred areas. Areas available for leasing are approximately 71.8 million acres or 12,744 Blocks located from 10-300 miles offshore in water depths ranging from 10 m to over 3,400m. Excluded from the offering are 23 blocks in the Florida Middle Ground area, 186 blocks containing seagrass beds, and 251 blocks in the Destin Dome Official Protraction Diagram area.



MMS has provided a mean-case scenario resource estimate of 0.030 billion barrels of oil and 0.180 tcf of gas during the period of 1990-2011. MMS estimates that the sale will result in the drilling of 10 exploration and delineation wells, installation of 2 production platforms, drilling of 19 development wells and the emplacement of 35 miles of pipeline. Based on this development scenario, MMS estimates the probability of one or more large oil spill (more than 1,000 bbls) to be 6%, medium spills (50-999 bbls) to be 34%, and small spills (1-49 bbls) to be 99+%.

MMS also provided a cumulative mean-case scenario resource estimate for the Eastern GOM of 0.42 billion bbls of oil and 2.06 tcf of gas to be developed during the period of 1988-2023. MMS estimates that subsequent to the proposed sale, 300 exploration and delineation wells will be drilled, 24 production platforms constructed, 340 development wells will be drilled and 540 miles of pipelines emplaced. No offshore infrastructure presently exists. Estimates of the probability of large, medium and small oil spills all exceed 99+%.

Listed Species and Critical Habitat

Listed species under the jurisdiction of the NMFS that may occur in the project area include:

| Listed Species | Scientific Name | Status | Date Listed |
|---|---|---|---|
| Sperm whale | Physeter catodon | E | 12/2/70 |
| Fin whale | Balaenoptera physalus | E | 12/2/70 |
| Humpback whale | Megaptera novaeangliae | E | 12/2/70 |
| Sei whale | Balaenoptera borealis | E | 12/2/70 |
| Right whale | Eubaleana glacialis | E | 12/2/70 |
| Blue whale | Balaenoptera musculus | E | 12/2/70 |
| Kemp's ridley | Lepidochelys kempi | E | 12/2/70 |
| Green | Chelonia mydas | T E* | 7/28/78 |
| Hawksbill | Eretmochelys imbricata | E | 6/2/70 |
| Leatherback | Dermochelys coriacea | E | 6/2/70 |
| Loggerhead | Caretta caretta | T | 7/28/78 |

*All of the U.S. green turtle populations are listed as threatened, except for the Florida breeding population which is listed as endangered.

No critical habitat has been identified by NMFS for the above species within the project area.

Marine Mammals

Sperm Whale

Little information on the distribution and abundance of endangered whales in the Gulf of Mexico is available, but it is believed that the sperm whale is the most numerous of the listed whales. Berzin (1971) reports sperm whales are restricted to waters deeper than 300m, while Watkins (1977) states that their primary distribution is in waters deeper than 1,000 m. Of 61 sperm whales sighted in the GOM/South Atlantic regions during aerial surveys conducted in 1980 and 1981 (Fritts et al. 1983), water depths ranged from 104 to 2,742m. This species is often found near the continental shelf break or in association with areas of upwelling (Gosho et al. 1984). Sperm whales feed primarily on deep water cephalopods (squid) which aggregate in large numbers near areas of cold and warm water convergence such as bottom drop-off areas (Marcuzzi and Pilleri 1971). The current estimated population of sperm whales in the North Atlantic is 99,500 (Braham 1984); no estimates of the sperm whale population size in the GOM are available.

The best available information on sperm whales in the Gulf of Mexico is provided by Fritz et al. (1983). The major findings of their survey included: (1) more sperm whale sightings occurred beyond the continental shelf off the Texas coast than in the other survey areas (LA, West FL and East FL), (2) the average depth of sightings in the GOM was 1,167m (N=19), (3) sperm whales were associated with oceanographic features such as the Loop Current, Gulf Stream and other currents, and (4) calves made up 20% of all whales observed. Mixed group sizes ranged from 2 to 14 individuals.

Other Listed Marine Mammals

Data on the other listed whales which potentially occur in the GOM is limited. Fritz et al. (1983) did not sight fin, sei, humpback, right or blue whales in their Gulf of Mexico surveys. Right whales (Eubaleana glacialis) are not common in the GOM, but Schmidly (1981) reports the sighting of two right whales near Sarasota, Florida in 1963 and one stranding near Freeport, Texas in 1972. In the western North Atlantic, right whales primarily range in the waters off east Florida to Iceland. Most recent population estimates for right whales in the western North Atlantic are between 200 and 400 individuals (Kraus et al. 1986).

Blue whales (Balaenoptera musculus) are primarily cold water inhabitants and are thought to avoid warmer waters (Mizroch et al. 1984). There are two questionable records of the occurrence of this species in the GOM (Schmidly 1981). One stranding was reported in 1940 in Brazoria County, Texas and the other near the mouth of Sabine Pass, Louisiana in 1924. Records of sei whale (Balaenoptera borealis) occurrence in the GOM are limited to two strandings from the coasts of Mississippi and Louisiana and one from Campeche, Mexico (Schmidly 1981). Fin whales (Balaenoptera physalus) are thought to be more abundant in the GOM where strandings have been documented in Louisiana, Texas and Florida. Based on the apparent presence of fin whales in the northern GOM throughout the year, Schmidly (1981) speculates that there may be an isolated stock. Humpback whales (Megaptera novaeangliae) are



not known to frequent the GOM, although there are have been occasional sightings off south Florida (Schmidly 1981).

Sea Turtles

Loggerhead turtle (Caretta caretta)

The threatened loggerhead turtle is the most abundant species occurring in GOM waters. Loggerheads inhabit coastal areas of the continental shelf where they forage around rocky places, coral reefs, shellfish beds and old boat wrecks; they commonly enter bays, lagoons and estuaries (Ernst and Barbour 1972). Aerial surveys of loggerhead turtles at sea indicate that they are most common in waters less than 50 m in depth (Shoop et al. 1981; Fritts et al. 1983), but they occur pelagically as well. The primary food sources of the loggerhead turtle are benthic invertebrates including molluscs, crustaceans and sponges (Mortimer 1982). Crabs and conchs were identified (Carr 1952) as the most frequently found items in stomachs, although loggerheads often eat fish, clams, oysters, sponges and jellyfish. Ernst and Barbour (1972) included marine grasses and seaweeds, mussels, borers, squid, shrimp, amphipods, crabs, barnacles and sea urchins among the foods of loggerhead turtles.

In the GOM, loggerhead turtles commonly occur throughout the inner continental shelf. Populations of loggerheads have been under stress for a number of years due, among other things, to mortalities caused by the incidental drowning in shrimp trawls. An estimated 3,129 individuals are killed annually by shrimp trawlers in the GOM (Henwood and Stuntz 1986).

The green turtle (Chelonia mydas)

Green turtles are circumglobally distributed mainly in waters between the northern and southern 20° C isotherms (Hirth 1971). In the western Atlantic, several major nesting assemblages have been identified and studied (Peters 1954; Carr and Ogren 1960; Duellman 1961; Parsons 1962; Pritchard 1969a; Schulz 1975; Carr and Carr 1978). However, in the continental U.S., the only known green turtle nesting occurs on the Atlantic coast of Florida (Ehrhart 1979). The major portion of the green turtle's life is spent on the foraging grounds. Some of the principal feeding pastures in the western Atlantic Ocean include: upper west coast of Florida, northwestern coast of Yucatan peninsula, south coast of Cuba, Mosquito Coast of Nicaragua, Caribbean coast of Panama, scattered areas along Colombia, and scattered areas off the Brazilian coast (Hirth 1971). The preferred food sources in these areas are: Cymodocea, Thalassia, Zostera, in Sagittaria and Vallisneria (Babcock 1937; Underwood 1951; Carr 1954; Carr 1952; Neill 1958; Mexico 1966).

In the GOM, the only major feeding pasture where juvenile and subadult green turtles (carapace length less than 81 cm) are known to occur is the upper west coast of Florida. Green turtles historically flourished in the inshore bays of Texas, but these populations were exploited by a fishery in the late 1800's (Hildebrand 1980; 1982; Doughty 1984). Green turtles occurring in other areas of the GOM may be in the omnivorous stage of their life cycles prior to the age of recruitment to feeding pastures. Older green turtles are unlikely to permanently reside in most areas of the GOM because of the scarcity of suitable sea grass pastures.

The Kemp's ridley turtle (Lepidochelys kempi)

Of the seven extant species of sea turtles of the world, the Kemp's ridley is probably in the greatest danger of extinction. The only major nesting area for this species is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963; Hildebrand 1963). Virtually the entire world population of adult females nest annually in this single locality (Pritcharo 1969b).

When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand 1963). By the early 1970's, the world population estimate of mature female Kemp's ridleys had been reduced to 2500-5000 individuals. Most recent estimates of the total population of sexually mature female Kemp's ridleys are less than 260 turtles (Byles pers comm 1987).

The foraging range of mature Kemp's ridley turtles is restricted to the Gulf of Mexico. Evidence provided by tagging programs (Chavez 1968), suggests that post-nesting females move in comparable numbers to the north (mostly to Louisiana) and to the south (mostly to Campeche) (Pritchard and Marquez 1973). Movements of hatchling Kemp's ridleys may be controlled by current patterns: either the Loop Current for northward transport or an eddy for southward transport with occasional transportation through the Florida Straits via the Gulf Stream (Hildebrand 1982). If distribution is controlled by currents, approximately half of the annual hatchling production from Rancho Nuevo will recruit to the nearshore waters of the central GOM.

Kemp's ridley turtles feed primarily in shallow coastal waters on bottom-living crustaceans (Hildebrand 1982). Organisms identified from stomachs include crabs (Palyonchus, Hepatus, Callinectes, Panopeus, Menippe, Ovalipes, Calappa, Portunus, Arenaeus), fish (Lutjanus, Leiostomus) and molluscs (Noculana, Corbula, Mulinia, Nassarius) (Doble et al. 1961; Pritchard and Marquez 1973). All of these genera are forms common in the Gulf of Mexico and the eastern coast of the United States.

In the Gulf of Mexico, the number of stranded Kemp's ridleys has increased in the last 5 years. This is possibly due to a variety of factors which include better identification of the species, a more efficient stranding network and an increase in mortality caused by shrimp trawlers, boat collisions, entanglement,



pollution, etc. An estimated 501 individuals are killed annually by shrimp trawlers in the GOM (Henwood and Stuntz 1987).

Hawksbill turtle (Eretmochelys imbricata)

The hawksbill turtle is relatively uncommon in the waters of the continental U.S. The preferred habitat of this species is coral reef, such as is found in the Caribbean and Central America. However, there are accounts of hawksbills in south Florida and a surprising number are encountered in Texas. Most of the Texas records are small turtles, probably in the 1-2 year class range. Many of these captures or strandings are of individuals in an unhealthy or injured condition (Hildebrand 1980; 1982). The lack of sponge-covered reefs and the cold winters in the northern GOM, probably prevent hawksbills from establishing a viable population size in this area.

Leatherback turtle (Dermochelys coriacea)

The leatherback turtle is found throughout the waters of the Atlantic, Pacific, Caribbean and the Gulf of Mexico (Ernst and Barbour 1972). It is the most pelagically distributed of the sea turtles feeding primarily off jellyfish (Rebel 1974). Leatherbacks are occasionally taken by shrimp trawlers and longline vessels in GOM offshore waters, but these records are scarce and Hildebrand (1982) speculates that the resultant mortality is small.

Assessment of Impacts:

Cetaceans

The effects of oil and gas activities on whales in the Gulf of Mexico have never been studied, but the DEIS (MMS 1987) concludes that the proposed activity will have a very low level of impact to whales. This determination appears justified considering the scarcity of whales in the GOM and their preference for deeper waters. The following are some concerns regarding the potential impacts of GOM oil and gas activities to whale populations:

(1) Increased ship traffic associated with OCS-related activities increases the potential for collisions with whales. Fritz et al. (1983) noted that this source of injury/mortality could increase the danger to sperm whale populations in the GOM. Numerous accounts of accidental collisions between sperm whales and a variety of boat/vessel classes have been documented (Berzin 1971; Gaskin 1964; Slijper 1979; Caldwell et al. 1966), but the potential impact of OCS-related vessel collisions to sperm whales and other marine mammals in the GOM is unknown. Because of the deep water habitat preference of sperm whales, NMFS anticipates that OCS vessel traffic will have minimal effects.

(2) Noise disturbances from OCS oil and gas exploration and development have been identified as potential sources of impact to whales. Considerable research emphasizing bowhead, gray and humpback whale behavioral responses to vessel and aircraft noises, drilling activities and seismic surveys has been conducted in the North Pacific. In general, these studies have demonstrated that whale avoidance reactions are limited to relatively close disturbance ranges (Malme et al. 1984), with more pronounced behavioral reactions observed on the breeding/calving grounds (Dahlheim 1983). In the central GOM, no areas of whale concentrations (feeding, breeding or calving grounds) have been identified. However, it should be noted that little cetacean research has been conducted in the Gulf of Mexico, and our knowledge of whales in this geographic area is extremely limited.

(3) Another potential impact to whales from the proposed activities is the chance of encountering oil spills which could occur during exploration, development and production phases of oil and gas operations. Whales may be affected by spilled oil in a number of ways. Metabolic and physiologic properties of the whale's skin may be impaired by toxic fractions in crude oil. Ingestion of oil would not likely occur in sufficient quantity to kill the animals, but petroleum fractions are subject to bioaccumulation which potentially may impact long-term survival. Fouling of baleen plates may occur, although Geraci and St. Aubin (1982) indicate a rapid cleaning of the plates. Eyes and sensitive mucous membranes may be irritated by toxic vapors. The ability of whales to detect and avoid spilled oil is unknown. Adverse effects associated with a large oil spill are more likely to be associated with the production and development phases than the exploration phase. The DEIS (MMS 1987) for the proposed oil and gas lease sales concludes that, based on the known distribution of whales in the GOM relative to areas being offered for lease, the chance of a whale contacting an oil spill as a result of the proposed activity is low.

Cetacean Conclusions

NMFS concludes that the proposed activities are not likely to jeopardize the continued existence of sperm, fin, sei, right, blue or humpback whales. The sperm whale and possibly the fin whale are the only species likely to occur in the Gulf of Mexico with any regularity or abundance. Sperm whales generally feed in deep waters and do not routinely visit the shelf areas where most oil and gas activity would occur. Little is known about fin whales in the GOM, although their migrations also occur in deep, open waters rather than along the coastlines.

Sea Turtles

Since the 1979 Biological Opinion, considerable new information



regarding the effects of oil contamination on turtles has become available. Of particular importance was a two year research project to determine the possible effects of oil on hatchling, juvenile and adult sea turtles conducted by the Florida Institute of Oceanography (FIO 1986). This research generated new experimental information on oil impacts on two selected species, the green turtle (Chelonia mydas) and the loggerhead turtle (Caretta caretta). The study dealt principally with oil exposure experiments to determine the physiological and clinicopathological effects of oil on sea turtles. Behavioral avoidance tests were also conducted and strategies to minimize the effects of oil contamination on sea turtles were recommended.

A brief summary of the FIO (1986) study follows:

(1) Experiments on the physiological and clinicopathological effects of oil conducted on juvenile loggerhead turtles demonstrated that major body systems were adversely affected by limited exposures to oil (South Louisiana Crude Oil - SLCO). These include: (a) changes in the respiration in acutely oiled turtles, (b) the reddening and sloughing off of the skin of exposed turtles, (c) effects on the integumentary system (i.e., skin lesions which increase the susceptibility to infections), (d) significant changes in the blood chemistry and composition, and (e) the temporary loss of salt gland function in acutely oiled turtles.

(2) There were inconclusive laboratory results on determining if young sea turtles selectively strike at tar balls floating on the surface of the water.

(3) In experiments to determine the effects of an oil slick on the behavior of sea turtles, it was demonstrated that the turtles would spend significantly more time in the water column and would surface to breathe more frequently in the unoiled water. This was attributed to the turtle's visual avoidance reaction to the darker oil and not necessarily to the chemical cues associated with the petroleums.

(4) After analyzing Florida's sea turtle stranding data (1980-1984), it was determined that 3.2% (50 turtles) of the strandings were petroleum related. Approximately 92% of these petroleum related strandings were juveniles. Petroleum related strandings included turtles that had been "fouled" in oil or had ingested petroleum residue such as tar balls.

(5) Hydrocarbon analysis of some oil-fouled sea turtles indicated that most of the ingested/fouling tar came from crude oil tanker discharge.

As a result of the FIO study and other related studies, it is becoming clear that serious adverse effects to listed sea turtles may occur as a result of oil spills. The potential for impacts to sea turtles is increased by the fact that oil contaminants tend to concentrate in areas of convergence or divergence (driftlines) which also play a vital role in the early years of sea turtles (Carr 1986). Hatchling turtles are believed to be associated with sargassum rafts during their early development, and these rafts tend to concentrate along driftlines. Several field studies have demonstrated that the sargassum community can be measurably contaminated by petroleum (Morris et al. 1976; Burns and Teal 1973).

NMFS is particularly concerned with the potential impacts of a major oil spill in the GOM on hatchling Kemp's ridley turtles, whose distributions are believed controlled by current patterns and driftlines (Hildebrand 1982).

MMS expects effects of oil and gas activities on sea turtles in the Gulf of Mexico to be moderate in the central and western Gulf and very low in the eastern GOM (MMS 1987). The following are some concerns regarding the potential impacts of GOM oil and gas activities on sea turtles.

(1) An increase in offshore oil and gas related vessel traffic in the GOM increases the potential for injuries to sea turtles through turtle/vessel collisions. This source of turtle mortalities in the Gulf of Mexico has not been quantified, but based on records of the Sea Turtle Stranding and Salvage Network (STSSN) the number of turtles with suspected propeller wounds has been increasing. These data, however, could be misleading and may reflect an increased efficiency of the reporting network or an increase in overall vessel traffic in the Gulf of Mexico.

(2) Another potential impact to sea turtles associated with OCS platforms is disorientation of hatchlings, which can result from offshore artificial lighting. Newly-hatched turtles utilize light (the brighter horizon) to find the ocean and this orientation continues while at sea. While nesting in the central GOM is relatively uncommon, Kemp's ridley turtles originating from the beaches of Rancho Nuevo, Mexico could potentially be affected by offshore lights. However, this possible impact is speculative and has never been documented.

With the exception of abandonment, this consultation addresses all phases of oil and gas activities in the GOM including ongoing and anticipated future production through the year 2023, therefore it is necessary to examine not only the impacts of the proposed sales but the additive impacts of all other oil and gas activities in the GOM. It is also necessary to consider the potential impacts of other activities in the GOM. As the government agency responsible for protecting listed marine species, we must attempt to determine at what point the additive effects of all activities impinging on the survival of listed species constitutes a jeopardy



to the species.

There is little doubt that the overall affect of OCS oil and gas activities in the GOM to listed species is negative. In this opinion, NMFS has discussed some of the major potential affects of these activities which include: oil/gas related oil spills, collisions with offshore support vessels, platform removals, noise disturbances from OCS oil/gas activities, offshore lighting, and offshore oil/gas related debris and trash. Considering the magnitude of MMS mean case scenario estimates of present and future development in the GOM, the probabilities of impacts to listed species are high.

Some other activities in the GOM which have negative impacts on listed species, but are not related to OCS oil and gas activities include: commercial and recreational fishing; ocean disposal of chemicals, radioactive wastes, munitions, etc.; marine trash and debris; loss of turtle nesting beaches through development; turtle egg predation; oil and tar balls from natural seeps, bilge cleaning and tanker spills; non-oil and gas related vessel traffic; pollution of rivers, bays, estuaries, etc.; and channel dredging. The additive effects of these activities plus the potential effects of oil and gas activities may at some point jeopardize the potential for the survival and recovery of listed species.

Of all the activities which may have negative impacts on listed species, the only quantitative information available concerns the catch and mortality of sea turtles by shrimp trawlers. Appropriate measures are being taken to minimize adverse impacts to endangered and threatened sea turtles associated with shrimp trawling. The magnitude of potential impacts from other activities is unknown, and without this information, it is difficult to determine if and when a species may be jeopardized by any single activity.

A final NMFS concern is the potential impacts of a major oil spill in the Gulf of Mexico should it contact the Kemp's ridley nesting beaches at Tamaulipas, Mexico. A disaster of this nature could seriously reduce the potential for survival and recovery of this species. Oil spills can result from well blowouts, pipeline ruptures, leakage, spillage during transfer activities and shipping activities. Of these activities, the most likely source of spilled oil is from spillage during transfer and shipping activities. Well blowouts are more likely to occur during the development and production phase than during exploration activities. Since the proposed lease sales include the entire GOM, it is possible that an oil spill in the western Gulf could impact Mexican beaches. However, based on MMS oil spill risk analysis and trajectory calculations for development and production in the western GOM, the risk of spilled oil contacting the ridley nesting beach in Rancho Nuevo is extremely remote.

Sea Turtle Conclusions

It is our opinion that the OCS oil and gas exploration, production and development activities for the proposed lease sales are not likely to jeopardize the continued existence of the Kemp's ridley, loggerhead, green, hawksbill or leatherback turtle.



## INCIDENTAL TAKE STATEMENT

Section 7(b)(4) of the Endangered Species Act requires that when a proposed agency action is found to be consistent with Section 7(a)(2) of the Act and the proposed action may incidentally take individuals of listed species, NMFS will issue a statement that specifies the impact (amount or extent) of such incidental taking and the terms and conditions that must be followed. Only incidental taking by the Federal agency or applicant that complies with the specified terms and conditions of this statement is authorized and exempt from the taking prohibition of the ESA.

No records of sea turtle take in the course of oil and gas activities have been reported. However, there is a growing body of evidence that oil and gas related activities (i.e. exposure to oil spills, vessel collisions, disorientation by platform lights, etc.) may adversely affect sea turtles. These potential impacts have been addressed in the consultation for oil and gas lease sales 113, 115 and 116. NMFS does not anticipate any sea turtle take as a result of exploration, production and development activities associated with lease sales 113, 115 and 116. As a condition of this statement, if a sea turtle is injured or killed during any phase of the proposed activity, the incident must be reported to the NMFS Southeast Regional Director as soon as possible. NMFS will cooperate with MMS in a review of the incident to determine the need for developing appropriate mitigation measures.

Section 7(b)(4)(C) of the ESA specifies that in order to provide an incidental take statement for an endangered or threatened species of marine mammal, the taking must be authorized under Section 101(a)(5) of the Marine Mammal Protection Act of 1972 (MMPA). Since no taking incidental to the proposed activity has been requested or authorized under Section 101(a)(5) of the MMPA, no statement on incidental take of endangered or threatened marine mammals is provided, and no take is authorized.

## CONSERVATION RECOMMENDATIONS

In formulating our opinion on the potential impacts to listed species of oil and gas related activities, NMFS used the best available information. However, to adequately evaluate the probable impacts of various oil and gas development/production scenarios, quantitative information is essential. Specifically, for each listed species we need to know: (1) what is the existing population size, (2) how many individuals may be affected as a result of the proposed activity, and (3) how many mortalities are expected to occur as a result of all other non-related activities? With this minimal information, it is possible to make a subjective judgment concerning whether an activity might jeopardize the continued existence of a species.

The NMFS acknowledges the past and present research efforts funded by MMS which address oil and gas related impacts to endangered and threatened species. While these studies have provided some valuable information, many questions remain unanswered. The following are NMFS research recommendations for future studies. Data derived from such studies will aid in our interagency responsibilities to ensure that oil and gas development will not jeopardize protected species.

(1) NMFS considers the scarcity of basic biological information on listed species to be the major limiting factor in our ability to adequately assess the potential impacts of activities in the GOM. Studies of age, growth, survival, distribution, seasonality, movements, migrations, habitat, populations, etc. for all listed species are needed. An overall research plan including Federal agencies (NMFS, FWS, MMS, COE, etc.), States, private institutions and universities should be developed to prioritize and fund needed research.

(2) Some specific recommendations for research as related to GOM OCS oil and gas activities are:

(a) Tar samples collected from stranded turtles, beaches, and driftlines should continue to be analyzed to determine their source.

(b) Research is needed to identify neonatal turtle habitat, particularly for the Kemp's ridley, and to determine the extent to which these turtles are associated with driftlines.

(c) The possible effects of chemical dispersants on marine mammals and sea turtles should be determined.



(d) Relationships between oil and gas platforms and sea turtles/marine mammals should be assessed on a temporal and spatial basis.

(e) In conjunction with the existing sea turtle stranding network, additional studies to determine "cause of death" are needed. If strandings could be attributed to specific activities, potential impacts of these activities might be quantified.

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# U.S. Fish and Wildlife Service

# Biological Opinion

# Central Gulf of Mexico

# Sale 139

United States Department of the Interior
FISH AND WILDLIFE SERVICE
75 SPRING STREET, S.W.
ATLANTA, GEORGIA
30303

MAR 15 1991

Memorandum

To: Associate Director for Offshore Leasing, Minerals Management Service, Washington, D.C.
Attn: Dr. Robert Middleton

From: ACTING Regional Director, Fish and Wildlife Service, Atlanta, Georgia (AWE/TS)

Subject: Biological Opinion on Outer Continental Shelf Oil and Gas Leasing, Exploration, Development, Production, and Abandonment in the Central Gulf of Mexico, Lease Sale 139

**Introduction**

The Minerals Management Service, by memorandum dated October 4, 1990, requested formal Section 7 consultation for Lease Sale 139 and an unnumbered sale encompassing blocks in the Central and Western Gulf of Mexico Planning areas, respectively. This consultation will include all aspects of oil and gas exploration, development, production, and abandonment activities as requested by the Minerals Management Service for the Central Gulf of Mexico Planning Area. Our Southwestern Regional Office in Albuquerque, New Mexico, will respond to your request regarding the unnumbered Western Gulf of Mexico Lease Sale.

The Fish and Wildlife Service concurs that the current Biological Opinion (Opinion) for the Central Gulf of Mexico Planning Area issued on July 18, 1989, and revised on August 25, 1989, is generally up-to-date. However, the Fish and Wildlife Service believes that the availability of seasonal oil-spill risk estimates require a re-evaluation of some species.

**Opinion Coverage**

The Central Gulf of Mexico Planning Area proposed for leasing under Sale 139 encompasses all unleased blocks in the planning area consisting of approximately 48 million acres.

The following Opinion, therefore, covers all phases of Outer Continental Shelf oil and gas activity including leasing, exploration, development, production, and abandonment for the Central Gulf of Mexico Area. In addition, this Opinion provides an informal conference for the proposed Gulf of Mexico sturgeon and advisory guidance for the candidate snowy plover. Sea turtles have split jurisdiction between the National Marine Fisheries Service and the Fish and Wildlife Service; therefore, this Opinion will only cover that portion of the species' life history that occurs on land.

Figure 1 shows the boundaries of the Central Gulf of Mexico Planning Area for which this Opinion was written. The Planning Area is offshore of the States of Louisiana, Mississippi, and Alabama.

**Opinion Preparation and Information Assumptions**

All previous Opinions for Outer Continental Shelf oil and gas activities in the Central Gulf of Mexico were reviewed in preparation of the current Opinion. Ms. Lorna Patrick, Panama City, Florida, Field Office, prepared the Opinion in consultation with the Fish and Wildlife Service's Washington Office, Southeast Regional Office, and Jacksonville, Florida; Lafayette, Louisiana; Jackson, Mississippi; and Daphne, Alabama, Field Offices; and coastal national wildlife refuges in Alabama, Mississippi, and Louisiana; and the Washington and the Gulf of Mexico Regional Offices of the Minerals Management Service. In addition, the Minerals Management Service furnished the preparer environmental analyses, oil spill analyses, other documents and maps which were used in preparing the Opinion.

Exploration, development, and production requires certain onshore support facilities including office space, helicopter and fixed-wing aircraft facilities, navigation channels and docks for boating activities, platform and drilling rig construction yards, pipelines, oil and gas processing and separating facilities, refineries, and supply bases. Oil and gas activities in the Central Gulf of Mexico began more than 30 years ago; therefore, necessary onshore facilities to support those activities are already in place and no major new facilities are anticipated as a result Sale 139. Due to the uncertain nature of oil and gas supply and demand, companies are generally unwilling to construct new facilities. They prefer instead to use existing areas and facilities.

At the present, there are numerous onshore facilities throughout the Gulf of Mexico being used for Outer Continental Shelf oil and gas activities. Should the use of these facilities be changed or additional onshore facilities be needed which may affect listed species or their habitats, consultation would need to be reinitiated.

Potential for large oil spills (greater than or equal to 1,000 barrels) resulting from oil and gas activities in the Central Gulf of Mexico is unlikely. Small chronic spills can and often do occur in the vicinity of drilling and production platforms. These spills are usually localized and are due to leakage from service and support vessels and small diameter pipes associated with oil production, including fuel transfer and routine operations. The Minerals Management Service does not regulate the transportation of oil and gas from the production sites or refineries as final products, and therefore, is not responsible for accidents or spills that occur during these activities. However, the agency is responsible for overseeing accidents or spills that may occur in the lease blocks. Species in the vicinity of these small spills are usually those under the jurisdiction of the National Marine Fisheries Service. An exception to this is the Gulf of Mexico sturgeon which makes marine migrations during the winter months.

The following information was used in preparation of this Opinion regarding potential oil spill impacts on endangered and threatened species in the Central Gulf of Mexico Planning Area. South Louisiana crude is a typical crude oil from the Central Gulf of Mexico. It is an oil that is light-weight and relatively nonpersistent. Historically, the vast majority of oil spills in the Gulf of Mexico from Outer Continental Shelf operations have consisted of South Louisiana crude.

A review of 92 crude oils produced from fields on the Central Gulf of Mexico Planning Area outer continental shelf and coastal Louisiana shows that a majority (51 percent) of the crude oils have API gravities between 33° and 38° API. However, the range of variability is great, with the lowest being 21.6° and the highest being 47.3° API (Minerals Management Service 1990). There have been few very large oil spills (greater than 10,000-barrels) from Central Gulf of Mexico outer continental shelf-related operations. These spills include a 160,638-barrel spill from an anchor damaged pipeline in block 73, West Delta Area on October 17, 1967, and another 19,833-barrel spill from an anchor damaged pipeline in block 317, Eugene Island Area on April 17, 1974. Two platform blowouts occurred in 1970, a 53,000-barrel spill at block 26, South Timbalier Area and a 30,000-barrel spill at block 41, Main Pass Area. No tanker spills related to Outer Continental Shelf activities have been reported for the Central Planning Area (U.S. Minerals Management Service 1990).

A number of processes occur when oil is spilled in water, altering the chemical and physical characteristics of the original oil mixture almost immediately. Collectively, these are referred to as weathering or aging of the oil and will determine, along with physical oceanography, the fate of the spilled oil. Weathering involves a number of physical/chemical and biological processes that change the characteristics of the crude oil mixture and reduce the concentration of oil components in the slick. These processes include evaporation, dispersion, dissolution, emulsification, biodegradation, photo-oxidation, sinking, and sedimentation. Any or all of these processes can be expected to operate on spilled oil. Their relative importance is largely dependent on oceanographic and meteorological conditions at the time of the spill. Eventually, a tar-like residue may be left, which would break up into tar lumps or tar balls (U.S. Minerals Management Service 1990).

Spilled Louisiana crude disperses and degrades rapidly under the influences of the Gulf of Mexico's warm climatic conditions and the properties of the



oil. Because Louisiana crude evaporates rapidly, slicks observed in gulf waters have disappeared within days. Very few oil slicks have ever been tracked for more than 30 days. Spills from the Torrey Canyon, Amoco Cadiz, and Ixtoc (which released oil over a long time period) remained on the sea surface longer than 30 days, but their volume was many times larger than the average spill. In contrast, a slick from South Pass Block 60 of 42,000 barrels, spilled on August 2, 1973, was reported dissipated with only small patches remaining after 5 days. Based on the above, 10 days is chosen as the most likely sea surface residence time. Assumptions regarding dominant weathering processes indicate that after 10 days the oil properties have changes extensively and the original volume has decreased greatly. The floating oil is largely devoid of its volatile (acutely toxic) components and is gradually forming emulsions (U.S. Minerals Management Service 1990).

This Opinion does not provide an assessment for oil spill cleanup activities on listed, proposed, or candidate species. The Fish and Wildlife Service does not believe it is practical to provide a generic oil spill cleanup evaluation. The Opinion can only address those activities or permits controlled by or under jurisdiction of the Minerals Management Service. This eliminates transportation related oil spills outside Minerals Management Service control or authority and oil spill cleanup outside the leased blocks. The U.S. Coast Guard and U.S. Environmental Protection Agency would have jurisdiction in most instances of spilled oil.

Offshore oil and gas structure removal (abandonment) has become a concern in recent years in regard to impacts on marine mammals and endangered and threatened species. Historically, approximately 55 to 65 of these structures are removed annually from offshore waters. The structures are removed by nonexplosive or explosive methods. The only species under the jurisdiction of the Fish and Wildlife Service that could potentially be affected by structure removal is the Gulf of Mexico sturgeon.

Public and private interests have indicated that debris and trash associated with oil and gas operations (oil drums, large plastic sheeting and containers, computer read-write rings, seismic markers, styrofoam floats, pipe-thread protectors, diesel filters, and hard hats) is a serious and chronic problem on major recreational beaches, national seashores, and national wildlife refuges in the Western and Central Gulf of Mexico (U.S. Minerals Management Service 1990; Wigginton 1990). Removal, analysis, and disposal of 55-gallon drums along South Texas beaches cost the Federal government nearly $400,000 in 1985. Over one-half of the 300 drums whose contents were analyzed in 1985 were found to contain hazardous materials, thereby, posing potential health hazards to beach users, marine resources, and wildlife. Other impacts caused by marine debris and trash include entanglement of birds, fish, sea turtles, and marine mammals in plastic rope, straps, or netting and the ingestion of plastic bags, sheeting, 6-pack rings, and styrofoam particles (U.S. Minerals Management Service 1990).

