1 of 8

Gulf of Mexico Sales 147 and 150:

Central and Western Planning Areas

Final Environmental Impact Statement

Volume II: Sections IV.D. through IX

Author

Minerals Management Service
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D. ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTIONS AND ALTERNATIVES

1. Proposed Central Gulf Sale 147

Proposed Central Gulf Sale 147 is scheduled to be held in March 1994. 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 IV.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 adjacent coastal region is divided into four coastal subareas (LA-1, LA-2, LA-3, and MA-1). These subareas are delineated on Figure IV-1.

(1) Impacts on Sensitive Coastal Environments

(a) Coastal Barrier Beaches and Associated Dunes

The major impact-producing factors associated with the proposed action that could affect barrier beaches 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 barrier beaches of the CPA. Impacts that affect barrier islands landward of the barrier dune system are considered in the wetland analysis. Impacts to other aspects of the barrier environment, such as animals, the recreational value of beaches, and archaeological resources, are described in other sections.

Oil spills associated with the proposed action can result from offshore platform accidents, barge or tanker collisions, and pipeline breaks. Tables IV-2 and IV-3 present estimates of the number of offshore spills that may occur as a result of various scenarios in the CPA over the 35-year life of the proposed action. Section IV.A.3.h. and Table IV-10 express the probability and anticipated number of offshore oil spills that may occur and contact land, during the same 35-year period. The probabilities of offshore spills contacting various shoreline segments (Figure IV-2) are provided in Table IV-10.

Spills also occur inshore as a result of barge, tanker, pipeline, and storage tank accidents. Most 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 or piped from OCS platforms and most OCS-related waterway segments are not located near barrier features. An accident that occurs during oil transfer operations at a terminal will not likely affect coastal barrier beaches. When transporting cargoes to terminals or refineries, oil barges make extensive use of interior waterways, remote from barrier beaches. Consequently, oil spilled from a barge in transit will not likely contact a barrier beach.

For a barge or pipeline accident to affect a barrier beach, the accident would have to occur in nearshore waters, on a barrier landform or inshore in the vicinity of a tidal inlet. In coastal Subarea MA-1, the Gulf Intracoastal Waterway cuts through 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 barges in Mississippi Sound. An accident there involving a barge carrying crude

oil to MA-1 could result in spilled oil contacting a barrier island. A spill occurred in Mississippi Sound in September 1989 resulting in the oiling of the landward side, but not the Gulf side, of Horn Island, further indication that coastal barrier beaches will not be adversely impacted by inland spills.

Pipeline landfall sites on barrier islands have been identified as potential causes of accelerated beach erosion and island breaching. Studies have showed that little to no impact to barrier beaches occurs as a result of modern techniques for pipeline crossings (Wicker et al., 1989; LeBlanc, 1985; Mendelssohn and Hester, 1988). Some techniques presently used by the industry, such as directional boring, have no impact upon beach topography.

No new navigation channels are expected to be dredged as a result of the proposed action (Section IV.B.2.a.); therefore, impacts from these activities are precluded. Some periodic maintenance dredging of navigation channels through barrier passes is expected. Maintenance dredging and stabilization of bar channels could affect the stability of the barrier landform if the bar channel serves as a sediment sink, intercepting longshore sediment drift. Dredged material from the sink is often discharged to deeper waters of the Gulf. This impact can be mitigated by discharging dredged material onto barrier beaches or strategically into the longshore sediment current, downdrift of the maintained channel. Misplacement of dredged materials sometimes forms sand bars that impair coastal navigation by shallow water vessels, such as shrimp trawlers.

Section IV.B.2.a. states that the channel leading to Port Fourchon, Louisiana (Belle Pass), will be deepened to provide access for larger service vessels used for deep-water operations. Preliminary project plans are still being developed. Ninety percent of this activity is attributed to the OCS Program. Jetties are not expected to be modified. The deepened bar channel through barrier passes could serve as a sediment sink and reduce sediment supply to beach areas downdrift, thereby intensifying the chronic erosion problem to the west of the inlet jetties, which is largely attributed to those jetties. An early U.S. Army Corps of Engineers (COE) feasibility report for deepening the Belle Pass channel indicates that some of the dredged material will be used for beach refurbishment in the area west of the jetties.

Periodic maintenance dredging of existing bar channels could exacerbate adverse impacts these conditions by maintaining channel depth, although dredged material could be placed in the longshore sediment drift such that it refurbishes the downdrift shoreline, thereby mitigating that adverse impact. Based on these assumptions, the expectation is that mitigative use of dredged material, will help abate ongoing erosion of barrier beaches as a result of artificially deepened and jettied channels.

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 habitat on barrier landforms. Previous studies have shown that efforts to stabilize and "armor" beaches usually lead to accelerated erosion in areas away from the protected beach. Hence, construction techniques will be employed to preclude disturbance or destabilization of barrier beaches.

Base Case Analysis

As described in Section IV.A.3.h., landfall by Sizes 1 and 2 offshore spills are not assumed to occur under the proposed action. Table IV-10 shows a 2 percent probability of an offshore Size 3 spill contacting a coastal barrier beach within 10 days of the spill event, during the 35-year life of the proposed action. Hence, it is assumed that no offshore spills related to the proposed action will contact a coastal barrier beach.

Table IV-13 indicates that no Size 3 spills are assumed to occur inland under this scenario. No Size 1 or 2 spills are assumed to occur inland. Therefore, no spills from inland sources will contact barrier beaches.

No new pipeline landfalls are projected (Section IV.B.2.a.). However, in the event of an unforeseen hydrocarbon discovery that would require a new landfall, modern techniques of pipeline emplacement and planning procedures can eliminate pipeline landfall impacts.

The contribution of the proposed action to vessel traffic in OCS-related navigation canals is 0.4 percent. Correspondingly, 0.4 percent of impacts attributable to maintenance dredging and wake erosion of those channels is also accredited to the proposed action. Sediments from maintenance dredging of bar channels and tidal inlets can be of considerable benefit to barrier beaches. If the dredged material is placed strategically in the interrupted longshore sediment drift, i.e., downdrift of the interruption, it would help mitigate the adverse

impact caused by jetties and channels. A corresponding percentage of this benefit is attributable to this proposal.

Three percent of the OCS Program-related impacts of deepening Belle Pass is attributed to proposed activities. An adequate analysis of the project cannot be performed concerning impacts until a project description is developed. Based upon previous proposals, more than 23 million m³ of dredged material are expected to be displaced when the channel is deepened. An as yet undetermined portion of that dredged material is expected to be used to refurbish the barrier beach downdrift of the channel jetties.

Summary

The mean number of oil spills expected to occur and contact barrier beaches is zero over the life of the proposal. Should an unforeseen contact occur, it is expected that resulting oiling will be very light.

Onshore and nearshore construction of new infrastructure (pipeline landfalls, navigation channels, service bases, platform yards, etc.) in wetlands as a result of the proposed action are not expected to occur.

Some maintenance dredging of barrier inlets is expected to occur, but has not been shown to have an appreciable negative impact on barrier beaches, and the need for dredging cannot be attributed to the small percentage of vessel traffic in these channels accounted for by proposed activities.

Deepening of the channel to Port Fourchon is expected to maintain continuing adverse impacts on nearby barrier features. Strategic placement of dredged material from this project and subsequent maintenance dredging is expected to benefit barrier beaches immediately to the west of the channel jetties.

Conclusion

The proposed action is expected to result in alteration of barrier beach configurations, in localized areas downdrift from navigation channels that are jettied and maintained or deepened. Strategic placement of dredged material resulting from these actions can mitigate adverse impacts upon those localized areas.

High Case Analysis

In Section IV.A.3.h., no Size 1 offshore spills are assumed to occur. According to Table IV-10, a 4 percent or less chance exists of an offshore Size 3 spill occurring and contacting a coastal barrier in the CPA within 10 days. Based on this low probability, it is assumed that an offshore Size 3 spill will not contact a coastal barrier. However, Section IV.A.3.h. assumes that one Size 2 spill will occur and contact coastal barrier beaches. Weathering of the spill, described in Section IV.A.3.h., will significantly reduce the volume of the Size 2 offshore spill before it contacts land. Any beached oil will be spread lightly over about a 2-km length of beach, which will be manually cleaned. Small volumes of sand will be taken from the littoral transport system of the beach as a result of cleanup operations. The beach is expected to readjust to its pre-spill configuration within a few months.

Cleanup operations of large oil spills can affect barrier beach stability. If large quantities of sand were scraped away and removed during cleanup operations after a spill, 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 as seen along the Louisiana Gulf Coast.

In coastal Louisiana, dune line heights range from 0.5 to 1.3 m above mean high tide levels. In Subarea MA-1, dune elevations exceed those in Louisiana. 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 range up to 16 percent. For tides to carry oil from a spill across and over the dunes, strong southerly winds would have to persist for an extended time prior to or immediately after the spill. Strong winds required to produce the high tides would also disperse and spread the oil slick, thereby reducing the oil concentration that would landfall at any given coastal location. The combined probability of significant dune contact during abnormally high water levels by a spill associated with the proposed action is very unlikely. In addition, a 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 these considerations, oil spills are not expected to adversely affect sand dune vegetation, significantly.

As provided in Table IV-13, no Size 3 spill is assumed to occur onshore. No Size 1 or 2 spills are assumed to occur onshore and contact coastal barriers under this scenario (Section IV.B.2.d.). No new pipeline landfalls are projected to occur (Section IV.B.2.a.). 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.

Under the High Case, vessel traffic within navigation channels attributable to the proposed action will be 0.8 percent of the total traffic. Correspondingly, 0.8 percent of the maintenance dredging done during the life of the proposed action can be attributed to activities associated with the High Case. Sediments from maintenance dredging of bar channels and tidal inlets can be of considerable benefit to barrier beaches. If the dredged material is placed strategically in the interrupted longshore sediment drift, it would help mitigate adverse impacts caused by the presence of jetties and artificially deepened tidal passes. A corresponding percentage of benefit is attributable to this case. Adverse and beneficial impacts resulting from channel traffic and maintenance dredging would be negligible.

No new infrastructure construction activity is projected to occur on barrier beaches, under the High Case (Section IV.B.1.).

Ninety percent of the impacts caused by deepening Belle Pass is attributed to the OCS Program, 6 percent of which is attributed to the High Case. An adequate analysis of the project cannot be performed concerning impacts until a project description is developed by the COE. Based upon previous proposals, more than 23 million m³ of dredged material are expected to be displaced when the channel is deepened. An as yet undetermined portion of that dredged material is expected to be used to refurbish the barrier beach downdrift of the channels jetties.

Expected weathering and dispersion of anticipated spills prior to contacting the beach is expected to cause light oiling with no significant adverse impacts. Cleanup activities of spills anticipated to occur as a result of this scenario will cause minor, short term disturbance of beach configuration.

Onshore and nearshore construction of new infrastructure (pipeline landfalls, navigation channels, service bases, platform yards, etc.) as a result of the proposed action are not expected to occur, hence no impacts are anticipated.

Some maintenance dredging of OCS-related bar channels is expected to occur, but has not been shown to have a significant negative impact on barrier beaches, and the need for dredging cannot be attributed to the small percentage of vessel traffic in these channels accounted for by proposed action activities.

Deepening of the channel to Port Fourchon is yet undescribed but is not anticipated to cause any additional or accelerated adverse impact on nearby barrier features. Strategic placement of dredged material from this project and subsequent maintenance dredging is expected to benefit barrier beaches of the CPA downdrift of channel jetties.

Conclusion

The High Case is expected to result in permanent alterations of barrier beach configurations in localized areas downdrift from OCS-related navigation channels that are jettied and maintained or deepened. Strategic placement of dredged material resulting from these actions can mitigate adverse impacts upon those localized areas.

(h) Wetlands

Wetlands considered in this analysis include forested wetlands (bottomland and swamp) and marshes. Seagrass beds are also included in this analysis. Swamps and marshes occur throughout the coastal zone. Seagrasses are restricted in distribution to small shallow areas behind barrier islands in Mississippi and Chandeleur Sounds.

Impact-producing factors resulting from OCS oil and gas activities that could adversely affect wetlands and seagrass beds include oil spills, pipeline construction and remaining canals, dredging of new navigation channels, maintenance dredging and vessel usage of navigation channels, and construction and maintenance of onshore facilities in wetland areas.

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, pipeline breaks, or navigational accidents. If offshore spills were to contact wetlands, they are not expected to result in high-enough concentrations of oil to affect wetland vegetation adversely for a long term. No offshore spill is expected to contact seagrass beds.

Spills can also occur inshore as a result of tanker, barge, or pipeline accidents, or during transfer operations at terminals. Most inshore Size 1 spills in the CPA are assumed to occur near or at OCS-related transfer facilities. It is assumed that most oil spills will either be confined within facility containment levees and will not contact wetlands, or will be contained and managed as a result of Spill Prevention Control and Countermeasure (SPCC) plans required for such facilities, thereby causing little impact on wetlands.

Size 2 and larger Size 1 spills are assumed to result from pipeline or navigation accidents, away from transfer facilities. Spills resulting from navigation accidents will be largely contained in the channel. Slicks will quickly spread through the channel by tidal, wind, and traffic currents. Most oil contacting wetlands is not expected to have long lasting adverse effects on significant areas of wetland vegetation. Spills that damage wetland vegetation fringing and protecting canal banks will accelerate erosion of those once protected wetlands and spoilbanks (Alexander and Webb, 1987).