Because of increased concern with the prevalence and effects of persistent marine debris both offshore and on coastal beaches, the Minerals Management Service issued a special advisory (NTL 86-11) in 1986 strongly encouraging the oil and gas industry to take special educational, operational, and awareness measures designed to reduce or eliminate the oil and gas industry's contributions to marine debris in the Gulf of Mexico (U.S. Minerals Management Service 1990). In addition, the Minerals Management Service has promulgated regulations (30 CFR 250.40) to assure lessees do 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 rules also 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 weighing 40 pounds or more 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. Should equipment, material, containers, drums, or other items be lost overboard, they are to be recorded on the facility's daily report and reported to the Minerals Management Service (U.S. Minerals Management Service 1990).

The Marine Pollution Research and Control Act (MARPOL) of 1987 is a recent United States law implementing Annex V of the International Convention for the Prevention of Pollution from Ships. Under provisions of the law, all ships and watercraft, including all commercial and recreational vessels, are prohibited from dumping plastics at sea. The law also severely restricts the dumping of other vessel-generated garbage and solid waste items both at sea and in United States navigable waters. Interim final rules explicitly state that fixed and floating platforms or all drilling rigs, manned production platforms, and support vessels operating under a Federal oil and gas lease are required to develop Waste Management Plans (U.S. Minerals Management Service 1990).

In the Central Gulf of Mexico Planning Area, staff at the Breton National Wildlife Refuge has noted a continuing accumulation of oil and gas related refuse on the Breton refuge beaches. Hard hats and a variety of plastic containers are routinely observed in what is considered some of the United States' most productive tern colonies (Wigginton 1990). Although marine trash may not be a major factor in the continued existence of any listed species in the area, it has become a justified concern in regard to protected species' management.

**Consultation History - Central Gulf of Mexico**

The original Opinion for Outer Continental Shelf oil and gas activities in the Gulf of Mexico was submitted by the Fish and Wildlife Service on April 10, 1979. Consultation for the Central Gulf of Mexico Planning Area was reinitiated in November 1981, which resulted in an Opinion dated June 30, 1982, which was amended October 25, 1982. Subsequent reviews of Opinions by the Service dated April 9, 1984, January 15, 1985, January 29,



1986, and June 22, 1987, concluded that formal consultation need not be reinitiated. The above referenced Opinions covered only oil and gas leasing and exploration. Consultation was reinitiated in January 1989, to include all phases of Outer Continental Shelf oil and gas activities consisting of leasing, exploration, development, production, and abandonment. This resulted in an Opinion dated July 18, 1989, and revised on August 25, 1989. The most recent Opinion and review by the Fish and Wildlife Service on July 26, 1990, concluded that formal consultation need not be reinitiated.

**Biological Information**

The following species are included in this Opinion as being potentially affected by the proposed actions.

Federal Listing in Each State

| Listed Species | Louisiana | Mississippi | Alabama |
|---|---|---|---|
| Brown pelican (*Pelecanus occidentalis*) | E | E | -- |
| Bald eagle (*Haliaeetus leucocephalus*) | E | E | E |
| Piping plover (*Charadrius melodus*) | T | T | T |
| Arctic peregrine falcon (*Falco peregrinus tundrius*) | T | T | T |
| Loggerhead sea turtle (*Caretta caretta*) | E | E | E |
| Alabama beach mouse (*Peromyscus polionotus ammobates*) | ---- | ---- | E,CH |
| Perdido Key beach mouse (*Peromyscus polionotus trissyllepsis*) | ---- | ---- | E,CH |
| Proposed Species | | | |
| Gulf of Mexico sturgeon (*Acipenser oxyrhynchus desotoi*) | PT | PT | PT |
| Candidate Species | | | |
| Southeastern snowy plover (*Charadrius alexandrinus tenuirostris*) | C | C | C |

**E = Endangered**
**T = Threatened**
**CH = Critical Habitat**
**-- = Not listed for that State**
**P = Proposed**
**C = Candidate**

The following other species have been considered in this consultation. They are the American peregrine falcon (*Falco peregrinus anatum*), the Eskimo curlew (*Numenius borealis*), American alligator (*Alligator mississippiensis*), green sea turtle (*Chelonia mydas*), leatherback sea turtle (*Dermochelys coriacea*), hawksbill sea turtle (*Eretmochelys imbricata*), Kemp's ridley sea turtle (*Lepidochelys kempii*), least tern (*Sterna antillarum*), red wolf (*Canis rufus*), and West Indian manatee (*Trichechus manatus*).

Existing and proposed oil and gas activities are not expected to impact the American peregrine falcon or the Eskimo curlew or their habitat needs. The American alligator has been reclassified as "threatened due to similarity of appearance" for enforcement purposes, but is not biologically endangered or threatened. The green, leatherback, hawksbill, and Kemp's ridley sea turtles are not known to nest on beaches within the Central Gulf of Mexico Planning Area.

The least tern is listed as endangered in Louisiana and Mississippi except within 50 miles of the coast. The tern freely mixes with other terns and shorebirds along the coast. The red wolf has been placed on Horn Island off Mississippi (national seashore) for captive breeding purposes because of the need for isolation. The occurrence of the manatee in coastal Central Gulf of Mexico waters is rare. It is the Fish and Wildlife Service's Opinion that existing and proposed oil and gas leasing, exploration, development, production, and abandonment activities in the Central Gulf of Mexico Planning Area are not likely to jeopardize the continued existance of these species or destroy or adversely modify their critical habitat. Further, if significant new information not considered by the Minerals Management Service or the Fish and Wildlife Service in this Opinion becomes available, reinitiation of Section 7 consultation may be required.

Brown Pelican (*Pelecanus occidentalis*)

The brown pelican was originally listed throughout its range as endangered on October 13, 1970. The species was delisted in Alabama on February 4, 1985, but is still listed as endangered in Louisiana and Mississippi (U.S. Fish and Wildlife Service 1989a, 1989b).

Three nesting colonies exist in Louisiana, one on North Island, one on North Grosier Island, and one at the "mud lumps" of the Mississippi River. The colony at the mud lumps (Plaquemines Parish) was established in 1990. No nesting rookeries have been identified in Mississippi (Wigginton 1990; Rabot 1990).

Historically, the brown pelican used the Shell Keys National Wildlife Refuge (Iberia Parish). However, it is unknown whether the bird currently nests on the refuge (Simmons 1990). Refuge staff at Delta National Wildlife Refuge (Plaquemines Parish) have noted that brown pelicans tend to use the



refuge more during the winter months and the coastal barrier islands during the spring. They suspect that the majority of the pelicans that use the refuge are immature and nonbreeding birds (Wigginton 1990).

Brown pelicans use the water around Breton National Wildlife Refuge (St. Bernard and Plaquemines Parishes) as loafing, feeding, and nesting areas. Flocks typically containing 50 to 100 birds are routinely observed by refuge staff on or near all islands in Breton and Chandeleur Sound (Curlew, Grand Gosier, and Breton Islands) (Wigginton 1990).

Over the past 5 years, brown pelicans have continued to increase in numbers in Breton and Chandeleur Sound. The refuge's 1990 annual survey nest count recorded 1,331 nests on North Island. Approximately 1,500 adult brown pelicans were observed during the count in and around the island; and on North Gosier Island, a new pelican colony was established and 62 nests with eggs were counted in June 1990 (Wigginton 1990).

The brown pelican nests in colonies on small coastal islands in salt and brackish waters. Nests are constructed from available vegetation. The major food of the pelican is fish, including menhaden, mullet, sardines, and pinfish. The pelican catches these fish by plunge-diving in coastal waters. Brown pelicans are rarely found away from saltwater and typically do not venture more than 20 miles (32 kilometers) out to sea. Extensive use of pesticides which were ultimately ingested by the brown pelican has been noted as the primary cause of decline of the species (U.S. Fish and Wildlife Service 1989b).

The brown pelican is extremely susceptible to disturbance and habitat alteration of key nesting areas. It is important to prevent disturbance of nesting colonies that could cause nest desertion and egg losses. Potential sources of impact to the brown pelican from existing and proposed oil and gas activities are from development of onshore facilities, associated aircraft and boat vessel traffic, offshore oil and gas related trash and debris, and the possibility of an oil spill reaching the coast and contaminating the pelican and its food source (U.S. Fish and Wildlife Service 1989b).

Future onshore oil and gas-related facility construction is expected to be minimal in the Central Gulf of Mexico Planning Area from this lease sale. Impacts to the brown pelican from ingestion, contact, or entanglement of trash and debris are not anticipated to be significant. The Gulf of Mexico Outer Continental Shelf Region Office, Minerals Management Service, by letter dated August 30, 1990, recommends to lessees and operators that they require all aircraft used in support of their Outer Continental Shelf oil and gas operations to maintain altitudes of 2,000 feet or more when flying over all lands located within national wildlife refuges and national parks and seashores (Pearcy 1990).

Pelicans may be susceptible to oil spills. Even though the island nesting sites in Louisiana might be partially protected from direct impact of an offshore oil spill by the seaward portion of the barrier islands, the wide-ranging nature of the birds when foraging would amplify the possibility of oil contamination. Their entire body can be coated with oil as the birds dive for fish. However, it is reasonable to assume that adult brown pelicans may in fact avoid feeding in oiled waters because of the difficulty in observing fish beneath the surface. Very small amounts of certain crude and refined oils applied to the surface of eggs cause high embryonic mortality or morphological abnormalities in a variety of avian species. If spills occurred during the nesting season of the brown pelican, oil can be transferred to eggs from feathers or feet of adults, resulting in reduction in hatching success and hatchling survival (U.S. Fish and Wildlife Service 1989b).

According to Oil Spill Risk Estimates, the highest annual conditional probability of an oil spill starting in the existing and proposed lease sale area and contacting the Chandeleur brown pelican nesting and foraging habitats within 10 days, is a 27 percent chance. The highest seasonal probabilities for spring and summer are less than the highest annual probability (Hannon and Lear 1990).

The conditional probability of an oil spill greater than or equal to 1,000 barrels occurring from the proposed sale base case, high case, or all Central Gulf of Mexico Planning Area oil and gas platform activities is a 8, 13, or 98 percent chance, respectively. The highest combined probability of an oil spill greater than or equal to 1,000 barrels occurring and reaching brown pelican nesting or foraging habitats within 10 days is a 5 percent chance (Hannon and Lear 1990).

The highest annual or seasonal conditional probability spill estimate from an offshore pipeline spill of contacting Chandeleur brown pelican nesting or foraging habitats within 10 days is a 24 percent chance. The conditional probability of an oil spill greater than or equal to 1,000 barrels occurring from the proposed sale base case, high case, or all Central Gulf of Mexico Planning Area oil and gas pipeline activities is a 9, 15, or 98 percent chance, respectively. The mean number of spills from pipelines for the above conditions is 0.09, 0.16, and 4.17 spills, respectively (Hannon and Lear 1990).

It is projected that there may be a total of three and four shuttle tanker trips for the proposed sale's base and high case scenarios, respectively. The planning and analysis area where the trips would originate is Central coastal area 3 (C-3) which encompasses the most eastern portion of Louisiana. The highest seasonal (winter) conditional probability for a spill to reach brown pelican habitats within 10 days from a shuttle tanker spill is a 5 percent chance within the C-3 area. The highest annual condition probability within the C-3 area is a 1 percent chance (U.S. Minerals Management Service 1990).

Since new onshore facilities construction is anticipated to be minimal and the possibility of an oil spill occurring and contacting (combined



probability) brown pelican nesting or foraging habitat is low, it is the Fish and Wildlife Service's Opinion that leasing, exploration, development, production, and abandonment activities for existing and proposed Central Gulf of Mexico Planning area leases are not likely to jeopardize the continued existence of the brown pelican. However, if new information not considered by the Minerals Management Service or the Fish and Wildlife Service in this Opinion becomes available regarding the brown pelican, re-initiation of Section 7 consultation may be required.

Bald Eagle (Haliaeetus leucocephalus)

The bald eagle was initially considered to have two distinct subspecies when the southern bald eagle was listed as an endangered species in the Federal Register of March 11, 1967. The entire species was listed as endangered in 43 of the conterminous 48 States and threatened in the remaining five States on February 14, 1978.

Historically, the bald eagle was a common nesting species throughout the coastal plain of the Southeast as well as along major lakes and rivers. Hence, the breeding range was uninterrupted along the east coast from the Chesapeake Bay to the Florida Keys and north along the west coast of Florida to the panhandle. The nesting range also appears to have been continuous along the entire Mississippi and other major rivers, through Louisiana and into east Texas with a low density along the gulf coast. The breeding range has been reduced to the remnant populations in South Carolina, Louisiana, and east Texas, with apparently secure nesting only in Florida.

The bald eagle actively nests in Louisiana and Mississippi; there is no known nesting in Alabama. In Alabama, on Bon Secour National Wildlife Refuge, bald eagles are sighted, but none are known to nest. The refuge has started a hacking program to reintroduce the eagle (Fulton 1990). In 1990, three birds were introduced at the refuge. However, there are no plans for hacking any eagles on the refuge in 1991 (Hicks 1991). All the bald eagles to be introduced into Alabama in 1991 will be the northern part of the State (Hicks 1991).

There were 45 active bald eagle nests located in coastal Louisiana parishes during the 1989 to 1990 winter nesting period. The majority of the nesting sites are west of the Mississippi River to the Atchafalaya Basin with a few scattered nests east of the Mississippi River. In Mississippi, the only known active nest near the coast in 1989, was in Harrison County just north of the junction of Biloxi River and Bay within visual distance of Interstate 10. The nest was destroyed during one of the 1985 hurricanes; however, a pair of bald eagles have since been observed in the area. Current nesting success is unknown. An active nest was reported in Hancock County, Mississippi, near the town of Logtown off Mississippi Sound in 1988. However, the status of that nest for 1990 is unknown (Bagley 1989; Rabot 1990).

According to the Bald Eagle Recovery Plan, essential habitat is an area of concentrated nesting that is looked upon as a nuclear population. The loss or substantial alteration of a population center would seriously jeopardize the long-term survival chances for the species in Louisiana. Wetland coastal habitats in Louisiana have been designated as essential habitat (U.S. Fish and Wildlife Service 1989c).

Eagles are opportunistic feeders, with fish constituting the bulk of their diet. They will feed on waterfowl and shorebirds, particularly sick or injured individuals, as well as carrion. Throughout most of the bald eagle's range, its population decline has been largely attributed to the effect of pesticide ingestion (which resulted in eggshell thinning) and indiscriminate shooting of both immature and adult birds (U.S. Fish and Wildlife Service 1989b).

Potential sources of impact to the eagle from existing and proposed oil and gas activities are disturbance to its nests, resulting from development of onshore facilities and aircraft and boat vessel traffic, trash and debris, and the possibility of an oil spill reaching the coast and contaminating the eagle and its food source (U.S. Fish and Wildlife Service 1989b).

Future onshore oil and gas-related facility construction is expected to be minimal in the Central Gulf of Mexico Planning Area from this lease sale. Impacts on the bald eagle from ingestion, contact, or entanglement from trash and debris is not expected to be significant. The Gulf of Mexico Outer Continental Shelf Region Office, Minerals Management Service, by letter dated August 30, 1990, recommends to lessees and operators that they require all aircraft used in support of their Outer Continental Shelf oil and gas operations to maintain altitudes of 2,000 feet or more when flying over all lands located within national wildlife refuges and national parks and seashores (Pearcy 1990).

According to the Oil Spill Risk Estimates, land segments in Louisiana and Mississippi where the bald eagle nesting occurs are 14, 15, 16, 17, 18, 19, 20, and 21. The highest annual or seasonal (winter, spring) conditional probabilities of an oil spill starting in the existing and proposed lease sale area and contacting these land segments within 10 days are 9 percent, 15 percent, 36 percent, 27 percent, 12 percent, 66 percent, 9 percent, and 26 percent, respectively. This represents a low to moderate threat.

It can be expected that bald eagles might be attracted to the area of a spill by dead and dying fish and birds as a food source, and thereby, consume oil adhering to prey species. Nevertheless, evidence from other species of birds suggests that adult birds may be able to tolerate the ingestion of fairly high concentrations of crude oil. Also, the direct effect of oil on plumage is perhaps not as significant a factor with bald eagles since adults, at least, tend to have minimal contact with the water from which they are taking prey. However, some direct mortality of adult bald eagles from oiling was observed after the 1989 tanker oil spill from



the Exxon Valdez in Prince William Sound in Alaska. The most important adverse impact of an oil spill on bald eagles would probably be on reproduction through contamination of eggs from adults carrying oil on breast feathers and feet. Bald eagle nesting in Alaska following the Exxon Valdez tanker spill had an 85 percent nest failure rate in heavily oiled areas and a 50 percent nest failure rate in lightly oiled areas. The main reason for failure was from direct contamination of the eggs from oiled adults. Another factor included disturbance of the breeding adult eagles from the helicopter and boat traffic related to the oil spill cleanup. A year later, decreased breeding rates were noted in the oiled areas compared to the unoiled areas (Schempf 1990).

The conditional probability of an oil spill greater than or equal to 1,000 barrels occurring from the proposed sale base case, high case, or all Central Gulf of Mexico Planning Area oil and gas platform activities is a 8, 13, or 98 percent chance, respectively. The combined probability of an oil spill greater than or equal to 1,000 barrels occurring and reaching bald eagle nesting or foraging habitats within 10 days has a high of a 1 percent chance for the sale base and high case, and a high of a 58 percent chance for all Central Gulf Planning Area (Hannon and Lear 1990).

Annual and seasonal conditional probability spill estimates for a spill originating from a pipeline starting and contacting bald eagle nesting or foraging habitats within 10 days are moderate to high (30 to 98 percent chance). The conditional probability of an oil spill greater than or equal to 1,000 barrels occurring from the proposed sale base case, high case, or all Central Gulf of Mexico Planning Area oil and gas pipeline activities is a 9, 15, or 98 percent chance, respectively. The mean number of spills from pipelines for the above conditions is 0.09, 0.16, and 4.17 spills, respectively (Hannon and Lear 1990).

It is projected that there may be a total of three and four shuttle tanker trips for the proposed sale's base and high case scenarios, respectively. The planning and analysis area where the trips would originate is Central coastal area 3 (C-3) which encompasses the most eastern portion of Louisiana. The highest seasonal (spring) conditional probability for a spill to reach bald eagle habitats within 10 days from a shuttle tanker spill is a 64 percent chance within the C-3 area. (The highest annual condition probability within the C-3 area is a 41 percent chance (U.S. Minerals Management Service 1990).)

Since new onshore facilities construction is anticipated to be minimal and the possibility of an oil spill occurring and contacting (combined probability) from the proposed lease sale is low, it is the Fish and Wildlife Service's Opinion that leasing, exploration, development, production, and abandonment activities for existing and proposed Central Gulf of Mexico Planning Area leases are not likely to jeopardize the continued existence of the bald eagle. However, if new information not considered by the Minerals Management Service or the Fish and Wildlife Service in this Opinion becomes available regarding the bald eagle reinitiation of Section 7 consultation may be required.

Piping plover (Charadrius melodus)

The piping plover was federally listed as endangered in the Great Lakes watershed and threatened elsewhere in its range on January 10, 1986. This species breeds only in North America in three geographic regions. The bird's primary winter range is along the Atlantic and gulf coasts from North Carolina to Mexico (U.S. Fish and Wildlife Service 1989a, 1989b).

Recreational activity, coastal development, and dune stabilization have resulted in loss of appropriate sandy beaches and other littoral habitats. Where breeding does occur, breeding success is curtailed because of human disturbance (foot and vehicular traffic) which destroys nests and young (U.S. Fish and Wildlife Service 1988, 1989b).

In a 1987 to 1988 survey of piping plovers along the gulf coast (Florida to Texas) approximately 323 birds, 7.7 percent of the total breeding population were found along the coasts of Alabama, Mississippi, and Louisiana. Of the total gulf coast survey, piping plovers were observed most frequently in Alabama, Mississippi, and Louisiana (53 to 60 percent of the sites had birds).

Sites surveyed in the three States having the highest densities included Chandeleur Islands and Rockefeller Refuge, Louisiana, and Little Dauphin Island, Alabama. Along with these sites, Buccaneer State Park, Mississippi; and Isle Dernieres East, Louisiana are considered important piping plover wintering sites. Other wintering habitats are located at Fort Morgan and Little Dauphin Island - Bon Secour National Wildlife Refuge in Alabama; Horn Island, Ship Island, and East Ship Island - Gulf Islands National Seashore, Hewes Avenue and Moses Pier - Gulf Port, Pass Christian and American Legion Pier in Mississippi; Fourchon Pass, Elmer's Island, Timbalier Island, Marsh Island, East Jetty Beach, and Smith's Bayou in Louisiana (Nicholls 1989). Critical habitat has not been designated for piping plover along the gulf coast.

The plover usually forages on sandflats adjacent to passes and inlets, on mudflats near sandy beaches, on overwash sandy mudflats, and on the foreshore of open beaches, plucking invertebrates from the surface layer. Most feeding occurs during low or falling tides (Nicholls 1989).

Impacts to the piping plover from oil spills would be caused by fouling of wintering habitat. The plover may be among the more vulnerable species because they forage in intertidal areas. Ingestion of oil could occur during the feeding process. Some oiling may occur through direct contact with oiled sediments or waves in the splash zone. Impacts on piping plover were documented from a 1979 oil spill in Texas.

According to the Oil Spill Risk Estimates, seasonal conditional probabilities, the most important wintering sites for the piping plover in Louisiana, Mississippi, and Alabama (land segments 12, 20, and 22) have a



40, 7, and 21 percent chance, respectively, of receiving oil within 10 days of an oil spill occurring in the existing and proposed lease area (Hannon and Lear 1990).

The conditional probability of an oil spill greater than or equal to 1,000 barrels occurring from the proposed sale base case, high case, or all Central Gulf of Mexico Planning Area oil and gas platform activities is a 8, 13, or 98 percent chance, respectively. The highest combined probability of an oil spill greater than or equal to 1,000 barrels occurring from this lease sale and reaching piping plover wintering habitats within 10 days is less than a 0.5 percent chance (Hannon and Lear 1990).

Other impacts may result from pipeline placement and construction, onshore facility construction near wintering habitats, and trash and debris. The probability of impacts from these disturbances are anticipated to be low due to the anticipated minimal activity or construction as a result of this lease sale. The impact on the piping plover from ingestion, contact, or entanglement is not anticipated to be significant.

Offshore pipeline annual and seasonal conditional probability spill estimates have a high of a 58, 4, and 25 percent chance, respectively, of contacting within 10 days piping plover important wintering habitats in Louisiana, Mississippi, and Alabama. The conditional probability of an oil spill greater than or equal to 1,000 barrels occurring from the proposed sale base case, high case, or all Central Gulf of Mexico Planning Area oil and gas pipeline activities is a 9, 15, or 98 percent chance, respectively. The mean number of spills from pipelines for the above conditions is 0.09, 0.16, and 4.17 spills, respectively (Hannon and Lear 1990).

It is projected that there may be a total of three and four shuttle tanker trips for the proposed sale's base and high case scenarios, respectively. The planning and analysis area where the trips would originate is Central coastal area 3 (C-3) which encompasses the most eastern portion of Louisiana. The highest seasonal (winter) conditional probability for a spill to reach the piping plover important wintering habitats within 10 days from a shuttle tanker spill is less than an 0.5 percent chance within the C-3 area (U.S. Minerals Management Service 1990).

Temporary displacement by aircraft traffic may also have an impact on the piping plover. The Gulf of Mexico Outer Continental Shelf Region Office, Minerals Management Service, by letter dated August 30, 1990, recommends to lessees and operators that they require all aircraft used in support of their Outer Continental Shelf oil and gas operations to maintain altitudes of 2,000 feet or more when flying over all lands located within national wildlife refuges and national parks and seashores (Pearcy 1990).

New onshore facilities construction is anticipated to be minimal and the possibility of an oil spill occurring and contacting (combined probability) piping plover Louisiana, Mississippi, and Alabama, important wintering habitat is low. Therefore, it is the Fish and Wildlife Service's Opinion that leasing, exploration, development, production, and abandonment activities for existing and proposed Central Gulf of Mexico Planning area leases are not likely to jeopardize the continued existence of the piping plover. However, if new information not considered by the Minerals Management Service or the Fish and Wildlife Service in this Opinion becomes available regarding the piping plover, reinitiation of Section 7 consultation may be required.

Arctic Peregrine Falcon (Falco peregrinus tundrius)

The Arctic peregrine falcon was listed as an endangered species in the Federal Register on October 13, 1970. The bird is a subspecies of the peregrine falcon (Falco peregrinus). This subspecies breeds in the North American tundra and winters along the gulf coast from Florida west to the eastern Mexican coast and Baja California, south to mid-Chile and mid-Argentina, and possibly on Pacific Islands. Critical habitat has not yet been determined for this subspecies (U.S. Fish and Wildlife Service 1989a, 1989b).

Field and laboratory evidence indicates that the decline of peregrine populations is generally due to the presence of chlorinated hydrocarbon pesticides in the falcon's food supply. This leads to reproductive failure through eggshell thinning and non-viable eggs, as well as increased adult mortality. Other factors which may cause local decreases in reproductive success are human disturbance and adverse weather conditions during nesting (U.S. Fish and Wildlife Service 1979, 1989b).

While the arctic peregrine migrates south through a broad area of Eastern and Middle North America to the gulf coast, it funnels into coastal areas and concentrates along the beaches and barrier islands. During spring, migrating falcons are observed offshore along the coastal areas of the Central Gulf of Mexico. The falcons are occasionally sighted on Breton Island and Bon Secour National Wildlife Refuges during the winter. At Delta National Wildlife Refuge, the falcons are frequently observed on the refuge during the winter. In 1987, peregrines peaked in late October at 8 to 12 birds and were present most of the winter. The winter population has remained stable for the last 3 years, and one or more birds can be seen perching on survey towers or pilings on any given day (U.S. Fish and Wildlife Service 1989b; Wigginton 1990; Fulton 1990).

The possible impacts on Arctic peregrines from existing and proposed oil and gas activities include the contamination of the peregrine's food sources from an oil spill. The Arctic peregrine feeds mostly on a wide variety of birds and occasionally on small mammals. Peregrines will kill oiled birds and in doing so, ingest considerable numbers of feathers with their meal.

According to the Oil Spill Risk Estimates, the highest seasonal [illegible] (winter) probability, of Arctic peregrine falcon wintering or migratory



habitats of receiving oil within 10 days of an oil spill occurring in the existing and proposed lease area, is a 66 percent chance (Hannon and Lear 1990).

The conditional probability of an oil spill greater than or equal to 1,000 barrels occurring from the proposed sale base case, high case, or all Central Gulf of Mexico Planning Area oil and gas platform activities is a 8, 13, or 98 percent chance, respectively. The highest combined probability of an oil spill greater than or equal to 1,000 barrels occurring and reaching the peregrine falcon's wintering or migratory habitats within 10 days is a 1 percent chance for the proposed and high case sale and 58 percent for all Central gulf lease sales (Hannon and Lear 1990).

Offshore pipeline seasonal conditional probability spill estimates have a high of a 27 percent chance of contacting the peregrine falcon's wintering or migratory habitats within 10 days. The conditional probability of an oil spill greater than or equal to 1,000 barrels occurring from the proposed sale base case, high case, or all Central Gulf of Mexico Planning Area oil and gas pipeline activities is a 9, 15, or 98 percent chance, respectively. The mean number of spills from pipelines for the above conditions is 0.09, 0.16, and 4.17 spills, respectively (Hannon and Lear 1990).

It is projected that there may be a total of three and four shuttle tanker trips for the proposed sale's base and high case scenarios, respectively. The planning and analysis area where the trips would originate is Central coastal area 3 (C-3) which encompasses the most eastern portion of Louisiana. The highest seasonal (winter) conditional probability for a spill to reach the peregrines' wintering or migratory habitats within 10 days from a shuttle tanker spill is a 32 percent chance within the C-3 area (U.S. Minerals Management Service 1990).

Potential sources of impact to the Arctic peregrine falcon from existing and proposed oil and gas activities are temporary disturbance of winter migratory habitats resulting from development of onshore facilities, and trash and debris (U.S. Fish and Wildlife Service 1989b).

Future onshore oil- and gas-related facility construction is expected to be minimal in the Central Gulf of Mexico Planning Area from this lease sale. Impacts on the peregrine falcon from ingestion, contact, or entanglement from trash and debris are not expected to be significant.

Another activity that could have an impact on the peregrine falcon is temporary displacement by aircraft and boat vessel traffic on their wintering grounds or along their migration route. The Gulf of Mexico Outer Continental Shelf Region Office, Minerals Management Service by letter dated August 30, 1990, recommends to lessees and operators that they require all aircraft used in support of their Outer Continental Shelf oil and gas operations to maintain altitudes of 2,000 feet or more when flying over all lands located within national wildlife refuges and national parks and seashores (Pearcy 1990).

Since new onshore facilities construction is anticipated to be minimal and the possibility of an oil spill occurring from the lease sale and contacting (combined probability) peregrine falcon wintering or migratory habitats is low, it is the Fish and Wildlife Service's Opinion that leasing, exploration, development, production, and abandonment activities for existing and proposed Central Gulf of Mexico Planning area leases are not likely to jeopardize the continued existence of the Arctic peregrine falcon. However, if new information not considered by the Minerals Management Service or the Fish and Wildlife Service in this Opinion becomes available regarding the Arctic peregrine falcon, reinitiation of Section 7 consultation may be required.

Loggerhead Sea Turtle (Caretta caretta)

The loggerhead was listed as threatened in the Federal Register on July 28, 1978 (U.S. Fish and Wildlife Service 1989a, 1989b).

The loggerhead sea turtle is found in temperate and subtropical waters worldwide. United States nesting occurs on suitable Southeastern beaches from Virginia to the Chandeleur Islands, Louisiana. The major nesting beaches, however, occur along the east coast of Florida from Brevard to Broward County. In the Gulf of Mexico, loggerheads nest on various barrier islands and beaches throughout the Florida Keys and up the Florida west coast with scattered nesting occurring throughout the northern Gulf of Mexico. No critical habitat has been designated for the loggerhead in the Gulf of Mexico (U.S. Fish and Wildlife Service 1989a, 1989b; Possardt 1990).

Major factors which threaten the loggerhead on nesting beaches include the problem of hatchling disorientation arising from artificial lights, destruction, and degradation of nesting habitats from beach armoring and excessive nest and hatchling predation (U.S. Fish and Wildlife Service 1989b; Ogren 1990; Possardt 1990).

Loggerhead nesting in the Central Gulf Planning Area begins in Alabama where one nest per mile is usually found on Bon Secour National Wildlife Refuge in Baldwin County (Fulton 1990). In 1989, 13 nests were counted at Gulf Shores and Fort Morgan (Eley 1989; Eley and Papadelias 1990). In Mobile County, Alabama, the sea turtle nests on the western end of Dauphin Island and has had a nesting density ranging from a low of 1 per year to a high of 12 per year (Fulton 1990; South and Tucker 1991). Also in 1989, nests were observed on Petit Bois, Horn and East Ship Islands offshore Mississippi (Eley 1989; Eley and Papadelias 1990). Loggerhead nesting has been recently reported at Biloxi, Mississippi (Gulf Coast Research Laboratory 1990; South and Tucker 1991). It is now thought that the Chandeleur Islands may support a significant amount of loggerhead nesting.



Aerial surveys conducted by National Marine Fisheries Service found surfaced sea turtles (probably loggerheads) offshore of the Chandeleur and Breton Islands were 6 to 30 times more abundant than surfaced sea turtles west of the Mississippi River. The Fish and Wildlife Service, National Marine Fisheries Service, and Louisiana State University have been conducting aerial surveys and ground truthing efforts on the islands since 1988 (Fuller 1988, 1989, 1990).

Sea turtle nesting habitat may be impacted by oil spills and human disturbance resulting from Outer Continental Shelf activities. Disturbance by development and other human use of beaches is incompatible with successful sea turtle nesting. Artificial lights in the nesting beach areas reduce nesting activity and disorient hatchlings rendering the young turtles vulnerable to road traffic, or predators, and desiccation (Ogren 1990; Possardt 1990).

Effects of petroleum on the development and survival of marine turtle embryos are variable. Study results indicate that oil remaining on the beach approximately 1 year after a spill did not cause significant mortality in sea turtle eggs; however, fresh crude oil deposited on sand above a nest can cause extensive mortality to incubating sea turtle eggs (Fritts and McGehee 1982). Important variables in determining the chance of damage are the stage of nesting, the amount of weathering the oil has undergone, and the height of deposition on the beach. In addition, it has been proposed that olfactory clues are imprinted on the turtle and guide it back to the natal beach for nesting when it reaches maturity. Oil on the beach could interfere with these chemical guides (Lutz et al., 1985; Ogren 1990; Possardt 1990).

Studies have shown that sea turtles do not seem to avoid oil slicks and may ingest or become fouled with the oil. The direct effects of oil can be lethal or sublethal involving reduction or alteration of organ functions such as salt excretion and respiration (Lutz et al., 1985).

According to Oil Spill Risk Estimates, the highest annual conditional probability of an oil spill starting in the sale area and reaching Chandeleur and Breton Islands and Alabama nesting habitats within 10 days, is a 29 percent and a 16 percent chance, respectively. The highest seasonal (summer) conditional probability for the above scenario is a 55 and 17 percent chance, respectively (Hannon and Lear 1990). The moderate conditional probabilities of receiving oil during sea turtle nesting season on the Chandeleur and Breton Islands are a concern.

The conditional probability of an oil spill greater than or equal to 1,000 barrels occurring from the proposed sale base case, high case, or all Central Gulf of Mexico Planning Area oil and gas platform activities is a 8, 13, or 98 percent chance, respectively. The highest combined probability of an oil spill greater than or equal to 1,000 barrels occurring and reaching loggerhead nesting habitats within 10 days is a 4 percent chance (Hannon and Lear 1990).

Construction of pipelines across barrier islands onto coastal beaches could impact loggerhead sea turtle nesting by habitat disturbance or elimination. Minimal pipeline landfalls or onshore pipeline projects are anticipated as a result of the proposed sale base and high case scenario and future activities.

Offshore pipeline annual and seasonal conditional probability spill estimates have a high of a 33 and 17 percent chance, respectively, of contacting Chandeleur and Breton Islands and Alabama coastal loggerhead nesting habitats within 10 days. The conditional probability of an oil spill greater than or equal to 1,000 barrels occurring from the proposed sale base case, high case, or all Central Gulf of Mexico Planning Area oil and gas pipeline activities is a 9, 15, or 98 percent chance, respectively. The mean number of spills from pipelines for the above conditions is 0.09, 0.16, and 4.17 spills, respectively (Hannon and Lear 1990).

It is projected that there may be a total of three and four shuttle tanker trips for the proposed sale's base and high case scenarios, respectively. The planning and analysis area where the trips would originate is Central coastal area 3 (C-3) which encompasses the most eastern portion of Louisiana. The highest annual or seasonal (summer) conditional probability for a spill to reach either the Chandeleur and Breton Islands or Alabama coastal loggerhead nesting habitats within 10 days from a shuttle tanker spill is less than a 0.5 percent chance within the C-3 area. (U.S. Minerals Management Service 1990; Hannon and Lear 1990).

Some sea turtles may not feed during the nesting process, and in these cases, ingestion of oil and gas activity related trash and debris should not be an impact. Also, since nesting and hatchling emergence occur at night, disturbance from aircraft or boat vessel traffic should be minimal on the beaches.

Although, the chances of oil reaching loggerhead sea turtle nesting beaches within 10 days of a summer spill are moderate to high, the chances of an oil spill occurring and contacting (combined probability) is low and the number of nests which could be harmed is low. Therefore, it is the Fish and Wildlife Service's Opinion that leasing, exploration, development, production, and abandonment oil and gas activities for existing and proposed Central Gulf of Mexico Planning Area leases are not likely to jeopardize the continued existence of the loggerhead sea turtle. However, if new information not considered by the Minerals Management Service or the Fish and Wildlife Service in this Opinion becomes available regarding the loggerhead sea turtle, reinitiation of Section 7 consultation may be required.

Additional study is needed regarding the actual sea turtle nesting that occurs on the Chandeleur Islands. Also, information is still needed regarding chemical and physical impacts to sea turtles from oil dispersants and/or oil as well as sea turtle behavior in regard to oil spill slick avoidance or ingestion of weathered oil products. The Fish and Wildlife



Service's Southeast Region Gulf of Mexico Regional Technical Working Group member has nominated and recommended that both these types of studies be conducted or continued. The Fish and Wildlife Service Sea Turtle Recovery Coordinator and staff of the National Wetlands Research Center have participated in study formulation and planning regarding the above issues.

Alabama beach mouse (Peromyscus polionotus ammobates)

Perdido Key beach mouse (Peromyscus polionotus trissyllepsis)

The Alabama beach mouse and the Perdido Key beach mouse were federally-listed as endangered on June 6, 1985. The mice are two of five subspecies of the old field mouse (Peromyscus polionotus) that occur on the gulf coast of Alabama and Florida (U.S. Fish and Wildlife Service 1989a, 1989b).

The Alabama beach mouse presently survives on disjunct tracts from Fort Morgan State Park to the Bon Secour National Wildlife Refuge, but has apparently disappeared or is non-functional from most of its original range, including all of Ono Island. Critical habitat for the mouse has been designated at Fort Morgan, Bon Secour National Wildlife Refuge, and a portion of the Gulf Shores Unit of the Gulf State Park, in Baldwin County, Alabama (U.S. Fish and Wildlife Service 1989b). However, the mouse appears to be absent from this area (Holler 1991).

The Perdido Key beach mouse is the most endangered of the three subspecies listed by the Fish and Wildlife Service. In 1986, the only known population of this mouse was at Gulf State Park, Alabama. Since then, the subspecies has been reintroduced to Gulf Islands National Seashore on Perdido Key by translocation of individuals from Gulf State Park through a cooperative State and Federal effort (Holler 1989; 1990; U.S. Fish and Wildlife Service 1987, 1989b).

Critical habitat for the subspecies has been designated at three different sites on Perdido Key, one in Alabama and two in Florida. In Alabama, critical habitat is located in Gulf State Park, Baldwin County; in Florida, critical habitat is located in the Perdido Key State Preserve and in the Perdido Key Unit of the Gulf Islands National Seashore, Escambia County (U.S. Fish and Wildlife Service 1987, 1989b).

Loss of habitat is considered to be the primary factor for both subspecies' decline. Also, the loss of habitat has resulted in fragmented populations of the beach mice. Tropical storms are the greatest current hazard to further loss of the subspecies. Their habitat is restricted to the primary and secondary sand dunes and scrub dunes along the gulf. The beach mice dig burrows mainly on the lee side (backside) of the primary dunes and in other secondary and interior dunes where the vegetation provides suitable cover. The mice also use ghost crab (Ocypoda quadratus) burrows. The Perdido Key and Alabama beach mice are nocturnal omnivores. It is thought that the beach mice feed primarily on the seeds of beach grass (Panicum amarum and P. repens) and sea oats (Uniola paniculata), and on insects and small invertebrates. Inland forms feed primarily on seeds and invertebrates (mainly insects) (Holler 1990; 1991; U.S. Fish and Wildlife Service 1987, 1989b).

Although the primary habitat of the beach mice subspecies is on the lee side of the dunes and their inferred food source, sea oats and beach grass, are located above the high tide line, there is a potential for impacts from an oil spill. The National Park Service describes the following occurrence during a small oil spill on Horn Island, Mississippi, in September 1989.

> "Several days after landfall of the Horn Island spill, strong surf action and winds combined to remobilize and distribute significant amounts of oil from the beach face up into the adjacent primary dunes. The spray generated by the wind and surf action was sufficiently oily to completely coat most of the dune vegetation, and resulted in leaf browning which persisted until the next growing season" (Zimmerman 1990).

Given the relatively narrow width of the beaches at Gulf State Park, an oil spill occurring during an episode of high winds and seas (a relatively common occurrence) could result in significant contamination of the primary dune habitat.

Other related, existing, and proposed oil and gas activities which would have an impact on the beach mice include onshore pipeline construction and placement, onshore facility construction, associated aircraft and boat vessel traffic, and offshore related trash and debris. Pipeline construction and placement as well as onshore facilities should be accomplished outside of the dune habitat within the beach mouse ranges and their critical habitat. Aircraft and boat vessel traffic should have minimal impact on the beach mice due to the mice's nocturnal behavior. It is unknown whether the beach mice ingest marine trash and debris mistaking it for food. Although ingestion could affect the mice by interference with the digestive process or produce a fatal response, accumulations of trash and debris do not appear to be a severe problem in beach mice habitats.

According to the Oil Spill Risk Estimates, the highest annual conditional probability of an oil spill starting in the existing and proposed lease areas and reaching beach mice habitat (land segments 22 and 23) within 10 days, is an 18 percent chance. The highest seasonal conditional probability for the same scenario is a 21 percent chance (Hannon and Lear 1990).

The conditional probability of an oil spill greater than or equal to 1,000 barrels occurring from the proposed sale base case, high case, or all Central Gulf of Mexico Planning Area oil and gas platform activities is a 8, 13, or 98 percent chance, respectively. The highest combined probability of an oil spill greater than or equal to 1,000 barrels occurring and reaching Alabama beach mice or Perdido Key beach mice habitat within 10 days is a 1 percent chance (Hannon and Lear 1990).



Offshore pipeline annual and seasonal conditional probability spill estimates have a high of a 28 percent chance of contacting beach mice habitats within 10 days. The conditional probability of an oil spill greater than or equal to 1,000 barrels occurring from the proposed sale base case, high case, or all Central Gulf of Mexico Planning Area oil and gas pipeline activities is a 9, 15, or 98 percent chance, respectively. The mean number of spills from pipelines for the above conditions is 0.09, 0.16, and 4.17 spills, respectively (Hannon and Lear 1990).

It is projected that there may be a total of three and four shuttle tanker trips for the proposed sale's base and high case scenarios, respectively. The planning and analysis area where the trips would originate is Central coastal area 3 (C-3) which encompasses the most eastern portion of Louisiana. The highest annual or seasonal conditional probability for a spill from a shuttle tanker within the C-3 area to reach beach mice habitat within 10 days is less than an 0.5 percent chance (U.S. Minerals Management Service 1990).

Since new onshore facilities construction is anticipated to be minimal and the possibility of an oil spill occurring and contacting (combined probability) Alabama beach mouse or Perdido Key beach mice habitat is low, it is the Fish and Wildlife Service's Opinion that leasing, exploration, development, production, and abandonment activities for existing and proposed Central Gulf of Mexico Planning Area leases are not likely to jeopardize the continued existence of the Alabama beach mouse or the Perdido Key beach mouse or destroy or adversely modify their critical habitat. However, should any onshore pipelines or facilities construction activities requiring any action by the Minerals Management Service be proposed in either of the beach mice's critical habitat, Section 7 consultation will be required.

In addition, if new information not considered by the Minerals Management Service or the Fish and Wildlife Service in this Opinion becomes available regarding the Alabama beach mouse or the Perdido Key beach mouse, reinitiation of Section 7 consultation may be required.

**Biological Opinion**

It is the Fish and Wildlife Service's Opinion that the existing and proposed Outer Continental Shelf oil and gas leasing, exploration, development, production, and abandonment activities in the area of the Central Gulf of Mexico Planning Area under the leasing and regulatory authorities of the Minerals Management Service, are not likely to jeopardize the continued existence of listed species under the Fish and Wildlife Service's jurisdiction or destroy or adversely modify their critical habitat.

Also, formal consultation must be reinitiated if new information reveals impacts on listed species or their habitat from Minerals Management Service actions that were not considered in this Opinion, if the proposed project is subsequently modified, or if a new species is listed or critical habitat is designated which may be affected by the existing and proposed actions.

**Incidental Take**

In meeting the provisions for incidental take in Section 7(b)(4) of the Endangered Species Act, we have reviewed the Opinion and all available information relevant to oil and gas activities. Based on the review, incidental take is not anticipated and, thus, not authorized for listed species. If the taking of a listed species under Fish and Wildlife Service jurisdiction should occur, the Fish and Wildlife Service's Regional Office in Atlanta should be notified immediately at (404) 331-3580 to determine whether reinitiation of consultation is necessary.

**Proposed Species**

Gulf of Mexico sturgeon (Acipenser oxyrhynchus desotoi)

The Secretary of the Interior approved listing of the Gulf of Mexico sturgeon as threatened in April 1990. The Proposed Rule was published in the Federal Register May 2, 1990.

The Gulf of Mexico sturgeon is a subspecies of the Atlantic sturgeon and is known to occur in most major rivers from the Mississippi River to the Suwannee River and in marine waters of the Central and Eastern Gulf of Mexico south to Florida Bay. Sturgeon in Alabama, Mississippi, and Louisiana can be described as rare; recent specimens have been obtained from Lake Ponchartrain, Pearl River, Pascagoula River, and the Mobile River. No catches of Gulf of Mexico sturgeon been recorded in Federal waters in the Gulf of Mexico. There has been no effort to the sturgeon during their offshore migration. Critical habitat is not proposed for the Gulf of Mexico sturgeon (Barkuloo 1988).

The sturgeon virtually disappeared throughout much of its range at the turn of the century. The declines were attributed to damming of rivers and other forms of habitat destruction, over-exploitation, and deterioration of water quality (Barkuloo 1988).

The Gulf of Mexico sturgeon spends a major portion of its life in rivers or bays, and makes winter marine migrations as they grow older. No studies have delineated the Gulf of Mexico sturgeon's marine habitats. Limited stomach analyses from Suwannee and Apalachicola River sturgeon indicate that sand bottom, hard bottom, and seagrass communities are probably very important marine habitats for A. o. desotoi. Our conclusion on habitat preference/utilization is circumstantial; however, if true, this could explain why the Eastern Gulf of Mexico has historically had larger populations than the central gulf, and why their range does not include the western gulf. Benthic marine habitats in the western gulf are mostly mud,



clay, and silt, with frequent incursions of organic nepheloid layers, almost the opposite of conditions in the eastern gulf (Barkuloo 1988).

The Gulf of Mexico sturgeon would be most vulnerable to oil spills during the winter marine migrations. Since the sturgeon is a benthic feeder, ingestion of contaminated sediments, organisms, or vegetation could occur once spilled oil has settled to the seafloor. The ability to sense and avoid oiled areas by sturgeon is unknown.

The adult sturgeon does little or no feeding in freshwater; and therefore, its growth and reproductive potential depend entirely on the resources accumulated by feeding during winter migrations. Consumption of contaminated food sources could lead to general body deterioration, lower reproductive potential, and lower viability of offspring. Information is also lacking on whether sturgeon aggregate during the winter migrations. Data suggests, however, that adults tend to enter and leave the freshwater system within a very narrow time period (Barkuloo 1988).

The conditional probability of an oil spill greater than or equal to 1,000 barrels occurring from the proposed sale base case, high case, or all Central Gulf of Mexico Planning Area oil and gas platform activities is 3 8, 13, or 98 percent chance, respectively.

The Gulf of Mexico sturgeon would be most affected by offshore oil and gas related structure removal (abandonment) during the winter migrations. The sturgeon is a benthic feeder and could be attracted to offshore structures. However, it has not been documented how far offshore Gulf of Mexico sturgeon migrate in winter. Also, the ability of the sturgeon to avoid an area where an offshore structure is being removed is unknown.

Analysis of known information on the Gulf of Mexico sturgeon indicates that leasing, exploration, development, production, and abandonment of oil and gas activities from the existing and proposed lease sale is not likely to jeopardize the continued existence of the Gulf of Mexico sturgeon. This constitutes an informal conference on the species for the existing and proposed activities. Should the Gulf of Mexico sturgeon be final listed or new information be developed before this action, consultation may need to be reinitiated.

Incidental take is not anticipated, and thus, not authorized for this species. If the taking of this species should occur, the Fish and Wildlife Service's Regional Office in Atlanta should be notified immediately at (404) 331-3580 to determine whether reinitiation of consultation is necessary.

There is a major gap in information on the Gulf of Mexico sturgeon's migratory habits. The offshore marine habitats have not been located due to researcher's inability to locate or track these fish in salt water. A study of this fish using acoustic tracking devices has been ranked moderately high by the Gulf of Mexico Regional Technical Working Group for inclusion into Minerals Management Service's Environmental Studies Program regarding Outer Continental Shelf oil and gas activities.

**Candidate Species**

Southeastern Snowy Plover (Charadrius alexandrinus tenuirostris)

The Fish and Wildlife Service considers the Southeastern snowy plover to be a Category 2 candidate for listing. Category 2 comprises taxa for which information now in possession of the Fish and Wildlife Service indicates that proposing to list as endangered or threatened is possibly appropriate, but for which conclusive data on biological vulnerability and threat are not currently available to support proposed rules. However, a recent report by the Florida Game and Fresh Water Fish Commission, partially funded by the Fish and Wildlife Service, indicates that the species could be proposed for listing in the foreseeable future.

The southeastern snowy plover is one of two subspecies of the snowy plover (Charadrius alexandrinus). The Southeastern snowy plover breeds along the gulf coast from Mexico to south Florida and on larger islands in the Caribbean. In Alabama, Mississippi, and Louisiana, snowy plovers occur only along sand beaches on the gulf coast. The snowy plover requires both dry and tidal sand flats for foraging. The birds feed on small crustaceans, mollusks, worms, and insects that they glean from beaches and sand flats (Gore 1990).

Throughout its range in the Southeast, the snowy plover's requirements for breeding habitat place it in conflict with humans. The sand beaches that the birds prefer for nesting are also highly desirable recreational resources for human populations. Unfortunately, snowy plovers do not tolerate much disturbance near their nests, and typically avoid or abandon beaches that are frequented by people. This loss of nesting habitat has led to an apparent decline in the number of snowy plovers breeding in the Southeast. Other known causes of decline include storms, vehicles, and predators (Gore 1990).

During a breeding population survey in 1989, approximately 30 pairs of the bird were estimated in Alabama and Mississippi (Chase and Gore 1989; Gore 1990). In Alabama, the plover has regularly nested at Fort Morgan, Baldwin County and Dauphin Island, and Sand Island, Mobile County in the past (Chase and Gore 1989). The plover occurs on Horn, Petit Bois, and East and West Ship Islands off Mississippi. In 1990, approximately 20 to 30 breeding pairs were observed on the gulf-facing side of the islands. Another 60 birds were counted as wintering on the island in 1990 to 1991. Wintering birds use habitat at the tips of the islands (Chase and Gore 1989; Simons 1991). In a 1990 survey conducted in conjunction with a sea turtle nesting/stranding survey on Breton National Wildlife Refuge no snowy plovers were observed (Fuller 1990).



Impacts to the snowy plover from oil spills would be caused by fouling of foraging habitat. Ingestion of oil could occur during the feeding process. Some oiling may occur through direct contact with oiled sediments or waves in the splash zone.

According to the Oil Spill Risk Estimates, the highest annual probability of an oil spill starting in the existing and proposed lease areas and reaching snowy plover habitat (land segments 21, 22, and 23) within 10 days, is 23 percent. The highest seasonal (winter or summer) conditional probability for the same scenario is 23 percent (Hannon and Lear 1990).

The conditional probability of an oil spill greater than or equal to 1,000 barrels occurring from the proposed sale base case, high case, or all Central Gulf of Mexico Planning Area oil and gas platform activities is a 8, 13, or 98 percent, respectively. The highest combined probability of an oil spill greater than or equal to 1,000 barrels occurring and reaching snowy plover habitat within 10 days is a 3 percent (Hannon and Lear 1990).

Probably the greatest impact resulting from proposed oil and gas activities would be from onshore pipeline placement and construction, onshore facility construction, and disturbance by aircraft. All these activities could cause reduced or abandonment of nesting sites and temporary displacement from wintering habitats.

Offshore pipeline annual and seasonal (spring) conditional probability spill estimates have a high of a 56 percent chance of contacting snowy plover habitats within 10 days. The conditional probability of an oil spill greater than or equal to 1,000 barrels occurring from the proposed sale base case, high case, or all Central Gulf of Mexico Planning Area oil and gas pipeline activities is 9, 15, or 98 percent, respectively. The mean number of spills from pipelines for the above conditions is 0.09, 0.16, and 4.17 spills, respectively (Hannon and Lear 1990).

Although there is a moderately high chance that snowy plover habitats would be contacted within 10 days of an pipeline oil spill, the probability of impacts from these disturbances are anticipated to be low due to the anticipated minimal activity or construction as a result of this lease sale. Impacts on the snowy plover from ingestion, contact, or entanglement from trash and debris is not expected to be significant.

Temporary displacement by aircraft traffic may also have an impact on the snowy plover. The Gulf of Mexico Outer Continental Shelf Region Office, Minerals Management Service, by letter dated August 30, 1990, recommends to lessees and operators that they require all aircraft used in support of their Outer Continental Shelf oil and gas operations to maintain altitudes of 2,000 feet or more when flying over all lands located within national wildlife refuges and national parks and seashores (Pearcy 1990).

It is projected that there may be a total of three and four shuttle tanker trips for the proposed sale's base and high case scenarios, respectively. The planning and analysis area where the trips would originate is Central coastal area 3 (C-3) which encompasses the most eastern portion of Louisiana. The highest annual or seasonal conditional probability for a spill from a shuttle tanker within the C-3 area to reach snowy plover habitat within 10 days is less than an 0.5 percent chance (U.S. Minerals Management Service 1990).

The Fish and Wildlife Service has no specific advisory guidance to provide for the southeastern snowy plover at this time.

**Conservation Recommendations**

The Minerals Management Service requires that lessees prepare and submit oil spill contingency plans with all permit applications in accordance with 30 CFR 250.33, 30 CFR 250.34, and 30 CFR 250.42. The plans must contain assurances that a full response capability exists for commitment in the event of an oil spill. Such a commitment includes specification of appropriate equipment and materials, their availability and deployment time, and provisions for varying degrees of response effort, depending on the severity of the spill. A Letter to Lessees (LTL) was issued by the Minerals Management Service Gulf of Mexico Outer Continental Shelf Regional Office on February 1, 1989, and September 5, 1989, providing guidelines for preparation of the oil spill contingency plans.

The historical record for Gulf of Mexico oil and gas offshore operations including exploration, development, production, and abandonment activities, from rigs, platforms, and pipelines (excluding oil transported by shuttle tanker or barge to shore-base-facilities) indicates five oil spills of 10,000 barrels or more have occurred from 1969 to 1989. An estimated 279,000 barrels have been spilled. Spills occurring in the early years were closer to the coast, whereas current activities are concentrated further offshore, thereby, increasing distances to shore.

In order to reduce impacts on threatened and endangered species, we recommend that the Minerals Management Service continue to require the petroleum industry to prepare adequate oil spill contingency plans for all activities. This should include the strategic placement of appropriate spill cleanup equipment, personnel training in cleanup techniques, and demonstration of response capabilities and implementation. Further, the Fish and Wildlife Service recommends the Minerals Management Service adopt the following conservation recommendations to minimize any potential impacts on the nesting and foraging habitats of the bald eagle, the nesting activity of loggerhead sea turtles, winter habitats of the piping plover, and the winter migratory habitat of the Arctic peregrine falcon.

(1) Specific oil spill contingency response plans for protecting the above identified species' activities (except the peregrine falcon for pipelines)



be included for each Plan of Exploration, Development, Production, and pipeline applications in the following lease blocks:

- -Mobile Area blocks 766, 809-816, 819-824, 826-830, 853-874, 898-918, 942-962, 987-1006
- -South Pass Area blocks 28, 32-34, 36-38, 43-58, 59-69, 70-73, 78
- -South Pass South Addition Area blocks 74-96
- -Mississippi Canyon Area blocks 21, 22, 109, 110, 147-153, 191-197, 234-241, 265, 266, 278-285, 309-313, 321-329, 353-373, 397-417, 441-461, 485-505
- -West Delta Area blocks 17-24, 28-36, 39-50, 57-68, 69-80, 85-154
- -West Cameron Area blocks 19-30, 34-48, 53-83, 90-118, 123-156, 161-191, 195-227, 287-315
- -Sabine Pass Area blocks 6-15
- -Ship Shoal Area blocks 9-14, 25-38, 49-63, 68-100, 112-115

Pipeline applications only lease blocks:
- -Main Pass Area all blocks
- -Grand Isle Area all blocks
- -South Pelto Area all blocks
- -South Timbalier Area blocks 20-107, 122-120
- -Eugene Island Area blocks 19-144

The response plans should include but not be limited to, identification of the identified species' habitat, oil spill trajectory modeling to ascertain the time for oil to reach the habitats, implementation plans for protection of the nesting habitats in case of an oil spill, cleanup methods, and State and Federal resource manager contacts.

In accordance with 50 CFR 27.34 the unauthorized operation of aircraft at altitudes resulting in harassment of wildlife above refuges is prohibited. Refuge boundaries are designated on Federal Aviation Administration aeronautical charts.

To further minimize impacts to endangered and threatened species, we recommend the Minerals Management Service continue to recommend that lessees' aircraft operators to adhere to the above altitude restrictions over national wildlife refuges and parks (including national seashores). In particular, Minerals Management Service should determine areas of significant pelican nesting and specifically recommend that lessees' aircraft operators maintain the minimum altitude restriction over these areas during the pelican's nesting season.

As cited in the Opinion, the Minerals Management Service has issued a special advisory (NTL 86-11) and promulgated regulations (30 CFR 250.40) to assure lessees do 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 (U.S. Minerals Management Service 1990).

To further minimize impacts to endangered and threatened species, we recommend the Minerals Management Service continue to enforce their regulations regarding marine debris disposal from offshore oil and gas operations.



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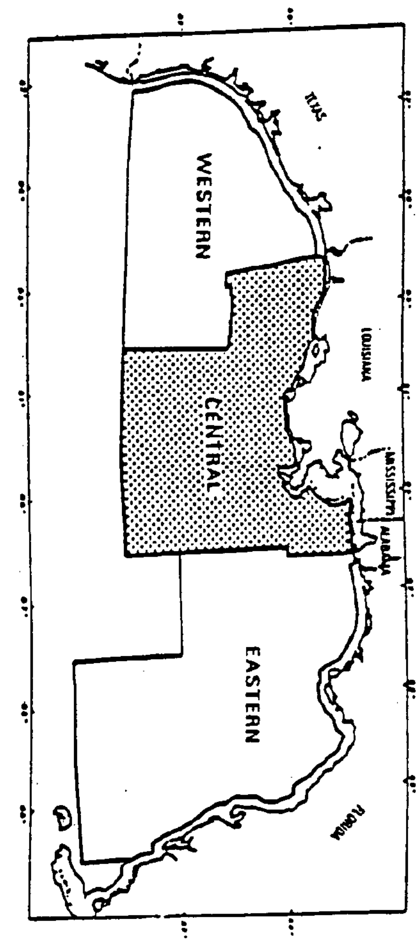
Figure 1: Central Gulf of Mexico Outer Continental Shelf Planning Area



# U.S. Fish and Wildlife Service

# Biological Opinion

# Western Gulf of Mexico

# Sale 141

United States Department of the Interior
Fish and Wildlife Service
DIVISION OF ECOLOGICAL SERVICES
17629 EL CAMINO REAL, SUITE 211
HOUSTON, TEXAS 77058

RECEIVED
JAN 9 1991
Minerals Management Service
Leasing & Environment

January 4, 1991

**MEMORANDUM**

To: Associate Director for Offshore Minerals Management, Minerals Management Service, Washington, D.C.

From: Acting Field Supervisor, U.S. Fish & Wildlife Service, Ecological Services, Houston, TX

Subject: Formal Consultation for Proposed Outer Continental Shelf Oil and Gas Lease Sale (Unnumbered) for the Western Gulf of Mexico under the Endangered Species Act, Section 7

Your letter dated October 4, 1990, requesting formal consultation for the proposed lease sale, pointed out that the June 19, 1987, biological opinion for the Gulf of Mexico Western Planning Area (WPA) was up-to-date and effective. We concur with this finding and you may consider the biological opinion and conservation recommendations as current.

If you have any questions, please contact Fred Werner, the Gulf WPA Coordinator, here at our Clear Lake Field Office (FTS: 526-6700).

Brian W. Cain

cc:
Regional Director, Gulf of Mexico OCS, Minerals Management Service,
Attn: Patrick Mangan, New Orleans, LA
Director, FWS, Washington, D.C. (FWS/DHC/BFA)
Regional Director, FWS, Attn: HC (Paul Fore), Albuquerque, NM

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Attachment 1

United States Department of the Interior
FISH AND WILDLIFE SERVICE
POST OFFICE BOX 1306
ALBUQUERQUE, N.M. 87103

In Reply Refer To:
Region 2/FWE

JUN 19 1987

Consultation No.: 2-13-87-F-28

**MEMORANDUM**

To: Director, Minerals Management Service, Washington, DC

From: Regional Director, U.S. Fish and Wildlife Service, Region 2, Albuquerque, NM

Subject: Endangered Species Act: Biological Opinion for Outer Continental Shelf Oil and Gas Lease, Sale No. 115, Western Gulf of Mexico.

By memorandum dated January 12, 1987, the Minerals Management Service requested the reinitiation of formal consultation with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act to consider all operations pertaining to Outer Continental Shelf oil and gas lease No. 115. This biological opinion covers the western Gulf of Mexico planning area, which borders Texas. This consultation was extended to June 15, 1987, by mutual agreement.

This biological opinion updates our October 25, 1982, opinion for the programmatic eastern, central, and western Gulf of Mexico oil and gas lease sales. The previous opinion addressed only the leasing and exploration aspects of oil and gas operations whereas this will, in addition, evaluate development and production. Platform removal will be included in National Marine Fisheries Service biological opinions.

Background Information

Since this is a reinitiation of a previous consultation on essentially the same region, comments will generally reference the previous biological opinion of October 25, 1982, and the statements in that opinion stand unless new information and new activities consulted on necessitate additional comment. This opinion is also based on updated oil spill risk analysis, discussions with experts on the various threatened and endangered species, field observations of species distribution and their reaction to oil spills, and selected literature.

There are two areas of concern when considering potential effects of oil and gas activities on endangered or threatened species. First is the chance of an oil spill impacting listed species. For this evaluation we used the accepted risk analysis for the spills from the western Gulf of Mexico under the Most Likely Find Scenario for sale 115, and for spills from the total aggregate of sources including past, proposed, and future sales for the entire Gulf, as well as transportation of imported oil through the Gulf. Spill projections presented are the percent probability that one or more spills of at least 1,000 barrels will strike a given target within 30 days of the initiation of the spill during the expected 35-year production life of the proposed lease area.

The second major source of potential impact is the development of onshore facilities that include pipelines, separator facilities, offices, helicopter and fixed-wing aircraft facilities, boat docks, refineries, gas processing plants, and other support bases. There is an extensive history of intensive oil and gas activity in the Gulf of Mexico, and numerous onshore facilities have been established throughout the region. The development of new onshore facilities is difficult to predict. This evaluation is, therefore, based largely on our past experiences with onshore facility development.

The following endangered species occur in Texas coastal counties, but are not likely to be affected by the proposed action: Aplomado falcon (Falco femoralis), Attwater's greater prairie-chicken (Tympanuchus cupido attwateri), red-cockaded woodpecker (Picoides borealis), black lace cactus (Echinocereus reichenbachii var. alberti), slender-rush pea (Hoffmannseggia tenella), and Texas bitterweed (Hymenoxys texana). The red wolf (Canis rufus) no longer occurs in Texas. The leatherback sea turtle (Dermochelys coriacea) occurs in Texas waters, but not on shores covered by this opinion. The National Marine Fisheries Service biological opinion will address any potential waterborne impacts to sea turtles and marine mammals.

Brown Pelican (Pelecanus occidentalis)

The nesting habitat of these colonial birds is small coastal islands in salt and brackish waters. Nests are constructed from available vegetation. The major food of the pelican is fish, including menhaden, mullet, sardines, and pinfish. The brown pelican catches fish by plunge-diving in coastal waters. Brown pelicans are rarely found away from saltwater and typically do not venture more than 20 miles out to sea. Extensive use of pesticides, which are ultimately ingested by the brown pelican, is the primary cause of the current population decline.

There is only one remaining brown pelican nesting site in Texas - Pelican Island in Nueces County. However, this colony is prospering with 300 nesting pairs in 1986. Current recovery planning aims at transplanting some of these nestlings to other Texas coastal islands, to establish additional breeding locations, but the specific transplant islands have not been identified. The brown pelican is extremely susceptible to disturbance, including low flying aircraft, and habitat alteration of key nesting areas. The disturbance of nesting colonies can cause nest desertion and egg losses.



Pelicans may be susceptible to oil spills. As brown pelicans dive for fish, their entire body can be coated with oil. This may contribute to direct mortality (King et al. 1979) or could result in a secondary impact in reduced hatchability of eggs that may become oiled by a contaminated adult bird. Even though the island nesting site in Texas might be partially protected by seaward barrier islands from the direct impact of an oil spill in the open Gulf, the wide-ranging nature of the birds when foraging would amplify the possibility of oil contamination. The most damaging effect of oil contamination on brown pelicans would likely be on reproduction. Due to the bird's feeding habits, it is reasonable to assume that adult brown pelicans might in fact avoid feeding in oiled waters because of the difficulty in observing fish beneath the surface. But very small amounts of certain crude and refined oils applied to the surface of eggs cause high embryonic mortality or morphological abnormalities in a variety of avian species (Albers 1982, King and Lefever 1979, Lewis and Malecki 1984, White et al. 1979). If spills occur during the nesting season of the brown pelican, oil can be transferred to eggs from feathers or feet of adults, resulting in reduced hatching rates. Under a worst case oil spill scenario, a full year's reproduction could be lost and an unknown number of adults killed. The impact of oil spills on the recoverability of brown pelicans in the Texas coastal region could be substantial. The probability of Nueces County receiving spilled oil from the proposed sale is 2 percent and 35 percent from the aggregate of sources.

Whooping Crane (Grus americana)

The wintering range of the entire reproducing wild population of the whooping crane exists along the Texas coast, including a portion of the critical habitat (Aransas, Calhoun, and Matagorda Counties). In recent years, as their population has increased, there has been a tendency for some whoopers to defend smaller winter territories than in the past, which results in more whooping cranes per unit of area in the traditional use areas. Others, though, are wintering away from these areas. These birds feed largely on crabs and clams while wading in tidal flats, shallow bays and channels. Oiled waters in these habitats could pose a considerable threat if a spill occurred between November and late April, when the cranes are on their wintering grounds. As with brown pelican nesting sites, this wintering habitat of whooping cranes is protected to some extent from oil spills in the open Gulf by barrier islands, but the loss of even a relatively small portion of a population, estimated to consist of approximately 110 individuals, could have a drastic impact on the continued existence of the species. The probability of whooping crane foraging habitat being impacted by one or more substantial oil spills is 2 percent for the proposed lease sale. This increases to 49 percent for the total aggregate of oil sources.

Like the brown pelican, the whooping crane is subject to disturbance from low flying aircraft, particularly helicopters.

Bald Eagle (Haliaeetus leucocephalus)

Bald eagles are opportunistic feeders, with fish constituting the bulk of their diet. They will also feed on waterfowl and shorebirds, particularly sick or injured individuals, as well as carrion. Throughout most of the bald eagle's range, its population decline has been largely attributed to the effect of pesticide ingestion, which resulted in eggshell thinning, and indiscriminate shooting of both immature and adult birds.

In 1986, there were 10 active bald eagle nests in four Texas coastal counties: Victoria (3), Calhoun (1), Matagorda (2), and Brazoria (4). In addition, there is a larger population of wintering bald eagles distributed throughout the upper Texas coast, with concentrations at reservoirs and major waterfowl wintering sites.

The two potential sources of impact to the eagle from the oil and gas activities are disturbance to its nests, resulting from development of onshore facilities, and the possibility of an oil spill reaching the coast and contaminating the food source of the eagle. It can be expected that bald eagles might be attracted to the area of a spill by dead and dying fish and birds as a food source and, thereby, consume oil adhering to prey species. Nevertheless, evidence from other species of birds suggests that adult birds may be able to tolerate the ingestion of fairly high concentrations of crude oil. However, oil on plumage could adversely affect reproduction through contamination of eggs from adults carrying oil on breast feathers and feet.

Arctic Peregrine Falcon (Falco peregrinus tundrius)

This subspecies breeds in the North American tundra and winters along the gulf coast from Florida, west to the eastern Mexican coast and Baja California, south to mid-Chile and mid-Argentina, and possibly on Pacific Islands.

Field and laboratory evidence indicates that the decline of peregrine populations is generally due to the presence of chlorinated hydrocarbon pesticides in the falcon's food supply (Evans 1982). This leads to reproductive failure through eggshell thinning and non-viable eggs, as well as increased adult mortality. Other factors which may cause local decreases in reproductive success are human disturbance and adverse weather conditions during nesting.