Numerous investigators have studied the immediate impacts of oil spills on wetland habitats in the Gulf area. Often, seemingly contradictory conclusions from impact assessments are generated from these studies. Differences can be explained by different oil concentrations contacting vegetation, the kinds of oil spilled (heavy or light crude, diesel, fuel oil, etc.), types of vegetation affected, the season of year, the preexisting stress level of the vegetation, and numerous other factors. In overview, the data suggest that light-oiling impacts will include plant die-back with recovery within two growing seasons or less without artificial replanting. Therefore, these impacts are considered short term and reversible (Webb et al., 1985; Alexander and Webb, 1987; Lytle, 1975; Delaune et al., 1979; Fischel et al., 1989).

It is assumed that the extent and severity of oil-spill impacts are dependent upon oil concentration and on the wetland type and condition contacted. Critical concentration of oil is that concentration above which impacts to wetlands will be long term and recovery will take longer than two growing seasons, and which cause plant mortality and some permanent wetland loss. Critical concentrations of various oils are currently unknown and assumed to be variable. In the stressed environment of coastal Louisiana, the wetland loss rate has been as high as 0.86 percent per year within the recent past. Wetlands there are assumed to be more sensitive to oil contact than elsewhere in the Gulf because of high cumulative stress.

The work of Mendelsohn and his colleagues (Fischel et al., 1989; Mendelsohn et al., 1990) provides data on long-term effects of a 300-bbl spill from a 1985 pipeline rupture in a Louisiana marsh. Response and recovery of marsh vegetation at that site have been monitored since that time. Results of these investigations are used in this analysis to identify effects of an oil spill on wetlands in the stressed environment of coastal Louisiana.

Because pipelines traverse wetland areas adjacent to the CPA, 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). Based on data from Mendelsohn et al. (1990), recovered vegetation is expected to be the functional equivalent to unaffected vegetation, ecologically. Impacts from spills will therefore be confined to a reduction in plant density. Because a pipeline spill could occur within the interior of a wetland, where wave-induced or tidal flushing is not as regular or as complete, oil could persist in the soil for more than 5 years.

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/m². Concentrations less than this will cause die-back of the above-ground vegetation for one growing season, but only limited mortality to the vegetation. Concentrations above this will cause either 35 percent die-back or mortality of contacted vegetation. Within 4 years, 35 percent of the affected area will recover. Oil will persist in the wetland soil for at least 5 years. After 10 years, it is expected that 10 percent of the affected wetland area will have been permanently lost as a result of accelerated landloss indirectly caused

by the spill. If a spill contacts wetlands exposed to wave attack, additional and accelerated erosion of the wetland fringe will occur, as documented by Alexander and Webb (1987).

Wetlands in other coastal areas of the CPA that could be contacted by an oil spill associated with the proposed activities (Mississippi, Alabama) occur on a more stable substrate, receive more sediment per unit of wetland area, and have not experienced the extensive alterations caused by canal dredging and rapid subsidence rates that affect 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. In wetlands along the Texas, Mississippi, and Alabama coasts, the critical concentration is assumed to be 1.0 l/m² (Alexander and Webb, 1983). Concentrations below this will result in short-term, above-ground die-back for one growing season. Concentrations above this will result in longer-term impacts to wetland vegetation, including plant mortality, which is extensive enough to require recolonization.

Using these studies as models, it is estimated that for every 50 bbl of oil spilled, approximately 3 ha will experience die-back of wetland vegetation; 1 ha of these damaged wetlands will recover within 4 years and 2 ha will recover in 10 years. About 1 ha of those wetlands are expected to be lost permanently to open-water habitat as a result of the spill. For the purpose of analysis of wetland impacts, Sizes 1, 2, and 3 spills onshore shall be considered to be 50, 500, and 6,500 bbl, respectively.

Seagrass beds generally occur in shallow, high-salinity waterbodies, landward of protective landforms, such as barrier islands and shoals. 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 in a region with a micro-tidal range. This protects them from direct contact with oil. The degree of impact will depend on water depth and tidal events in the affected area. Seagrasses generally occur at shallow depths of 50 cm or less.

Another reason for seagrass insusceptibility to oil spills is that a large percentage of their biomass is found in the root and rhizome, which are buried in sediment. The large root mass allows plants to regenerate. It is expected that an oil spill that moves into a seagrass area will cause slight damage to the vegetation. Because of the shallow depths, it is expected that a spill in the vicinity of a bed will cause some seagrass die-back for one growing season. No permanent loss of seagrass habitat will result from the spill. In the CPA, few seagrass beds are found near OCS-related navigation channels. A spill will have dissipated before it has moved near seagrass beds.

The major impact to seagrass communities has been to the community composition and numbers of organisms associated with the faunal assemblages.

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 leasing activities. These locations, however, are not near seagrass beds. It is expected that no spills will occur from these pipelines and contact seagrasses.

Neither need nor primary impacts concerning construction of new onshore pipelines are considered for assessment, hence no impacts generated by pipeline construction will be attributed to it. Coastal pipeline construction impacts are attributed to the OCS Program. Pipeline maintenance activities that disturb wetlands are very infrequent and are considered to be insignificant.

After backfilling a pipeline canal, a right-of-way may revegetate or remain as a shallow waterbody (Tabberer et al., 1985; Wicker et al., 1989). In areas where soils have high organic content, backfilling does not usually fill a canal completely. In areas with soils having low organic content, most of the canal length is usually filled and naturally revegetated after backfilling. Most of these disturbances, described in Section IV.B.2.a., are anticipated to result in temporary adverse impacts that are assumed to be partially corrected after 2 years in Subarea MA-1 and after 5 years in Louisiana.

Secondary impacts of pipeline channels are considered to be more damaging to coastal wetlands and associated habitats than primary impacts (Tabberer et al., 1985). Secondary impacts include expansion of tidal influence, saltwater intrusion, hydrodynamical alteration, erosion, sediment export, and habitat conversion. During reviews of pipeline projects for Federal and State permits, agencies consistently comment with concern upon the extent of these secondary impacts. As a result, structures engineered to mitigate secondary adverse impacts are included as permit requirements.

Decisions to not maintain structures constructed for the purpose of mitigating adverse impacts of pipeline construction allows such structures to deteriorate and eventually fail. Significant, indirect, and adverse impacts upon wetlands that the structures were designed to prevent or mitigate then proceed. Since the current length of OCS-related pipeline canals and the number of related mitigative structures in the CPA is unknown, hence impacts creditable to the proposed sale are unknown. The extent of impacts caused by failure to maintain mitigation structures is unknown.

Widening of pipeline canals over time is one of the more obvious and quantifiable secondary impacts. Craig et al., (1980) studied a series of canals in Louisiana and determined that the canals widened at rates that ranged from 2 to 14 percent per year. Dead-end canals that conducted no traffic or significant flow were shown to widen at rates within this range. Due to their shallow nature, it is assumed that OCS-related pipeline canals will widen on average at a rate of 4 percent per year over the 35-year life of the proposal. The length and width of OCS-related pipelines canals in Louisiana are unknown.

It is assumed that no produced waters generated by this proposal will be transported to land to be treated and discharged to inland waters. It is anticipated that the present practice of discharging OCS-related produced water to inshore waters will be discontinued by 1997. 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.B.2.). This observation of no adverse impact has been confirmed by Boesch and Rabalais (1989b).

According to Table IV-13, produced sands and drilling fluids will be transported to shore for disposal. According to Section IV.B.2., 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 to establish new disposal sites. Some seepage from waste sites may occur into adjacent wetland areas and result in damage to wetland vegetation. Several State and Federal laws are enforced to prevent and correct such occurrences.

No new navigation channels are anticipated to be constructed as a result of the proposed sale. As discussed in Section IV.B.1., deep water activities are anticipated to increase, requiring use of larger service vessels for efficient operations.

A previous proposal of the U.S. Army, COE (1991) for a -6.7 m, NGVD, 8.5-km long channel at Port Fourchon was abandoned in favor of a still deeper channel, for which a feasibility report is not yet available. From the original feasibility report, it is expected that the dredged material will be placed for the creation of at least 192 ha of saline marsh, over the 50-year project life. Because 192 ha is given as a minimum size and because the vast majority of the material will be dredged in the beginning of the project, the entire 192 ha is attributed to the 35-year life of the proposal. Ninety percent of the impacts generated by deepening the Port Fourchon Channel will be attributed to the OCS Program, a percentage of this is attributable to the proposed sale.

The previous feasibility report did not anticipate significant saltwater intrusion effects on wetlands as a result of the deepening project, because the project will only extend approximately 8.5-km inland and will be entirely in a saline environment where the existing vegetation thrives in high salinities.

Impacts to wetlands can occur from periodic maintenance dredging of navigation channels. If spoil is deposited onto existing spoil banks, the effects of the spoil banks on wetland drainage is expected to continue unchanged, although there may be some localized and minor aggravation of problems. Typically, some dredged material intended for placement on a spoil bank is placed in adjacent wetlands or shallow water. Wetland loss due to this action is assumed to be offset by wetland creation as adjacent margins of shallow water are filled. In both events, areas impacted are estimated to be small.

Material from maintenance dredging should be considered for use as a sediment supplement in deteriorating wetland areas to enhance and increase wetland acreage, where appropriate. Disposal of dredged material for marsh enhancement has been done only on a limited basis, as of 1988 (Section IV.B.2.). Given the restatement of the "mission" of the COE to take environmental impacts into consideration, increased emphasis has been placed on the use of dredged material for marsh creation. 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.

According to Johnson and Gosselink (1982), canals that have high navigation usage in coastal Louisiana widen about 2.58 m/yr, compared to 0.95 m/yr for little used canals. It is assumed that OCS-related navigation canals will widen at a average rate of 1.5 m/yr. As established in Section IV.B.2., 811 km of navigation canals, bayous, and rivers are found in the coastal regions of the CPA (derived from Wicker et al., 1989).

Prop-wash of vessel traffic in navigation canals resuspends sediments, increasing the turbidity of nearby coastal waters, which has the greatest potential impact upon seagrass beds. Navigation routes in the area are not located near seagrass beds.

Various kinds of onshore facilities have been constructed to service OCS development. These facilities are described in Section IV.B.1. and Table IV-14. All proposed new facilities are attributed to the OCS Program in direct association with proposed pipelines. Hence, no impacts associated with any new facilities will be attributed to the proposed action.

Base Case Analysis

Table IV-2 provides the number of offshore spills expected to occur as a result of the proposed action over 35 years. Because of the very low probability of occurrence described in Table IV-10 and explanation in IV.A.3.h., no offshore Size 1, 2, or 3 spills are assumed to contact wetlands.

Table IV-13 indicates that 36 onshore oil spills are expected to occur as a result of this scenario in the CPA. Twenty-three (64%) of these spills will be less than one barrel and are assumed to occur at transfer facilities where they will be contained without impacts on wetlands. Eleven (30.5%) spills are listed to be Size 1 spills, six of which are assumed to occur in direct association with transfer facilities where effective spill recovery plans are in place. The remaining five Size 1 spills and two Size 2 spills are assumed to result from pipeline or navigation accidents, away from transfer facilities. For the purpose of analyses, typical Size 1, 2, and 3 spills will be considered as 50, 500, and 6,500 bbl, respectively. Hence, it is estimated that a total of 1,250 bbl will be spilled by the seven events, thereby impacting approximately 68 ha of wetlands over the course of 35 years. After 4 and 10 years, 25 and 35 ha will recover, respectively. An estimated 8 ha of wetlands will be converted to open water.

Secondary wetland losses resulting from widening of proposed and existing OCS-related pipeline canals is accredited proportionally to the OCS Program and the proposed sale. After the 32 km of pipelines are constructed in Subarea MA-1, the remaining canal, estimated to be 9.6-km long and 1.5-m wide, will widen at a rate of 4 percent per year, resulting in the loss of 4.2 ha after the 35 years considered; 0.13 ha is accredited to the proposed action. The estimated 40 km of canal projected for construction in Subarea LA-1 is assumed to result in a 20-km long, 2.25-m wide pipeline canal, which is assumed to widen at a rate of 4 percent per year, resulting in the loss of 12.5 ha after 35 years; 0.38 ha is accredited to the proposed action. For existing pipeline canals, it is estimated that the cumulative length is 1,780 km, with an average width of 4 m, which will widen at a rate of 4 percent per year, resulting in the loss of 1,994 ha after 35 years; 60 ha is accredited to the proposed action. Estimated total wetland loss due to pipeline canal widening is estimated at 2,011 ha after 35 years; 61 ha is accredited to the proposed action.

Ninety percent of need to deepen the Fourchon Navigation Channel is attributed to OCS activities, and 3 percent of the OCS Program is attributable to the proposed action. Hence, the creation of 6 ha of wetlands related to the Fourchon Channel project can be attributed to the proposed action. Impoundment sites in the area may later be filled to provide additional commercial sites for this developing port facility. In this event, wetland gains will be lost.

On average, only 0.4 percent of channel usage will be attributed to the proposal. Therefore, only 0.4 percent of the maintenance dredging of the channels is attributable to the proposed action. Because of this small percentage of usage and because the likelihood that much of the dredged material resulting from maintenance dredging will be placed on existing spoil disposal sites or used to enhance wetland habitats, it is expected that no significant adverse impacts will occur to wetlands from maintenance dredging.

Due to widening of OCS-related navigation channels, it is estimated that 122 ha/yr of wetlands, or 4,258 ha of wetlands during the 35-year life of the proposed action will be lost. Based on the assumption that the proposal represents approximately 0.4 percent of the use and widening of OCS-related channels, wetland area

lost to widening of canals as a result of the proposed action will be approximately 0.5 ha/yr, or 18 ha over the next 35 years.

Summary

Only spills from pipeline and navigation accidents are expected to result in high-enough concentrations of oil contacting wetlands to result in impacts. Several onshore barge and pipeline accidents are expected to occur, impacting approximately 68 ha of wetlands over the course of 35 years. Four and 10 years after each spill, 25 and 35 ha will recover, respectively. Cumulatively, 8 ha of wetlands will be converted to open water. Seagrass beds will be contacted by low concentrations of oil if any, from these spills. No impacts to seagrass beds are expected.

As a secondary impact of OCS-related pipeline canals attributable to the proposed action, 61 ha wetlands are estimated to be lost over 35 years.

Deepening an existing channel to accommodate larger service vessels is expected to occur within a saline marsh environment and affords the opportunity for creation of 6 ha of wetlands.

Insignificant adverse impacts from maintenance dredging are expected. Alternative dredged material disposal methods can be used to enhance coastal wetlands.

Erosion of wetlands from vessel wakes is expected to result in up to 18 ha of wetlands loss during the 35-year life of the proposed action.

Conclusion

The proposed action is expected to result in the loss of up to 87 ha of wetlands, suppressed productivity of up to 25 ha of wetlands for 4 years and 35 ha for 10 years, and a gain of up to 6 ha of wetlands due to the beneficial use of dredged material.

High Case Analysis

Table IV-2 provides the number of offshore spills expected to occur as a result of the High Case over 35 years. Because of the very low probability of occurrence described in Table IV-10, no offshore Size 1 or 3 spills are assumed to contact wetlands, other than barrier beaches, which are analyzed elsewhere. One Size 2 spill from offshore is anticipated to contact land, but due to the volume reduction after 10 days, the relatively nontoxic remaining fraction is expected to cause only light oiling over only 2 km of beach front.

Table IV-13 indicates that 81 onshore oil spills may occur as a result of the High Case in the CPA. Fifty-one (63%) of these spills will be less than one barrel and are assumed to occur at transfer facilities where they will be contained without impacts on wetlands. Twenty-five (30.8%) spills are assumed to be Size 1 spills, 13 of which are assumed to occur in direct association with transfer facilities where effective spill recovery plans are in place. The remaining 12 Size 1 spills and 5 Size 2 spills are assumed to result from pipeline or navigation accidents, away from transfer facilities. For the purpose of analyses, typical Size 1, 2, and 3 spills will be considered as 50, 500, and 6,500 bbl, respectively. Hence a maximum of 3,100 bbl will be spilled by the 17 events, thereby impacting approximately 168 ha of wetlands over the course of 35 years. After 4 and 10 years, 62 and 86.8 ha will recover, respectively. An estimated 19 ha of wetlands will be converted to open water.

Because no new onshore pipelines will be constructed, no direct impacts caused by pipeline construction or maintenance will be attributed to the High Case. These impacts are accredited to the the OCS Program.

Secondary wetland losses resulting from widening of pipeline canals is accredited proportionally to the OCS program and to the proposed sale. After the 32 km of pipelines are constructed in Subarea MA-1, the remaining canal, estimated to be 9.6-km long and 1.5-m wide, will widen at a rate of 4 percent per year, resulting in the loss of 4.2 ha after 35 years; 0.25 ha is accredited to the High Case. The estimated 40-km of canal projected for construction in LA-1 is assumed to result in a 20-km long, 2.25-m wide pipeline canal, which is assumed to widen at a rate of 4 percent per year, resulting in the loss of 12.5 ha after 35 years; 0.75 ha is accredited to the High Case. For existing pipeline canals, it is estimated that the cumulative length is 1,780

km, with an average width of 4 m, which will widen at a rate of 4 percent per year, resulting in the loss of 1,994 ha after 35 years; 120 ha is accredited to the High Case. Estimated total wetland loss due to pipeline canal widening is estimated at 2,011 ha after 35 years; 121 ha is accredited to the High Case.

Ninety percent of the need to deepen the Fourchon Navigational Channel is attributed to OCS activities, and 6 percent of the OCS Program is attributable to the High Case. Hence, creation of 12 ha of wetlands can be attributed to the High Case. Impoundment sites in the area may later be filled to provide additional commercial sites for this developing port facility. In this event, wetland gains will be lost.

On average, only 0.8 percent of channel usage will be accounted for under the High Case. Therefore, only 0.8 percent of the maintenance dredging of the channels is attributable to the High Case. Because of this small percentage of usage and the likelihood that much of the dredged material resulting from maintenance dredging will be placed on existing spoil disposal sites or used to enhance wetland habitats, it is expected that no significant adverse impacts will occur to wetlands from maintenance dredging.

On the assumption that the High Case represents approximately 0.8 percent of the use and widening of OCS-related channels, wetland area lost to widening of canals will be approximately 1 ha/yr or 35 ha over the next 35 years.

Conclusion

The High Case is expected to result in the loss of up to 175 ha, suppressed activity of up to 62 ha for 4 years and 87 ha for 10 years, and a gain of up to 12 ha due to the beneficial use of dredged material.

(2) Impacts on Sensitive Offshore Resources

(a) Live Bottoms (Pinnacle Trend)

Seventy 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 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.L.c.(2) as a potential mitigating measure for leases resulting from the proposed action. The stipulation is designed to protect the pinnacles from damage resulting from drilling activities and anchor emplacement--the major potential impacting factors on these live bottoms resulting from offshore oil and gas activities. Under the Stipulation, all postlease plans would be reviewed on a case-by-case basis to determine whether a proposed operation could impact a pinnacle feature. If it is determined from studies information, geohazard survey information, or another source that the operation would impinge directly on a pinnacle feature, the operator would be required to relocate the proposed operation. The impact analysis presented below is for the proposed action and includes the proposed Live Bottom (Pinnacle Trend) 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. Subsurface oil spills from pipeline ruptures would have a greater potential to bring high concentrations of oil in contact with the biota of the pinnacle trend. The actual concentrations of oil to which the organisms would be subjected in this case would be dependent on the severity of the spill, the proximity of the spill, and the speed and direction of prevailing subsea currents.

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 thousand meters of the blowout site. A severe subsurface blowout within 400 m of a pinnacle community could result in the smothering of some biota within a limited area of a pinnacle due to sedimentation. Not all blowout incidents result in sediment releases or resuspensions, however.

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 (impacts to growth and reproduction) 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.

Produced water, described in detail in Section IV.A.3.d.(2), usually contains high amounts of dissolved solids and total organic carbon, and low amounts of dissolved oxygen. Other common components include heavy metals, elemental sulfur and sulfide, organic acids, treating chemicals, and emulsified and particulate crude oil constituents. Salinity can vary from a few parts per thousand (ppt) to 300 ppt. The constituents of produced water have the potential to impact adversely the live-bottom organisms of the pinnacle trend if the constituents reach them in high enough concentrations. Domestic and sanitary wastes originate from sinks, showers, laundries, and galleys, as well as waste water from safety showers, eye-wash stations, and fish-cleaning stations. Human wastes, which contain fecal coliform bacteria, are treated by approved marine sanitation devices prior to discharge. A more complete description of domestic and sanitary wastes can be found in Section IV.A.3.d.(5). The proposed Live Bottom Stipulation would prevent the placement of oil and gas facilities upon (and consequently would prevent the discharge of produced water and domestic and sanitary wastes from occurring directly over) the pinnacle-trend, live-bottom areas. Rapid dilution and dispersion of these wastes would occur upon discharge.

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.

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, 18 Size 1 spills, 1 Size 2 spill, and 1 Size 3 spill are assumed as a result of the proposed action (Table IV-2). Surface spills would likely have no impact on the biota of the pinnacle trend because the crests of these features are much deeper than 20 m.

Small subsurface oil spills are unlikely to cause damage to pinnacle trend biota because the low volumes of oil would be quickly diluted by prevailing subsea currents. Low concentrations of oil and the wide spread nature of the biota would limit the severity and area impacted by small subsurface spills. For the purpose of this analysis, a single subsurface pipeline Size 3 oil spill (6,500 bbl) is assumed to occur as a result of the proposed action. The biota of the pinnacles could be significantly impacted by a Size 3 oil spill if the spill occurs near the pinnacles and oil impinges directly on the pinnacles. Few pipelines exist within the pinnacle area, and based on an MMS analysis of proprietary data, new pipeline construction would be very limited in the vicinity of the pinnacle trend as a result of the Base Case. Based on these considerations, the pipeline spill in the CPA is not expected to contact the pinnacle area with high enough concentrations of oil to cause serious or fatal impacts to the biota. Should a pipeline spill occur in the pinnacle area, however, impacts, including uptake of hydrocarbons and reduced visibility, could be serious or even fatal to the local biota. Most of the biota, however, would likely survive and recover once the pinnacles were clear of oil. Thus, if a contact were to occur, the severity to the pinnacle community would be slight.

Blowouts can pose a threat to pinnacle biota if one occurred nearby. Table IV-2 estimates the occurrence of only one blowout in all of Subarea C-3 as a result of the Base Case. The severity and proximity of such an occurrence to the pinnacle trend cannot be predicted, but many blowouts do not result in sediment releases or resuspensions. A severe subsurface blowout within 400 m of a pinnacle community could result in some smothering of the biota within 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 on the order of 2-4 months.

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. In addition, an MMS analysis of proprietary data indicates that a very low level of drilling activity is expected as a result of the Base Case.

For the purpose of this analysis, it is presumed that the Live Bottom Stipulation would prevent oil and gas activities in the immediate vicinity of the pinnacle communities. It is estimated that eight 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 eight platform complexes in offshore Subarea C-3 will not be located in the pinnacle trend area based on an MMS analysis. For the same reasons, anchor damage from support vessels would be minimal because of the implementation of the Live Bottom Stipulation in the pinnacle regions. Furthermore, as noted above, any platforms placed in this region would most often be sited to avoid pinnacle features for safety reasons. Thus, anchoring events are not expected to 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 m³ of sediment are resuspended per kilometer of pipeline in water depths shallower than 61 m, disrupting a total of approximately 215,000 m³ (Table IV-2) in offshore Subarea C-3. However, it should be noted that data gathered for the Mississippi-Alabama Marine Ecosystem Study (Brooks and Giamonna, 1990) 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, and as previously stated, very few pipelines in the vicinity of the pinnacle trend would result under the

Base Case. 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 818,000 bbl of drilling muds and 251,000 bbl of drill cuttings generated from 125 exploration/delineation and development wells over the 35-year life of the proposed action in Subarea C-3. As previously stated, drilling activity in the vicinity of the pinnacle trend is expected to be very low. 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 greatly 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 only within 1,000 m of the discharge point, and have little biological effect except very close to the discharge point. Such an event would rarely impact the pinnacle-trend, live-bottom communities.

The discharge of produced waters and domestic and sanitary wastes has the potential to impact adversely the live-bottom organisms of the pinnacle trend due to the toxicity of these wastes. Estimates presented in Table IV-2 project that 72,000 m³ of domestic and sanitary wastes and 62 MMbbl of produced water will be discharged in Subarea C-3 over the 35-year life of the proposed action. An MMS analysis of proprietary data finds it likely that most of the activities generating these wastes in Subarea C-3 would not be located in water depths where the pinnacle features exist. As previously stated, the proposed Live Bottom Stipulation would prevent the placement of oil and gas facilities upon (and consequently would prevent the discharge of produced water and domestic and sanitary wastes from occurring directly over) the pinnacle-trend, live-bottom areas. The depth of the pinnacle features, the prevailing currents in the area, and the offset of the discharges from the pinnacle features (provided through enforcement of the Live Bottom Stipulation) would cause produced waters and domestic and sanitary wastes to be diluted to harmless levels before reaching the live-bottom organisms of the pinnacle trend. The discharge of produced water and domestic and sanitary wastes are not expected to cause adverse impacts to the pinnacle-trend, live-bottom areas.