The Arctic peregrine falcon feeds mostly on a wide variety of birds. Peregrines will kill oiled birds and in doing so, ingest considerable numbers of feathers with their meal. The impact of this ingested oil is unknown.

Essential habitat for the Arctic peregrine falcon includes preferred breeding areas near rivers, lakes, or the sea in the Arctic tundra, where nesting sites include cliffs, dikes, cutbanks, and occasionally boulders,



hummocks, or the ground. While the Arctic peregrine falcon migrates south through a broad area of eastern and middle North America to the gulf coast, it funnels into coastal areas and concentrates along the beaches and barrier islands, especially on Padre Island, Texas. The total North American population of Arctic peregrine falcons is estimated to be 20,000. Each year 2,000 - 5,000 of these birds migrate through Padre Island, with an average stay of 10 - 12 days. An additional 100 - 200 birds winter on the Texas coast.

The possible impacts on Arctic peregrine falcons from the oil and gas activities include the contamination of food sources and disruption of habitat along their migration route.

Jaguarundi (Felis yagouaroundi cacomitli)

The jaguarundi was listed as an endangered species on June 14, 1976. This small nocturnal cat is very elusive and difficult to study. About twice the size of a domestic cat, it has two color phases, one grayish, the other reddish. Males are about 3.5 feet long, of which the tail is more than half (Davis 1974). It is thought to occur in the lower Rio Grande valley with sporadic unconfirmed sightings as far north as Brazoria County. Loss of its prime habitat, native brushlands, is the main reason for its decline.

The development of onshore oil and gas service bases has caused the clearing of native brush. Future similar developments would further reduce available habitat.

Ocelot (Felis pardalis)

The ocelot was listed as an endangered species on July 21, 1982. This spotted cat is also relatively unstudied. Adult males may be as much as 3 feet, 10 inches long; females up to 3 feet, and weigh 20 - 35 pounds (Davis 1974).

In the United States, the ocelot is confined to native brushlands in the lower Rio Grande valley, and a small area of southeast Arizona. Predator control activities and brush clearing have greatly reduced the population. Brush clearing associated with onshore oil and gas developments in south Texas would contribute to its decline and inhibit recovery efforts.

Eskimo Curlew (Numenius borealis)

The Eskimo curlew was listed as an endangered species on March 11, 1967. This formerly abundant shorebird previously nested in the Arctic tundra and wintered in southern South America. The population decreased drastically in the 1880's, apparently from spring market hunting (Gallup et al. 1986).

Since 1945, there have been eleven sightings of one or more Eskimo curlews on the Texas coast. The most recent sighting on May 7, 1981, was of 23 birds on Atkinson Island in Galveston Bay. Habitats used have included sand flats, grassy marshes, and grazed pasture. The most recent sighting anywhere was of 6 birds on Kendall Island, Northwest Territories, Canada on July 10, 1985.

This species is nearly extinct, so the loss of even one individual would be very serious. The Texas coast was, and possibly is, a regular stopping point on its spring migration (fall migration was primarily over the Atlantic Ocean off the eastern United States). Eskimo curlews could be killed by an oil spill striking the Texas coast. The probability of an oil spill striking Galveston County is 5 percent from the proposed sale and 89 percent from the aggregate sources.

Piping Plover (Charadrius melodus)

The piping plover is listed as endangered in the Great Lakes watershed and as threatened in the remainder of its range, including Texas. This species has three primary breeding areas: the mid-continent prairies, the Great Lakes, and the Atlantic coast from North Carolina to the maritime provinces. It winters on the Atlantic Ocean and Gulf of Mexico coasts and on Caribbean islands. Preliminary information indicates that Texas is the most important wintering area. The estimated world population is 4,000 birds with at least 400 wintering in Texas (Haig and Oring 1985). Throughout its range, the piping plover uses unvegetated open sand areas where it feeds mainly on surface and infaunal invertebrates. In Texas, the extensive sand flats of the Laguna Madre and sand flats associated with barrier island passes and river mouths are the most important habitats. These areas are subject to heavy disturbance from recreational use, and are also susceptible to damage from oil spills. Although shorebirds have a tendency to avoid oiled beaches, this does not totally eliminate direct oiling of birds. In addition, an oil spill forces birds to use less desirable feeding areas until the cleanup is completed. There is also some evidence of long-term reduction of infaunal populations following an oil spill. This could lower the habitat quality of prime wintering sites for an undetermined period.

Because the piping plover is so very restricted to coastal sand habitats, it is one of the species that could be most severely damaged by an oil spill.

Sea Turtles

Studies on the effects of petroleum on the development and survival of marine turtle embryos are inconclusive. The results of these studies indicate that oil remaining on the beach approximately one year after a spill did not cause significant mortality in sea turtle eggs; however, fresh crude oil deposited on sand above a nest can cause extensive mortality to



incubating sea turtle eggs. Important variables in determining the chance of damage are the stage of nesting, the amount of weathering the oil has undergone, and the height of deposition on the beach (Fritts and McGehee 1982). In addition, it has been proposed that the release of some chemical substance guides the turtle on its return from the sea to the natal beach for nesting (Lutz et al. 1986). Oil on the beach could interfere with these chemical guides, as well as physically impede nesting attempts. More definitive information is needed to assess the impacts of oiling on sea turtle nesting beaches.

Kemp's Ridley Sea Turtle (Lepidochelys kempii)

Except for sporadic nests on Padre Island, Texas, and at scattered locations on the Mexican Gulf coast, the entire population of this species nests on approximately 17 miles of beach at Rancho Nuevo, Tamaulipas, Mexico (Hopkins and Richardson 1984). Since 1978, the U.S. Fish and Wildlife Service has been involved in an international cooperative project designed to establish nesting sites in the United States. Eggs are collected in Mexico, transported to Padre Island National Seashore, and placed in artificial nests. After hatchlings are released from these nests into the water, they are recaptured and raised in "head start" facilities until they are mature enough to be released into the Gulf. It is hoped that this procedure will result in turtles that are imprinted on Padre Island as a nesting site, and that they will return there when sexually mature. The impacts of a fresh oil spill would probably be significant if the oil hit the beaches during the nesting season. The probability of a 1,000 barrel or more oil spill striking some part of Padre Island within 30 days of its inception is 3 percent. When the aggregate of oil sources are considered, this probability climbs to 51 percent. Such probability figures are high enough to warrant concern.

The likelihood of oil spilled from a well in the U.S. western Gulf of Mexico striking the Rancho Nuevo beach is small, approximately 1 percent. If tanker oil transported in U.S. waters is considered, the probability increases to at least 16 percent. Oil production in Mexican waters increases the probability by an unknown but significant amount. The IXTOC oil spill in 1979 oiled the Rancho Nuevo beaches.

Green Sea Turtle (Chelonia mydas)

The green sea turtle is listed as threatened in all of its range except the state waters of Florida and the Pacific coast of Mexico, where it is endangered. This turtle has a broad, heart-shaped shell and a small head, and is found throughout the world in tropical and semi-tropical waters. In eastern North America, it is found from the coasts of Massachusetts to Mexico. The known U.S. nesting is limited to southern Florida beaches. It also nests in small numbers at scattered locations on the Mexican gulf coast. Oil spill probabilities for the Mexican gulf coast are as described for the Rancho Nuevo beaches.

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Loggerhead Sea Turtle (<u>Caretta caretta</u>)

The threatened loggerhead sea turtle nesting is scattered along most of the Gulf of Mexico. The oil spill probabilities for the Mexican gulf coast are as described for the Rancho Nuevo beaches.

Hawksbill Sea Turtle (<u>Eretmochelys imbricata</u>)

The distribution of the hawksbill in the Atlantic Ocean extends from southern Brazil to Massachusetts. Nesting occurs on scattered islands and shores generally between 25 degrees north and south latitude, including beaches in the states of Campeche and Yucatan, Mexico.

Hawksbills frequent rocky areas, reefs, shallow coastal areas, lagoons of oceanic islands, and narrow creeks and passes, and are generally found in water less than 20 meters deep. Hatchlings are often found floating in masses of sea plants. The hawksbill feeds on the bottom and forages close to shores and reefs. It is omnivorous although it prefers invertebrates.

Precise population estimates are not available. Although the former distribution was probably equal to the present, population numbers have declined considerably. Many nesting beaches have been abandoned due to natural disasters (such as hurricanes and erosion), alteration of habitat, or commercial utilization by man.

The probability of oil spilled from a well in the U.S. western Gulf of Mexico striking the Campeche and Yucatan nesting beaches is less than one percent. Tanker oil transport and Mexican offshore oil and gas operations increase the probability by an unknown amount.

<u>BIOLOGICAL OPINION</u>

It is my biological opinion that the proposed activities are not likely to jeopardize the continued existence of any species addressed in this biological opinion. It is also not likely that the proposed action would result in the destruction or adverse modification of critical habitat of the whooping crane.

<u>INCIDENTAL TAKE</u>

No incidental take of any species is anticipated to result from the proposed action. In the event that an incident occurs as part of and during the course of the activities covered by this opinion that could result in the incidental take of listed species, the activities causing the incident must be terminated and consultation must be reinitiated so the degree and amount of anticipated incidental take can be assessed and reasonable and prudent measures can be developed to reduce the levels of such take.

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<u>CONSERVATION RECOMMENDATIONS</u>

In order to reduce impacts on threatened and endangered species, we recommend that the Minerals Management Service continue to require the petroleum industry to prepare oil spill contingency plans for all activities. This should include the strategic placement of spill cleanup equipment, training personnel in both cleanup techniques and providing them with locations of sensitive threatened and endangered species habitats. To avoid disturbance of brown pelican nesting activities, we recommend all aircraft, both helicopter and fixed wing, be required to avoid flying lower than 1,000 feet above ground level over Pelican Island or within a 2,000 foot perimeter around this island in Corpus Christi Bay. In addition, to avoid disturbing wintering whooping cranes between October 15 and April 15, all aircraft should fly above 1,000 feet over Aransas National Wildlife Refuge; whooping crane critical habitat in Aransas, Calhoun, and Refugio Counties; Blackjack Peninsula; the northern 1/2 of San Jose Island; and the southern two-thirds of Matagorda Island.

To avoid or reduce oil spill damages to sea turtle nesting activities, we recommend that the Minerals Management Service continue to require the petroleum industry to prepare contingency plans to remove eggs from beaches that are imminently expected to receive spilled oil. The eggs should be incubated and the young turtles released in an uncontaminated area. Research should be conducted on the measures needed to rehabilitate oil impacted turtles.

There remains for consideration the cumulative effects of State and private actions in the western Gulf of Mexico region that are reasonably certain to occur prior to completion of the Federal action which is the subject of this consultation. Since no specific information on such actions has been provided to us, we reserve the right to make a supplementary comment on the potential effects of these projects (cumulative effects).

Formal consultation must be reinitiated if new information reveals impacts on listed species or their habitats from this Federal project that were not considered in this opinion, if the proposed project is subsequently modified, or if a new species is listed or critical habitat is designated which may be affected by the proposed actions.

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# Appendix C

# Resource Estimates Guidelines

# ESTIMATES OF QUANTITIES OF UNDISCOVERED RESOURCES

## I. Resource Assessment Methodology

Estimates of potential quantities of undiscovered oil and gas are vital to essential long-range national planning. The Federal Government's offshore oil and gas leasing program depends heavily on projections of the potential amounts of undiscovered hydrocarbon resources on the Outer Continental Shelf (OCS) and on an estimate of those resources that may be technologically and economically recoverable. The pace of discovery and development of these resources affects national security, the economic health of a large sector of the economy, the balance of trade, and many other important national issues.

The Minerals Management Service (MMS) develops estimates of the undiscovered oil and gas resource base and economically recoverable undiscovered hydrocarbons in support of the OCS leasing program. These estimates are used in a number of public and internal documents related to leasing, such as sale-specific Environmental Impact Statements (EIS), Action Update Memorandums (AUM), the Biennial Report to Congress (Section 606, OCS Lands Act), formulation of the 5-year leasing program, and technical publications.

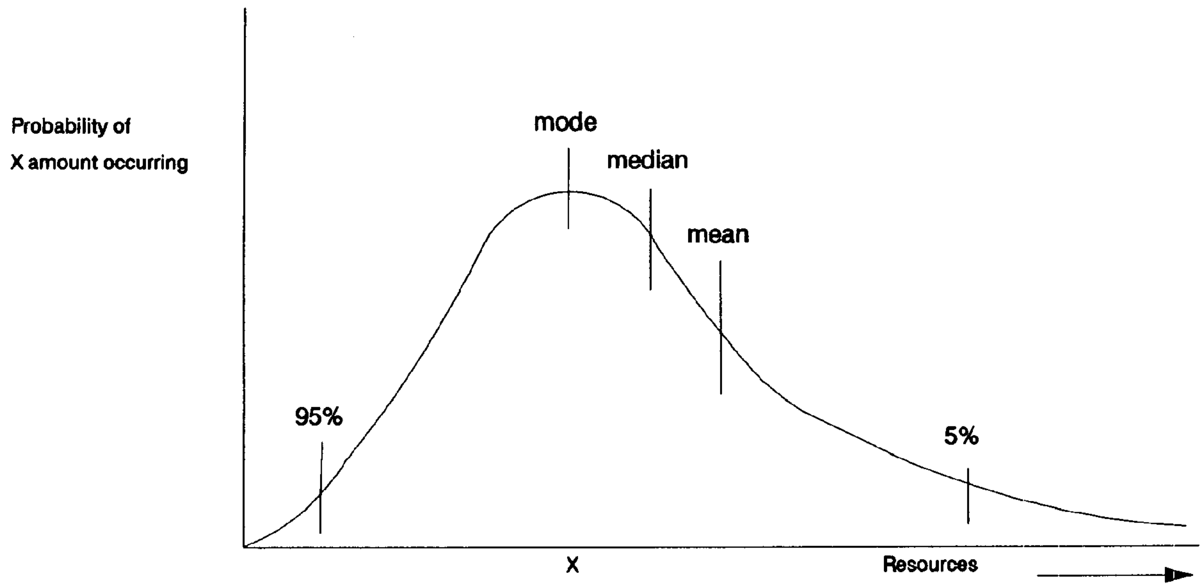
The EIS's for specific lease sales and events such as the development of a 5-year leasing program use the estimates as a basis for analyzing potential environmental impacts of a proposed activity, e.g., oil spill risk analysis, sale alternatives and deferral options, or any other requirement for which the potential resources in specific areas may serve as the basis for evaluating potential actions. In the AUM, estimates of the amounts and locations of potential resources are used to assist the Secretary of the Interior in balancing the economic benefits of development against the environmental consequences resulting from the leasing of offshore areas for petroleum exploration and development. Estimates provided in the Biennial Report to Congress may be used by the legislative branch and others for national strategic and economic planning purposes.

Estimating the economically recoverable amounts of oil and gas remaining to be discovered on the OCS is a difficult task because of the uncertainties inherent in the process. The actual existence of hydrocarbon accumulations is not known with certainty prior to exploratory drilling. The only information concerning the existence of a potential producing field is derived from inferences, extrapolations, and subjective judgments. Geophysical data provide clues as to the existence and location of possible traps (prospects) and their general dimensions, but geologic data on the quality of any potential reservoir rocks or source materials are usually absent. Generally, until drilling operations commence, no data will be available on the nature and distribution of included hydrocarbons or indeed whether hydrocarbons are present at all. Obviously, an exact prediction of resource quantities under such circumstances is impossible because the uncertainties in the input data set translate directly to uncertainties in the estimates.

Two main types of undiscovered resource estimates are commonly used, each responding to different needs. *Conditional*, undiscovered resource estimates represent the amount of resources anticipated if a certain condition exists, the condition being that recoverable quantities of oil and/or gas are present in the area of study. In other words, if oil and/or gas are found to exist in an area, the conditional estimates represent the amount of hydrocarbons determined to be ultimately recoverable. These estimates are used, for instance, to assess the potential environmental impacts in an area if leasing, exploration, development, and production were to occur; the condition that hydrocarbons exist must be assumed, otherwise impacts would not be a concern.

However, if the economic value of a resource is being considered, conditional estimates are not the appropriate measure. In these cases, such as the economic analysis prepared for sale-specific AUM's, the resource estimates must incorporate the probability (or risk, which is often extremely high in frontier areas) that recoverable hydrocarbons may *not* be present in the entire area. The conditional estimates are modified by consideration of the probability that recoverable resources do not exist (that is, factoring in the risk) and are then said to be *risked* resource estimates.

Because of the uncertainty of geologic and engineering variables associated with hydrocarbon traps, resource estimates are usually presented as a range or distribution of values; reporting just one value lends a false sense of precision to the estimate. If a single estimate is required, the mean value of the distribution of possible values is the single best indicator of central tendency, since it reflects both the probability and magnitude of the estimates. The mean, also known as the expected value, is the arithmetic average of all values in the distribution. It is not the "most likely" estimate. The most likely estimate is a probability-weighted average called the mode. Another indicator is the median, which is the value that divides a probability distribution into two equal parts; it corresponds to the 50th percentile on a cumulative frequency distribution. The figure below depicts these three measures on a sample probability density curve. The 95-percent estimate shown on the graph indicates a low estimate having




a 19-in-20 chance that the actual amount will be greater. The 5-percent value is a high estimate, with a 1-in-20 likelihood that the actual amount will be greater.

The resource estimation process used by MMS to generate estimates under conditions of uncertainty incorporates a computer program called PRESTO (*P*robabilistic *R*esource *EST*imates *O*ffshore). The MMS requires a model that provides a range of estimates, both conditional and risked.

The program is objective and utilizes a large geological and geophysical database, not only from the offshore areas, which MMS has accumulated through regulation of OCS oil and gas exploration and development activities, but also from onshore and offshore State lands. The results are reproducible and revisable. This flexibility allows new data or new interpretations to have a quantifiable effect on the resource estimates. Results are presented as ranges of values rather than as single-point estimates, so that useful limits can be provided for planning purposes. The model is also functional under a wide range of uncertainty, since our knowledge of potential offshore petroleum provinces varies from considerable to practically none.

The current PRESTO program is in its third generation and incorporates many new, state-of-the-art enhancements. The program uses the types of geologic and geophysical data normally used by the oil industry to locate and define potential hydrocarbon-bearing geologic features. These data are analyzed, interpreted, and eventually refined to a set of input values that numerically model all potential prospects in the study area.

Since these values are rarely exactly known, uncertainty is accounted for by range-of-values estimation, i.e., the inputs for variables can be entered as distributions over an appropriate range of possible values. The results are also presented as ranges of possible values with associated probabilities of occurrence. The variables used to define prospects and their resource potential are:

(1) areal extent (acres);

(2) zone pay thickness (feet);

(3) oil recovery factor (stock tank barrels/acre-feet);

(4) gas recovery factor (thousand cubic feet/acre-feet);

(5) proportion (PROP) of the zone pay thickness consisting of gas;

(6) solution gas-to-oil ratio (standard cubic feet/stock tank barrel); and

(7) condensate yield (stock tank barrels/million cubic feet of gas).

Dependencies among these input variables can be specified where appropriate. Two other zone properties that may be specified are (1) probability of all oil (OPROB) and (2) probability of all gas (GPROB) for each zone.

Before calculating resources, the model first determines if hydrocarbons are present. Next it determines whether a reservoir contains all oil, all gas, or both (by using OPROB, GPROB, and PROP). Then PRESTO calculates volumes of oil, associated and nonassociated gas, condensate, and solution gas, as appropriate, for all hydrocarbon-bearing prospects on each trial by the following equations:

(1) volume of oil, barrels = (acres) x (thickness) x (1-PROP) x (oil recovery factor);

(2) volume of nonassociated and associated gas, million cubic feet = (acres) x (thickness) x (PROP) x (gas recovery factor) x (0.001);

(3) volume of condensate, barrels = (condensate yield) x (nonassociated and associated gas); and

(4) volume of solution gas, thousand cubic feet = (gas-to-oil ratio) x (oil, barrels) x (0.001).

Using the above set of inputs as the basis for estimates of resource volumes, the program uses sophisticated statistical sampling techniques to calculate resources. Since each input can be represented by a distribution of values, one point on the distribution for each variable is randomly sampled, and the selected values are entered into the volumetric equations to solve for resource amounts. This process is called a "drilling simulation trial" or "pass" and can be repeated as many as 10,000 times. On each of these trials, the model simulates a state of nature by "discovering" which prospects will be hydrocarbon-bearing by using input risks to simulate drilling of each prospect.

The program uses a four-level risk assessment (zone, prospect, basin, and area) to determine the number of trials that a prospect or zone contributes to the total. The evaluator must enter risk values that measure the probability that the prospect or zones within a prospect will be dry and the overall probability that the basin (and area) may be dry.

Estimates of minimum economic field size for each prospect and minimum economic basin and area reserves in barrels of oil equivalent (BOE) are required to determine the portion of the undiscovered resource base that is economically recoverable. Minimum economic field sizes are calculated exogenously through use of a discounted cash flow (DCF) model. They represent the smallest resource amount that would balance development and operating costs (including transportation costs for the gathering system) for a prospect and yield a minimum rate of return. The minimum economic field size is tailored to the prospect, considering factors such as water depth, distance from shore, depth to the potential pay horizon, and current and projected economic conditions.

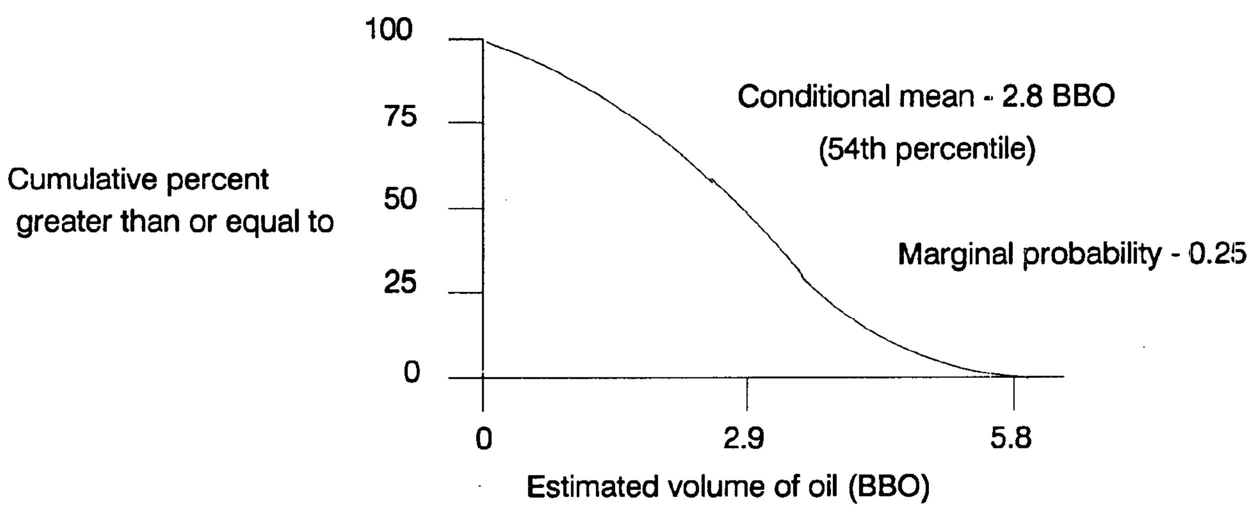
By comparing the calculated resource volumes of each successful prospect to the minimum economic field size values provided by the user, PRESTO develops estimates of economically recoverable resources on a trial. The gas volumes caslculated for a prospect are converted to a volume of oil equivalent on the basis of energy or economic equivalency and then added to the oil volume to yield a total BOE for the prospect. If the calculated prospect resource volume in BOE exceeds the minimum economic field size, the prospect is considered to be economically viable, and its resources contribute to the total. If the calculated prospect resources are less than the minimum economic field size, then the prospect is considered noncommercial, and its resources are set equal to zero for that trial. Resource amounts greater than the minimum economic field size for prospects within a basin are aggregated on each trial and compared to a minimum economic basin reserve. The minimum economic basin reserve, also calculated exogenously, is the minimum amount of resources necessary to justify a regional production infrastructure in a basin. Finally, resource amounts for all basins in an area on a given trial are compared to a minimum economic area reserve to determine whether enough resources are present to justify production facilities for the area. This feature is more appropriate for frontier areas than for mature areas with an existing infrastructure.

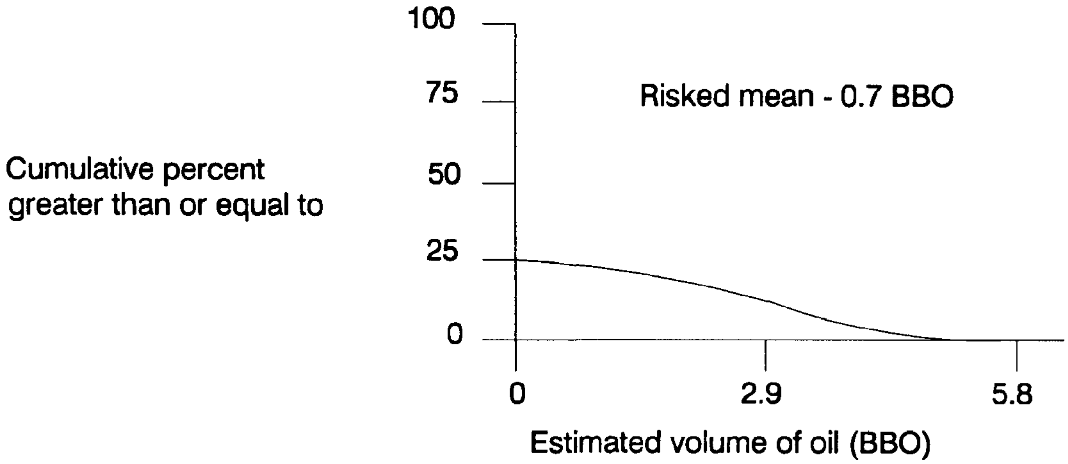
When the specified number of trials are completed, the solutions of each trial are sorted and ranked, and the results are defined by distributions of solutions. Thus, the full range of possible volumetric solutions is represented by a single curve with each point on the distribution having an equal probability of occurrence. PRESTO outputs include both conditional and risked distributions. Since the output of PRESTO is a distribution of resource estimates, for convenience the results are usually reported using only the mean value and the 5th and 95th percentiles. The 5th percentile can be considered a high case where there is a 5-percent chance of that amount or more occurring; the 95th a low case where there is a 95-percent chance of that amount or more occurring; the mean is the average value of all trials.

Conditional resource estimates are constrained by a number of statistical caveats, which are not intuitive. By statistically aggregating the estimates of resources in each individual prospect, PRESTO calculates planning area resource estimates (or any subset such as an alternative sale configuration). It does not follow, however, that the total planning area estimate is the arithmetic sum of the prospect estimates. This is because each prospect has a different condition (i.e., the marginal probability of hydrocarbon occurrence in the prospect). Prospect resources can be aggregated to planning area totals only by rerunning the program using all prospect data and making any required risk adjustments.

An important number associated with conditional estimates is the marginal probability. The condition is quantified by assigning it a numerical value, the marginal probability (MP). The MP is a measure of the probability that hydrocarbons exist in an area and is represented as a decimal fraction. (For economically recoverable resources, the MP is a measure of the probability that *commercial* hydrocarbons exist in the area.) An MP of 1.00 indicates certainty of hydrocarbon occurrence in the area; an MP of zero indicates no chance whatsoever. The MP applies to the entire conditional distribution. As an example, consider an area having an MP equal to 0.25. This means that the area has a 25-percent chance of containing a hydrocarbon accumulation. If hydrocarbons *do* exist, then the conditional distribution represents the range of possible values. By removing the condition and incorporating the risk that the entire area may be barren of hydrocarbons, the estimates are said to be risked.

The following graphs illustrate conditional and risked resource distributions. Cumulative percentages are given on the vertical axis and oil volumes on the horizontal axis. The conditional curve has a corresponding MP of 0.25 and, if hydrocarbons do exist, the conditional curve displays the calculated range of values. It can be seen on the conditional curve that the 50th percentile corresponds to 2.9 billion bbl of oil (BBO), i.e., there is a 50-percent probability that *at least* 2.9 BBO will be found *if* there are accumulations of oil present in the area (the mean or average value is 2.8 BBO, which corresponds to the 54th percentile in this case). The graphs below show the risked distribution of estimates. Note that the risked mean estimate is only 0.7 BBO (0.25 x 2.8), reflecting the low probability of success in this hypothetical area. The risked curve also shows that the chance of resource amounts being greater than or equal to zero is 25 percent (corresponding to the MP); there is a 75-percent chance the area is dry.






The conditional mean multiplied by the MP yields the risked mean, i.e., the average value factoring in the potential risk of no hydrocarbons existing in the area. However, this is statistically valid only for the mean value; the 5th and 95th percentiles cannot be multiplied by the MP for risked 5th and 95th percentiles. (The 5th and 95th percentiles on the conditional distribution, when multiplied by the marginal probability, will correspond to different percentiles on the risked distribution.)

The *risked mean* values can be added or subtracted. However, conditional means are not additive; conditional or risked percentile estimates (such as the 5th- and 95th-percentile estimates) cannot be added or subtracted. Risked mean resource values are most useful in comparing different areas for ranking purposes. However, as mentioned earlier, it is the conditional and not risked mean that is the amount anticipated if recoverable (or commercial) quantities of oil and gas occur in nature. The following example illustrates the essential difference between the two types of estimates and the need to consider both in making informed judgments and decisions. Two areas have been assessed, resulting in very different conditional mean resource levels and marginal probabilities:

| | Conditional Mean (million bbl) | MP | Risked Mean (million bbl) |
|---|---|---|---|
| Area A | 1,000 | 0.10 | 100 |
| Area B | 125 | 0.80 | 100 |

The risked mean values calculated for both areas are the same. However, Area A has a larger potential (eight times larger than Area B), with only a small chance (10%) of hydrocarbons existing in the area. If Area B contains hydrocarbons, the average amount anticipated is much smaller, but the chance of hydrocarbons existing in the area is greater (80%).

The distinction between conditional and risked results is further illustrated by the following example. The undiscovered resources for a fictitious OCS basin are estimated to be between 1 and 7 BBOE, with an average of 3 BBOE *if hydrocarbons are present in the basin*. However, it is estimated that there is only a 25-percent chance that this condition will be met (hydrocarbons present in the basin). In other words, if there were 100 basins in the world similar to this fictitious basin, 75 would be dry and 25 would contain hydrocarbons. The 25 basins containing hydrocarbons would each have between 1 and 7 BBOE, with the average size being 3 BBOE. The average amount found in the 100 basins would be reported as 750 MMbbl. This is the "risked mean" estimate. Therefore, based on current geologic, engineering, and economic knowledge, if this one fictitious basin is fully explored and hydrocarbons are found, the amount found will be between 1 and 7 BBOE, with an average value of 3 BBOE. There is, however, only a 25-percent chance of hydrocarbons being present, so the risked mean estimate is reported at 750 MMBOE. In actuality, the amount found (if our models are correct) would be either zero or between 1 and 7 BBOE and not the risked mean estimate of 750 MMBOE.

## II. Categories of Resource Estimates

Various categories of undiscovered resource estimates, each responding to a different question or need, can be developed using the models and methodologies described above. These estimates can be derived from a baseline data set comprised of all prospects in the area. These resource estimates form a nested hierarchy, where each estimate is a subset of previous estimates.

Geologic Province
(Conventionally Recoverable)

↓

Planning Area Estimate
(Economically Recoverable)

↓

Sale Area Estimate
(Economically Recoverable)

↓

Economically Recoverable
Resources Assumed to be
Leased Due to Sale

↓

Resources Assumed to be
Leased Due to Alternative
Sale Configurations

*Geologic Province Estimates* are the top tier of undiscovered resource estimates. These estimates were based fundamentally upon analysis and review of the province petroleum geology, exploration history, play analysis, finding rate studies, and structural analyses.

The *conventionally recoverable* estimates include the quantities of oil and gas resources in excess of 1 MMBOE in undiscovered accumulations analogous to those in existing fields producible with current recovery technology and efficiency, but without reference to economic viability. These estimates involve statistical projections based upon large-scale geologic observations in entities such as basins and provinces and, as such, may not directly translate to administrative regions such as planning areas.

For the Gulf of Mexico, the undiscovered conventionally recoverable resource estimates are divided into two provinces--Cenozoic and Mesozoic. The Western and Central Planning Areas are almost entirely in the Cenozoic province. The Cenozoic and Mesozoic Province estimates for the entire Gulf of Mexico are shown in the following chart:

| | Oil (BBO) | Gas (tcf) | BOE (BBOE) |
|---|---|---|---|
| Conditional | | | |
| 95th Percentile | 5.52 | 63.02 | 16.73 |
| Mean | 9.57 | 103.34 | 27.96 |
| 5th Percentile | 15.12 | 156.92 | 43.04 |
| Marginal Probability = 1.00 | | | |
| Risked | | | |
| 95th Percentile | 5.52 | 63.02 | 16.73 |
| Mean | 9.57 | 103.34 | 27.96 |
| 5th Percentile | 15.12 | 156.92 | 43.04 |

*Planning Area Estimates* are for policy guidance and, as such, they are broad and all encompassing in nature. They are used, for example, to develop the 5-year leasing program and the Biennial Report to Congress (as required by Section 606, OCS Lands Act). These estimates include both prospects identified through interpretation of geologic and geophysical data and prospects postulated by the extrapolation of geologic trends into areas having scant data. Where justified, they may also include speculative plays, which are poorly defined by the available information.

Planning area estimates that are described as *economically recoverable* include resources only from those prospects that are of sufficient size to be economically producible and marketable, based on current and projected economic conditions and foreseeable technological trends.