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 trend area from structure removal are expected to be minimal because of the restricted regions affected by the shock wave from explosives, the limited duration and area of impact associated with sediment resuspensions (about 1,000 m), and the low number of structure removals (two removed explosively over the 35-year life of the proposed action in Subarea C-3) 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 adversely impact 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 physical damage, the most potentially damaging of these activities. The impacts of the proposed action are 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 from blowouts, pipeline emplacement, mud and cutting discharges, and structure removals are infrequent because of the proposed Live Bottom Stipulation. Potential impact from Size 3 oil spills would be minor because of the depth of the features, currents in the area, and the low levels of

pipeline activities in the area. 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 proposed action is expected to be such that any changes in the regional physical integrity, species diversity, or biological productivity of the pinnacle features 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 without the protection of the proposed biological stipulation (Section II.A.1.c.(2)) could have an extremely deleterious impact to localized portions of the pinnacle trend. Physical damage from anchoring, drilling operations, and other activities are potentially the most damaging impact because these activities could destroy biological communities or damage the structure of the pinnacles themselves, resulting in a reduction of the area as habitat or shelter for commercial and recreational fishes. However, the unevenness of the seafloor associated with the larger pinnacle features would reduce the likelihood that rigs or platforms would be emplaced directly over a pinnacle feature. In addition, the pinnacles are widespread throughout the region, so that loss of a few localized features (or areas within a feature) would cause only slight community-wide impacts to the pinnacle trend. Because of the low levels of projected OCS activities in the pinnacle-trend area and the small size of many features, occurrences of damage would be infrequent. Potential impacts to the pinnacle-trend, live-bottom areas from other impact-producing factors associated with OCS activities (such as Size 3 oil spills, blowouts, pipeline emplacement, discharges of muds and cuttings, and explosive structure removals) would occur infrequently because of the low projected levels of OCS activities and the widespread nature of the pinnacle 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. It is assumed that within the CPA (in which portions of the pinnacle trend are located), 1 Size 3 spill, 2 Size 2 spills, and 47 Size 1 spills will occur over the 35-year life of the proposed action. The offshore infrastructure estimates (wells and platforms) are slightly greater in this scenario (260 wells and 17 platform complexes for the High Case in Subarea C-3), as are the lengths of pipeline installed (200 km for the High Case) and the volume of drilling mud discharges (1.726 MMbbl for the High Case). The volume of produced water would increase to 117 MMbbl under the High Case as would the amount of domestic and sanitary wastes discharged (151,000 m³ under the High Case). The frequency of blowouts would also be increased under the High Case (two for Subarea C-3). 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 Size 3 oil spills is estimated at 17 percent for the High Case (Table IV-9). 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 is expected to be such that any changes in the regional physical integrity, species diversity, or biological productivity of the pinnacle features would recover to pre-impact conditions in less than 2 years, more probably on the order of 2-4 months.

(h) *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. 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, pipeline installation, and seafloor blowout accidents. 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.3.b.(1)), and structure emplacement (Section IV.A.3.a.), as well as a seafloor blowout (Section IV.A.3.h.(1)). 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). 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 of bottom is disturbed per kilometer 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 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.

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, 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 320 wells are assumed to be drilled, 15 platform complexes installed, and 225-km of pipeline installed. Two blowouts are expected in all three subareas.

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 analysis, the frequency of such impact is expected to be once every 6 months to 2 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 6 months to 2 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. Seafloor disturbance is considered to be a threat only to the high-density (Bush Hill-type) communities; the widely distributed low-density communities would not be at risk. The provisions of NTL 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 as a result of physical disturbances is expected to take less than 2 years.

High Case Analysis

In the High Case analysis, the deep water benthic communities (e.g., chemosynthetic communities) would be subject to the following impact-producing factors: physical disturbance of the bottom where these communities are found, such as disturbance by emplacement, platform and pipeline installation, anchoring, and seafloor blowouts. No other impact producing factor is expected to present a threat to these deep-water communities. 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, 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 685 wells are assumed to be drilled, 44 platform complexes installed, and 455-km (250 mi) of pipeline installed. Four blowouts are projected throughout the three subareas.

While the opportunities for impact are somewhat higher under the High 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 6 months to 2 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 6 months to 2 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 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 as a result of physical disturbances is expected to take less than 2 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 potential impact-producing factors to the topographic features of the Central Gulf are anchoring (Section IV.A.3.b.(1)), structure emplacement (Section IV.A.3.a.), effluent discharge (Section IV.A.3.d.), blowouts (Section IV.A.3.h.(1)), oil spills (Sections IV.A.3.h.(2)), and structure removal (Section IV.A.3.c.).

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. 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). Chor (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 ppt. Hydrocarbons, other organic compounds, and trace metals may be present in parts per million (ppm) levels in the produced water discharges (USDOD, NMFS, 1977; USEPA, 1993; Walk, Haydel, and Associates, Inc., 1984). 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.3.d.(2) 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 and sand will be redeposited within 400 m of the 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. Sizes 1, 2, and 3 oil spills 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.A.3.h.(2)), 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. Despite some conflicting results, most studies suggest a detrimental influence of oil on corals (Keller and Jackson, 1991; Guzman et al., 1991; Guzman and Jackson, 1991). The depth and distance from shore of topographic features in the Gulf of Mexico, which possess thriving coral populations, offer some protection of these features from surface oil slicks resulting from platform and tanker spills. Subsurface spills from pipelines or blowouts, however, could result in the formation and settling of oil-saturated material with oil-sediment particles coming into contact with living coral tissue. In addition, use of chemical dispersants on surface slicks could cause oil/dispersant mixture to reach these deep reef environments. Studies suggest that the effect of chemically dispersed oil on corals do not differ from that of oil alone (Dodge et al., 1984; Wyers et al., 1986). It is unlikely that chemical dispersants would be used on surface slicks as far offshore as the banks of the Gulf of Mexico. Knap et al. (1985) found that *Diploria strigosa*, a common massive coral of the Flower Garden Banks, 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.

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 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 charges in open water showed only 5 percent mortalities at distances of 8 m. Crabs exposed to 14-kg charges of explosives in open water showed 90 percent mortalities at 8 m, but very few died at 46 m. 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* [USDO, MMS, 1987a] 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 22.7 kg 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, including direct contact to the banks from pipeline, rig, and platform emplacements and from anchoring activities. 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 mi, 3 mi, or 4 mi, 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 and affecting small areas of 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 on the order of 2-4 weeks.

Two blowouts are estimated to occur (see Section IV.A.3.h.(1) and below), and with the application of the proposed stipulation, none would 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 Subarea C-3 and none in C-2, 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 on the order of 2-4 weeks.

There is an estimated 14 percent chance of one or more Size 3 oil spills occurring in the Central Gulf as a result of the proposed action (Base Case) (Table IV-9), and it is assumed that 18 Size 1 spills will occur during the 35-year program. It is further assumed that there will be one Size 2 spill and one Size 3 spill (6,500 bbl) during the 35-year life of the proposed action (Table IV-2 and Section IV.A.3.h.). In addition, it is assumed there will be nine spills of diesel oil and other pollutants, the average size of which will be 34 bbl (Section IV.A.3.h.). 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, the Size 3 spill resulting from this proposal is 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). If a seafloor oil spill (e.g., pipeline) 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.

A total of eight structure removals using explosives is estimated for the Base Case. Effects from explosive removals of platforms on the topographic features of the Gulf are not expected to impact the biota of 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 on the order of 2-4 weeks.

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 on the order of 2-4 weeks.

Oil spills (there is an estimated 14 percent chance of a Size 3 oil spill 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. Small localized areas would be impacted by operational discharges (i.e., muds and cuttings), and recovery 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 m²) 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 with released oil, causing turbidity and sedimentation, and resulting in death to benthic organisms. Recovery from such damage may take many years. As noted above, only one blowout is 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.

Surface 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. The biota of the topographic features would be subject to the following impact-producing factors: discharges associated with drilling, blowouts, and oil spills. 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 on the order of 2-4 weeks.

The five blowouts estimated 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 on the order of 2-4 weeks.

There is an estimated 29 percent chance of one or more Size 3 oil spills occurring in the Central Gulf as a result of the High Case (Table IV-9). It is also assumed that 41 Size 1 spills and 2 Size 2 spills will occur during the 35-year life of the proposed action. In addition, it is assumed there will be 20 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 Size 3 oil spill of 6,500 bbl will occur (Section IV.A.3.h.). 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.

A total of 15 structure removals using explosives is estimated for the High Case. Effects from explosive removals of platforms on the topographic features of the Gulf are not expected to impact the biota of the banks.

Conclusion

The High Case 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 would be impacted by operational discharges (i.e., muds and cuttings), and recovery 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

Major contaminant sources along the Gulf Coast include the petrochemical industry, hazardous waste disposal operations, agricultural and livestock farming, manufacturing industry activities, fossil fuel and nuclear power plant operations, pulp and paper mills, commercial and recreational fishing, municipal wastewater treatment, and maritime shipping activities. The coastal portion of the north-central Gulf of Mexico experiences 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.A.5.b.

Water quality in coastal and nearshore areas adjacent to the OCS may be altered by a number of OCS-related activities resulting from proposed Sale 147. These include onshore support facility operations, support vessel traffic, channel construction and maintenance dredging, pipeline emplacements, and onshore disposal of OCS-related oil-field wastes. These activities result in spills and discharges into coastal waters. Spills occurring offshore and reaching coastal waters are also expected to affect water quality. Disturbances of the physical surroundings due to these activities can result in degradation of water quality.

Oil spills constitute one of the most visible forms of pollution. Spills of both crude oil and petroleum products can occur onshore from coastal transport of OCS oil by pipelines and barges, near refineries and storage facilities (terminals), during fuel and bulk transfer operations associated with barge and tanker operations, and from barge and tanker accidents along navigation channels and near terminals. Spills can also occur from offshore operations, especially pipelines, and subsequently reach coastal areas. Significant deterioration of nearshore water quality can occur proximate to a continuous source of oil contamination and would continue until the source is removed. If a slick from an OCS Size 3 oil spill 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. Levels 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 from spills 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 the oil coating the sediments and vegetation might be released into the surrounding water for a much longer time period. Because of this, the impact to coastal water quality from Size 3 spills is expected to result in a disturbance of sufficient severity to degrade localized water quality parameters for up to 10 years after the spill occurs. In the case of Size 1 and Size 2 spills there would be some change in water quality parameters lasting up to 5 years. In both cases, the aerial extent of this contamination is expected to decrease significantly over the expected time period and is dependent on the water proximity to oiled vegetation and sediments.

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 and accidental spills. All existing onshore infrastructure and associated operations will contribute to the degradation of regional coastal 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 during the use of the existing infrastructure and facilities. Effluents from onshore infrastructure are commonly discharged into surface waters after treatment. The degree of environmental damage will be related to the level of contamination in the discharge and the characteristics of the receiving waters. Likewise, runoff from existing OCS facilities can have significant impacts to the surrounding area. Runoff from support facilities is likely to contain oil, 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.

Vessel usage of coastal waters may degrade water quality from bilge and ballast water discharges, discharges of treated sanitary and domestic wastes, wake erosion of channel banks, trash and debris loss, and

spills. Spills are most likely to occur in connection with the offloading and onloading of crude from shuttle tankers and barges and from fueling activities associated with service boat support.

Dredging operations for navigation channel construction and maintenance release sediments into the water column, resulting in short-term, localized impacts. Navigation channels serve as routes for vessel traffic traveling to and from OCS service and supply bases, for barges carrying oil from the OCS to shore or between coastal terminals, and for the transport of new pipelines and platforms to the OCS. Likewise, pipeline excavation and burial techniques disturb bottom sediments and wetland vegetation, and increase turbidity. These activities can result in the resuspension of settled pollutants, heavy metals, and pesticides, if present. Channel and pipeline canal construction can also result in saltwater intrusion into fresher water habitats, which can result in vegetation die off and erosion of soils.

A small portion of the wastes generated from offshore oil and gas exploration and production activities is brought ashore for disposal. These generally include oil-based drilling muds and cuttings, liquid wastes (fracking fluids, emulsifiers, workover fluids, biocides, mud additives, etc.), and production solids. Some of these wastes can be contaminated with naturally occurring radioactive material (NORM), toxic or hazardous compounds, heavy metals, and oil and grease. Once ashore, many of these wastes are transported via barge to adjacent parishes or counties for off-site storage and disposal. Section IV.B.2.c. provides more information on onshore disposal practices. Improper storage of drums or incorrect landfarming or landfilling of these wastes presents a potential for environmental problems, adversely impacting surrounding surface and ground waters and wetland areas. Because of lax disposal requirements, the potential exists for radium-226 and other contaminants to enter both aquatic and terrestrial food chains and groundwater systems. 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 NORM.

Base Case Analysis

The existing onshore infrastructure base in the Central Gulf is expected to be sufficient to support proposed Sale 147 activities, and no new infrastructure will be constructed. Table IV-14 lists 274 facilities expected to support all future OCS operations. The subset that will support Sale 147 activities is not provided. Also, not included in these numbers are the 10 onshore transfer stations and 5 disposal sites used to landfarm wastes generated and brought onshore for disposal (Section IV.B.1.a.(3)(e)). Routine point- and nonpoint-source discharges, non-quantified but characterized in Section IV.B.2.b., and chronic spillage occurring from existing onshore support facilities will continue to impact coastal and nearshore water quality as long as the facilities are in operation. Because the number and types of existing onshore support facilities is expected to remain the same or decline over time (discussed in Section IV.B.1.a.), historical trends in surrounding water quality are assumed to be indicative of future conditions.

Most of the infrastructure that will support Sale 147 is located in Louisiana (Table IV-14), and it is here that historical sediment and water contamination has been documented near these facilities (Louisiana Dept. of Environmental Quality, 1990; Louisiana Dept. of Transportation, 1984). Waters near support facilities have been found to be contaminated with petroleum compounds, heavy metals, NORM, high total suspended sediments and organic carbon, and low dissolved oxygen as a result of inputs from effluent discharges, runoff, and chronic spillage. Such contamination is a result of all oil and gas operations that use the facilities. The percentage utilization of these facilities to support Sale 147 operations is assumed to be very small, about 3 percent of their operating capacities (see Section IV.B.1.a. for individual utilization assumptions). Given this, the proportion of expected future water quality degradation associated with discharges and chronic spills from the use of these facilities for Sale 147 activities would be very small, but will be widespread and continuous, especially in the Mississippi deltaic area of Louisiana where support operations are concentrated.