For the Central Gulf, the economically recoverable estimates are shown in the following chart:

| | Oil (BBO) | Gas (tcf) | BOE (BBOE) |
|---|---|---|---|
| Conditional | | | |
| 95th Percentile | 0.30 | 3.34 | 0.89 |
| Mean | 1.87 | 18.36 | 5.14 |
| 5th Percentile | 4.05 | 38.57 | 10.91 |
| Marginal Probability = 1.00 | | | |
| Risked | | | |
| 95th Percentile | 0.30 | 3.34 | 0.89 |
| Mean | 1.87 | 18.36 | 5.14 |
| 5th Percentile | 4.05 | 38.57 | 10.91 |

For the Western Gulf, the economically recoverable estimates are shown in the following chart:

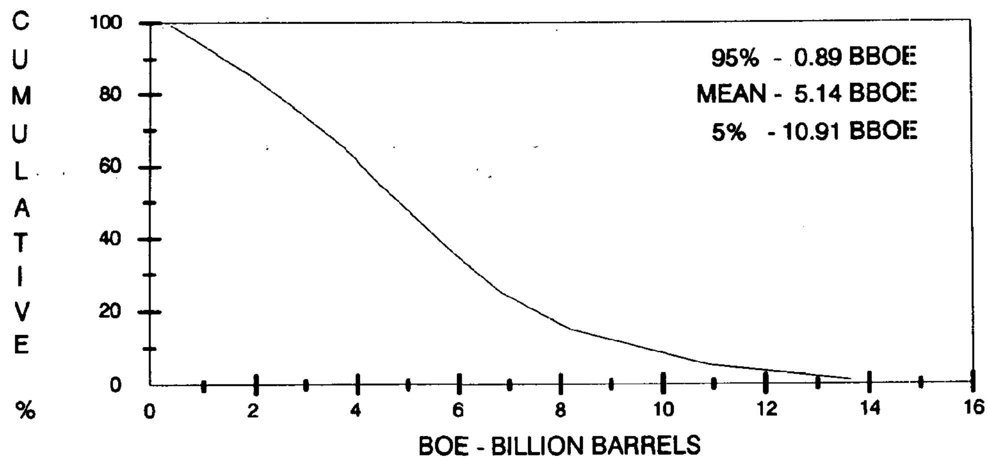
| | Oil (BBO) | Gas (tcf) | BOE (BBOE) |
|---|---|---|---|
| Conditional | | | |
| 95th Percentile | 0.09 | 1.73 | 0.40 |
| Mean | 1.22 | 17.95 | 4.41 |
| 5th Percentile | 3.13 | 44.98 | 11.13 |
| Marginal Probability = 1.00* | | | |
| Risked | | | |
| 95th Percentile | 0.09 | 1.66 | 0.39 |
| Mean | 1.22 | 17.91 | 4.41 |
| 5th Percentile | 3.10 | 44.63 | 11.04 |

For the Eastern Gulf, the economically recoverable estimates are shown in the following chart:

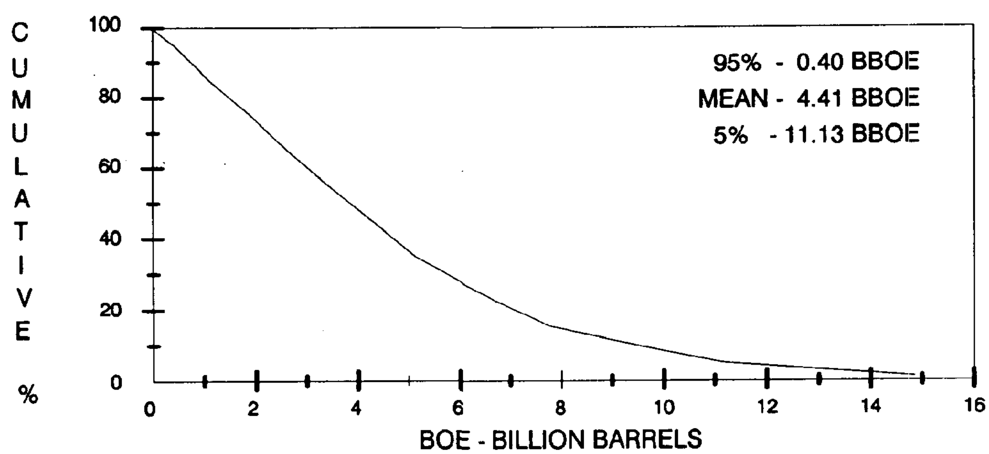
| | Oil (BBO) | Gas (tcf) | BOE (BBOE) |
|---|---|---|---|
| Conditional | | | |
| 95th Percentile | 0.31 | 0.85 | 0.46 |
| Mean | 0.80 | 1.11 | 1.00 |
| 5th Percentile | 1.54 | 1.35 | 1.78 |
| Marginal Probability = 1.00 | | | |

* The rounding of marginal probability will not necessarily be evident in risked estimates.

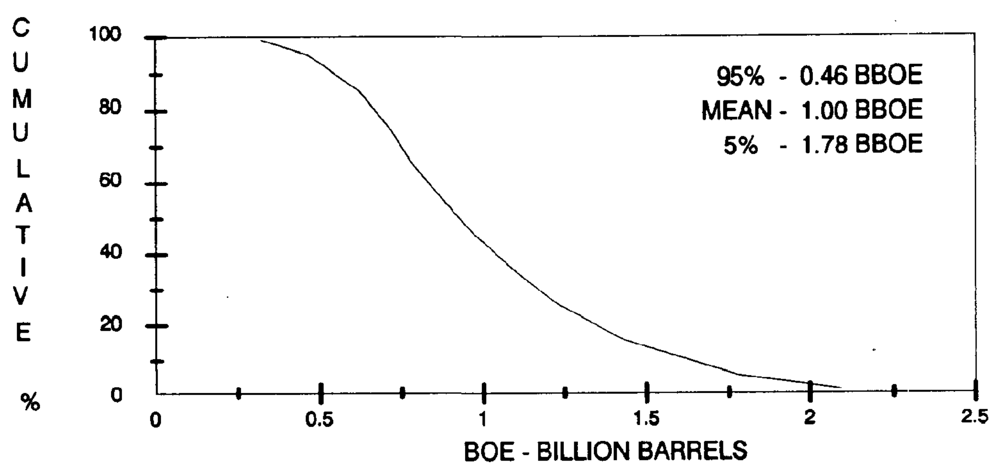
CONDITIONAL RESULTS - CENTRAL GULF




CONDITIONAL RESULTS - WESTERN GULF




CONDITIONAL RESULTS - EASTERN GULF



| | Oil (BBO) | Gas (tcf) | BOE (BBOE) |
|---|---|---|---|
| Risked | | | |
| 95th Percentile | 0.31 | 0.85 | 0.46 |
| Mean | 0.80 | 1.11 | 1.00 |
| 5th Percentile | 1.54 | 1.35 | 1.78 |

Although estimates are shown at the 95th percentile, 5th percentile, and mean cases, these are only three possible numbers from a full and continuous distribution of possible values. Figures below show a conditional distribution for the economically recoverable resources in BOE. Gas volumes are converted to barrels of oil on an energy equivalent basis and then added to the oil volume. One BOE equals 5.62 Mcf of gas based on 5.8 MM Btu/bbl and 1,032 Btu/cu ft of gas. Every point on these curves is equally probable. However, the low and high estimates indicate the range of possible values, and the conditional mean represents the average amount anticipated, given that recoverable hydrocarbons exist in at least one of the prospects modeled.

Sale Area Estimates are prepared to comply with sale-specific analytical requirements related to environmental analyses and cost/benefit studies. Oftentimes the area offered for lease is smaller than the entire planning area. Therefore, prospects lying outside of the proposed sale area must be deleted from the assessment. These estimates are undiscovered, economically recoverable resources that are based on current economic and technological conditions and projections. Since these estimates are more area-specific and of nearer term use than planning area estimates, postulated (unmapped) prospects generally are not included, except where justified on a case-by-case basis.

For Central Gulf Lease Sale 142 and Western Gulf Lease Sale 143 the entire planning area is offered for lease. Therefore, the economically recoverable resource estimates for the entire area offered for lease are the same as those estimates for each planning area.

The sale area estimates represent the amount of undiscovered resources offered for lease. The *Resources Assumed to be Leased* represent an assessment by the MMS staff of the amount of the sale area resources that would be leased, discovered, and produced as a result of the sale and, therefore, the amount upon which the impact analysis is to be based. For proposed Sales 142 and 143, the MMS staff considered previous leasing rates, industry interest, prospect distribution, economic and technological considerations, and infrastructure distribution. Recognizing the inherent uncertainty associated with resource estimates, the EIS includes an analysis of a range of potential outcomes as represented by three distinct scenarios: (1) Low Case, (2) Base Case, and (3) High Case. The Low Case is an exploration-only case, based on a scenario of a reasonably anticipated level of exploration activity, but assuming that no commercial accumulations are discovered. The Low Case is analyzed in frontier planning areas. The Base Case analyzes an estimate of the resources assumed to be leased, developed, and produced, given that hydrocarbons exist in the area (i.e., a conditional estimate) and an estimate of the exploration, development, production, and transportation activities appropriate to that level of resources. The High Case analyzes a significantly higher estimate of resource recovery and attendant exploration and development activity that could result from higher leasing interest than estimated for the Base Case or that could result from the discoveries of larger oil and gas accumulations than estimated under the Base Case assumptions. An examination of these levels of resources and subsequent development will cover the range of possible outcomes and impacts that could reasonably be anticipated to occur as a result of each sale.

The economically recoverable resources assumed to be leased, developed, produced, and transported as a result of Sale 142 are the following:

| | Conditional Oil (BBO) | Conditional Gas (tcf) | Conditional BOE (BBOE) |
|---|---|---|---|
| Low Case | N.A.* | N.A.* | N.A.* |
| Base Case | 0.14 | 1.40 | 0.39 |
| High Case | 0.31 | 2.93 | 0.83 |

Marginal Probability = 1.00

*N.A. = not applicable.

The economically recoverable resources assumed to be leased, developed, produced, and transported as a result of Sale 143 are the following:

| | Conditional Oil (BBO) | Conditional Gas (tcf) | Conditional BOE (BBOE) |
|---|---|---|---|
| Low Case | N.A.* | N.A.* | N.A.* |
| Base Case | 0.05 | 0.74 | 0.18 |
| High Case | 0.13 | 1.82 | 0.45 |

Marginal Probability = 1.00

*N.A. = not applicable.

The procedures used to determine these different categories of resource estimates are similar in all cases. While subjectivity exists in determining inputs and which prospects are likely to be leased, judgments are consistently applied by specialists in each discipline. For example, inputs such as acreage and net pay are provided by geologists, reservoir engineering parameters are estimated by petroleum engineers, and so forth. The advantages of the model are that subjective judgments of subject matter experts are handled in an objective manner, and written documentation of the various judgments is provided so that the estimates can be readily updated in the future as new information and interpretations become available.

## III. Rationale for Multiple Scenarios in Environmental Impact Statements (EIS)

Estimates of remaining undiscovered, economically recoverable oil and gas in a proposed sale area are reported in EIS's to provide the basis for an assessment of the environmental, social, and economic impacts that might realistically be assumed to result from a specific sale. Resource estimates serve as the focus of the assumed exploration and development activities that are fundamental to a rigorous assessment of the potential effects of a proposed sale.

Formerly, the impact analyses for sales were conducted on the conditional mean sale area resource (except in the Gulf of Mexico) with a much abridged high (5th percentile) and low (95th percentile) case analysis separated from the primary analysis. The assumption that the total resources estimated to be present in the sale area would be leased, developed, and produced as a result of the sale overstated the level of activity that would result. Since the bulk of the analysis involved the mean resource, a perception developed among some readers that this amount of resource would, in fact, be discovered and produced. This and the resulting estimates of subsequent exploration and development activities acquired a validity among some readers that generally could not be supported by the available leasing data. The uncertainty inherent in the estimates, and by inference, in the complex series of environmental, economic, and social effects predicated on them needed to be emphasized.

Recognizing the inherent uncertainty associated with resource estimates, the EIS includes an analysis of a range of potential outcomes as represented by three distinct scenarios. This procedure acknowledges the uncertainties associated with estimating the amounts of resources that will be leased and emphasizes that the resource estimates are presented as a range. The limits of the range of resources are constrained by low and high estimates, both of which represent realistic levels of exploration and development activity. Within the range is a Base Case estimate of resources that are believed likely to be leased, developed, and produced as a result of the sale. The Base and High Cases, and their attendant impacts, are presented in the EIS for the proposed action.

The Base Case includes undiscovered resources estimated to be leased, developed, and produced, assuming that hydrocarbons exist in the area (i.e., a conditional estimate), and an estimate of the exploration, development, production, and transportation activities appropriate to that level of resources. The Base Case estimate is presumed to be the expected result if hydrocarbons are present in the sale area in commercial quantities and if the sale occurs as proposed. Post-exploration NEPA analysis is obviously pointless if commercial oil and/or gas does not exist; therefore, the Base and High Case resources are reported as conditional estimates because these estimates assume that economically recoverable hydrocarbons exist and will be discovered, developed, produced, and transported to the market. Most of the analytical effort is focused on the Base Case because it represents the resource quantity that is expected to be found and developed as a result of the sale if hydrocarbons are present in economic volumes in the sale area. The Base Case estimate reflects the following: successes or failures since the previous sales in a planning area, previous leasing rates; perceived industry interest, costs associated with exploration and development, existing infrastructure to transport oil or gas to market, and so forth.

The High Case is an estimate of a significantly higher level of resource recovery and attendant exploration and development activity that could result from leasing more acreage than may occur in the Base Case or that could result from the discoveries of larger oil and gas accumulations than estimated under the Base Case assumptions. The High Case estimate is a larger but still reasonable quantity of resources that may produce distinctly different impacts. Ordinarily, the effects of this scenario would be higher than those of the Base Case because they are predicated on more and larger discoveries. The High Case represents a more optimistic scenario and assumes higher than expected leasing rates, favorable geologic conditions, or improved economics.

An examination of these levels of resources and subsequent development will cover the range of probable outcomes and impacts that could be anticipated to occur as a result of a sale.

The object of the analysis is to scrutinize a spectrum of activity levels, rather than to assess a single scenario, which can change because specific estimates change during the 2- to 3-year prelease process. Representing resource estimates as a range recognizes the uncertainties associated with the estimation methodologies and allows some flexibility if the estimates should change. If revisions remain within the range of the Base to High Case estimates of the original assessment, no changes in the scenarios and analysis in the EIS would be necessary.

Regional offices develop Base Case resource estimates consistent with the data available to them. The Gulf of Mexico Region uses an historical approach that derives the Base Case from a rigorous analysis of past leasing rates. The result is a time-dependent decline in resource volume for a succession of sales, wherein each sale is assumed to contribute a percentage of the total planning area resource. Other Regions use (with variations) a methodology that extracts and aggregates the resource volumes of those prospects considered most attractive from the PRESTO database. These prospects usually have high industry interest and are the most likely to yield the highest rate of financial return by reason of size, distance from shore, proximity to transportation infrastructure, water depth, etc., and are thus the most likely to be leased as a result of the sale.

## IV. Exploration and Development Scenarios

Infrastructure for each EIS scenario (Low, Base, and High Cases) is estimated for the Exploration and Development (E&D) Report based on the amounts of conditional resources assumed to be leased and subsequently discovered and developed. The E&D Report is composed of timetables with the yearly numbers of successful and unsuccessful exploration, delineation, and production wells for oil and gas; the number of platforms; oil and gas pipeline mileage; and production schedules. The E&D infrastructure is estimated using methodologies that are specific to each MMS Region and based on the amount of historical information available, the evaluator's professional judgment, and the geologic, engineering, and economic uncertainties associated with each sale area.

## V. Cumulative Analysis

In August 1989, USGS and MMS published the National Oil and Gas Resource Assessment (NOGRA) of the undiscovered conventionally recoverable oil and natural gas resources of the United States. It considers new geological, technological, and economic information and uses more definitive methods of resource appraisal than previous assessments. The assessment was conducted over a period of more than two years and reflects data and information available as of January 1, 1987. The Eastern Gulf was reassessed through the acquisition and interpretation of geological and geophysical data after the NOGRA was released; the Central and Western Gulf resources were updated to reflect leasing, and resource estimates are dated as of January 1, 1990, and published in July 1991 by MMS in the report *Estimates of Undiscovered, Economically Recoverable Oil and Gas Resources*. The NOGRA is the basis for the generation of both the sale area resource estimates and the Cumulative Case resource estimate.

Conditional resource estimates are directly comparable between Gulf of Mexico planning areas, since they are generally based on equivalent marginal probabilities (M.P. = 1.00 for all three planning areas). Planning area resource estimates derived from the NOGRA will be provided for the Cumulative Case Analysis for individual lease sale EIS's. This resource estimate takes into consideration the marginal probabilities of each planning area. It provides a resource estimate that gives a better indication of the likelihood of oil and gas activities occurring within the planning area over the life of the proposal and provides consistency in the Cumulative Analysis from one EIS to the next.

For the purposes of EIS analysis, conditional mean resource estimates derived for any planning area assume that the sales on the 5-year schedule in that planning area will result in exploration, development, and production.

It is logical to assume that exploration and/or development could occur from more than one sale in the planning area at the same time, and this could continue throughout the life of the leases from those sales. Therefore, the Cumulative Analysis is based upon an estimation of the resources explored, developed, and produced during the productive life of leases in a planning area from the proposed sale, reasonably foreseeable future sales, and prior sales.

The cumulative number will remain valid until the NOGRA is changed. Consequently, the analysis of the cumulative case for a sale in a given planning area will be similar for all other sales in that planning area, provided the NOGRA does not change. There will likely be some differences in the discussion of the contribution of the proposal to cumulative impacts from EIS to EIS, which will provide a consistent analysis of the Cumulative Case for all sales on the 5-year schedule in a given planning area. This method of analysis avoids the problem of using a different basis for the Cumulative Analysis in a given area from one EIS to the next, which would result in inconsistent, conflicting analyses in the EIS's.

# Appendix D

# Alternative Energy Resources

# ALTERNATIVE ENERGY SOURCES AS AN ALTERNATIVE TO THE OCS PROGRAM

## A. INTRODUCTION

The oil and gas that could become available from the proposal could add to National domestic production. To delay or eliminate the proposed sale in part or in whole would reduce future OCS oil and gas production, necessitate escalated imports of oil and gas, and/or require the development of alternative-energy sources to replace the energy resources expected to be recovered if the proposed sales took place.

If the proposed sales were canceled, an additive effect of greater oil and gas deficits could be expected to result in increased imports; and the following energy actions or sources might be used as substitutes. (Some of these actions are not feasible at this time and may not be feasible during the estimated production life of the proposed actions.)

| | |
|---|---|
| Imported Oil and Gas | (See Section B of this appendix) |
| Coal | (See Section C) |
| Coal Conversion to Synthetic Fuels | (See Section D) |
| Oil-Shale Conversion to Synthetic Fuels | (See Section E) |
| Biomass Conversion to Synthetic Fuels | (See Section F) |
| Domestic Onshore Oil and Gas | (See Section G) |
| Geothermal Power | (See Section H) |
| Solar Power | (See Section I) |
| Wind-Turbine Power | (See Section J) |
| Hydroelectric Power | (See Section K) |
| Nuclear Power | (See Section L) |
| Conservation | (See Section M) |

This appendix briefly discusses these alternatives. For more detailed information on each of these energy sources and their respective environmental effects, refer to "Energy Alternatives: A Comparative Analysis" (University of Oklahoma, 1975), prepared for the Bureau of Land Management by the Science and Public Policy Program of the University of Oklahoma and the Proposed 5-Year Outer Continental Shelf Oil and Gas Leasing Program, Mid-1987 to Mid-1992 (USDOI, MMS, 1987).

## B. IMPORTED OIL AND GAS

### 1. Background Considerations

Spurred by new discoveries and competition, Middle East oil production expanded in the 1950's and 1960's. New markets were opened and prices softened. Between 1948 and 1972, the real price of oil fell. The U.S. consumption of oil simultaneously increased while production remained constant; imports were relied upon to make up the difference.

Three major shocks to the world oil market focused public attention on oil-supply issues. The 1973-1974 Arab oil embargo cut off Middle Eastern oil sources from unrestricted trade in world oil markets and resulted in escalation of oil prices from a pre-embargo world price of $7.74 per barrel in 1970 to a postembargo price of $24.40 in 1975. The world oil market received its second major jolt during the 1979-1980 Iranian revolution, which once again reduced oil-supply levels and accelerated prices to a 1980 world price of $42.36 per barrel. In 1990, the political instability of the Arab region once again forced world oil prices to the $40.00 per barrel price range.

In response to these events, the U.S. and the rest of the world instituted a wide variety of measures to conserve energy and to find alternative sources of supply. The results of these efforts to reduce imports generally have been successful. The underlying market structure for energy has been altered. World demand for oil peaked in 1977 and appears to be in a structural decline. Gross national products have been rising along with nonenergy output, alternative-energy sources, and non-OPEC (Organization of Petroleum Exporting Countries) production. The overall success for these measures was reflected by the 1984 decline in the world oil price to about $29.00 per barrel.

The inability of the OPEC to secure the cooperation of its members to reduce production and halt this price slide contributed to decisions by certain OPEC members to substantially increase production. During 1986, the combination of lower demand--initially brought about as a response to high OPEC pricing--and the decisions to increase rates of production resulted in very rapid declines in oil prices to levels that were inconceivable only months earlier. During 1986, world oil prices on the spot markets also frequently fell to levels well below $10.00 per barrel; by year's end, prices had increased modestly to approximately $15.00 per barrel.

### 2. Environmental Effects

The primary hazard to the environment from increased oil and gas imports is the possibility of oil spills, which can result from intentional or accidental (tanker casualties) discharges. For a more detailed discussion of the environmental effects from oil spills, see Section IV.A. of this EIS. Intentional discharges would result largely from uncontrolled deballasting of tankers. The effects of this chronic, low-level pollution are largely unknown. The worldwide tanker-casualty analysis indicates that, overall, an insignificant amount of the total volume of transported oil is spilled due to tanker accidents. However, a single incident--such as the breakup of the *Torrey Canyon* in 1967 or the *Amoco Cadiz* in 1978--can have disastrous results. Further, even relatively small spills from tankering of imported oil can have major effects on sensitive coastal environments. For example, in less than one year, two spills occurred off San Francisco and generated serious effects on marine and coastal birds around the Farallon Islands National Marine Sanctuary and up and down the coast of California. Over 2,000 seabirds were killed by the Puerto Rican tanker spill, which contacted the Farallon Islands. The assessment of cumulative effects in the Proposed 5-Year OCS Leasing Program (USDOI, MMS, 1987) includes the estimated mean number of oil spills associated with importing oil and refined products via tanker. The assumed frequency of tanker spills greater than 1,000 barrels was 1.3 spills per billion barrels transported. Further, only one-half of the 1.3 spills per billion barrels was assumed to occur in U.S. waters. The estimated most likely number of large oil spills from tankering of imported oil used in the cumulative case--based on estimated imports over a 30-year period--was equal to 61 spills of 1,000 barrels or greater. This compares with an estimated most likely number of 157 spills from all sources (all past and future OCS leasing, all domestic and import tankering). Thus, oil spills associated with imports represent nearly 40 percent of all oil spills greater than 1,000 barrels over the 30-year period used in the assessment of cumulative effects.

### 3. Conclusions

Major oil spills from tankers could result in the most significant environmental effect associated with the use of imported oil. Additional major environmental concerns include effects from tanker spills that occur in sensitive areas that are otherwise protected from oil spills, e.g., the Farallon Islands; air-quality effects associated with tanker unloadings; and increased vessel traffic and port congestion.

# C. COAL

## 1. Background Considerations

Coal is our Nation's most abundant fossil fuel, with more than one-quarter of all the world's known coal within U.S. borders. More than one-half of our Nation's electric power is coal generated (DOE, 1990).

Coal is a combustible rock that contains more than 50 percent by weight and 70 percent by volume of carbonaceous material from the accumulation, and physical and chemical alteration, of vegetation. Classification of coal is based on chemical analysis and certain physical reactions that measure the progressive response of coal to heat and/or pressure. The analysis involves the determination of four constituents: (a) moisture, (b) mineral impurity (ash), (c) volatile material (gas/vapor), and (d) fixed carbon (solid residue after removal of the gases). Based upon these constituents, coal is ranked from low-ranked lignite through subbituminous and bituminous coal to high-ranked anthracite and meta-anthracite. Ninety-seven percent of the U.S. coal reserves are either bituminous (66%) or subbituminous (31%), with the remaining coal being anthracite.

Most of the bituminous coal produced in the U.S. is burned to obtain thermal energy for generating electricity, processing raw or manufactured material, and heating industrial complexes (Tables D-1 and D-2). Other uses include gasification and liquefaction (Sections C.1. and C.2. of this appendix).

Table D-1

Coal Consumption by End-Use Sector
(million short tons)

| Year | Electric Utilities | Coke Plants | Other Industrial | Residential and Commercial |
|---|---|---|---|---|
| 1980 | 569.3 | 66.7 | 60.3 | 6.5 |
| 1981 | 596.8 | 61.0 | 67.4 | 7.4 |
| 1982 | 593.7 | 40.9 | 64.1 | 8.2 |
| 1983 | 625.2 | 37.0 | 66.0 | 8.4 |
| 1984 | 664.4 | 44.0 | 73.7 | 9.1 |
| 1985 (a) | 693.5 | 40.9 | 76.3 | 7.9 |

Source: Energy Information Administration, Annual Energy Review 1985, (a) Preliminary.

Table D-2

Coal Overview
(million short tons)

| Year | Production | Consumption | Imports | Exports |
|---|---|---|---|---|
| 1980 | 829.7 | 702.7 | 1.2 | 91.7 |
| 1981 | 823.8 | 732.6 | 1.0 | 112.5 |
| 1982 | 838.1 | 706.9 | 0.7 | 106.3 |
| 1983 | 784.9 | 736.7 | 1.3 | 77.8 |
| 1984 | 895.9 | 791.3 | 1.3 | 81.5 |
| 1985 (a) | 886.1 | 818.6 | 2.0 | 92.7 |

Source: Energy Information Administration, Annual Energy Review 1985, (a) Preliminary.

The total demonstrated U.S. reserve base is about 488 billion tons (Table D-3). The Federal Government manages about 60 percent of the coal resources within Colorado, Montana, New Mexico, North Dakota, Utah, and Wyoming. At the close of Fiscal Year 1983, 18 competitive and noncompetitive coal leases were issued covering 22,108 acres. As of September 30, 1982, 691 coal leases covering 1,288,310 acres were active (USDOI, 1984a).

Table D-3

Demonstrated Reserve Base of the Major Coal Provinces in the United States

| Province | Demonstrated reserves (in millions of tons) Underground | Surface | Total |
|---|---|---|---|
| Appalachian | 97,000 | 19,200 | 116,900 |
| Interior | 94,000 | 41,400 | 135,400 |
| Western | 140,900 | 95,200 | 236,000 |
| | 331,900 | 155,800 | 488,300 |

Source: Energy Information Administration, Annual Energy Review 1985.

Coal showed a slight recovery in 1984 and 1985 after a series of setbacks due to the recession and the falling export market (Table D-2). Coal usage indicated an increase of coal consumption, particularly by the utilities and steel industries (Table D-1). Coal production has increased steadily to a record 975 million tons in 1989.

## 2. Environmental Effects

Numerous environmental effects can result from the mining and combustion of coal--land-disturbance effects of mining; reclamation procedures; acid-mine-drainage problems; problems of air pollution, including the local and global effects of sulfur oxides and carbon-dioxide emissions; and problems associated with transportation. While existing environmental problems related to the present coal-fuel cycle are likely to increase in scale, additional problems are likely to arise as new coal-gasification and -liquefaction plants begin operating. These new plants may be needed to offset the shortfall in availability of existing fuels if OCS oil and gas is reduced through delay or elimination, in part or whole, of the proposed OCS leasing program.

Coal can be mined by two methods--surface mining and underground mining. Surface-minable coal accounts for about 32 percent of the demonstrated coal reserves in the U.S. (Table D-3). Surface mining can result in effects on air, land, and water by creating conditions that promote water and wind erosion, destruction of topsoil, elimination of vegetation, and contamination of soil and water from weathering of toxic strata.

According to Federal Office of Surface Mining Final EIS (1980), surface mining of coal completely eliminates existing vegetation, destroys the genetic soil profile, displaces or destroys wildlife and wildlife habitat, degrades air quality in the area, alters the current land uses, and--to some extent--changes the general topography of the area being mined. Without diligent reclamation, surface-mined lands are often unsuitable for other uses.

The Department of Energy (DOE) Environmental Development Plan on Coal Extraction and Preparation (USDOE, 1979) reports significant water-quality degradation from former mining sites, with severe effects on aquatic ecosystems. Streams and reservoirs (primarily in the eastern U.S.) have been affected by sedimentation from surface mines, acid-mine drainage, and erosion of spoil piles from mining and coal cleaning and preparation.

Surface-mining effects on ground water include: (a) drainage of usable water from shallow aquifers, (b) lowering of the water table in adjacent areas and changes in flow direction within aquifers, (c) contamination of aquifers below mine operations from leakage of mine waters, and (d) increased infiltration of precipitation on spoil piles. The improper removal of overburden can cause the loss of topsoil and exposure of the parent material, and can create vast wastelands. The stockpiling of topsoil from the area can destroy or alter many of the natural soil characteristics.

Surface mining of coal causes indirect and direct effects on wildlife that come primarily from the removal and redistribution of the land surface. The area being surface mined (open pit) and the associated stockpiles are not capable of providing food or cover for wildlife. Without proper rehabilitation, the area must go through a weathering period and may require a few years to several decades before vegetation is re-established. Broad and long-lasting effects on wildlife within the area can occur from this alteration of the habitat.

Mechanical cleaning of coal also causes effects on land use. Although the amount of land required for disposal of coal-cleaning wastes varies with coal- extraction techniques and characteristics, National estimates range from 0.3 to 0.9 acres used per million tons of coal cleaned.

Underground mining of coal has the potential to result in subsidence, dropping of the water table, or interception of surface-water drainages. Subsidence is probable in most underground coal mining. Depending upon the degree of extraction, subsidence occurs immediately or at some future time. Subsidence may disrupt aquifers, damage surface facilities, and trigger mud slides or rock falls. In some cases, subsidence can lead to permanent loss of coal resources.

The health and safety of mine workers are major concerns associated with both surface and underground mining. Safety and health hazards to the workers, especially in underground mining, are the highest of any industry. Additional discussion on effects associated with coal development can be found in the Final EIS on the Proposed Federal Coal Leasing Program (USDOI, 1974).

Coal is transported by rail, truck, water, slurry pipeline, or conveyor belt. The environmental effects of coal transport occur during loading, while enroute, and during unloading. All forms of coal transport exhibit common environmental-effect factors. All forms use land for terminal/handling plants or for railroad installations or pipeline throughways. Rail transport and trucks cause damage to buildings, and trucking causes major structural damage to highways. Air pollutants and noise are emitted from engines powering the transportation facility. The transport of coal necessarily involves fugitive dust emission, which further affects the air quality.

Combustion of coal results in the emission of carbon dioxide, sulfur oxides, and nitrogen oxides, which contribute to the problems of acid rain and potential climatic warming (greenhouse effect). Acid rain is being recognized as a major environmental concern that adversely affects aquatic and terrestrial ecosystems. Many uncombusted or partially combusted carbon compounds, including known or potential mutagens and carcinogens such as polycyclic aromatic hydrocarbons are also emitted during coal combustion. These carbon-compound emissions are cause for ecological and human-health concerns.

## 3. Conclusions

The major environmental effects of expanding coal production include disruption of large areas of land surface with surface mines, additional acid-mine-drainage problems, and the greater air-quality effects associated with burning coal rather than natural gas or oil in power plants.

# D. COAL CONVERSION TO SYNTHETIC FUELS

## 1. Background Considerations

Synthetic-fuel development has slowed down due to the sagging price of crude oil that resulted from a world surplus. Oil-price moderation, soaring costs, and lack of Federal assistance have led operators throughout the U.S. to shelve, delay, or abandon commercial synfuel ventures. Some operators have kept their projects in order to alleviate future depression of fossil fuels.

Coal can be converted to synthetic fuel by either gasification (synthetic gas) or liquefaction (synthetic liquid). These processes involve the breaking, or "cracking," of heavy hydrocarbon molecules into lighter molecules and the simultaneous enrichment of the molecules with hydrogen.

Water is required in both processes as a source of hydrogen and for other process steps (e.g., removing sulfur compounds and as a cooling component). In general, lower-quality coals (lignitic, subbituminous, and bituminous) are more efficiently converted to synthetic fuels than anthracite (Rickert et al., 1979).

### a. Coal Gasification

The coal-gasification process uses coal to produce gaseous fuel products that can be directly combusted in a boiler, used as chemical feedstock, or used as a product that can be converted into liquid fuels (see Sec. D.1.b of this appendix).

Three ingredients are required to chemically synthesize gas from coal--carbon, hydrogen, and oxygen. The synthesis is performed by reacting coal under sufficient heat with steam and air. Depending on combustion (air vs. pure oxygen), the gas produced is either a low-Btu (100-200 Btu's standard ft$^3$) or medium-Btu (300-650 Btu's) gas. The medium-Btu gas can be further processed by methanation to produce high-Btu (950-1,050 Btu's) gas (Bentz and Salmon, 1981).

Several types of gasifiers are commercially available for the production of low and medium Btu gas (Koppers - Tetzek, Winkler, and Lurgi). A detailed discussion on the chemical and design considerations, as well as a process description, can be found in "Environmental, Health, and Control Aspects of Coal Conversion: An Information Overview" (Braunstein et al., 1977).

Coal gasification seems to be the leading commercial-scale synfuel project throughout the world. In the U.S., only 30 coal-to-synthetic-fuel projects were in operation in 1981. Of these, only 8 are commercial operations. The remainder are demonstration/pilot plants or process-development plants.

The state-of-the-art gasifier available for use in gasification of the highly caking eastern bituminous coal and other coals is an atmospheric Koppers-Totzek unit. The most advanced gasifier is the pressurized Texaco gasifier.

### b. Gas Liquefaction

Coal can be liquefied by both direct and indirect processes. Indirect-liquefaction processes convert coal to liquid products by first gasifying coal to a mixture of carbon monoxide and hydrogen (synthetic gas) and then allowing these gases to react in the presence of a catalyst to form liquid products. In the direct-liquefaction process, a coal slurry is reacted directly with hydrogen in the presence of a catalyst, thus eliminating the step involving the indirect-liquefaction process. After hydrogeneration, the solids and liquids are separated. The residual solids are then burned in a gasifier to generate hydrogen and steam. The quality of the liquid can be either a boiler-fuel grade or a synthetic-crude grade.

The Fisher-Tropsch process, which converts synthetic gas to a liquid product, has been operating in South Africa's Sasol plants using a commercial gasifier (Lurgi). These facilities convert coal mined onsite into 27 different fuel and chemical products. The combined coal consumption of all three plants will be about 33 million metric tons per year. It is predicted that Sasol, Ltd., could produce sufficient quantities of hydrocarbon to make South Africa self-sufficient (Engineering and Mining Journal, November 1982). Four major direct-liquefaction processes are under development: Solvent Refined Coal (SRC) I and II, H-Coal, and Donor Solvent.

## 2. Environmental Effects

The major potential environmental, health, and socioeconomic problems related to coal conversion are terrestrial, air- and water-quality effects resulting from discharged effluents, air emissions, and solid-waste disposal associated with mining, transportation, and processing of the coal. (See Section C of this appendix for a discussion of the effects associated with the mining of coal to supply coal-gasification or liquefaction plants.)

In its EIS on Synthetic Fuels and the Environment - An Environmental and Regulatory Impact Analysis (USDOE, 1980), the DOE reports that substantial quantities of solid-waste material will be generated in each stage of the coal-conversion process. *Waste material will be generated directly from the process that is part* of the original feed, such as ash, unreacted carbon in the form of chars and tars, and fly ash from auxiliary boilers. Secondary wastes consist of added materials/chemicals, such as catalysts or coal conditioners, lime from scrubbers, and added reactants from water treatment.

There is concern for the health and safety of workers since many hazardous and toxic substances are formed and used in the synfuel process. Many substances are identified carcinogenic materials that can form in coal conversion, e.g., benzo(A)pyrene, dibenz(a,h)anthracene, chrysene, and 7-methylbenz(c)-acridine as well as aromatic amines (e.g., naphthylamine and benzidine) (USDOE, 1980).

Air-quality emissions from coal-conversion facilities can include sulfur oxides, particulate matter, nitrogen oxides, hydrocarbons, hydrogen sulfides, ammonia, hydrogen cyanide, polynuclear aromatic hydrocarbons, nitrogen and sulfur containing heterocyclic compounds, and trace elements. The appropriate use of existing available technology should control source emissions to levels in compliance with applicable current regulations.

Wastewater will result from numerous sources within the process. Standard treatment systems using flocculation and biodigestion should prevent water quality problems.

## 3. Conclusions

The major environmental effects of expanding the use of coal in synthetic-fuel production include air-quality effects generated by synthetic-fuel plants, wastewater generated in the production of synthetic fuels, and concerns for the health and safety of workers in synthetic-fuel plants.

# E. OIL-SHALE CONVERSION TO SYNTHETIC FUELS

## 1. Background Considerations

The production of synthetic fuels from oil shale provides an alternative- energy source. Oil shale is a fine-grained, sedimentary rock containing material called kerogen. Kerogen is of high molecular weight and has low solubility in any solvent. The only practical method of recovering hydrocarbons from the oil shale is by heating the rock to high temperatures (approximately 500°C) and thereby recovering shale oil and hydrocarbon gases–a process known as retorting. The retorting of oil shale can be achieved by (a) surface retorting, (b) *in situ* retorting, and (c) modified *in situ* retorting.

There are two methods for surface retorting of oil shale–the direct- and indirect-heat methods. In both cases, heat is required to bring about pyrolysis of the raw shale. In the direct-heated process, the heat is supplied by the creation of a combustion zone within the retort. In the indirect-heated processes, gases are circulated to an external reactor for combustion. Heat is transferred back to the retort by recirculating gases or solids through the retort and the external reactor.

*In situ* retorting refers to a process of retorting the shale in place, without the removal of any material. This eliminates the disposal problem associated with surface processing. In this process, the oil shale is fractured underground, after which heat is introduced to liquefy the kerogen. The produced oil is then removed through wells, utilizing natural permeability.

The modified *in situ* oil-shale process involves mining or removing up to 30 percent of the shale from the retort zone so that void volume is created and permeability is increased. The remaining oil shale in the retort is then explosively fractured and retorted in place. In the case of leached shale, the shale is not fractured; hot gas is injected as the retorting medium. Retorting can then be accomplished by moving the retorted oil either horizontally or vertically.

After retorting, the raw shale oil is processed to remove water and other contaminants by a separation system that typically consists of a closed-cycle processing unit, such as impingement or centrifugal separators, or mechanical demisters. The principal functions of the system are separation and recovery of oil or gaseous products from contaminants that include water produced in the retorting process as well as particulate material carried over the retort.

Following product recovery, crude shale oil requires further treatment to remove nitrogen, oxygen, and sulfur compounds and to reduce viscosity and pour points to allow pipeline or tanker transport. Removal of the nitrogen compounds requires a special refinery process.

Large areas of the western U.S. are known to contain oil-shale deposits; those in the Green River Formation in Colorado, Wyoming, and Utah have the greatest commercial potential. The oil-shale resources of the Green River Formation are estimated at 54 billion barrels of recoverable oil with an assay of 30 gallons per ton, and 600 billion barrels of reserves in place from shale with an assay exceeding 25 gallons per ton. Therefore, the Green River Formation represents 20 to 30 times the known reserves of conventional crude oil in the U.S.

Development in the U.S. shale industry is concentrated in Colorado's Piceance Basin, where approximately 85 percent of the western high-grade deposits are found (Rickert et al., 1979). The oil-shale projects, in some cases, are funded or underwritten by the DOE. Several of the projects are experiencing the effects of soaring costs, sagging oil prices, and delayed development. Many of the companies are extending their timetables and reducing production goals.

In the eastern U.S., the shale deposits underlie Indiana, Ohio, Illinois, Kentucky, Tennessee, Michigan, and Pennsylvania. The eastern shales are of a lower quality than the western shales, but the deposits are more extensive. The eastern shale has a poor carbon-hydrogen ratio and is therefore required to be retorted in the presence of hydrogen. In contrast, the western shale requires only the application of heat to release the oil.

There is an estimated 1 trillion barrels of recoverable reserves within U.S. deposits. The 1-trillion-barrel figure is based on hydrogen retorting rather than on Fischer assay (International Petroleum Encyclopedia, 1982).

## 2. Environmental Effects

The conversion of oil shale to synthetic fuels will have effects on air, land, and water quality. These effects are related to various air emissions, effluent discharges, and solid-waste disposal (spent shale from surface retorting).

Air-quality concerns relate to (a) the production of both criteria pollutants and (b) particulate matter and noncriteria pollutants associated with dust from mining and crushing of raw shale, and resuspension of disposed spent shale.

Control of particulates resulting from the production of oil shale can be a problem. For large surfaces at the mine, "wetting" or vegetation of the stock piles is an adequate control, whereas for more limited areas (e.g., conveyors and crushers), baghouse filters, scrubbers, and cyclones are used to control particulate emissions. Fugitive emissions due to traffic and wind are a potential problem and may require the use of chemical additives and best control-management practices.

Sulfur in raw-oil shale amounts to about 0.7 percent by weight, either as organic sulfur or associated with iron pyrite. During retorting, about 40 percent of the organic sulfur in shale appears as $H_2S$ in the produced gases; and the other 60 percent appears as heavier sulfur compounds in the raw shale oil, spent shale, or water residuals. If shale oil or low-Btu gas from the retort is used for steam generation or any other combustion process, sulfur oxides will be formed and flue-gas-desulfurization scrubbers will need to be used for tail-gas cleanup. The kerogen fraction of the raw shale can contain up to 2 percent of nitrogen. The extent of $NO_x$ formation from the use of retort off-gases or shale oil to hear the retort will be related to flame-temperature-residence time and the air/fuel mixture. Combustion efficiency during oil-shale retorting is not expected to be a significant problem. The HC and CO emissions will therefore be small. The low-Btu gas formed during retorting will either be flared or used for onsite steam production with traditional flue-gas-cleanup controls.

Water-resource effects encompass effluent control and water-supply issues. In the semiarid Piceance and Uinta geological basins in Colorado and Utah, where most of the high-quality-oil-shale resource is found, water pumped from mines or drawn for process use is expected to be recycled or consumed. Effluent problems are focused on potential contamination of aquifers and surface waters by leaching from spent-shale piles, evaporative and lagoon concentrates, or burned-out *in situ* retorts, rather than from direct emissions. Problems with *in situ* processes concerning backflood water and fugitive-gas emissions may result in contamination of ground-water aquifers. Ground-water supplies and surface-water supplies fed by ground-water aquifers might be affected for very long periods of time, thereby creating difficulties in securing adequate water supplies for retort operation.

Wastewater from surface-retorting operations (up to 8 gallons/ton of input shale and more from some *in situ* operations) and process water from product- upgrading operations will have to be controlled. Wastewater can then be used for moisturizing spent shale. Under current planning, oil-shale developers envision zero discharge of their wastewaters.

Disposal of spent shale and storage of raw shale could create land disturbances of large magnitude, potential accumulation of toxic substances in vegetation, and contamination of ground waters and surface waters from runoff.

The DOE (1980) reports that retorted shale contains varying amounts of organic and inorganic residuals depending on the retorting process. It presents a major solid-waste-management and disposal problem for the surface and modified in situ operations from both the amount and its content. Retorted shale will have a density of about 75 to 100 pounds per cubic foot after compaction. This means that for every 50,000 barrels of surface-retorted shale oil produced, there will be enough spent shale to occupy a volume of almost 2 million cubic feet, or about a 2-foot depth over a square mile for every month of operation.

Above-ground-retorted shale from modified *in situ* operations would have considerably less solid waste for disposal. Large areas are required for the storage of raw shale and the disposal of retorted shale. The resulting potential loss of habitat for plant and animal communities and natural erosion of the disposal piles by wind and water may not be fully mitigated by vegetating or physically stabilizing the disposal piles. Problems and uncertainties related to the vegetation of retorted shale include water requirements, accumulation of toxic trace substances in the vegetation, and long-term stability.

Potential problems with stability of waste piles will require several years to emerge, and uncertainties will remain for 10 to 20 years. Spent shale can either be returned to the mine or stockpiled above, in which case it will bcompacted and vegetated or otherwise stabilized to prevent erosion by wind or water. Dust control will be accomplished by application of water or chemical wetting agents. Surface-disposal options include filling valleys and recontouring surfaces. The major consideration is to ensure that the large quantities of spent shale can be economically disposed of with minimum environmental damage.

The occupational work force will be exposed to an environment largely uncharacterized in terms of industrial hygiene and safety analyses. The miners will be subject to exposure to possible toxic materials.

## 3. Conclusions

The major environmental effects of oil-shale development include: effects from disposal of spent shale, air-quality effects from dust and vehicle emissions, disruption of land, the large quantities of water needed in processing, and water-quality effects from wastewater disposal.

# F. BIOMASS CONVERSION TO SYNTHETIC FUELS

## 1. Background Considerations

Biomass conversion is the process of transforming biomass (organic material) into usable energy sources. This conversion transforms the biomass into (a) liquid form (alcohol) or (b) methane gas.

A biomass-fueled gasification project that will convert peach pits into gas is planned for a greenhouse in Lodi, California. This is the first commercial application of an automated, small-scale, biomass-fueled gasifier in California (California Energy Commission, 1984). The gas produced will be used to supply heat to greenhouses. The system will result in a substantially reduced energy cost compared with the existing natural gas system. As a result, the growers will be able to expand their growing seasons, increase plant yield, and expand their market to include high-energy plants.

### a. Ethanol and Methanol

Ethanol from grain is one of the alternative fuels that can be produced from a renewable resource. Ethanol can partially replace current transportation fuels derived from petroleum. Although ethanol can be produced from grain, 70 percent of the high-proof ethanol is made synthetically from ethylene gas derived from petroleum (USDOE, 1980).

Ethanol may also be derived from any carbohydrate source, such as starch in corn and other grains. The DOE (1980) reports that nearly 12 billion gallons of ethanol would be required to produce a National 10-percent alcohol/gasoline blend by the year 2000. Assuming an average yield of 100 bushels per acre and an ethanol yield of 2.5 gallons per bushel, this amount of alcohol would require 48 million additional acres of corn production.

Methanol production is based upon the gasification of wood to produce a medium-Btu gas followed by a chemical reaction to combine water and carbon monoxide to form hydrogen and carbon dioxide (Section C of this appendix). Additional carbon monoxide is combined catalytically with hydrogen to produce methanol.

Forest residue--"slash" cuttings left behind after conventional logging, and stump/root systems--can be used to generate methanol. A recent assessment estimated that forest-industry waste (lumber and pulp mills) could serve as the major resource for methanol production.

### b. Organic (Urban) Waste

The basic processes for converting urban waste to energy are combustion, pyrolysis, and bioconversion. Each process requires waste collection and transportation. Some processes require mechanical preprocessing to separate the municipal solid waste into a refuse-derived fuel and other noncombustible and nonbiodegradable materials. Some of the noncombustible and nonbiodegradable materials such as ferrous metal, aluminum, and glass are recyclable.

Combustion of urban wastes in waterfall boilers is the most developed process, with eight plants commercially operating in U.S. cities. Urban-waste furnaces are being demonstrated at a facility processing 600 tons per day in Milwaukee, Wisconsin; and a 200-ton-per-day unit has been undergoing tests (joint Environmental Protection Agency [USEPA] and DOE sponsorship) with 50-percent refuse-derived fuels at Ames, Iowa, since 1974.

Pyrolysis or thermal-gasification processes have been tested in Charleston, West Virginia; Baltimore, Maryland; and El Cajon, California. Municipal solid waste is decomposed in an oxygen-deficient atmosphere to produce combustible gas and liquids. Scrubbing is used to remove hydrochloric acid, hydrogen sulfide, and $SO_2$. Wastewater is a byproduct that requires treatment.

The bioconversion process for converting solid and liquid urban wastes into methane is in the research and early pilot-plant stages. The processes leave a waste-disposal problem in the form of liquid-digester residues, microorganisms, and inorganic nonbiodegradable material. A DOE-sponsored digestion plant at Pompano Beach, Florida, and the ANFLOW project are currently producing methane.

## 2. Environmental Effects

Biomass conversion to synthetic fuels, and its residual wastes, will have effects on water and air quality and on the land (erosion and nitrogen depletion of the soil). Additionally, the general public may be exposed to aesthetic problems--dust, noise, and odor. Following is a description of the adverse effects on the ecosystem from biomass conversion.

### a. Ethanol and Methanol

Growing corn for ethanol production requires large amounts of nitrogen. In order to prevent nitrogen loss in the soil, rotation of crops with legumes or the use of anhydrous ammonia would be required. The runoff and leaching of pesticides and fertilizers would accompany increased grain cultivation. This can have an adverse effect on the ecosystem and possibly on humans.

The loss of sediments due to erosion, as well as the leaching of salts, could cause a wide variety of effects on ecosystems and could cause a reduction in land productivity.

Extensive production of methanol from silviculture-biomass resources may disturb up to 50 percent (350 million acres) of current forest land. In addition to pollution effects, methanol production has the potential to cause severe ecosystem effects, such as the elimination of the range of certain species, elimination of threatened and endangered species, and elimination of specific ecotypes.

Silviculture-biomass production and residue-removal schemes have the potential to significantly increase air and water erosion of the soil. Erosion of the soil from cleared areas is fairly predictable and can be serious in areas of high rainfall and hilly topography.

Silviculture for methanol production should not contribute to air pollution as dusting does to farming. For a plant that would process 2,000 tons per day of green wood and produce 170,000 gallons per day of methanol, it has been estimated that 1,000 tons per day of $CO_2$ would be vented into the atmosphere (USDOE, 1980). With the generation of methanol from wood using an estimate of 0.25-percent product loss to the air, 1.4 tons per day of hydrocarbons are estimated. The facility would also generate 0.44 ton per day of particulate emission from the grinding room. When grain starch is converted to alcohol by means of hydrolysis and fermentation, approximately equal weights of ethanol and carbon dioxide are formed in the process.

Residual wastes (solids remaining after the fermentation process) have been estimated for a 20-million-gallon-per-day ethanol plant. The amount of raw waste might range from approximately 12 to 55 gallons per gallon of product. The waste may contain contaminants equivalent to 0.12 to 0.17 pound of (5-day biochemical oxygen demand/gallon of ethanol product).

Approximately 0.5 pound of excess activated sludge can be expected for each pound of BOD5 removed. Assuming that the raw waste contains 0.17 pound of BOD5 per gallon of product ethanol, 95-percent removal corresponds to 961 tons of BOD5 removed per 1,012 Btu's produced. Excess waste will amount to 480 tons per 1,012 Btu's.

For a 170,000-gallon-per-day methane plant with activated-sludge treatment, it has been estimated that 0.64 ton per day of BOD5 would be produced along with 6 tons per day of waste-activated solids and 25 tons per day of ash and unburned carbon.

### b. Organic (Urban) Waste

Waste-conversion processes greatly reduce municipal solid-waste volume but still leave waste residuals that go into landfills or impoundments. The chemical composition and source (domestic, industrial) of the municipal solid waste--leachability of fly and bottom ash, pyrolysis byproducts, scrubber sludge, and the anaerobic digestion sludge--is a concern. Selection of landfill sites and facility siting may be affected.

Effluents discharged at disposal sites (pits, ponds, lagoons) are likely to contain the same ingredients that are present in raw municipal waste and may pose a hazard to water resources and ecosystems.

Waste-plant, front-end processing, storage, and transport operations may pose an occupational hazard to workers. Data indicate that dust, micro-organisms, hazardous chemicals, and noise are all highest close to equipment for providing and storage of municipal solid waste. Emissions from combustion and co-combustion facilities are known to contain fly ash, organic compounds, and trace elements and are a health-and-welfare concern.

The presence of combustible dust may create explosion hazards. These operations also expose the general public to aesthetic problems (dust, noise, and odor), which can result in siting problems. Traffic flow in the vicinity of the plant is also a concern.

## 3. Conclusions

The major environmental effects associated with expanded production of synthetic fuels generated from biomass include the land erosion associated with farming and silviculture water-quality effects associated with wastewater disposal, residual solid wastes, and air-quality effects--especially from burning urban waste for power generation.

# G. DOMESTIC ONSHORE OIL AND GAS

## 1. Background Considerations

The Annual Energy Review 1985 estimated that onshore, undiscovered, recoverable oil resources ranged from 42 billion barrels (Bbbl) of oil with a 95-percent probability to 71 Bbbls with a 5-percent probability (mean resource of 55 Bbbl). Onshore, natural gas resources range from 320 trillion cubic feet (tcf) of gas with a 95-percent probability to 570 tcf of gas with a 5-percent probability (mean resource of 430 tcf).

The major areas for oil and gas activities (exploration and development) in the U.S. are within three regions: the Rocky Mountain Region, the Mid-Continent, and the Eastern Overthrust Belt. According to the 1984 International Petroleum Encyclopedia, 7,914 new-field wildcat wells were completed during 1982, with 1,402 wells completed as producers--for a success rate of 17.72 percent. That compares with 17.67 percent producers in 1981 and a record 19.05 percent in 1980. The 1,402 new-field discoveries of 1982 represent a 1.5-percent decrease from 1981. The American Association of Petroleum Geologists estimated that 1982's new-field discoveries contained reserves of 651.64 million barrels of oil and condensate and 3.84 tcf of gas–a decrease of 0.2 percent in liquids and 10.7 percent in gas from figures reported for 1981.

## 2. Environmental Effects

The environment can be affected by the different phases of oil and gas activity--exploration and development, and production. The environmental effects of onshore oil and gas are similar to those already described (Sections IV.A. and IV.B. of this EIS). These include physical, biological, and socioeconomic effects resulting from drilling activities, transportation, and processing of the oil and gas.

In the exploratory phase, two activities–off-road-vehicle traffic and exploratory techniques–would have an effect on wildlife populations and habitats. Noise from heavy-duty exploratory vehicles and associated human involvement would adversely affect wildlife, particularly ground-nesting birds, reptiles, and burrowing animals. Seismic exploration utilizes explosives, thumpers, and vibrators to test for oil and gas resources. These techniques disturb wildlife by disrupting their habitat and creating loud, sudden noise.

Off-road vehicles, seismic activity, drilling of test wells, excavation of construction materials (sand and gravel), and building of service roads and drilling pads cause soil particles to become unconsolidated and increase the soil's susceptibility to wind and water erosion. The disposal of drilling muds and dumping of waste oil in sump pits would contaminate soils in the area of drilling sites.

In areas where unstable soils are located and the potential for natural revegetation is low, such activities can cause long-range effects on surface-water quality, increase erosion, and decrease wildlife habitat and vegetative cover. Accidents such as fires, explosions, well blowouts, spills, and leaks can lead to major contamination and higher temperatures for surface waters when oil enters streams, ponds, or lakes, and to adverse effects on terrestrial vegetation.

Oil and gas activity can cause degradation of water quality and reduction of water supplies. During exploration, water supplies can be lost or reduced from seismic testing, stratigraphic testing, and wildcat drilling. During exploration, the ground-water hydrology can be altered from the fracturing of impermeable zones below aquifers, permitting the water resources to be lost or reduced through vertical drainage. Well drilling can also require large quantities of water, especially if porous and permeable formations are encountered. Oil spills and/or leaks, blowouts, and spills or leaks of caustic, salty, or polluted water can cause adverse effects.

During the development and production phase, the removal and handling of water from producing wells and separation facilities can cause further degradation of surface-water quality. Upon abandonment of a producing oil field, those facilities that contain residual oil, brine waste, or solid wastes may cause further water pollution. Batteries, tanks, sumps, and pipelines may deteriorate and release pollutants into adjacent surface and ground waters.

Injection of additional waters into a producing well may become necessary during the production phase to obtain additional oil production through flooding with massive amounts of water. This may be either fresh or produced (brackish) water. Such production techniques generally require additional water resources and deplete the availability of ground-water supplies.

## 3. Conclusions

The major environmental effects associated with expanded production of onshore oil and gas resources include effects on pristine areas from roads; off-road-vehicle traffic; and other oil and gas infrastructure that generates loss of natural vegetation and erosion, effects on air quality, and effects on water quality.

# H. GEOTHERMAL POWER

## 1. Background Considerations

Geothermal energy is the heat contained in and continuously flowing from the earth. Today, it is proving to be a viable source of energy for the generation of electricity and space heating. There are four different types of high-grade geothermal reservoirs that may be exploitable–(a) the hyperthermal system, (b) the geopressured system, (c) the molten-rock system, and (d) the hot-dry-rock system. At the present time, only the hyperthermal system is viable.

The hyperthermal systems that are being exploited around the world have extremely high temperatures (500-600°F) and often occur at depth (frequently 2 miles). All occur in hot, fractured rock with a high water content. This water serves as a heat-exchange medium that flows into the boreholes. The heat is then carried to the surface and to the electrical-generating turbines. The pressure of the overlying rock and water generally keeps the water in the reservoir in a liquid state, even when temperatures are far above the liquid's boiling point. However, as the drill bit penetrates the cap rock of the reservoir, the pressure is relieved and the contained water flashes to steam. A few reservoirs such as those found at the Geysers, California, and Lardarello, Italy, consist of superheated, high-pressure steam.

The largest geothermal development is underway at the Geysers Geothermal Field in California's Sonoma and Lake Counties, located about 90 miles north of San Francisco. The field yields almost 750,000 kilowatts of installed electrical-generating capacity. Plans presently call for an additional 220,000 kilowatts of capacity. Predictions are that full development in the Geysers Field will account for about 2 million kilowatts of generating capacity by the end of the decade (International Petroleum Encyclopedia, 1982). Pacific Gas and Electric Company's complex of 17 geothermal power plants at the Geysers produced a record 6 billion kilowatt-hours of electricity in 1983 (California Energy Update, August 8, 1984). See Table D-4 for annual U.S. production of electricity from geothermal sources.

Table D-4

Production of Electricity from Geothermal Sources

| Year | Net Summer Capacity On-Line (thousand kilowatts) | Production (million kilowatt-hours) |
|---|---|---|
| 1979 | 667 | 3,889 |
| 1980 | 909 | 5,073 |
| 1981 | 909 | 5,686 |
| 1982 | 1,022 | 4,843 |
| 1983 | 1,207 | 6,075 |
| 1984 | 1,231 | 7,741 |
| 1985 | 1,590 | 9,325 |

Source: Energy Information Administration, Annual Energy Review, 1985.

Another development program is underway in southern California's Imperial Valley. The geothermal resources present would generate more than 3 million kilowatts of electrical-power capacity. A second prospect, Heber, in the Imperial Valley, contains enough geothermal energy to provide a capacity of 500,000 kilowatts for at least 30 years (International Petroleum Encyclopedia, 1982).

Utah Power and Light has proposed a 20,000-kilowatt electrical-power-generating plant fueled by geothermal energy from Roosevelt Hot Springs, in southwest Utah. Phillips Petroleum has also entered into a commercial geothermal venture at Roosevelt Hot Springs. The Roosevelt prospect is thought to be capable of supporting 200,000 to 400,000 kilowatts of power capacity. Other areas of potential development include the Jemez Mountains in New Mexico, Dixie Valley in Nevada, and Desert Peak in California.

## 2. Environmental Effects

Environmental effects from the development of geothermal resources vary depending upon the pre- and postlease exploration and development activities, and the nature of the geothermal find. The chief effect from the use of geothermal power occurs during the period of development of the field and construction of the steam-gathering lines and power plants. Natural steam does contain a small percentage of noncondensable gases, including hydrogensulfide and methane, that are vented to the air and that may affect air quality. Impurities in the water released from the development of geothermal energy also may affect water quality in the area.

Any effects of geothermal development upon climate will be localized and should not affect regional patterns. Local temperature patterns will change by several degrees due to waste heat emitted from the power plants, particularly from the cooling towers.

According to the Department of the Interior (1980) Final EIS for Proposed Leasing within the COSO Known Geothermal Resource Area, the principal gaseous emissions associated with geothermal development are the noncondensable gases hydrogen sulfide ($H_2S$) and carbon dioxide ($CO_2$), and water vapor from flow testing and from cooling towers. In addition, fugitive dust will be emitted into the atmosphere as a result of construction and vehicle activity and by wind erosion.

Noise effects can result from direct geothermal activities such as well drilling and power-plant operation, and from related activities such as automobile and truck traffic. Noise can also result from developmental operations, during preparation and construction of well pads and power plants. Further noise effects are likely to occur during drilling, cleanout, and flow testing of new wells; noise associated with these activities is short-term.

The operation of the power plant represents the major long-term, continuous noise source resulting from geothermal development. Major contributors to the noise include cooling towers, turbines, and stream-jet ejectors. The cooling towers, which are physically large and have a large-band-frequency spectrum, become the dominant noise source at distances greater than 200 ft from the unit.

Subsidence and seismic activities may be accentuated during the production phase. The potential for subsidence is greatest in hot-water systems produced from unconsolidated sediment. Since the majority of geothermal systems are in more competent rock, they are not subject to large amounts of subsidence. Geothermal systems are often found in areas of seismic activity. Possible fault movements can result from the removal and reinjection of fluids causing cyclic variations in reservoir pressures.

Geothermal development requires cooling water, which could displace other uses or degrade other supplies. It also produces enormous amounts of liquid waste requiring disposal. Exploration and well drilling and construction of development facilities can cause short-term effects of surface erosion and drilling-waste disposal. This could cause alteration of surface runoff and erosion patterns, sediment yield, and ground-water degradation. The development and production of geothermal energy could lower the water table. Degradation of the natural water could locally reduce the temperature of the fluids, causing mineral precipitation and/or depletion of the geothermal reservoir.

The amount of land used and altered ranges from zero in the very earliest stages of exploration to many tens of acres in a field that has undergone fuel-stage development. Surface-disturbing activities generally are (a) road building; (b) drill-pad, power-line, and/or other facility-site construction; and (c) construction and clearance of pipelines and transmission facilities.

Effects on wildlife could result due to increased vehicular traffic, drilling activities, removal of wildlife habitat, and noise associated with construction and production activities.

Recreational uses would be affected by noise, dust, traffic conflicts, or physical displacement from specific recreation-use areas. Public-safety concerns could restrict recreational use of an area until drilling operations ceased. Geothermal development could modify the landscape character of an area if striking contrasts occurred in form, line, color, or texture of land-scape features.

## 3. Conclusions

The major environmental effects generated by increased use of geothermal resources include the considerable noise associated with the operation of many geothermal-power plants, air-quality effects, development pressures in pristine areas, and water-quality effects.

# I. SOLAR POWER

## 1. Background Considerations

The sun is the earth's most abundant source of energy. Only an infinitesimal fraction of the sun's radiant energy strikes the earth. It is estimated that about 180 trillion kilowatts of electricity--more than 25,000 times the world's present industrial-power capacity--is received. However, this energy requires conversion to a suitable form.

Solar energy can be captured either directly through rooftop collectors, photovoltaic cells, and building-design features or indirectly through storage of solar energy in nature. In comparison to producing energy from conventional fuels, direct solar energy is relatively clean and pollution-free.

Solar systems convert the sun's radiation into energy for heating and air conditioning by means of absorptive coolers, industrial-process heat, and electricity generation. Photovoltaic cells convert sunlight directly into electricity, although the relatively low conversion efficiency requires large collector areas. Another method of utilizing solar power is solar thermal, wherein the sun's rays are directed by mirrors to a central point and are then capable of being used as the heating source for a thermal-power plant. There are four different solar-thermal systems that have different temperature ranges, applications, and types of collectors: (a) solar pond, 140-180°F; (b) flat plate, 100-250°F; (c) parabolic concentrating, 300-1,500°F; and (d) heliostats, 500-2,000°F. Much of the recent work in solar-energy production has focused on reducing the manufacturing costs of solar collectors, improving their efficiencies and reliabilities, and simplifying their design and installation.

Solar technologies will require more land per unit of capacity than will conventional-energy systems due to the diffuse nature of the solar resource and the generally low efficiencies of solar devices. If the facility is to provide process steam to an industry or utility, the collectors must be in close proximity to the point of end use. If the plant is electricity generating, it must give a clear access for an electrical interconnection with the local-utility-grid network. The amount of available solar radiation at a specific geographic location dictates the number and size of the collectors required. The amount of available solar radiation can vary dramatically from site to site. Table D-5 gives an estimate of the collector-area-to-land-area ratios.

Table D-5

Solar Energy Collector to Land Ratios

| Collector | Collector Area | Land Area |
|---|---|---|
| Solar Pond | | 1.0 |
| Flat Plate | 1.0 | 2.0-2.2 |
| Photovoltaic Array | 1.0 | 2.0-2.2 |
| Parabolic Trough | 1.0 | 2.2-2.4 |
| Parobolic Dish | 1.0 | 3.4-3.8 |
| Heliostats | 1.0 | 3.0-3.8 |

Source: Sheahan, 1981.

Legal right to the sun is an important aspect of solar power. Height of structures, trees, or land features on adjacent land--especially on the south side--is important because of potential shading of the collectors. Sheahan (1981) reports the recommendation that there be an uninterrupted view of the south down to an angle of 10 degrees above the horizon and clear to the southwest and the southeast, to the point where the sun rises and sets on the summer solstice. This area may need to be controlled through legal restrictions or land acquisition.

Land surfaces need to be as flat as possible with grades not exceeding 10 percent. If the land is contoured, more spacing would be required due to potential shading from collectors on the higher ground.

Areas with excessive wind would need to be avoided, since windblown sand and dirt would erode mirrored collector surfaces. Similarly, high wind could cause structural damage to the sail-like collectors. Hailstones and heavy snowfalls could also damage the collectors. In addition, adjacent industrial facilities may give off air emissions that could erode mirrored collector surfaces.

## 2. Environmental Effects

The major environmental effect of solar-energy-conversion systems results from the relatively large surface area required for the collectors and from disruptions that occur during development. During the manufacture of photovoltaic cells, minimal air-quality effects would result, with some water-quality degradation occurring due to discharge of waste-rinse solutions. Other effects from solar-energy development include cooling-water (aquatic-thermal-pollution) requirements, height requirements for a solar-power tower, and heat and light-beam intensity from mirror collectors.

Solar energy will not contribute to air pollution except during the production of solar equipment or during the cleaning of the mirrors. Increasing solar use will cut emissions of particulates, hydrocarbons, sulfur oxides, carbon monoxides, and nitrogen oxides. At the same time, solar systems will not increase atmospheric carbon-dioxide levels that could cause major changes in global climate.

Some solar-thermal electric plants with once-through cooling could have significant water requirements. Leakage and disposal of antifreeze and anticorrosion fluids from solar heating and hot-water systems could produce a minor water-pollution problem.

The height of a solar-power tower is significant and could be potentially as high as 1,000 ft for a 100-megawatt plant. Therefore, if a solar-plant site is proposed in proximity to an airport or major airline route, special precautions are required.

The solar reflections from heliostats and parabolic collectors can be very intense, and special precautions must be taken when working in the area of operating collectors. The solar beam with an intensity of approximately 70 heliostats in Albuquerque, New Mexico, melted through a one-quarter-inch steel plate in 2 minutes. Therefore, cleaning and maintaining the mirrored surfaces must be a nighttime procedure.

Biological resources can be affected during the installation and development stages. There also are many possible effects from support activities, such as road building to provide access to the solar sites, development of electric-feeder and transmission lines, and construction and maintenance of substations. Immediate habitat loss due to solar-energy development would occur during the construction of roads, solar plant, substations, and power-distribution and transmission lines. Other indirect effects include increased human activity, noise and visual disturbance, and subtle habitat changes, such as the invasion of new plant species in disturbed areas.

## 3. Conclusions

The major environmental effects generated by increased use of solar-energy production include use of the major land areas needed for reflectors or heliostats with attendant loss of wildlife habitat; intense reflections from heliostats; and air- and water-quality effects associated with the manufacture of solar equipment. However, operation of solar-energy-production facilities does not cause air- or water-quality effects.

# J. WIND-TURBINE POWER

## 1. Background Considerations

Wind has been used as an energy source for centuries. Historians believe that the earliest wind machines probably were primitive devices used to grind grain in Persia around 200 B.C. Manufacturers presently are producing small wind machines (less than 100 kilowatts) to be used in homes, farms, factories, and small businesses. Although the home market for wind turbines is growing rapidly, energy experts say that the type of wind technology most beneficial to the Nation will be the large turbines that feed electricity to the utilities. Several utilities are experimenting with wind power.