The improper storage and treatment of OCS-related oil-field waste and contaminated oil-field equipment could adversely impact surface and groundwaters in proximity to disposal facilities, cleaning sites, and scrap yards. Improper operation or maintenance of such facilities have resulted in adverse impacts to surrounding waters, particularly from elevated concentrations of heavy metals, petroleum hydrocarbons, and NORM (Section IV.B.2.c.). Regulatory restrictions have been passed by the State of Louisiana that provide strict

management of oil-field wastes [LAC Title 43: Part XIV (Amendment to Statewide Order No. 29b) and LAC Title 33: Part XV (Regulation and Licensing of Naturally Occurring Radioactive Materials)] to protect worker safety. The oil industry is taking new precautions regarding the storage and disposal of NORM-contaminated drums. Because of new State regulations and industry precautions, no impacts are expected at the four landfarms in Louisiana, one landfarm in Mississippi, and one treatment center in Texas that are projected to receive future OCS wastes (Section IV.B.1.a.(3)(e)) or at any of the pipe cleaning or storage yards. Some impact is expected to occur around a few temporary storage facilities (usually service bases) due to human error. However, historical contamination conditions are not indicative of future trends and will greatly improve over time despite continued oil-field waste disposal operations.

Approximately 8,400 service-vessel trips and 197 barge trips are estimated to result from proposed sale-related activities (Table IV-18). Eighteen navigation channels, 12 located in Louisiana, will be used to various degrees. The Calcasieu Ship Channel to Cameron (LA-1), Atchafalaya River waterway to Morgan City (LA-2), Freshwater Bayou to Intracoastal City (LA-1), and Mississippi River passes (particularly the reach to Venice) (LA-3) are expected to receive the bulk of sale-related support vessel trips in the CPA (Table IV-18). In addition to barge trips to and from platforms, about 18 percent of the barge traffic carrying oil from terminals to other terminals or refineries is expected to be OCS-related (less than 1% of this will be linked to oil movement resulting from Sale 147 activities) (Section IV.B.1.b.(2)). All of these vessel operations are expected to result in bilge and ballast water discharges, bank erosion, and spills.

About 2.6 million liters of bilge water are estimated to be discharged over the 35-year analysis period (peak year 166,000 liters) (Table IV-13) into the waters of the 18 navigation channels projected to be used for service vessel traffic, especially into the four channels receiving the bulk of sale-related traffic. Operational discharges from barge operations are not quantified. If one assumes that 80 percent of these discharges will occur in the estimated 811 km of confined channels in the CPA (Section IV.B.1.b.(4)), there will be about 160 liters discharged per km of channel, during the peak year, or about a half a liter per km per day. Bilge waters can contain petroleum and metallic compounds leaked from machinery. New MARPOL regulations severely restricting the levels of oil and grease in bilge water discharges in coastal areas (40 CFR 110) should diminish the types of impacts that have been historically noted from such discharges.

Channel bank erosion from vessel traffic may also add to water-quality degradation. It is estimated that 2.4 ha of sediments will erode from canals, bayous, and river banks due to the approximately 8,600 service vessel and barge trips estimated to occur from the sale. This erosion averages 0.068 ha per year for the 811 km of confined channels or 0.002 m² per day per km of canal and will cause increased turbidity and resuspension of contaminants from sediments.

Balancing the acute impacts that are projected to result from (1) the small levels of contaminants resulting from 0.002 m² of sediment input per day per km of channel from bank erosion and 0.5 liters of bilge water input per km per day, (2) decreased contaminant levels due to new restrictions on discharge contaminants, and (3) the assimilative capacity of water bodies, with the long-term, continuous nature of the discharges, it is expected that there will be minor, localized, long-term changes in water quality in the confined portions of the channels identified above.

No new channel dredging is projected in support of Sale 147 operations. Dredging activities associated with maintenance of the 18 channels that support service vessel traffic (discussed in Section IV.B.1.b.) are expected to occur every two years and will result in localized impacts (primarily increased turbidity) occurring over the duration of the activities (up to several months). In addition, Pass Fourchon will be deepened to support OCS activities. Three percent of this activity will be attributable to leases resulting from the proposed action. The 37 expected dredging operations will preclude some recreational and commercial uses within the immediate area. The periods between expected dredging operations will generally allow for the recovery of affected areas. Impacts from dredging are expected to be somewhat higher near the mouths of major rivers where sediment quantities are greater.

Spills can occur from both offshore and onshore operations. Section IV.A.3.h.(2) and Table IV-10 show that offshore spills are not likely to contact land and therefore are not expected to cause impacts to coastal water quality. Onshore spills projected to occur from barge and pipeline operations (Section IV.B.2.d.(1)), and near refineries and terminals, will cause some water quality degradation. Size 1 spills related to the proposed action (estimated at 1 per year in Louisiana) will occur more frequently than a larger spills but are more likely

to be contained at facilities within the Spill Prevention Control and Countermeasure (SPCC) levee systems. Within these confined water bodies, background water quality conditions will return to normal in 6 weeks for spills 1 bbl or less, and in 6 months for spills less than 50 bbl. Two Size 2 spills estimated at 500 bbl each are projected to occur also (Section IV.B.2.d.(1)). It is assumed that these two spills will occur outside of the facility catch systems and will enter coastal waters. As discussed above, in shallow, low-energy areas, oil may become entrained in suspended particles and bottom sediments and be subsequently reintroduced into the water column, thereby resulting in longer-term effects. In Section IV.B.2.d.(1), each spill this size is assumed to affect up to 27 ha of marsh and to cause changes in water quality for up to 5 years. Applying this acreage, onshore spills associated with Sale 147 operations will result in low-level hydrocarbon contamination of coastal waters affecting localized, confined areas for up to 6 months in 11 locations and up to 6 weeks in 26 locations along the Louisiana coast, and will persist for up to 5 years in 54 ha of marsh.

Summary

Expected future water-quality degradation associated with discharges and chronic spills from the use of onshore infrastructure supporting Sale 147 operations will be very minor but will be widespread and continuous, especially in the Mississippi deltaic area of Louisiana where support facilities are concentrated. Onshore disposal and storage of offshore operational wastes will only result in some minor localized degradation around a few temporary storage sites in Louisiana. There will be minor, localized, long-term changes in water quality characteristics in the confined portions of the 18 channels identified above due to bank erosion and bilge and sanitary wastes discharges associated with vessel traffic operations. Thirty-seven maintenance or deepening dredging operations will result in localized impacts (primarily increased turbidity) during the duration of the operations (up to several months). Low-level hydrocarbon contamination of coastal waters will occur from onshore spills associated with Sale 147 operations and will affect localized, confined areas for up to 6 months in 11 locations and up to 6 weeks in 26 locations along the Louisiana coast, and will persist up to 5 years in 2 locations along the coast affecting 54 ha of marsh waters.

Conclusion

The proposed action will result in minor, localized, long-term changes in water quality within, or in the vicinity of, navigation channels and support complexes. These changes will not preclude current uses of the waters affected. The proposed action will also result in localized short-term changes in water quality during dredging operations or from most spill occurrences, which will alter uses of the affected waters for up to 6 months. Two spill incidents may affect water quality in the Louisiana marsh for up to 5 years.

High Case Analysis

As indicated in the Base Case, the existing onshore infrastructure base in the Central Gulf is expected to be sufficient to support proposed Sale 147 activities, and no new infrastructure will be constructed. Table IV-14 lists 274 facilities expected to support all future OCS operations. The subset that will support Sale 147 activities is not provided. Also, not included in these numbers are the 10 onshore transfer stations and 5 disposal sites used to landfarm wastes generated and brought onshore for disposal (Section IV.B.1.a.(3)(e)). Routine point- and nonpoint-source discharges, nonquantified but characterized in Section IV.B.2.b., and chronic spillage occurring from these existing onshore support facilities will continue to impact coastal and nearshore water quality as long as the facilities are in operation. Because the number and types of existing onshore support facilities is expected to remain the same or decline over time (discussed in Section IV.B.1.a.), historical trends in surrounding water quality are assumed to be indicative of future conditions.

Most of the infrastructure that will support Sale 147 is located in Louisiana (Table IV-14), and it is here that historical sediment and water contamination has been documented near these facilities (Louisiana Dept. of Environmental Quality, 1990; Louisiana Dept. of Transportation, 1984). Waters near support facilities have been found to be contaminated with petroleum compounds, heavy metals, NORM, high total suspended sediments and organic carbon, and low dissolved oxygen as a result of input from effluent discharges, runoff,

and chronic spillage. Such contamination is a result of all oil and gas operations that use the facilities. The percentage utilization of these facilities to support Sale 147 operations is assumed to be very small, about 3 percent of their operating capacities (see Section IV.B.1.a. for individual utilization assumptions). Given this, the proportion of expected future water quality degradation associated with discharges and chronic spills from the use of these facilities for Sale 147 activities would be very small, but will be widespread and continuous, especially in the Mississippi deltaic area of Louisiana where support operations are concentrated.

The improper storage and treatment of OCS-related oil-field waste and contaminated oil-field equipment could adversely impact surface and groundwaters in proximity to disposal facilities, cleaning sites, and scrap yards. Improper operation or maintenance of such facilities have resulted in adverse impacts to surrounding waters, particularly from elevated concentrations of heavy metals, petroleum hydrocarbons, and NORM (Section IV.B.2.c.). Regulatory restrictions have been passed by the State of Louisiana that provide strict management of oil-field wastes [LAC Title 43: Part XIV (Amendment to Statewide Order No. 29b) and LAC Title 33: Part XV (Regulation and Licensing of Naturally Occurring Radioactive Materials)] to protect worker safety. The oil industry is taking new precautions regarding the storage and disposal of NORM-contaminated drums. Because of new State regulations and industry precautions, no impacts are expected at the four landfills in Louisiana, one landfill in Mississippi, and one treatment center in Texas that are projected to receive future OCS wastes (Section IV.B.1.a.(3)(e)) or any of the pipe cleaning or storage yards. Some impact is expected to occur around a few temporary storage facilities (usually service bases) due to human error. However, historical contamination conditions are not indicative of future trends and will greatly improve over time despite continued oil-field waste disposal operations.

A total of 18,780 service-vessel trips and 442 barge trips are estimated to result from proposed sale-related activities (Table IV-18). Eighteen navigation channels, 12 located in Louisiana, will be used to various degrees. The Calcasieu Ship Channel to Cameron (LA-1), Atchafalaya River waterway to Morgan City (LA-2), Freshwater Bayou to Intracoastal City (LA-1), and Mississippi River passes (particularly the reach to Venice) (LA-3) are expected to receive the bulk of sale-related support vessel trips in the CPA (Table IV-18). In addition to barge trips to and from platforms, about 18 percent of the barge traffic carrying oil from terminals to other terminals or refineries is expected to be OCS-related (less than 1% of this will be linked to oil movement resulting from Sale 147 activities) (Section IV.B.1.b.(2)). All of these vessel operations are expected to result in bilge and ballast water discharges, bank erosion, and spills.

About 5.9 million liters of bilge water are estimated to be discharged over the 35-year analysis period (peak year 166,000 liters) (Table IV-13) into the waters of the 18 navigation channels projected to be used for service vessel traffic, especially into the four channels receiving the bulk of sale-related traffic. Operational discharges from barge operations are not quantified. If one assumes that 80 percent of these discharges will occur in the estimated 811 km of confined channels in the CPA (Section IV.B.1.b.(4)), there will be about 450 liters discharged per km of channel during the peak year, or about 1.2 liters/km/day. Bilge waters can contain petroleum and metallic compounds leaked from machinery. New 'ARPOL regulations severely restricting the levels of oil and grease in bilge water discharges in coastal areas (40 CFR 110) should diminish the types of impacts that have been noted historically from such discharges.

Channel bank erosion from vessel traffic may also add to water quality degradation. It is estimated that 4.8 ha will erode from canals, bayous, and river banks due to the approximately 19,200 service-vessel and barge trips estimated to occur from the sale. This averages 0.136 ha per year for the 811 km of confined channels or 0.005 m² per day per km of canal and cause increased turbidity and resuspension of contaminants from sediments.

Balancing the acute impacts that are projected to result from (a) the small levels of contaminants resulting from 0.005 m² of sediment input per day per km of channel from bank erosion and 1.2 liters of bilge water input per km per day, (b) decreased contaminant levels due to new restrictions on discharge contaminants, and (c) the assimilative capacity of water bodies, with the long-term, continuous nature of the discharges, it is expected that there will be minor, localized, long-term changes in water quality in the confined portions of the channels identified above.

No new channel dredging is projected in support of Sale 147 operations. Dredging activities associated with maintenance of the 18 channels that support service-vessel traffic (Section IV.B.1.b.) are expected to occur every two years and will result in localized impacts (primarily increased turbidity) occurring over the duration

of the activities (up to several months). In addition, Pass Fourchon will be deepened to support OCS activities. Six percent of this activity will be attributable to operations resulting from the proposed action under the High Case. The 37 expected dredging operations will preclude some recreational and commercial uses within the immediate area. The periods between expected dredging operations will generally allow for the recovery of affected areas. Impacts from dredging are expected to be somewhat higher near the mouths of major rivers where sediment quantities are greater.