A wind turbine needs a supply of wind in order to operate. The velocity, direction, and time (frequency and duration) of the wind would need to be calculated prior to site selection. Potential obstructions such as buildings, vegetation, and other wind turbines can affect the supply of wind to a wind turbine in two ways--the velocity can be altered, and the turbulence can be increased.

A decrease in velocity means that reduced energy output and an increase in turbulence may also reduce the energy output and, perhaps more critically, reduce the useful life of the turbine. Buildings and vegetation are more of a problem with small machines and with machines in urban areas. The only man-made structure in rural areas that would affect wind turbines is another wind turbine.

Southern California Edison's 10-year resource plan calls for generation of 2,100 megawatts of power from renewable resources by 1990. Wind turbines could contribute almost 7 percent of these needs and provide 1.226 trillion kilowatt hours on an annual basis (USDOI, 1982). Southern California Edison is targeting 360,000 kilowatts of wind-generated power by 1990 (International Petroleum Encyclopedia, 1982).

International Petroleum Encyclopedia (1982) reports that the Pacific Gas and Electric Company (PG&E) signed a contract with Windfarms, Ltd., of San Francisco to buy most of the 360,000 kilowatts to be generated. This project will entail installation of 146 wind turbines at a cost of about $700 million. When completed in 1989, it could yield as much as 963 million kilowatt-hours of electricity.

PG&E also plans to purchase all the electricity to be generated by a wind park to be built by U.S. Windpower of Burlington, Massachusetts. The project involves installation of 600 horizontal-axis wind turbines at an estimated cost of $60 million.

California Energy Update (August 8, 1984) reports that wind-project developers within California are announcing and installing record numbers of wind turbines. Over 2,400 wind turbines totaling more than 250 megawatts have been approved by zoning commissions and planning councils or announced by project developers. Major permitted wind-turbine projects include Altamont Pass, a total of 7,626 wind turbines; San Gorgonio Pass, a total of 1,352 wind turbines; and Tehachapi, 280 wind turbines. A total of 2,400 turbines have already been erected at Altamont Pass.

## 2. Environmental Effects

The primary environmental effects that would result from wind-turbine-energy production include adverse ecological effects from site development and presence of the structures, noise levels, interference with television reception, and potential recreational and visual conflicts.

Biological resources can be affected by many stages of wind-energy development, including initial material acquisition and processing, turbine production and assembly, and turbine installation and operation. There are also many possible effects from support activities, such as road building to provide access to turbine sites, development of electric-feeder and transmission lines, and construction and maintenance of substations. Other indirect effects include increased human activity, noise and visual disturbance, and subtle habitat changes, such as the invasion of new plant species in disturbed areas.

The USDOI (1982) reports that the direct effects of wind-energy development on biological resources include two main categories: (a) loss of animals through surface disturbance at turbine sites and in road and along powerline rights- of-way; and (b) at substation sites, disturbance of animal behavior through interference with courtship, rearing of the young, feeding, and other necessary aspects of animal-life histories.

Wildlife activity would decrease significantly in the immediate construction area or facility site, and animal habitats near development will often be deserted. If associated long-term indirect effects are high, the developed area may be permanently abandoned. Such indirect effects include immediate habitat loss as well as long-term, cumulative habitat deterioration.

The potential exists for low incident rates of collision between birds and wind-turbine generators. Placement of large turbines along ridge tops may affect the behavior of large soaring birds that utilize air currents deflected upwards by the terrain as a source of lift. Certain species, including small mammals and lizards, would be very vulnerable to crushing and other direct effects from construction of the turbines and roads.

Noise effects can result from the construction of the wind turbines by earth-moving equipment and increased traffic on local roads and highways in the study area. There are a number of potential noise sources from wind-turbine operations. Noise would be generated from the operation of the generator, the transformer, and the gearbox, and from the wind-turbine blades. The turbine blades would be the predominant noise source in the far-field of the wind turbine. The other noise sources would generally be discernible only in the near-field of the wind turbine.

Noise would be generated from a number of phenomena associated with wind- turbine-blade interaction with the air. The primary causes of noise are (a) fluctuating lift resulting from the interaction of the blades with the atmospheric turbulence of the wind, (b) interaction of the blade turbulent-boundary layer with the trailing edge of the blade, (c) direct acoustic radiation from the turbulent-boundary layer, (d) direct acoustic radiation from the wakes of the blades, and (e) interaction of the tower wake with the turbine blades on wind turbines where the blades are downwind of the tower. Of these causes, the first two are the dominant causes of noise. Noise associated with the operation of the wind turbines has become an increasing concern with residents in the area of the wind park.

Placement of the turbines in an area can cause a reduction in the area's suitability for recreational and other land uses. Conflicts have arisen due to the potential placement of wind parks in areas designed for wilderness review, and in areas of highly concentrated archaeological resources. Wind turbines are highly visible because of their height. Wind development in an area would have a significant visual effect on the character of the existing landscape. Visual aesthetic effects would result from removal of vegetation; soil disturbances associated with construction of wind-tower pads, access and service roads, electrical-transmission lines; and introduction of a variety of wind-turbine structures.

Wind and water erosion are likely to result from the construction of wind farms in an arid environment. Localized desert-pavement development would occur as a result of construction. This could result in a worsening of flood-hazard potential and downstream-sediment deposition. Changes in natural drainage courses could also increase channel erosion.

Wind turbines may interfere with television reception by causing visual distortions. Sengupta et al. (1980) report that interference to television reception is caused by the scattering of television signals by the wind turbines. In the vicinity of an appropriately oriented wind turbine, a television receiver will receive the scattered signals in addition to the direct signal. The scattering by the rotating blades of the wind turbine will produce both amplitude and phase modulations of the signals at the receiver. Since video information in television signals is transmitted by amplitude modulation, any extraneous amplitude modulation will, if sufficiently strong, distort the video reception.

The upper ultra-high-frequency channels are found to be particularly vulnerable to such distortions. For a given television channel, the maximum distance from the wind turbine at which adverse interference may occur is a function of the wind-turbine-blade dimensions and orientations and the receiving-antenna characteristics. The size of the interference decreases as the television-channel number is decreased.

## 3. Conclusions

Expanding the generation of electricity with wind power would cause the following major environmental effects: disturbance of sizable areas with thousands of giant windmills disrupting existing uses and affecting wildlife, visual impacts, considerable noise generated by the operation of windmills, and wind turbines interfering with television reception.

# K. HYDROELECTRIC POWER

## 1. Background Considerations

Hydroelectric sites operating today were developed in the early 1950's. The total developed and undeveloped hydroelectric power in the U.S. is 6.75 trillion kilowatt hours (Table D-6).

Table D-6

Hydroelectric Power in the United States - Total Potential

| Geographic Division | Average Annual Generation (1,000 kilowatt hours) |
|---|---|
| New England | 13,589,232 |
| Middle Atlantic | 37,763,815 |
| East North Central | 9,779,997 |
| West North Central | 17,645,343 |
| South Atlantic | 34,324,480 |
| East South Central | 27,879,762 |
| West South Central | 10,585,090 |
| Mountain | 97,658,028 |
| Pacific | 249,284,546 |
| Alaska | 176,290,145 |
| Hawaii | 333,400 |
| Total - United States | 675,133,838 |

Source: Federal Power Commission, 1976.

### a. Hydroelectric Dams

Conventional hydroelectric developments convert the energy of naturally regulated streamflows to produce electric power. The construction of a dam for hydroelectric power interrupts the flow of a river, creating a lake or reservoir behind the dam. This alters the physically unstable riverine ecosystem and shifts it into a relatively stable lacustrine ecosystem.

PG&E's 65 hydroelectric plants produced three times more energy in 1983 (almost 18.1 billion kilowatt-hours) than in 1982. In addition to production from its own hydro plants, PG&E purchased 24.5 billion kilowatt-hours of economical hydro power produced mainly in the Pacific Northwest. Hydroelectric power accounted for 59 percent of the electricity available to PG&E customers in 1983.

### b. Pumped-Storage Projects

Pumped-storage projects generate electric power by releasing water from an upper pool to a lower storage pool and then pumping the water back to the upper pool for repeated use. A pumped-storage project consumes more energy than it generates but converts off-peak, low-value energy to high-value, peak energy. To meet peak-load requirements, power companies have been utilizing pumped-storage hydroelectric stations to a greater degree. There are many advantages to pumped-storage hydroelectric power, which increases the number of sites acceptable for construction of dams whose primary purpose is to supply peak-power needs.

Relatively small streamflows can support large generating capacities, since water is stored and a portion of it can be reused. The pumped-storage plant also does not require a large stream in a deep, natural valley.

The PG&E announced in 1984 that the Helms Pumped-Storage Project, the largest hydroelectric plant in its 65-plant hydro system, had begun commercial operation. Located about 50 miles east of Fresno, California, the plant produces electricity during peak hours by drawing water from the Courtright Reservoir. Once the water passes through the hydraulic-turbine generator, it is released into Wishon Reservoir. The units are then reversed and the water is pumped back up to the Courtright Reservoir for use during the next peak period. Each of the three units at the Helms Project is capable of generating 402,000 kilowatts (California Energy Update, July 1984), and total capacity would be approximately 1.2 million kilowatts. This makes any one of the units among the largest reversible hydroelectric systems in the world.

## 2. Environmental Effects

The generation of hydroelectric power causes a variety of environmental effects. The following information describes effects resulting from hydroelectric dams and pumped-storage projects.

### a. Hydroelectric Dams

Construction of a dam represents an irreversible commitment of the land resources beneath the newly created lake. Flooding eliminates wildlife habitat and prevents uses such as agriculture, mining, and some recreational activities. The interruption of the river's flow, even if only temporarily eliminated during the period required for the reservoir filling, can affect the flora and fauna downstream. However, with the construction of a dam, new water-related recreational facilities will be generated.

Changes in the hydrologic system resulting from the construction and operation of a hydroelectric dam are physical but can directly and indirectly bring about changes in all the dependent biological and human systems.

With the construction of a dam, the relative stabilization of the water level in the basin would affect the volume of discharge and current velocity downstream, thereby affecting the energy flow of the ecosystem. Increased input to ground-water supplies could result in possible benefits to distant aquifers. In comparison to the previous riverine ecosystem, reduction in turbidity through settling of sediments and possibly from the reduction of erosion in the new lake could result. Furthermore, probable reduction of turbidity downstream may also reflect settling (basin action) of the reservoir, in addition to benefits of stabilized water flow through the system. An increase in basin evaporation loss could occur due to (a) the existence of a large open body of water and (b) increased evapotranspiration of emergent aquatic plants.

A change of water chemistry would be detectable within the reservoir, and in some cases would cause stratification of the water, represented by deep-water, oxygen-depleted zones. These zones would be unable to support fish life. Decomposition within the reservoir of submerged vegetation and organic material may produce an explosive release of chemical nutrients into the biosystem. Alteration of water temperature would occur not only within the reservoir but also downstream, influenced by lake-water outflow from the dam.

Depending on factors such as moisture content, temperature, and movement of air masses, along with regional topography and size of reservoir, alteration in the local microclimate may result from a hydroelectric impoundment. The biological systems in the reservoir area and downstream usually show marked changes as a result of the dam's effect on the hydrologic system. This can have an effect on both terrestrial and aquatic ecosystems. The terrestrial habitat above the dam shrinks as the reservoir fills, yet the land/water interface increases. Both factors will be reflected in the floral and faunal changes.

If seasonal flooding has been arrested downstream, long-established patterns of water/soil-fertility relationships would be altered. Net reduction of soil-moisture content and changes in nutrient input and nutrient cycling would result in changes in flora and fauna.

The initial flooding that covers plants, animals, and organic-soil components sets the stage for a sudden release of nutrients into the water. This can cause an increase in the density and extent of higher aquatic plants. An increase in the aquatic plants within the reservoir can, in turn, cause interference with human activities such as boating, fishing, and even power generation (should the turbines or water intakes become clogged). For migratory aquatic (e.g., fish) species, a hydroelectric dam may act as a physical barrier that can be ultimately destructive to a species population.

### b. Pumped-Storage Projects

Lakes and impoundments created for pumped storage are usually much smaller than those created by dams. The effect on local water systems caused by the construction of a dam can be severe (Section J.2 of this appendix) and can affect total changes in the area. The pumped-storage-project changes need not be as great, since they are physically smaller and constitute branches of local water systems. Water in pumped-storage systems can be reused. Natural flows are required only for make-up purposes and the initial filling. Percolation from the upper reservoir into locally surrounding land can cause land instability and water-quality effects. The reservoirs can cause disruption of migratory-fish species. Nonmigratory species seem to survive in the upper reservoirs; therefore, this area can be utilized for sportfishing.

Although each case is special--involving local characteristics of terrain, water quality and flow patterns, fish populations, human factors, and effects on visual appearance of the countryside--the total adverse effects are less than those of the conventional hydroelectric-power plant.

## 3. Conclusions

The major environmental effects associated with increased use of hydroelectric power include irreversible commitment of the land and resources beneath newly constructed lakes, modification to destruction of river or streamflow patterns below the dam, and changes in the ecology of the floodplain below the dam.

# L. NUCLEAR POWER

## 1. Background Considerations

Commercial use of nuclear fission as an energy source has a history of less than 30 years. This first electric-power-generating plant went into operation at Shippingport, Pennsylvania, in 1957. At the present time, there are 110 operable nuclear-power-generating plants in the U.S. Although nuclear energy is an alternative-energy source, delays and cancellation of plants have occurred. Since the incident at Three-Mile Island occurred, it has been argued that nuclear-power plants are unsafe and uneconomical.

The two main types of nuclear reactors include light-water reactors--which are widely used in the U.S. breeder reactors, and gas-cooled reactors--which are used in the United Kingdom. Light-water reactors include two types--the boiling-water reactors and pressurized-water reactors. The fuel in both is usually slightly enriched uranium in the form of oxide pellets contained in stainless-steel and zircaloy tubes. Water is used as both coolant and moderator.

In the boiling-water reactor, the cooling-water boils in the core, and the steam generated is used directly to drive a steam turbine, thereby driving a generator. The steam is then condensed to water and pumped back to the reactor to complete the cycle. Thus, the reactor acts as the boiler in the process.

In the pressurized-water reactors, the core-cooling water is kept at a very high pressure and is heated to 600°C. The water is then sent to a separate heat exchanger, where a secondary water supply is boiled and used to drive the turbines.

The problem with the boiling-water-type reactor is that the cooling water becomes radioactive from slight leaks in the thin cladding of the fuel rods and/or radioactively induced by the neutrons just outside the cladding. The radioactive steam goes directly to the turbines, so great care must be exercised to avoid steam leaks in the turbine. This problem is avoided in the pressurized-water-reactor system, because the cooling water and the steam for driving the turbines are separate.

McMullan et al. (1983) report that there are two main criticisms of light-water-moderated reactors. First, it is alleged that the technology of welding the very heavy steel sheets of the pressure vessels is not capable of providing the necessary reliability. This is important due to the potential catastrophe that would occur if the pressure vessel ruptured. Second, there are the possible effects of a sudden failure in the water supply to the core; if this occurred, the large mass of fuel and radioactive-fission products could become so hot as to cause a meltdown. From a meltdown, radioactive containment could possibly infiltrate the ground-water supply and become a hazard.

In breeder reactors, neutrons are captured by $^{238}U$ to form $^{239}PU$. No moderator is used in the reactor core to slow the neutrons down; as a result, the neutrons are captured by the uranium. From this reaction, the reactor produces significant quantities of plutonium.

The breeder reactor has some unpleasant characteristics that are regarded by its critics as rendering it unacceptable for generating electric power. The first of these is that plutonium is highly toxic. It also has a very low thermal conductivity that adds to the difficulty of extracting the heat from the reactor core. Further, there is no moderator. The core runs at a very-high-energy density and must be cooled, not by water or by a gas, but by a liquid metal--sodium. Therefore, the sodium must reach extremely high speeds in the tightly packed core in order to remove the heat that is generated. Failure to remove the heat would lead to a situation that could cause a meltdown, if left uncorrected.

Sodium reacts explosively with water. In the breeder reactor, the sodium is pumped around the reactor core at an elevated temperature; after a while, the coolant becomes radioactive. Any rupture or leak in the cooling system would cause an extremely violent reaction.

Another major criticism of the breeder reactor is that it uses plutonium in its fuel. The fuel rods are enriched in $^{239}PU$, which can be used as fuel for a nuclear bomb. However, it is likely that any country with the capability to build and operate a series of nuclear-power facilities on a commercial scale also will have the capability to construct the rather less complex facilities needed to prepare fissile materials for nuclear weapons.

Most failures of commercial reactors have been minor in nature except for the incidents at Three-Mile Island and Chernobyl, U.S.S.R., which indicate the potential dangers of nuclear-power generation. Since the Three-Mile-Island incident occurred, there has been a large increase in public concern for the safety of these power plants. Attempts have been made to stop all future construction and shut down all existing nuclear plants in some areas. Yet dependence on this power source tends to preclude total shutdown, because no suitable alternative is available.

## 2. Environmental Effects

In addition to numerous land use and ecological effects associated with the construction of a nuclear-power plant, there are environmental effects that may result from the utilization of nuclear energy. These include thermal pollution of cooling water, leakage of radiation into water and air, production and transport of the fuel to the use site, radioactive-waste management including transportation and storage or disposal, and the potential for a catastrophic nuclear-reactor accident.

Nuclear plants are essentially the same cooling process as fossil-fueled plants and, thus, share the problem of heat dissipation from cooling water. However, nuclear plants obtain 33-percent conversion to electricity with all the remaining 67 percent going to the cooling water, thereby requiring larger amounts of cooling water and discharging greater amounts of waste heat to the water than comparably sized fossil-fuel plants. In comparison, per unit of electric energy generated, modern fossil-fuel plants contribute 1.2 units of aquatic-thermal pollution, while nuclear plants contribute 2.0 units.

Thermal pollution causes damage by upsetting or modifying aquatic ecosystems. Thermal pollution can disrupt an ecosystem in a variety of ways: (a) large temperature increases that can kill many aquatic species; (b) reduction of available oxygen (as temperature increases, solubility of oxygen decreases); (c) alteration of the rate of biological activity (i.e., rapid growth of algae or pond weeds); (d) reduction of resistance to diseases; (e) alteration of behavior patterns; and (f) providing a competitive advantage to species that can tolerate temperature changes.

Increased concern has been raised regarding the potential danger of radiation leakage. When an organism sustains a large dose of radiation, acute somatic damage can result. Radiation can cause fatal damage to a large number of cells, resulting in sickness (nausea, vomiting, headaches, weakness, and sometimes death) and delayed somatic damage when an organism receives a dose of radiation that is not fatal. Cells that are lethally damaged by the dose will not reproduce and will be eliminated. Cells that are nonlethally damaged will stay with the organism and may later cause malfunctions (cancer, cataracts, prenatal abnormalities, and nonspecific shortening of lifespan). Genetic damage may result where a reproductive cell is nonlethally affected, and this may give rise to a genetically defective offspring.

While effects associated with an accident in a nuclear-power plant are serious, a more long-term effect can result due to the storage problems associated with the waste products from power generation. Low-level radioactive wastes from normal operation of a nuclear plant must be collected, placed in protective containers, and shipped to a federally licensed storage site and buried. High-level wastes created within the fuel elements remain there until the fuel elements are processed. There exists a potential for radioactive leakage during transportation activities or accidents.

Low-level radioactive solid wastes are buried in near-surface trenches at specific sites where topography, meteorology, and hydrology are such that migration of radioactivity is not anticipated. Low-level waste from a 1,000-megawatt plant and the fuel-cycle activity attributed to the plant require about 2.0 acres of land per year.

High-level wastes are currently stored as liquids in tanks, although storage in bedded-salt formations deep underground has been suggested. Spent fuel is currently stored at facilities licensed by the Nuclear Regulatory Commission. Plans call for recovering unused fuels at reprocessing plants, solidifying the wastes, and placing them in storage at Federal repositories.

The effects associated with the mining and milling of uranium ore are similar to those for coal mining (Section C of this appendix), with the exception of radioactive tailings and water being produced.

## 3. Conclusions

The major environmental effects associated with expanded use of nuclear energy include the need to mine, process, and use radioactive materials that would result in the release of small amounts of radiation; disposal of the heated cooling water; difficulties associated with selecting and using a suitable disposal site for spent fuel; and considerable public concern about possible accidents.

## M. CONSERVATION

### 1. Background Considerations

This section briefly addresses reducing energy consumption through a variety of improvements in the energy efficiency of each of the five energy-consuming sectors of the U.S. economy--transportation, residential, commercial, industrial, and transformation. Over the past decade, projections of future energy consumption by the U.S. have changed dramatically as a result of much higher world energy prices. A decade ago, projections of U.S. energy consumption in the year 2000 ranged from 150 to 175 quads. The NEPPP's 1985 projections of energy consumption in the year 2000 range from a low of 88.8 quads in the high U.S.-energy-efficiency case, to a high of 104.8 quads in the high U.S.-energy-supply case, with the reference case at 98.6 quads. (The 1985 NEPPP was prepared before the rapid decline of world oil prices in 1986. If lower world oil prices persist, future U.S. energy consumption will increase in response to both lower prices and higher world economic wealth. Nevertheless, projections of future U.S. energy consumption include substantial improvements in the efficiency with which energy is used in the U.S. economy.) Table D-7 provides a comparison of the projected energy consumption for each sector under the assumptions of both the NEPPP-reference case and the high U.S.-energy-efficiency case.

The NEPPP-reference case includes future improvements in energy conservation that are both technologically expected and economically efficient. Future energy consumption is projected for each sector using the energy-conservation improvements that are either already available or expected, given anticipated technological improvements. The rate at which these energy-conservation improvements enter in the NEPPP-reference case is determined by consumer preferences under projected future energy prices. Projected improvements in energy efficiency play a major role in the projected future energy consumption by each sector of the U.S. economy.

Within each of the five categories of energy use, the demand for energy services is the result of two typically offsetting trends--an upward trend caused by population and economic growth, and a downward trend caused by increased efficiency in the use of energy stimulated by higher energy prices. Brief summaries of the expected energy conservation for each sector, which are abstracted from the 1985 NEPPP-reference case, are presented below.

In the residential sector, energy is consumed for space conditioning, lighting, and operating appliances. Total energy use in this sector is dependent on the total number of households and the energy consumed by each. The Census Bureau estimates that, between 1984 and 2010 (the projection period for the 1985 NEPPP), the number of housing units will increase by 30 percent. The estimated 1984 average end-use efficiency for the residential sector was 72 percent. The rate of energy-efficiency improvements is projected to be 14 percent over the 1984-to-2010 period. Thus, the net result under the assumptions of the NEPPP-reference case is a gradual increase in total-residential-energy consumption.

In the commercial sector, energy also is consumed for space conditioning, lighting, and operating appliances. Since 1970--apparently in response to the energy-price increases of the last decade--commercial-energy use per square foot has been declining at a little less than 2 percent per year. The estimated 1984 average end-use efficiency of the commercial-sector equipment was 81 percent. The pattern of increased energy efficiency in the commercial sector is expected to continue through the projection period. The net result may be a leveling off in the commercial-sector-energy payments per square foot, despite the projected increase in energy prices.

The industrial sector consumes energy resources for space conditioning, lighting, operating machinery, and feedstocks used to manufacture certain products. In response to the energy-price increases of the 1970's, the decline in energy use per unit of industrial output accelerated from 2 percent per year to 4 percent per year. It is likely that the rate of energy-efficiency improvements has peaked and, therefore, that an average improvement of 2 percent per year is used in the projections. Decreased energy use per unit of output is projected to result from improved process efficiency and a change in the product mix being produced, with energy-intensive productions decreasing as a share of the total.

Motor vehicles (cars and trucks) use the largest share of energy consumed--about 75 percent--to transport people and goods. About one-fourth of the energy consumed in the transportation sector is used in the operation of pipeline, air, rail, and marine transportation. Because of improvements in both the design and mechanics of motor vehicles, it is estimated that the actual road miles per gallon (mpg) for the entire fleet of motor vehicles has increased by as much as 85 percent since the early 1970's. (The actual road mpg for the entire fleet of cars and trucks should not be confused with the USEPA's estimated mpg for new cars.) The 85-percent improvement in the actual road mpg represents less than a 2-mpg improvement for the entire fleet of cars and trucks to its present level of around 15 mpg. Improvements in the energy efficiency of the total U.S. fleet are expected to plateau at around 23 mpg toward the end of the projection period. However, the average fleet road mpg will continue to increase beyond 2010.

The two energy-transformation-sector industries are electric utilities and synthetic fuels. Large energy losses are unavoidable in these industries. In terms of energy actually delivered to the end-use sectors, the utility industry has been, for at least the last 20 years, and is expected to continue to be around 32-percent efficient. This is not to say that little has changed or will change in the utility industry. In the 1960's, coal and hydro facilities lost share to oil and natural gas. In the 1970's, this movement reversed; and oil and gas lost share to coal and newly completed nuclear facilities. This trend is expected to continue through the year 2000. See the sections of this appendix that address coal and nuclear and synthetic fuels for further discussion of these trends.

The high-energy-efficiency case in the 1985 NEPPP used assumptions that generate a 10-percent improvement in the overall end-use efficiency in the year 2000 by comparison to the reference case. The efficiency assumptions that were changed to generate this improvement include the consumer discount rate, the energy demand per unit of industrial output, and the fuel efficiency of each transportation mode. Perhaps the most important factor is the assumed change in the discount rate that consumers use in deciding to purchase higher- efficiency equipment like furnaces, air conditioners, and insulation. (By assuming a lower discount rate for consumer decisions, the economic attractiveness of energy-efficient investments is improved.) Further, the high-energy-efficiency case decreased the energy use per unit of industrial output such that energy use was 15 percent lower than in the reference case. The higher-fuel-efficiency assumptions for the transportation sector increased actual road mpg 10 to 12 percent over those used in the reference case. (See Table D-7 for the full sector-by-sector comparisons and the changes in total energy consumption over the projection period.)

Five major types of conservation options are often proposed as substitutes for a wide variety of energy-development projects: (a) improved gas-mileage performance, (b) greater use of mass transit, (c) improved energy efficiency of household appliances, (d) higher energy efficiency in the industrial and commercial sectors, and (e) augmented public and private research in energy conservation. The proposals to use conservation rather than to develop an energy resource typically start with an observation of historical improvements in the efficiency of energy use in the U.S. and other economies. They then assume a specific rate or amount of future improvement and calculate energy savings via the difference between present-use rates and the assumed future-use rates. All such proposals should be examined against the information provided above concerning projections of future gains in U.S. energy efficiency. Very considerable further improvements in energy efficiency are part of the expectations built into the projections of future energy consumption. Thus, much of the calculated energy savings or conservation assumed for each of the five major energy-conservation options are already counted.

Nearly all energy-conservation policies can be classified in one of five broad categories--price, supply restriction/allocation, regulation, incentives, and information.

*Price:* Energy consumption would be cut by relying on consumers' reaction to higher prices, either for petroleum or for all forms of energy.

*Supply Restriction/Allocation:* In order to reduce energy consumption, energy supplies would be restricted to a fixed level. Then, employing some nonmarket allocation or rationing scheme, the limited supply would be distributed among competing uses or users.

*Regulation:* Regulations could be developed that would place restrictions on how energy could be used and would outlaw those uses or technologies thought by lawmakers to be the most wasteful.

*Incentives*: Incentives, usually monetary, can be developed for energy-saving forms of production and consumption. On the other hand, disincentives, such as taxes, could be used to discourage specific kinds of waste.

*Information*: Programs would be developed to change consumers' habits of energy use, either by exhorting them to change their lifestyles or by pointing out the economics and other advantages of particular energy-saving practices.

## 2. Environmental Effects

The reduced production and consumption of energy resources associated with various energy-conservation proposals generates much of the public appeal for these proposals. Simply by learning to use less energy, which appears to have neither cost nor environmental effects, the adverse environmental effects caused by production and use of the energy resources conserved will be avoided or reduced. Potential energy savings through conservation methods would result in reduction of the environmental effects associated with energy production and use.

This summary of the environmental effects of energy conservation separates possible future energy conservation into two parts. The first is the energy conservation that is expected to occur as a result of improved technology in response to future energy prices. This part is included in the 1985 NEPPP-reference case, and it is called "expected conservation" in this summary of environmental effects. The second part of possible future energy conservation includes all additional energy conservation that could result from changes in government policies. (These possible policy changes are summarized at the end of Section M.1 in this appendix.) This part of possible future energy conservation is called "additional conservation" in this summary of environmental effects.

The environmental effects associated with the expected part of possible future energy conservation are wholly beneficial. The reductions in energy consumption in the four energy end-use sectors expected to occur under the assumptions of the NEPPP-reference case will mean that fewer pollutants associated with energy use will be emitted.

The environmental effects associated with the additional part of possible future energy conservation are primarily beneficial. The reductions in future energy use that could result from changes in government policies would further reduce the levels of pollutants associated with energy use.

There are, however, costs associated with the additional conservation scenario. Energy-conservation improvements that are mandated by government programs rather than in response to consumer preferences reduce the total value of the Nation's goods and services and thus reduce National income. Such reductions are a form of adverse effect on the quality of the human environment.

Conserving energy resources under government-policy changes could require considerable investments in new or retrofitted equipment. There are environmental effects associated with production of the capital goods needed for most energy-conservation options. For example, production of the more fuel-efficient boilers used in retrofitting existing commercial and industrial buildings would generate a variety of adverse environmental effects that otherwise would not occur. Similarly, in order to render existing buildings more energy-efficient, materials whose production entails adverse environmental effects may be used.

## 3. Conclusions

Reduction of the environmental effects associated with production and consumption of energy resources is one of the primary advantages of energy-conservation measures. However, the investments and programs often associated with improved energy efficiency generate environmental effects. Thus, energy-conservation options are not void of environmental effects.

# N. COMBINATION OF ALTERNATIVES

A combination of some of the most viable energy sources available to this area (discussed above) could be utilized to attain an energy equivalent comparable to the estimated production within the anticipated field life of this proposed action. However, in order to attain the needed energy mix peculiar to the infrastructure of this area, this combination of alternatives would have to consist of energy sources--attainable now or within the suggested timeframe--that are transferable to the technology presently used. Viable substitutes would have to be available for the petroleum and natural gas required by the petrochemical-industrial complex; the petroleum used for the transportation sector; and the electricity and fuels used in residential and commercial sectors.

Allowing favorable technologies and economies, the most viable domestically available energy alternatives would probably consist of the use of coal, oil shale, tar sands, and biomass to produce synthetic liquids; nuclear energy and coal to compete for the utility market; and renewables to supply a sizable portion of total energy requirements. The environmental effects of each of these alternatives have been discussed briefly in the previous sections. The result will be a long-term energy-supply transition from crude oil to alternative-energy sources and less dependence on oil imports. Such patterns will require new and efficient technologies, major capital investments, and a high rate of growth in coal production.

The future U.S. energy-source mix will depend on a multiplicity of factors--the identification of resources, research-and-development efforts, development of technology, rate of economic growth, economic climate, changes in lifestyle and priorities, capital-investment decisions, energy prices, world oil prices, environmental-quality priorities, government policies, and availability of imports.

It is unlikely that there will ever be a single definitive choice among energy sources, or that development of one source will preclude development of others. Different energy sources will differ in their rate of development and the extent of their contribution to total U.S. energy supplies. Understanding of the extent to which they may replace or complement offshore oil and gas requires reference to the total National energy picture. Relevant factors are:

- Historical relationships indicate that energy requirements will grow in proportion to the gross National product.

- Energy requirements can be constrained to some degree through the price mechanisms in a free market or by more direct constraints. One important type of direct constraint that operates to reduce energy requirements is the substitution of capital investment in lieu of energy, e.g., insulation to save fuel. Other potentials for lower energy use have more far-reaching effects and may be long-range in their implementation--they include rationing, altered transportation modes, and major changes in living conditions and lifestyles. Even severe constraints on energy use can be expected only to slow, not halt, the growth in energy requirements within the timeframe of this statement.

- Energy sources are not completely interchangeable. For example, solid fuels cannot be used directly in internal-combustion engines. Fuel-conversion potentials are severely limited in the short term, although somewhat greater flexibility exists in the longer term and generally involves choices in energy-consuming capital goods.

- The principal competitive interface between fuels is in electric-power plants. Moreover, the full range of flexibility in energy use is limited by environmental considerations.

Table D-7

Comparison of NEPPP-Reference and High-Energy-Efficiency Cases
(Quads)

| Year | Total Energy to U.S. | Energy Loses Transfor-mation | Energy Used by Final Consumers Excluding Inputs to Utilities and Synthetics: Liquids | Gases | Coal Solids | Electricity | Renew-able[1] | Total | Residential | Com-mercial | Industrial | Trans-portation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Estimate | | | | | | | | | | | | |
| 1984 | 76.6 | -18.0 | 29.6 | 15.2 | 3.1 | 7.8 | 2.8 | 58.8 | 9.9 | 6.1 | 22.6 | 19.8 |
| Projected | | | | | | | | | | | | |
| 1990 | | | | | | | | | | | | |
| Ref. Case | 87.3 | -22.1 | 32.3 | 16.7 | 3.8 | 9.1 | 3.3 | 65.2 | 10.8 | 7.2 | 28.2 | 19.2 |
| High Effic. | 81.6 | -20.6 | 30.6 | 15.3 | 3.5 | 8.5 | 3.1 | 6.0 | 9.7 | 6.7 | 26.2 | |
| 1995 | | | | | | | | | | | | 18.5 |
| Ref. Case | 93.1 | -25.2 | 32.3 | 17.5 | 3.7 | 10.3 | 4.0 | 67.9 | 11.2 | 7.8 | 29.6 | 19.4 |
| High Effic. | 85.4 | -23.3 | 30.0 | 15.5 | 3.3 | 9.5 | 3.7 | 62.1 | 9.7 | 7.2 | 27.0 | 18.4 |
| 2000 | | | | | | | | | | | | |
| Ref. Case | 98.6 | -28.0 | 32.9 | 17.4 | 3.9 | 11.5 | 4.8 | 70.6 | 11.3 | 8.4 | 30.4 | 20.7 |
| High Effic. | 88.8 | -25.6 | 30.0 | 15.0 | 3.4 | 10.5 | 4.3 | 63.3 | 9.6 | 7.7 | 27.0 | 19.2 |
| 2005 | | | | | | | | | | | | |
| Ref. Case | 104.2 | -30.9 | 32.9 | 17.2 | 4.6 | 12.8 | 5.8 | 73.3 | 11.3 | 8.8 | 31.9 | 21.4 |
| High Effic. | 92.7 | -28.0 | 29.6 | 14.5 | 3.9 | 11.5 | 5.3 | 64.8 | 9.4 | 8.0 | 27.7 | 19.7 |
| 2010 | | | | | | | | | | | | |
| Ref. Case | 110.8 | -34.5 | 33.0 | 16.8 | 5.4 | 14.3 | 6.9 | 76.3 | 11.2 | 9.4 | 33.5 | 22.3 |
| High Effic. | 97.9 | -31.0 | 29.4 | 13.9 | 4.4 | 12.8 | 6.3 | 66.8 | 9.5 | 8.6 | 28.4 | 20.4 |

[1]Renewable central electric is included in electric column

Source: U.S. Department of Energy, National Energy Policy Plan Projections to 2010, December 1985.