Spills can occur from both offshore and onshore operations. Section IV.A.3.h.(2) and Table IV-10 show only one Size 2 offshore spill is likely to contact land; therefore, offshore spillage is not expected to contribute significantly to changes in water quality. Onshore spills projected to occur from barge and pipeline operations (Section IV.B.2.d.(1)), and near refineries and terminals, will cause some water quality degradation. Size 1 spills related to the proposed action (estimated at 2 per year in Louisiana) will occur more frequently than Size 2 and Size 3 spills but are more likely to be contained at facilities within the SPCC spill prevention levee systems. Within these confined water bodies, background water quality conditions will return to normal in 6 weeks for spills 1 bbl or less, and in 6 months for Size 1 spills. Four Size 2 spills estimated at 500 bbl each are projected to occur also (Section IV.B.2.d.(1)). It is assumed that these four spills will occur outside of the facility catch systems and will enter coastal waters. As discussed above, in shallow, low-energy areas, oil may become entrained in suspended particles and bottom sediments and be subsequently reintroduced into the water column, thereby resulting in longer-term effects. In Section IV.B.2.d.(1), each spill this size is assumed to affect up to 27 ha of marsh and to cause changes in water quality for up to 5 years. Applying this acreage, low-level hydrocarbon contamination of coastal waters will occur from onshore spills associated with Sale 147 High Case operations and will affect localized, confined areas for up to 6 months in 22 locations and for up to 6 weeks in 52 locations along the Louisiana coast, and will persist for up to 5 years in 108 ha of marsh.

Expected future water-quality degradation associated with discharges and chronic spills from the use of onshore infrastructure supporting Sale 147 operations under the High Case will be very minor but will be widespread and continuous, especially in the Mississippi deltaic area of Louisiana where support facilities are concentrated. Onshore disposal and storage of offshore operational wastes will only result in some minor localized degradation around a few temporary storage sites in Louisiana. There will be minor, localized, long-term changes in water quality characteristics in the confined portions of the 18 channels identified above due to bank erosion and bilge and sanitary wastes discharges associated with vessel traffic operations. Thirty-seven maintenance or deepening dredging operations will result in localized impacts (primarily increased turbidity) during the duration of the operation (up to several months). Low-level hydrocarbon contamination of coastal waters will occur from onshore spills associated with Sale 147 operations and will affect localized, confined areas for up to 6 months in 22 locations and up to 6 weeks in 56 locations along the Louisiana coast, and will persist up to 5 years in 4 locations along the coast affecting 108 ha of marsh waters.

Conclusion

The High Case will result in minor, localized, long-term changes in water quality within, or in the vicinity of, navigation channels and support complexes. These changes will not preclude current uses of the waters affected. The proposed action will also result in localized short-term changes in water quality during dredging operations or from most spill occurrences, which will alter uses of the affected waters for up to 6 months. Four spill incidents may affect water quality in Louisiana marshes for up to 5 years.

Marine Waters

The Gulf of Mexico is a semi-enclosed water body with oceanic inputs through the Yucatan Channel and with principal outflow through the Straits of Florida. Section III.A.5.a. describes the chemical oceanography of the Gulf. The Mississippi River, as well as the many 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, mixing into the surface water of the northwestern Gulf and making 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. The method of disposal into the environment, the mixing of the wastes through turbulence and large-scale currents, and the chemical properties of each source will influence a substance's distribution within the Gulf. The residence of contaminants within bottom sediments is usually indicative of episodic or chronic water contamination and will be discussed when appropriate.

Potential impact-producing factors that may lead to water quality degradation and that result from offshore OCS oil and gas operations include the resuspension of bottom sediments through platform and pipeline emplacement and removal, operational wastes discharged overboard, and accidental spills, blowouts, or pipeline leaks. These factors are more thoroughly discussed in Section IV.A.3.

Emplacement and removal of platforms and pipelines increase water-column turbidity by resuspending bottom sediments. Impacts to water quality from two platform emplacements were studied off California (Arthur D. Little, Inc., 1985). During the installation of the offshore platforms, sediment disturbance and suspension resulted from pile driving and anchoring when foundations for the production platforms were prepared. The operations produced localized, temporary impacts on water quality conditions in the immediate vicinity of the platforms.

In addition to 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. Gaseous products form spherical bubbles that rise to the surface, resulting in the ejection of most of the gases into the atmosphere (USDOL MMS, 1987a).

Contaminants from vessels transporting oil or supplies to and from offshore platforms can enter the Gulf through routine operational discharges or accidental spills. Service vessels routinely discharge sanitary and domestic wastes and bilge and ballast waters. Shuttle tankers only discharge sanitary and domestic wastes; bilge waters are taken to onshore receptacles.

Oil spills present a threat to the water quality of any area contacted by the oil. Wind and currents would rapidly disperse oil released on the surface. Section IV.C.2. of the Final EIS 142 and 143 (USDOL, MMS, 1992b) provides an in-depth discussion on the fate of spilled oil.

The OCS oil and gas industry routinely generates and discharges into open waters a number of wastes that have the potential for degradation of the marine water quality. Section IV.A.3.d. describes these wastes and their major contaminants in substantial detail. There are two USEPA regulatory processes, which are almost completed, that will affect the way the OCS oil and gas industry disposes of their wastes. Recently, USEPA, Region 6, partially reissued their general NPDES permit for the Gulf of Mexico. Simultaneously, the Washington Office of USEPA is in the process of promulgating standards of performance for new sources and new effluent limitations guidelines for existing sources; these standards are expected to be finalized in early February. Once the effluent limitations are promulgated, the recently issued NPDES permit will be modified to incorporate these more stringent standards.

The current general NPDES permit for oil and gas operations in the Western Gulf of Mexico OCS was issued on November 19, 1992. Significant new requirements found in this permit include monitoring for toxicity, bioaccumulation, and naturally occurring radioactive material levels in produced-water effluents and fish tissue, and restrictions on the levels of mercury and cadmium in the barite used in drilling fluids. Once the effluent limitations are incorporated into the permit, industry will have to meet more stringent restrictions that include decreases in the allowable limits of oil and grease in produced waters and production well fluids, the use of the static sheen test to determine the presence of free oil rather than visual observation, and a prohibition on the discharge of produced sands.

The discharge of treated sanitary and domestic wastes and deck drainage from rigs, platforms, and support vessels may increase suspended solids, nutrients, chlorine, and biological oxygen demand (BOD) in a small area near the point of discharge. The constituents of these waste streams are quickly diluted, however, when discharged into the open Gulf. It is assumed if operators adhere to conditions in the new NPDES permit or USCG regulations for these wastes, such discharges are rapidly assimilated and dispersed and will be evaluated no further. No impacts are expected to occur from these and other minor discharges.

Impacts to water quality from OCS waste streams occur primarily through the discharge of drilling fluids, cuttings, and produced water. This document will address the impacts to water quality only as it occurs in

association with these waste streams. These wastes form the vast majority of effluent discharge volumes from oil and gas development and production facilities and have been identified as having significant potential for producing adverse environmental effects due to their toxicities (USEPA, 1993).

The effect of the discharge of drilling muds and cuttings on water quality is dependent on the direction and dispersion of the plume created during the discharge. The direction of ocean currents determines the predominant location of the potential impacts, while current speed influences the extent of the area affected. Continuous discharges occur during the entire drilling phase. Bulk discharges at high rates of discharge (500-1,000 bbl/hr) and lasting for a period of 20 minutes to 3 hours (Petrizzuolo, 1981; Avanti Corporation, 1992) may take place once or twice during the drilling of a well. The physical fate of drilling discharges has been the subject of considerable study (e.g., NRC, 1983; Avanti Corporation, 1992; Neff, 1981; Petrizzuolo, 1981; Menzie, 1983; Ecomar, Inc., 1980). When discharged into the surrounding offshore waters, drilling muds create turbidity plumes several hundred meters to 3,000 m in length. At a discharge rate of 1,000 bbl/hr and a current speed of 10 cm/s, dilution of the plume contaminants at 100 m was 400 fold and dispersion was close to a 1,600-fold decrease from levels at the discharge point (Avanti Corporation, 1992).

Elevated levels of metals, primarily barium (Ba) and chromium (Cr), in sediments near rigs and platforms occur from drilling fluid and cuttings discharges. Other metals with elevated concentrations around rigs include arsenic, cadmium, copper, mercury, nickel, lead, vanadium, and zinc. Sediment enrichment seldom exceeds a factor of 10, with the exception of Ba and Cr, which have had enrichment factors of up to 300 and 36, respectively (Avanti Corporation, 1992). Levels of Ba and Cr in barite are now limited by the new NPDES permit, and it is assumed that limiting these concentrations in the source barite will decrease historical sediment contamination noted. Metals are generally distributed to 200-500 m around a platform, although significant Ba enrichment has been found out to 1,000-3,000 m down current from the discharge plume (Boothe and Presley, 1985). In general, drilling discharges are mobile and can spread out over a large area (greater than 3 km) on time scales of about a year.

Acute laboratory toxicity tests of whole drilling fluids and produced water have generally shown low toxicities or limited bioavailability to marine organisms. Petrizzuolo (1983), testing 68 muds and 70 species, found that only 1-2 percent had LC₅₀'s ranging from 100 to 999 ppm (the range of toxicities for priority pollutants). Some of the additives of drilling fluids have been shown to be more toxic (NRC, 1983). Although the new NPDES permit and effluent limitations will reduce the number of exceedances of water quality criteria/toxic values from previous measurements, the USEPA still projects some future exceedances (Avanti Corporation, 1992). Using models of a projected typical plume, the USEPA determined that, at the 100-m mixing zone, 4 of the 11 metals will be above Federal water quality criteria (As, Cr, Cu, Hg). Future OCS drilling mud discharges will exceed current water quality criteria twice in the water column and from 3-9 times in sediment pore water (depending on the number of wells drilled) (USEPA, 1993). Beyond 200-500 m from the discharge point, concentrations of contaminants in drilling muds will generally fall below the toxicity limits (USEPA, 1993).

Produced water constitutes the largest single source of materials discharged into the Gulf during normal oil and gas operations. The effects of produced water are difficult to separate out from the other production-related discharges occurring during the life of a field. There is limited data on acute toxicities of produced waters. Testing associated with the Buccaneer Field study found acute toxicities of produced waters ranged from 8,000 to 154,000 ppm for invertebrates and 7,000 to 208,000 for vertebrates (Rose and Ward, 1981). Using modeling, 3 of the 21 pollutants identified in produced waters will fail to meet water quality criteria at the 100-m mixing zone (anthracene, fluorene, phenanthrene) (Avanti Corporation, 1992). Chronic lethal and sublethal effects of produced waters are occurring in some low energy area where the hydrocarbons are not rapidly being removed from the system and where there is a continuous input (Armstrong et al., 1979). Discharges of produced water are continuous discharges creating a potential for longer exposure periods for platform-associated organisms located near the outfall (Avanti Corporation, 1992). Numerous studies showed that hydrocarbons discharged with produced waters are bioaccumulated. Low levels of alkylated benzenes, naphthalenes, alkylated naphthalenes, phenanthrene, alkylated three-ring aromatics, and pyrene were found in various fish and epifauna (Avanti Corporation, 1992).

A number of studies have investigated the fate and effects of OCS discharges around production platforms in marine waters. Major studies have included the Offshore Ecology Investigation in Louisiana Waters

conducted by the Gulf Universities Research Consortium (Ward et al., 1979); the Central Gulf Platform Study of the continental shelf off Louisiana conducted by the Southwest Research Institute (Bedinger, 1981); the Buccaneer Field Study conducted off Galveston, Texas, by the National Marine Fisheries Service (Middleditch, 1981); the Produced Water Study conducted by Batelle for the American Petroleum Institute (Neff et al., 1989); and three studies that focused on estuarine and nearshore Louisiana waters (Boesch and Rabalais, 1989a and b; Rabalais et al., 1991). The three studies conducted prior to 1989 have all been heavily reviewed and critiqued (USDOL, MMS, 1990b). Interpretation of the study results must factor in these criticisms and the fact that water depths in all five studies are less than the average depth of platform locations projected in the future.

In general, the studies showed that only within localized areas around platforms could biological effects and contaminant levels in sediments be directly linked to platform discharges. The broad areas studied were often characterized as contaminated with pollutants. Although some implicated the Mississippi River as the probable source (Bedinger, 1981); others attributed it to the oil and gas industry. Neff et al. (1989) found barium present in sediments in his entire study area at concentrations substantially higher than expected of clean sediments. Neff projected that the excess barium may have been from areawide platform discharges of barium-laden drilling muds and produced waters. In two reports (Brooks, 1979; Brooks et al., 1977), Brooks concluded that produced waters are an important source of light petroleum hydrocarbon contamination in Texas-Louisiana shelf waters, particularly large amounts of low-boiling aromatics such as benzene and toluene. Most recently, the shelf was characterized as potentially being contaminated with low-level NORM from produced water and sand discharges (Randolph et al., 1992).