- Regulation of oil and gas prices lowered the price below the product level that refiners (and consumers) paid for domestic oil and prevented the incremental cost of all domestic producing fields from equating to the price of imports. This impaired the economy's ability to adjust to world energy prices. Under deregulation, the real prices of oil and gas will be closer to the marginal costs of alternative energy.
- A broad spectrum of research and development is being directed toward energy conversion--more efficient nuclear reactors, coal gasification and liquefaction, liquefied natural gas, and shale retorting, among others.

Several of these factors could assume important roles in supplying future energy requirements, although their future competitive relationship is not yet predictable.

Table D-8

Replacement Energy Needs
Central and Western Planning Areas
(Base Case)

| | Central Gulf Sale 142 | Western Gulf Sale 143 |
|---|---|---|
| Btu equivalents: *(trillion Btu) | | |
| Oil - 0.14 billion barrels | 784.0 | |
| 0.05 billion barrels | | 280.0 |
| Gas - 1.40 trillion cubic feet | 1,429.4 | |
| 0.74 trillion cubic feet | | 755.5 |
| Oil equivalents: *(billion barrels) | | |
| Oil from other sources needed to directly replace expected oil production | 0.14 | 0.05 |
| Oil from other sources needed to replace expected gas production | 0.255 | 0.135 |
| Gas equivalents: *(trillion cubic feet) | | |
| Gas from other sources needed to replace expected oil production | 0.768 | 0.274 |
| Gas from other sources needed to directly replace expected gas production | 1.40 | 0.74 |
| Coal equivalents: *(billion short tons) | 0.092 | 0.043 |
| Electrical equivalents: *(billion kilowatt/hour) | | |
| Substitutes for end uses** | 337.3 | 157.8 |
| Substitutes for input to electricity generation*** | 207.6 | 97.1 |

Notes: *Conversion factor used:
1 barrel of oil = $5.6 \times 10^6$ Btu.
1 cubic foot of natural gas = 1,021 Btu.
1 short ton of bituminous coal = $24 \times 10^6$ Btu.
1 kilowatt hour = 3,412 Btu at the theoretical conversion rate of other energy forms of electricity at 100% efficiency.
**Based on a 65% average efficiency of end use of oil and gas (such as oil and gas heating) and a plant load factor of 80%.
***Efficiency of fossil fuel electricity generation was assumed to be 40%. The plant load factors equals 80%.

Source: USDOI, Minerals Management Service, Gulf of Mexico OCS Region, 1992.

# Appendix E

# Recent Mitigating Measures

United States Department of the Interior

MINERALS MANAGEMENT SERVICE
GULF OF MEXICO OCS REGION
1201 ELMWOOD PARK BOULEVARD
NEW ORLEANS, LOUISIANA 70123-2394

In Reply Refer To: MS 5221

November 20, 1990

Gentlemen:

Recent questions and concerns have been raised regarding the disposal of solids removed from production vessels located on the Outer Continental Shelf. Many of these concerns are related to the disposal of solid accumulations which contain naturally occurring radioactive materials (NORM).

In accordance with 30 CFR 250.40(b)(2), approval of the method of disposal of drill cuttings, sand, and other well solids shall be obtained from the appropriate district supervisor. Due to the increasing concerns and occurrence of NORM, the Minerals Management Service regional office is directing more attention to the approval and discharge of all solids. Therefore, operators planning to remove solid accumulations from production vessels and/or flow lines or tubing must now submit a full description of the method that will be used in the removal and disposal of these solids. Approval must be received from the regional office prior to the discharge or disposal of any such materials. Radioactive readings must be recorded and the results submitted on all solid materials. Any filtered wash water involved in the removal of produced sand and pipe scale that has a radioactivity level at or below that of produced water may be disposed overboard in accordance with the conditions of your NPDES permit.

Sincerely,

D. J. Bourgeois
Regional Supervisor
Field Operations

E-5

# United States Department of the Interior

MINERALS MANAGEMENT SERVICE
GULF OF MEXICO OCS REGION
1201 ELMWOOD PARK BOULEVARD
NEW ORLEANS, LOUISIANA 70123-2394

In Reply Refer To: MS 5221

DEC 11 1991

Gentlemen:

The purpose of this letter is to provide clarification of our Letter to Lessees and Operators (LTL) dated November 20, 1990, concerning the removal and disposal of well solids produced from Gulf of Mexico (GOM) OCS Region lease operations; specifically, those solids containing natural occurring radioactive material (NORM). This letter will also serve to establish interim guidelines for the reporting, disposal, and transportation of produced well solids until the data collected during the interim period is evaluated and formal policy can be promulgated.

In accordance with the November 20, 1990, LTL, approval of methods for disposal of drill cuttings, sand, scales, and other well solids is handled by the GOM OCS Regional Office. Only well solids produced from GOM OCS Region lease operations may be approved for disposal. It has been determined that the information available concerning the occurrence of these solids has not been sufficiently addressed. Accordingly, the interim guidelines contained herein were devised to closely monitor the disposal of well solids containing NORM and assist in the collection of data pertinent to the establishment of regulations necessary for disposal of this material.

The following will provide the GOM OCS Region application of the provisions of 30 CFR 250.40(b)(2):

## I. DISPOSAL CRITERIA

Overboard Discharge of Produced Well Solids

The operator must submit an application for each facility where overboard discharge is proposed. Overboard discharges may be approved based on the following criteria:

1. The discharge site is not in close proximity to a biologically sensitive area.

2. Adherence to the Environmental Protection Agency (EPA) discharge requirements outlined in the National Pollutant Discharge Elimination System (NPDES) general permit.

3. A representative 1-liter sample of the material to be discharged must be acquired and analyzed for radiation dose equivalent rate. Based on this analysis, the material must demonstrate a radiation dose equivalent rate of no greater than 25 microroentgens per hour above background.

4. The volume of well solids to be discharged cannot exceed 100 barrels per day. However, more stringent volume constraints may be required at time of application approval depending upon water depth, location, current, and other such parameters.

5. The sample(s) described in Item 3 for each discharge during each 3-month period in which discharges occur must be stored as a composite, mixed, and subsampled. These subsamples must be analyzed by a laboratory capable of supplying accurate results for concentrations of Radium 226 and Radium 228. Records concerning these data, tests, and details such as discharge dates, volume discharged, and radiation dose equivalent rates must be maintained and made available for review by this office upon request.

6. Based on the data provided in Item 5, a quarterly calculation must be made to determine the total radium discharged to date. Should the total radium discharged surpass 50,000 microcuries this office must be notified and all future discharges stopped until an assessment of the area is completed. More stringent total radium constraints may be imposed at time of application approval depending upon water depth, location, and oceanographic conditions.

Discharge of Well Solids Encountered During Workover Operations

During well workover operations, solids recovered may be discharged without prior approval if the following criteria are met:

1. Adherence to the EPA discharge requirements as outlined in the NPDES general permit.

2. Approval is obtained from the appropriate District Supervisor for the workover operation. Disposal procedures must be specified in the sundry notice if there is a possibility that produced solids will be recovered.

3. A minimum of two representative 1-liter samples are acquired and analyzed for radiation dose equivalent rate. Based on this analysis the material must have a rate of no greater than 5 microroentgens per hour above background.

4. A detailed report concerning the discharge is submitted to the appropriate District Supervisor with the subsequent sundry notice. This report should include the lease number(s), well, area, block, date(s) of discharge, volume, description of the material, and dose rate measured.

Specific approval must be obtained from this office for the discharge of produced well solids encountered during workover operations which do not meet the previously-described criteria.

Alternative Methods of Disposal

If onshore disposal/storage is proposed or the material is unsuitable for overboard discharge, this material may be transported to shore for subsequent storage and/or disposal without prior approval from this office. All associated activities must adhere to applicable federal and state guidelines concerning the transportation, storage, and ultimate disposal of NORM. Documentation detailing the volume, activity level, facility of origin, and final destination must be submitted to the Regional Supervisor within seven days of such disposal from OCS facilities.

Other Disposal Methods

The overboard discharge of produced well solids having a dose equivalent rate of greater than 25 microroentgens per hour above background will be considered by this office on a case-by-case basis following the submittal of an application containing information such as, but not limited to, the dose equivalent rates, radioactive isotope concentrations, total radium, discharge modeling, location, and oceanographic conditions.

All other disposal alternatives such as downhole injection, encapsulation, or offshore storage will require prior approval. These disposal methods may be approved by the Regional Director based upon the submittal of environmental, geological, and operational data which demonstrate that the operation is safe and environmentally sound.

II. APPLICATION REQUIREMENTS

Overboard Discharge of Produced Well Solids

The application for overboard discharge of produced well solids from a facility should include:

1. Identification of the platform from which the discharge will occur including water depth and oceanographic conditions.

2. If applicable, a listing of other facilities from which solids were generated that will be transported to the discharge site for processing and discharge.

3. Expected frequency and volume of materials to be discharged.

4. Preliminary activity measurements.

5. Proposed program for monitoring, sampling, and recordkeeping.

6. Description and characterization of material to be discharged.

7. Method of discharge (i.e., at surface).

Alternative Methods of Disposal

As discussed previously, disposal options not meeting the criteria for overboard discharge or other approved methods will require an extensive geological, operational, and environmental review. Therefore, all data pertinent to the proposed operation should be submitted with the application to expedite its evaluation. Some proposals may require a detailed assessment and mathematical modeling, as well as other information, such as the radioactive isotope concentrations, volume, disposal site, and transportation and handling procedures.

## III. SAMPLING, TESTING, AND RECORDKEEPING

Sampling and testing protocol should be performed using the best technology available to provide accurate results. A suggested method to obtain a representative sample would be to place the material in "cutting boxes," take at least 9 random cores that include the entire column of material, combine, and mix the cores in a 1-liter or larger wide-mouth high-density polyethylene or similar container which should be lightly packed as full as possible with the material to minimize any air spaces and capped. Details of the collection such as sample identification, date, and location should be attached to the container.

It is understandable that for operations such as sand jetting the above procedure would be impractical. Therefore, other sampling procedures must be approved to ensure precautions are taken to obtain a representative 1-liter sample for testing during each of these operations.

The radiation detection instruments to be used for dosage rates should adequately measure alpha, beta, and gamma radiations. State-of-the-art radiation detectors capable of properly measuring 1 microroentgen per hour through 500 microroentgens per hour and calibrated by a qualified person at intervals not to exceed 6 months should be used. The survey, calibration, and measurements are to be performed by trained personnel.

All measurements should be made with the meter's sensing element in contact with the sample container. Measurements recorded in microroentgens per hour should be taken at the center of the bottom of the filled container while it is lying on its side. Additional measurements should be made against the side of the container at the longitudinal and vertical center by rotating the container 360 degrees, taking a measurement every 90 degrees. The measurements should then be averaged, documented, maintained at the site, and made available upon request by a representative of this office.

For the quarterly specific activity measurements in accordance with routine discharge criteria, the 1-liter samples acquired as mentioned above, should be stored as a composite with samples from other discharges occurring within the 3-month sampling period, mixed, and subsampled. An analysis should then be performed to accurately determine the concentration of Radium 226 and Radium 228 expressed in picocuries per gram. The method of analysis is to be gamma-ray spectroscopy. A qualified laboratory should be used and results of laboratory quality control test recorded.

Additionally, documentation pertaining to the transportation, storage, disposal method, sampling, and testing for those produced well solids which are transported to shore must be maintained at the field office and made available upon request by a representative of this office.

These guidelines were prepared for an interim period to assist in the collection of data pertinent to the establishment of regulations for the handling of produced well solids. Therefore, your cooperation in providing this office with information concerning the occurrence of NORM in produced well solids as accurately and completely as possible is greatly appreciated and will expedite the preparation of appropriate regulations.

Sincerely,

D. J. Bourgeois
Regional Supervisor
Field Operations

UNITED STATES DEPARTMENT OF THE INTERIOR
MINERALS MANAGEMENT SERVICE
GULF OF MEXICO OCS REGION

91-02 December 20, 1991

NOTICE TO LESSEES AND OPERATORS OF FEDERAL OIL, GAS, SULPHUR, AND SALT LEASES AND PIPELINE RIGHT-OF-WAY HOLDERS IN THE OUTER CONTINENTAL SHELF, GULF OF MEXICO OCS REGION

OUTER CONTINENTAL SHELF ARCHAEOLOGICAL RESOURCE REQUIREMENTS FOR THE GULF OF MEXICO OCS REGION

The Federal Government's responsibilities in archaeological resource management and protection on the Outer Continental Shelf (OCS) are based on the requirements of the National Historic Preservation Act of 1966, as amended, and on other applicable laws and regulations. The Minerals Management Service (MMS) has issued regulations at 30 CFR 250.33(b)(15), 250.33(o), 250.34(b)(8)(v)(A), 250.34(s), 250.157(a)(5), as well as lease stipulations which, if invoked, require OCS operators to conduct surveys and prepare reports designed to fulfill these archaeological resource legal responsibilities. Notices to Lessees and Operators (NTL) Nos. 74-10 and 75-3 were issued by the Gulf of Mexico OCS Region (GOMR) to implement the provisions of the lease stipulations. On October 1, 1982, NTL No. 75-3 was revised and issued by the GOMR to provide guidance on uniformity and consistency of archaeological resource field surveys and reports.

In June 1987, the MMS contracted with Texas A & M University to update and improve a 1977 historic resources study and to broaden the historic shipwreck database. This study was specifically designed to reevaluate the zone of historic shipwreck high probability. In November 1989, the study was completed. Based on the study results, the MMS has redefined the high probability areas for the occurrence of historic shipwrecks. This has resulted in a substantial reduction in the number of lease blocks in the Gulf of Mexico (i.e., approximately 50%) requiring a magnetometer survey. The study also demonstrated a compelling need to increase magnetometer data density in the high probability areas in order that historic shipwreck magnetometer patterns may be recognized. This shall be accomplished by reducing the survey linespacing interval, in the historic shipwreck high probability areas, from 150 meters (m) to 50 m. The NTL is presented as a series of enclosures. Enclosure No. 1. is titled Requirements for Archaeological Field Surveys. Enclosure 2. is titled Standards for Archaeological Resource Reports. Enclosure No. 3. is titled Requirements for Mitigation and Operational Restrictions.

The provisions of this NTL shall become effective as of February 17, 1992.

J. Rogers Pearcy
Regional Director

Enclosures

**ENCLOSURE NO 1.**

REQUIREMENTS FOR ARCHAEOLOGICAL RESOURCE FIELD SURVEYS

## I. Introduction

After a lease is issued the GOMR will:

(1) Notify the operator, in writing, if the decision is made to invoke the archaeological resource report requirement portion of the stipulation.

(2) Identify to the operator the type of report (historic shipwreck, historic shipwreck/prehistoric site, or prehistoric site) and the standards that shall be required for compliance.

After notification from the GOMR of the decision to invoke the report requirement of the stipulation, the operator shall conduct the appropriate high-resolution remote sensing survey to determine the potential existence of archaeological resources that may be affected by future lease operations. In most cases, the archaeological resource field survey requirements will be similar to those for surveys conducted for shallow hazards or other purposes. The operator is encouraged to conduct the surveys concurrently. Pipeline right-of-way holders are directed to contact the Regional Supervisor, Leasing and Environment, GOMR, for determination of the type of archaeological resource field survey and report that will be required.
In the letter of invocation, the GOMR may request to be notified at least 72 hours prior to commencement of the survey so that arrangements can be made for observation of field procedures. An archaeologist and geophysicist need not be present while the archaeological resource field survey is being conducted, but they should be involved in survey planning. The survey shall be conducted prior to submitting an Exploration Plan, Development Operations Coordination Document, or pipeline application which proposes bottom disturbing operations.

When any of the following requirements cannot be met for technical or logistical reasons, an explanation of the problem shall be provided in the archaeological resource report.

## II. Data Acquisition Instrumentation

Geophysical instrumentation for archaeological resource field surveys shall be representative of the state-of-the-art in technological development and shall be deployed in a manner which minimizes interference among the instrumentation systems. All data recorders shall be interfaced into the navigation system to assure proper integration of information. The equipment operator shall ensure that all instrumentation is adequately tuned and that all recorded data are readable, accurate, and properly annotated.

The following instrumentation shall be utilized in conducting archaeological resource field surveys:

A. Magnetometer

A magnetometer need be used only for historic shipwreck (HS) and historic shipwreck/prehistoric site (HS/PS) surveys. Total field intensity instruments shall be used to determine the possible presence of historic shipwrecks. Data obtained shall be of such quality so as to permit detection and evaluation of magnetic anomalies within the survey area.

The sensor of the magnetometer shall be towed as near as possible to the seafloor; a distance of six meters or less is required. A mechanical or digital depth sensor shall be attached to the magnetometer sensor, and each survey line shall be annotated with tow sensor depth and with the start of the line (SOL) and end of the line (EOL) times.

Magnetometer sensitivity shall be one gamma or less, with the data sampling rate not to exceed one-second intervals. The use of the "zero-mode" setting during magnetometer surveying is prohibited. This surveying mode does not measure the ambient magnetic field as required. Background noise level shall not exceed three gammas peak to peak. Analog strip chart recorders shall be equipped with dual trace pens. Recording scales shall include both 1,000-gamma and 100-gamma full scale, respectively. Shot points and recorder speed must be annotated on the strip charts for each survey line. The GOMR recommends that the strip chart recorder speed be approximately two inches per minute. Whenever possible, the magnetometer should be towed a minimum distance of two and one-half vessel lengths behind the vessel to eliminate the magnetic influence and effect of the vessel.

B. Dual Channel Side-Scan Sonar

A dual channel side-scan sonar system shall be used to record continuous planimetric images of the seafloor. The system shall be operated in a manner that provides 100 percent coverage of the seafloor in the survey area. Data obtained should be of such quality so as to permit detection and evaluation of seafloor objects and features within the survey area.

Whenever possible, the side-scan sonar sensor shall be towed above the seafloor at a distance of 10 to 20 percent of the range of the instrument. The vertical sound beam width shall be appropriate to the water depth, and the horizontal sound beam width shall provide optimum resolution. Tuning should be accomplished in a manner that enhances the echo returns from small nearby objects and features without sacrificing the quality of echo returns from more distant objects and features.

C. Subbottom Profiler

A subbottom profiler system shall be used to determine the character of near-surface geological features. Data obtained should be of such quality so as to permit evaluation of these features for determining any possible prehistoric archaeological significance. The system used shall be capable of providing at least one to two meters of resolution within the upper 15 meters of sediment.

D. Depth Sounder

Continuous water depth measurements shall be made using a high-frequency narrow-beam depth sounder. Bathymetric data shall be recorded with a recording sweep appropriate to topography and water depth.

E. Additional Investigations

Under certain conditions, MMS may require additional instrumentation and methods such as underwater television; still, video, or movie cameras; divers; remote or manned submersibles; coring; and additional geophysical survey lines. The operator will be notified, by letter, of such requirements at the time of stipulation invocation. Right-of-Way Pipeline holders are directed to contact the Regional Supervisor, Leasing and Environment, to ascertain whether additional instrumentation and methods are required.

III. Survey Parameters

The following navigation and survey pattern requirements shall be adhered to when conducting archaeological resource field surveys:

A. Navigation

Navigation for the survey shall be accomplished by using a state-of-the-art continuous positioning system correlated to annotated geophysical records. The system shall have an accuracy of 5 meters or less. The nominal fix spacing shall be no more than 152 meters.

B. Survey Pattern

1. Lease Surveys - When multiple operations on the lease are planned or probable, it may be advantageous to conduct a lease survey. This survey shall cover the entire area of the lease, as well as that portion external to the lease within which operational activities may cause physical and/or long-term

magnetic disturbances. The area of physical disturbances includes, but is not limited to, the area within which drilling vessel anchors may be placed, but does not include the area within which work boat anchors may be placed or the area within which similar minimal disturbances may occur. The survey shall be run along parallel primary lines spaced at a maximum of 50 meters for HS or HS/PS surveys and at a maximum of 300 meters for prehistoric site (PS) surveys with cross-tie lines spaced at a maximum of 900 meters for each type of survey. Tighter line spacing may be required by the GOMR in areas of known significant or potentially significant archaeological resources. The operator will be notified by letter of such requirements at the time of stipulation invocation.

Lease HS and HS/PS surveys which are conducted on lease blocks that have been identified by the letter of invocation as being in water depths greater than 60 m shall have the same survey pattern as lease PS surveys.

2. Single Drill Site/Platform Surveys (Site Specific Surveys) - These surveys shall be run in an area approximately 914 meters (3,000 feet) square centered upon the proposed drill site with primary lines spaced at a maximum of 50 meters for HS or HS/PS surveys or at a maximum of 300 meters for PS surveys with three equidistant cross-tie lines. Additional survey lines may be necessary so that the area surveyed includes the area within which operations may cause physical and/or long-term magnetic disturbances. Tighter line spacing may be required by the GOMR in areas of known significant or potentially significant archaeological resources. The area of physical disturbances includes, but is not limited to, the area within which drilling vessel anchors may be placed, but does not include the area within which work boat anchors may be placed or the area within which similar minimal disturbances may occur. Single drill site/platform surveys are not required in areas where lease surveys have already provided sufficient archaeological coverage of the area.

Site-specific HS and HS/PS surveys which are conducted on lease blocks that have been identified by the letter of invocation as being in water depths greater than 60 m shall have the same survey pattern as site-specific PS surveys.

3. Pipeline Surveys

(a) Right-of-Way Pipelines - The survey pattern for all right-of-way pipelines shall include a line along the proposed pipeline route (center line) and offset parallel lines (on either side of the center line) spaced at a maximum of 50 meters for HS and HS/PS surveys. For PS surveys, the survey shall include a line along the proposed centerline with offset parallel lines spaced at a maximum of 300 meters. The number of offset parallel lines must be sufficient to provide adequate survey coverage of the area within which operations may cause physical and/or long-term magnetic disturbances. A minimum of

two offset parallel lines shall be required. The area of physical disturbances includes, but is not limited to, the area where pipeline lay barge anchors will be placed.
A survey for a right-of-way pipeline which will be laid in an area where an HS or HS/PS survey is required and will be in water depths greater than 60 meters shall include a center line with offset parallel lines spaced at a maximum of 300 meters. The number of offset parallel lines must be sufficient to provide adequate survey coverage of the area within which operations may cause physical and/or long-term magnetic disturbances. A minimum of two offset parallel lines shall be required.

(b) Lease-Term Pipelines - Archaeological resource surveys for lease-term pipelines which will be laid within leases that have been previously surveyed at 50 m line spacing interval (i.e., HS, or HS/PS) are not required. Surveys for lease-term pipelines which will be laid within block(s) that have been previously surveyed and are exclusively considered to have a high potential for prehistoric archaeological resources (i.e., PS) are also not required.

In water depths shallower than 60 meters, surveys for lease-term pipelines on leases designated to have a high probability for historic period shipwrecks (i.e., HS, HS/PS) shall be conducted using the survey pattern discussed in paragraph 3(a) for right-of-way pipelines. Previous surveys of these leases at 150 or 300 meter linespacing will not be adequate.
Surveys for lease-term pipelines which will be laid within leases in water depths greater than 60 meters are not required. However, for these pipelines, an archaeological resource report based on data obtained from a previous shallow hazard survey shall be required.

## ENCLOSURE NO. 2

## STANDARDS FOR ARCHAEOLOGICAL RESOURCE REPORTS

### I. Introduction

An evaluation and synthesis of data gathered during an archaeological resource survey shall be included in a report prepared and signed by an archaeologist and a geophysicist. Professional personnel in these fields should have credentials and experience sufficient to ensure that they are able to adequately perform the necessary work. As needed, specialists in other fields may participate in data analysis and report preparation.

All original data used to prepare the archaeological resource report shall be maintained by the lessee or permittee and be made available to the GOMR upon request at any time prior to lease termination or pipeline right-of-way relinquishment.

Prior to commencing any drilling, production, or construction operations, the operator/applicant/permittee shall submit to the Regional Supervisor, Field Operations, an original report and three (3) copies to determine the potential existence of any archaeological resource that may be affected by the operations. In the case of historic shipwreck reports, the required representative magnetometer data samples must be included in the original report and two (2) of the three (3) copies. The report shall be based on an assessment of the data from remote-sensing surveys in accordance with the specifications of this NTL, subsequent appropriate LTL's, and other pertinent archaeological and environmental information. Data required for shallow hazard surveys and platform foundation analyses shall generally be sufficient for PS resource reports.

### II. Contents of Archaeological Resource Reports

Archaeological resource reports shall include the following information:

A. A description of the area surveyed including lease number(s), block numbers(s), OCS lease area(s), and water depths.

B. A listing of personnel and duties for individuals involved in survey planning, survey conduct, and report preparation.

C. A discussion of the archaeological resource field survey including the following:

(1) A brief description of the navigation system with a statement of its estimated accuracy for the area surveyed.

(2) A brief description of survey instrumentation including scale, sensitivity settings, sampling rate per second, and tow depths where required.

(3) A description of the survey vessel including vessel size, sensor configuration, navigation antenna locations, and cable lengths.

(4) Vessel speed and course changes.

(5) Sea state and weather conditions.

(6) A copy of the original daily survey operations log.

(7) A description of survey procedures including a statement of survey and record quality, a comparison of survey line crossings, and a discussion of any problems which may affect the ability of the report preparation personnel to determine the potential for archaeological resources in the survey area.

D. A navigation postplot map of the survey area at a scale of 1:12,000 showing survey lines, shot points at 152 meter (500 feet) intervals, line direction in the grid projection in which the lease is described, e.g., UTM, Lambert, TM, etc., and x, y grid coordinates and tics placed every five inches thereon with geodetic graticules every 60 seconds. This map, or separate maps at the same scale which also show survey lines, shot points, and line direction, shall be oriented to true north and shall delineate the following, as appropriate:

(1) The horizontal and vertical extent of all relict geomorphic features having potential for associated prehistoric sites. Such areas include, but are not limited to, tidal estuaries, embayments, barrier islands, beach ridge sequences, spits, alluvial terraces, and stream channels. When relict fluvial systems are recorded, the map shall:

(a) differentiate between generations of channeling when more than one generation is present;

(b) show any internal channel features such as point bar deposits and terraces;

(c) delineate any channel margin features such as natural levee ridges; and

(d) indicate all depths of channel banks and channel axes.

Note: An isopach map of channel fill sediments is often the most efficient means of conveying the above information, but this method alone will not allow differentiation between more than one generation of channeling.

(2) Bathymetry.

(3) All magnetic anomalies and seafloor side-scan sonar contacts of unknown source (i.e., magnetic anomaly, map symbol = ; side-scan sonar contact, map symbol = (SSS). The duration of all magnetic anomalies shall be plotted on the survey map at a scale of 1:12,000.

(4) Sites of proposed oil and gas operations (i.e., proposed well locations, platform sites, and/or pipelines), when available at the time of report preparation.

(5) Sites of former oil and gas operations (i.e., abandoned well locations, platform sites, and/or pipelines).

E. If an analysis of the potential for prehistoric sites within the survey area is required, the report shall include:

(1) A review of current existing literature on the late Pleistocene and Holocene geology, paleogeography and sea level change in the area, marine and coastal prehistory, and previous archaeological resource reports in the area, when available. A list of suggested references will be made available upon request.

(2) A discussion of relict geomorphic features and their archaeological potential to include the following:

(a) the type, age, and association of the features mapped;

(b) the acoustic characteristics of channels and their fill material;

(c) evidence for preservation or erosion of channel margins;

(d) evidence for more than one generation of fluvial downcutting; and

(e) the sea level curves used in the assessment.

(3) A discussion of the potential for identification and evaluation of buried prehistoric sites based on the capabilities of current technology in relation to the thickness and composition of sediments overlying the area of a potential site.

F. If an analysis of the potential for historic shipwrecks within the survey area is required, the report shall include, as appropriate, the following:

(1) A current review of existing records for reported shipwreck locations in the survey area and adjacent areas;

(2) A list of the magnetic anomalies with the lease block and survey line location (corrected for sensor offset), gamma intensity, lateral extent (duration), whether the anomaly is characterized by a dipolar or monopolar signature, and magnetometer sensor tow depth of each;

(3) A list of side-scan sonar contacts with the lease block and survey line location (corrected for sensor offset), size, shape, and height of protrusion above the seafloor of each;

(4) A discussion of any magnetic anomalies and side-scan sonar contacts of unknown source in terms of their potential as historic shipwrecks;

(5) A discussion of any correlation between magnetic anomalies or side-scan sonar contacts and known or probable sources;

(6) A discussion of the potential for shipwreck preservation in terms of the effects of past and present marine processes; and

(7) A discussion of the potential for identification and evaluation of potential shipwrecks based on the capabilities of current technology in relation to the water depth, probable thickness and composition of sediments overlying the potential shipwreck location, and the preservation potential.

G. Representative data samples, as appropriate, shall be submitted for the following:

(1) A representative sample of subbottom profiler data <u>for each type</u> of relict landform identified. When more than one generation of fluvial channeling is evident, a sample depicting each shall be submitted. Each sample must be readable and include horizontal and vertical scales. Any interpretive <u>highlighting</u> or <u>annotation</u> of the <u>sample data</u> shall be on either a <u>separate overlay</u> or a <u>copy</u> of the representative sample data. In <u>no</u> instance should original survey data be highlighted. If relict channel features are referenced in the text of the archaeological report, representative copies of the subbottom profiler record of these geologic features <u>shall</u> be included in the report.

(2) A copy of the side-scan sonar data where contacts representing unidentified objects are recorded. The copies must be readable and shall include the scale. Any highlighting or annotation of the sample data shall be on either a separate overlay or a copy of the representative sample data. In no instance should original survey data be highlighted.

(3) Magnetometer data as follows:

(a) for lease surveys and site specific surveys, a clear copy of three complete lines of magnetometer data. Two of these lines shall be representative data samples of primary survey lines and the third survey line shall be a cross-tie line. The primary survey lines shall be adjacent lines and run in two different cardinal directions (e.g., one survey line heading north and the other heading south). Whenever possible these survey lines shall include unidentified magnetic anomalies.

(b) for pipeline surveys (i.e., lease term or right-of-way) that are three miles or longer in length, a clear copy of approximately one-quarter (25%) of the magnetometer data (analog strip chart) for the center line of the survey. For pipeline surveys less than three miles in length, the entire center line magnetometer survey shall be submitted. These data shall include representative samples of unidentified magnetic anomalies (if any) that were recorded on the center line. Sample data may be reduced in size for report reproduction. Data quality must be sufficient to clearly depict both the 1000-gamma and 100-gamma scale traces of the analog strip chart recorder.

H. A summary of conclusions and recommendations supported by the archaeological resource field survey data and archaeological analyses including:

(1) A discussion of known or potential archaeological resources;

(2) Recommendations for avoidance or for further archaeological investigations; and/or

(3) Recommendation that operations be permitted because data recovery negates adverse effects to archaeological resources.

I. A discussion of the data and results from any additional investigations that may be required by the GOMR shall be appended to the archaeological resource report.

III. Review of Archaeological Resource Reports

A. The GOMR will determine whether a report meets the requirements contained in the invocation notification and/or this NTL. The review will be conducted by personnel with archaeological, geophysical, and other appropriate expertise. The GOMR will determine if the survey was performed properly and will evaluate the geophysical interpretations and archaeological conclusions.

B. If the report is not adequate or complete, the GOMR will notify the operator or right-of-way holder, in writing, of the problems and identify the data or information necessary to correct or complete the report.

C. Based on the GOMR review of the report findings, the GOMR will notify the operator or right-of-way holder, in writing, of any mitigating measures or operational restrictions which may be required.

D. A previously submitted archaeological resource report may be acceptable for satisfying the archaeological resource report requirements under a new lease agreement, particularly if the lease falls exclusively within the area of high probability for the occurrence of prehistoric archaeological resources. Prior to submittal of an Exploration Plan or Development Operations Coordination Document, the operator shall submit to the Regional Supervisor, Leasing and Environment, a written request for review of an archaeological report prepared for an expired lease to determine its compliance with current MMS requirements. A clean copy of the report to be reviewed shall be included with the operator's request.

## ENCLOSURE NO. 3

### REQUIREMENTS FOR MITIGATION AND OPERATIONAL RESTRICTIONS

A. When an archaeological resource field survey and report indicate that a potential archaeological resource may be present and lease operations or pipeline right-of-way operations are proposed within its immediate area, the GOMR will require the operator or right-of-way holder to either:

1. Locate the operation so as not to adversely affect the area of the archaeological resource; or

2. Establish to the satisfaction of the GOMR that an archaeological resource does not exist or will not be adversely affected by operations. This shall be done by further archaeological investigation, conducted by an archaeologist and a geophysicist, using survey equipment and techniques deemed necessary by the GOMR. A report on the investigation shall be submitted to the GOMR for review.

B. If the GOMR determines that an archaeological resource is present in the area and may be adversely affected by operations, the operator or right-of-way holder will be notified immediately. Under these circumstances, the GOMR is required to engage in additional consultations in accordance with 36 CFR 800.4. The operator or right-of-way holder shall take no action that may adversely affect the archaeological resource until the GOMR has concluded these consultations and has provided the operator with instructions on how to protect the resource.

C. If the operator or right-of-way holder discovers any archaeological resource while conducting operations, a report of the discovery shall be immediately made to the GOMR. The operator or right-of-way holder shall make every reasonable effort to preserve the archaeological resource until the GOMR has issued instructions on how to protect it.