The following summarizes the expected fate and effects of routine, operational waste discharges occurring from exploration, development, and production offshore:

- (a) Moderate petroleum and metal contamination of sediments and the water column will occur around production platforms generally out several hundred meters, particularly in very shallow, inner shelf areas. Discharges of drilling fluids and drill cuttings can exist in sediments out to several thousand meters from OCS rigs (Booth and Presley, 1985) up to 1 year after the drilling operation on a production platform ceases.
- (b) Small magnitude, localized effects on benthic marine organisms in proximity to OCS rigs and platforms are expected to occur, usually extending out to 200-500 m away from the structure, but can exist within 1,000 m during the discharge of drilling fluids and cuttings. Benthic effects have been detected as long as 5 years after the discharge ceases in shallow low-energy areas.
- (c) Both drilling fluids and produced-water components are rapidly diluted in the water column, are not significantly soluble, and are not expected to produce adverse effects to water-column organisms (Avanti Corporation, 1992). Any direct impacts to fisheries around offshore platforms on the OCS are expected to be relatively localized and short-term.
- (d) In open ocean conditions, the factors that enhance local dispersion also contribute to regional-scale, low-level contamination. Historical operations in the Gulf associated with the OCS oil and gas industry have contributed to some cumulative, regional contamination of waters and sediments on the Central Gulf of Mexico shelf, primarily from barium, low-boiling aromatic hydrocarbons, and radium. These concentrations have not been shown to be resulting in any regional impacts on the Gulf's biology.

Base Case Analysis

Table IV-2 indicates that 130 exploration and delineation wells, 220 development wells, 20 platforms, and 515 km of pipeline supporting Sale 147 operations will be installed. Eight of these platforms will be removed explosively during the 35-year analysis period. None of the pipelines are projected for removal.

The drilling of the wells, construction of the platforms, and laying of the pipe will result in increased water-column turbidity in overlying offshore waters. Using average rig and platform sizes, the total bottom area disturbed by the pile-driving, anchoring, or dredging needed for the temporary presence of rigs during drilling and by all pipeline and platform installation operations is estimated at 165 ha. For those pipelines laid in water depths shallower than 61 m, burial below the seafloor is required. Pipeline burial activities will result in the resuspension of some 523,000 m³ of sediment during the installation of 105 km of pipelines in water depths of 61 m and less. Offshore Subareas C-1 and C-3 are the only subareas where burial will take place (Table IV-2). Bottom disturbance of sediments will result in resuspension of any settled pollutants, such as trace metals, chlorinated hydrocarbons, and excess nutrients, that may have accumulated in the sediments. Major sources of these contaminants are both coastal or land-based, and sediment contamination is a function of distance from shore. Examination of the extent of these operations in each subarea (Table IV-2) indicates that the vast majority of the activities projected for Sale 147 will occur at a substantial distance from shore, and therefore, the sediments are not as likely to be contaminated. The resuspension of significant quantities of contaminants from bottom disturbances is not expected to occur. Furthermore, activities resulting in suspension of offshore sediments will occur very infrequently. Looking at peak-year estimates for Subareas C-1 and C-2, the two subareas nearest to the shore, no more than five wells will be drilled, one platform installed, and 5 km of pipeline laid. Such levels of activity are similar to the level of operations examined in a study researching water quality effects from platform installation discussed above (Arthur D. Little, Inc., 1985). The conclusion of the study can therefore be applied to Sale 147 installation operations. Sediment disturbance and resuspension resulting from pile-driving and anchoring and associated dredging from the emplacement of 20 platforms and 515 km of pipelines and the drilling of 350 wells over a 35-year period will result in minor, localized, temporary impacts on water quality.

In addition to increasing 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. Explosive removal operations related to Sale 147 will occur very infrequently. No more than three platforms per year will be removed (Section IV.A.2.a.(4)), and it is likely that not all of these will be removed explosively. The consensus of research on explosive removals is that resuspension of sediments has only a short-term local effect of a very limited nature. Given the frequency of occurrence, minimum impacts on water quality are expected from these operations.

Historically, most oil spills have impacted water quality during the life of the spill and for a short time afterwards (Neff et al., 1989). Most of the components of oil are insoluble in water, and most of the spilled oil floats. A number of weathering processes act on an oil spill to remove oil from the water column and surface of the water within several months (Neff, 1990a). Section IV.C.2. of the Final EIS for Sales 142 and 143 (USDOL, MMS, 1992b) provides more detail on weathering processes. The frequency of occurrence and the area of contact of spilled oil are the major factors determining water quality degradation. Section IV.B.2.d.(1) provides projections on spill occurrence, average size of each spill, and the areal coverage of projected spills. One subsurface 6,500-bbl spill, 1 Size 2 spill, and 18 Size 1 spills are projected. In addition, 9 spills of diesel and oil-based drilling muds are assumed to occur offshore from platforms. The maximum slick area is projected to be about 1 million m² (Section IV.A.3.h.(2)) for the 6,500-bbl spill. Given the infrequent nature of these spills, especially for the larger size categories, impacts on offshore water quality from oil-spill events related to Sale 147 are projected to be negligible, to be of short-duration (2-3 months), and to affect only a small area of offshore waters at any one time.

About 2.3 MMbbl of drilling fluids and 707,000 bbl of drilling cuttings will be discharged from the drilling of 130 exploratory wells and 220 development wells (Table IV-2). The exploratory wells will be drilled over a 10-year period, the peak number in any one year being 20 (Table IV-2). About three exploratory wells will be drilled per lease, and the discharge from each well will last for approximately 40 days. The development wells will be drilled throughout the 23-year period, with 10 wells being drilled in the peak year. As wells

become depleted during production, new wells will be drilled from the platform. On the average, about 14 wells are typically drilled from each platform, and 12 of these wells will go into production (Section IV.A.2.). The discharge from each well will last for approximately 35 days. If the development wells are all drilled immediately, a maximum number of wells in any one year from any one platform will be nine. Applying information on discharge quantities to the above scenario, it is possible that the area around any of the 20 projected platforms can be contaminated from the discharge of 36,000 bbl of drilling discharges continuously for about a year and a half (assuming 3 exploratory wells and 9 development wells were drilled at one site) and then intermittently afterwards when old wells become depleted and new wells are drilled. These quantities are consistent with the level and frequency of discharges studied historically. The introductory section of this analysis summarizes known impacts from past discharges. The same levels and types of impacts are expected to result from these future discharges. In general, discharges of drilling wastes will affect an area several thousand meters around a platform. Sediment contamination can be expected out to 3 km from the discharge point in the direction of the primary flow and will last up to 1 year after drilling ceases. Benthic marine organisms will be affected out to 1,000 m. Water quality criteria may be exceeded twice within 100 m from the discharge; sediment-pore water quality criteria will be exceeded 3-9 times.

Approximately 243 MMbbl of produced water will be discharged from one-half the projected platforms (10) over a 32-year time period. (It is assumed that about 50% of the 20 projected platforms will treat their water; the other 50% will pipe their water to platforms equipped with three-phase separators; and no new platforms will ship their production wastes to existing platforms.) These quantities are consistent with historical operations, for the most part, and it is expected that historical impacts summarized above will be applicable. Moderate petroleum and metal contamination of sediments and water column will occur out to several hundred meters around 10 platforms and will have small-scale, localized effects on benthic organisms out to 200-500 m.

Two exceptions to the application of historical impact data for predicting future impacts are projections of future impacts from oil and grease and NORM contamination in wastes discharged. The new NPDES permit and effluent limitations will significantly decrease the quantities of oil and grease in produced-water effluents. It is expected, therefore, that levels of petroleum compounds measured in the water column and sediments around the 10 production platforms will be decreased from historical levels.

Most importantly, very little is known about the impacts of NORM in produced water. There have been no historical studies determining what impacts may be occurring. Toxic effects have not been noted in laboratory tests of the toxicities of whole produced-water effluents (Avanti Corporation, 1993). There is very limited data available on the bioaccumulation and sublethal effects of NORM in produced-water discharges. Levels of radionuclides in produced waters are projected by USEPA (based on a small data set) to be about 0.2 lb of radium/Bbbl of produced-water effluent. For the proposed action, therefore, about 0.04 lb of radium will be released into the water column over the production life of the 10 platforms discharging produced water.

The USEPA addresses why they continue to allow discharges of produced waters containing NORM and not set standards. They believe there is not enough information to conclude that radionuclides are a pollutant of concern. The USEPA has the authority under Sections 304(b)(2)(A) and 306(b)(1)(B) of the Clean Water Act to exclude certain pollutants from regulation and have exercised this authority to not set limits on NORM. The USEPA states in their recent effluent limitation regulations (40 CFR 435), which are not yet published, that "while the agency recognizes that it needs additional information concerning radionuclides in produced water effluent . . . and intend to seek such information through monitoring requirements (now imposed in the general permit), EPA believes that without this information, regulation of the entire offshore subcategory is likely to impose unnecessary regulation on a significant number of facilities."

The contribution of operational discharges related to Sale 147 to regional, chronic water-column degradation and sediment contamination must be considered. Activities resulting from Sale 147 will make up about 3 percent of all future OCS oil and gas industry-related operations. If, for analytical purposes, an assumption is made that regional water quality degradation by the OCS industry makes up 50 percent of the total contamination that occurs, then discharges from Sale 147 operations would contribute a little more than 1 percent of the cumulative contamination (Section IV.D.1.d.).

Summary

Sediment disturbance from the emplacement of 20 platforms and 515 km of pipeline and from the drilling of 350 wells over a 35-year period will result in minor, localized, temporary impacts on water quality. The drilling of the wells, construction of the platforms, and laying of the pipe will result in increased water column turbidities in offshore waters. Such bottom disturbance of sediments will result in resuspension of any settled pollutants, such as trace metals, chlorinated hydrocarbons, and excess nutrients, that may have accumulated in the sediments. The resuspension of significant quantities of contaminants from bottom-disturbance operations is not expected to occur due to a lack of contaminants in deep-water sediments and the infrequency of the operations. Given the low frequency of platform removals (maximum is three in the peak year), minimum impacts on water quality due to resuspension of sediments, especially resulting from explosive removals, are expected from these operations.

One 6,500-bbl spill, 1 Size 2 oil spill, and 18 Size 1 spills are projected. Given the infrequent nature of these spills, especially the larger sizes, impacts on offshore water quality from oil-spill events related to Sale 147 are projected to be negligible, to be of short-duration (2-3 months), and to only affect a small area of offshore waters at any one time.

The area around each of the 20 projected platforms can be contaminated from the discharge of 36,000 bbl of drilling muds and cuttings at each site. These discharges may be released continuously for about a year and a half (assuming 3 exploratory wells and 9 development wells were drilled at one site) and then other quantities discharged intermittently when old wells become depleted and new wells are drilled. These discharges of drilling wastes will affect an area several thousand meters around a platform. Sediment contamination can be expected out to 3 km from the discharge point in the primary direction of the current and will last up to 1 year after drilling ceases. Benthic marine organisms will be affected out to 1,000 m. Water quality criteria are expected to be exceeded within 100 m from the discharge. Moderate petroleum and metal contamination of sediments and water column from the discharge of 243 MMbbl of produced water at 10 platforms will occur out to several hundred meters from the discharge point and will have small-scale, localized effects on benthic organisms out to 200-500 m. If, for analytical purposes, an assumption is made that the regional, long term contamination of Gulf waters and sediments by the OCS industry makes up 50 percent of the total water quality degradation that occurs, then discharges from Sale 147 operations would contribute a little more than 1 percent of the Gulf water quality cumulative contamination (Section IV.D.1.d.).

Conclusion

As a result of the proposed action, marine waters will be degraded from discharges, oil spills, and bottom disturbances. Bottom disturbances (platform and pipeline emplacements and removals) and oil spills are expected to result in minor, localized, temporary impacts to water quality. Changes in water quality parameters will return to background within months from the disturbance. Operational discharges are primarily muds and cuttings and produced waters. Drilling muds and cuttings, which are discharged intermittently throughout the life of a platform, are expected to contaminate a localized area around platforms out to 3,000 m for up to 1 year after drilling ceases. Production wastes, which are discharged continuously throughout the life of most of the platforms, will change some water quality and sediment parameters within several hundred meters downcurrent from the discharge point for an average of 20 years. These discharges will also contribute, to a very small extent, to the long-term, regional contamination of Gulf waters and sediments.

High Case Analysis

Table IV-2 indicates that 290 exploration and delineation wells, 450 development wells, 50 platforms, and 921 km of pipeline supporting Sale 147 operations will be installed. Fifteen of these platforms will be removed explosively during the 35-year analysis period. None of the pipelines are projected for removal.

The drilling of the wells, construction of the platforms, and laying of the pipe will result in increased water-column turbidity in overlying offshore waters. Using average rig and platform sizes, the total bottom area disturbed by the pile-driving, anchoring, or dredging needed for the temporary presence of rigs during drilling

and by all pipeline and platform installation operations is estimated at 363 ha. For those pipelines laid in water depths shallower than 61 m, burial below the seafloor is required. Pipeline burial activities will result in the resuspension of some 921,000 m³ of sediment during the installation of pipelines in water depths of 61 m and less. Offshore Subareas C-1 and C-3 are the only subareas where burial will take place (Table IV-2). Bottom disturbance of sediments will result in resuspension of any settled pollutants, such as trace metals, chlorinated hydrocarbons, and excess nutrients, that may have accumulated in the sediments. Major sources of these contaminants are both coastal or land based, and sediment contamination is a function of distance from shore. Examination of the extent of these operations in each subarea (Table IV-2) indicates that the vast majority of the activities projected for Sale 147 will occur at a substantial distance from shore, and therefore, the sediments are not as likely to be contaminated. The resuspension of significant quantities of contaminants from bottom disturbances is not expected to occur. Furthermore, activities resulting in suspension of offshore sediments will occur very infrequently. Looking at peak year estimates for Subareas C-1 and C-2, the two subareas nearest to the shore, no more than 13 wells will be drilled, 1 platform installed, and 8 km of pipeline laid. Such levels of activity are similar to the level of operations examined in a study researching water quality effects from platform installation discussed above (Arthur D. Little, Inc., 1985). The conclusion of the study can therefore be applied to Sale 147 installation operations. Sediment disturbance and resuspension resulting from pile driving and anchoring and associated dredging from the emplacement of 50 platforms and 921 km of pipelines and the drilling of 740 wells over a 35 year period will result in minor, localized, temporary impacts on water quality.

In addition to increasing 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. Explosive removal operations related to Sale 147 will occur very infrequently. No more than 10 platforms per year will be removed (Section IV.A.2.a.(4)), and it is likely that not all of these will be removed explosively. The consensus of research on explosive removals is that resuspension of sediments has only a short-term local effect of a very limited nature. Given the frequency of occurrence, minimum impacts on water quality are expected from these operations.

Historically, most oil spills have impacted water quality during the life of the spill and for a short time afterwards (Neil et al., 1989). Most of the components of oil are insoluble in water, and most of the spilled oil floats. A number of weathering processes act on an oil spill to remove oil from the water column and surface of the water within several months (Neil, 1990a). Section IV.C.2. of the Final EIS for Sales 142 and 143 (USDOL, MMS, 1992b) provides more detail on weathering processes. The frequency of occurrence and the area of contact of spilled oil are the major factors determining water quality degradation. Section IV.B.2.d.(1) provides projections on spill occurrence, average size of each spill, and the areal coverage of projected spills. One subsurface 6,500 bbl spill, 2 Size 2 spills, and 41 Size 1 spills are projected. In addition, 20 spills of diesel and oil based drilling muds are assumed to occur offshore from platforms. The maximum slick area is projected to be about 1 million m² (Section IV.A.3.b.(2)) for the 6,500 bbl spill. Given the infrequent nature of these spills, especially for the larger size categories, impacts on offshore water quality from oil-spill events related to Sale 147 are projected to be negligible, to be of short duration (2-3 months), and to affect only a small area of offshore waters at any one time.

About 4.9 MMbbl of drilling fluids and 1.5 MMbbl of drilling cuttings will be discharged from the drilling of 290 exploratory wells and 450 development wells (Table IV-2). The exploratory wells will be drilled over a 10-year period, the peak number in any one year being 45 (Table IV-2). About three exploratory wells will be drilled per lease, and the discharge from each well will last for approximately 40 days. The development wells will be drilled throughout the 23 year period, with 25 wells being drilled in the peak year. As wells become depleted during production, new wells will be drilled from the platform. On the average, about 14 wells are typically drilled from each platform, and 12 of these wells will go into production (Section IV.A.2.). The discharge from each well will last for approximately 35 days. If the development wells are all drilled immediately, a maximum number of wells in any one year from any one platform will be nine. Applying information on discharge quantities to the above scenario, it is possible that the area around any of the 50 projected platforms can be contaminated from the discharge of 36,000 bbl of drilling discharges continuously for about a year and a half (assuming 3 exploratory wells and 9 development wells were drilled at one site) and then intermittently afterwards when old wells become depleted and new wells are drilled. These quantities

are consistent with the level and frequency of discharges studied historically. The introductory section of this analysis summarizes known impacts from past discharges. The same levels and types of impacts are expected to result from these future discharges. In general, discharges of drilling wastes will affect an area several thousand meters around a platform. Sediment contamination can be expected out to 3 km from the discharge point in the direction of the primary flow and will last up to 1 year after drilling ceases. Benthic marine organisms will be affected out to 1,000 m. Water quality criteria may be exceeded twice within 100 m from the discharge; sediment pore water quality criteria will be exceeded 3-9 times.

Approximately 514 MMbbl of produced water will be discharged from, about one half the projected platforms (25) over a 32-year time period. (It is assumed that about 50% of the projected number platforms will treat their water; the other 50% will pipe their water to platforms equipped with three phase separators; and no new platforms will ship their production wastes to existing platforms.) These quantities are consistent with historical operations, for the most part, and it is expected that historical impacts summarized above will be applicable. Moderate petroleum and metal contamination of sediments and water column will occur out to several hundred meters around 25 platforms and will have small-scale, localized effects on benthic organisms out to 200-500 m.

Two exceptions to the application of historical impact data for predicting future impacts are projections of future impacts from petroleum and NORM contamination. The new NPDES permit and effluent limitations will significantly decrease the quantities of oil and grease in produced-water effluent. It is expected, therefore, that levels of oil compounds measured in the water column and sediments around the 25 production platforms will be decreased from historical levels.

Most importantly, very little is known about the impacts of NORM in produced water. There have been no historical studies determining what impacts may be occurring. Toxic effects have not been noted in laboratory tests of the toxicities of whole produced-water effluents (Avanti Corporation, 1993). There is very limited data available on the bioaccumulation and sublethal effects of NORM in produced water discharges. Levels of radionuclides in produced waters are projected by USEPA (based on a small data set) to be about 0.2 lb of radium/Bbbl of produced-water effluent. For the proposed action, therefore, about 0.11 lb of radium will be released into the water column over the production life of the 25 platforms discharging produced water.

The USEPA addresses why they continue to allow discharges of produced waters containing NORM and not set standards. They believe there is not enough information to conclude that radionuclides are a pollutant of concern. The USEPA has the authority under Sections 304(b)(2)(A) and 306(b)(1)(B) of the Clean Water Act to exclude certain pollutants from regulation and have exercised this authority to not set limits on NORM. The USEPA states in their recent effluent limitation regulations (40 CFR 435), which are not yet published, that "while the agency recognizes that it needs additional information concerning radionuclides in produced water effluent . . . and intend to seek such information through monitoring requirements (now imposed in the general permit), EPA believes that without this information, regulation of the entire offshore subcategory is likely to impose unnecessary regulation on a significant number of facilities."

The contribution of operational discharges related to Sale 147 to regional, chronic water column degradation and sediment contamination must be considered. Activities resulting from Sale 147 (High Case) will make up about 6 percent of all future OCS oil and gas industry related operations. If, for analytical purposes, an assumption is made that regional water quality degradation by the OCS industry makes up 50 percent of the total contamination that occurs, then discharges from Sale 147 operations would contribute about 3 percent of the cumulative contamination (Section IV.D.1.d.).

Conclusion

As a result of the High Case, marine waters will be degraded from discharges, oil spills, and bottom disturbances. Bottom disturbances (platform and pipeline emplacements and removals) and oil spills are expected to result in minor, localized, temporary impacts to water quality. Changes in water quality parameters will return to background within months from the disturbance. Operational discharges are primarily muds and cuttings and produced waters. Drilling muds and cuttings, which are discharged intermittently throughout the life of a platform, are expected to contaminate a localized area around platforms out to 3,000 m for up to 1 year after drilling ceases. Production wastes, which are discharged continuously throughout the life of most

of the platforms, will change some water quality and sediment parameters within several hundred meters downcurrent from the discharge point for an average of 20 years. These discharges will also contribute, to a very small extent, to the long-term, regional contamination of Gulf waters and sediments.

(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. Supporting materials and discussions are presented in Sections III.A.2. and III.A.3. (descriptions of Gulf of Mexico meteorology and the coastal counties' air quality status), IV.A.3.h.(2) and IV.B.2.d.(1) (oil-spill assumptions), and IV.A.3.f. (air emissions).

The parameters of this analysis are the emission rates, 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. Nitric oxide and nitrogen dioxide comprise NO_x emissions. Nitric 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), a very toxic gas at very high concentrations, 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 (PM₁₀) 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 regulated 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 μppm^{-1} 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.3.f. 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.

Platform emission rates for the Gulf of Mexico region (presented in Section IV.A.3.f.) 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 40-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, mixed layer height, exhaust gas temperature and speed, and wind speed. 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 (USDOL, MMS, 1988b) 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 instability is important because it helps to distribute and diffuse the available energy or momentum of the atmosphere.

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 136 exploration and delineation wells and 220 development wells would be drilled, and 20 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_2 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)

<u>Activity/Pollutant</u>	<u>NO_x</u>	<u>CO</u>	<u>SO_x</u>	<u>THC</u>	<u>TSP</u>
Service Vessels	4,341.0	508.6	68.6	220.9	306.3
LTO Helicopters	28.9	23.4	4.5	1.2	1.1
Cruise Helicopters	93.4	267.0	20.0	21.8	26.7
Blowouts without Fire	0.0	0.0	0.0	24.0	0.0
Spills without Fire	0.0	0.0	0.0	255.0	0.0
Barge Loading	0.0	0.0	0.0	102.3	0.0
Tanker Loading	0.0	0.0	0.0	0.0	0.0
Transit Loss	0.0	0.0	0.0	195.0	0.0
Tanker Exhaust	0.0	0.0	0.0	0.0	0.0
Tug Exhaust	356.1	32.1	4.6	16.1	21.4
Exploratory Wells	1,257.1	335.4	146.9	126.1	36.4
Development Wells	1,503.6	401.1	176.4	151.2	44.1
Platforms	34,214.3	4,456.8	59.9	12,967.5	83.8
Totals	41,794.5	6,024.3	480.8	14,081.1	519.7

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

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

<u>Pollutant</u>	<u>C-1</u>	<u>C-2</u>	<u>C-3</u>	<u>C-4</u>
NO _x	10,448.6	6,269.2	16,717.8	8,358.9
CO	1,506.1	903.7	2,409.7	1,204.9
SO _x	120.2	72.1	192.3	96.2
THC	3,520.3	2,112.2	5,632.4	2,816.2
TSP	129.9	78.0	207.9	103.9

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 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 combined 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. Aggregate emissions represent the sum of the peak emissions for vessels, others, and the peak of the platforms and wells. The platform and well peak emissions were obtained from the super position of their temporal distribution. 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)

<u>Pollutant</u>	<u>Wells</u>	<u>Platforms</u>	<u>Vessels</u>	<u>Others</u>	<u>Mean</u>	<u>Aggregate</u>
NO _x	265.0	1,715.0	137.7	0.00	1,194.13	1,924.30
CO	70.7	223.4	23.7	0.00	172.12	266.24
SO _x	31.0	3.0	2.8	0.00	13.74	34.54
THC	7.7	650.0	7.4	16.50	402.32	681.09
TSP	26.6	4.2	10.2	0.00	14.85	18.91

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 emission levels. The column headed by "Others" includes emissions from accidents, helicopters, tankering, and barging operations and represents average emissions per year.

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 analysis, a uniform distribution of average size sources throughout the planning areas at this early stage is assumed. 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]=0.138[NO_x]; [SO_x]=0.018[NO_x]; and [TSP]=0.010[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 can be neglected because the pollutants are transported offshore. The greater the wind speed, the lower the concentration, and the smaller the mixing height, the larger the concentration. Conditions of onshore winds indicate that concentrations reaching land from Subarea C-3 varied between 0.15 and 0.02 μgm⁻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 0.45 to 0.06 μgm⁻³ under the same wind speeds. For Subarea C-1 the concentrations varied from 0.08 to 0.01 μgm⁻³ with a 900-m mixing height across the entire wind speed range; concentrations varied from 0.23 to 0.02 μgm⁻³ with a 300-m mixing height across the entire wind speed range. These results represent long-term average concentrations.

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·D^{2/3} and 33.3·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 VOC emission for Subarea C-1 is estimated as 170.3 tons/yr. Transport of pollutants toward onshore areas has a frequency maximum of 61 percent during summer and only 37 percent during winter. 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 (USDOl, 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. 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 calculated was $71.89 \mu\text{gm}^{-3}$, while the annual arithmetic mean varied between 0.82 and $1.83 \mu\text{gm}^{-3}$, which is below the NO_2 national standard of $100 \mu\text{gm}^{-3}$. 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, 20 platform complexes (24 percent of that used in the model), spread over 193.4 billion m^2 would have a much smaller effect.

Oil-spill effects on air quality are examined below. It is assumed that Size 1 and Size 2 oil spills would cause low pollutant concentrations on air quality because their input of pollutants (it is assumed that 30 percent of the spill evaporates in 3 days) would be very small. Information from OCS accidents indicates emissions of fewer than 100 tons/hour by the second hour. For Size 3 spills, 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. Pollutant concentrations reaching onshore will 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 3 percent of OCS crude-oil production is offloaded from surface vessels at ports. The estimated VOC emissions from offloading in the Base Case are 102.0 tons over the 35-year life of the proposed action. These emissions represent about 0.73 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 surface 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 $2 \mu\text{m}$ and a third peak with diameters larger than $2 \mu\text{m}$. Particles with diameters of $2 \mu\text{m}$ or larger settle very close to the source (residence time of approximately $\frac{1}{2}$ day, Lyons and Scott, 1990), so their concentration on these areas would be low. For particles smaller than $2 \mu\text{m}$, which do not settle fast, wind transport determines their impacts. Results from the box model indicate that the largest concentration for TSP will be $0.01 \mu\text{gm}^{-3}$, which is less than the allowable annual increase level of $5 \mu\text{gm}^{-3}$.

Blowouts are accidents related to OCS and State oil and gas activities and are defined as an uncontrolled flow of fluids from a wellhead or wellbore. Two blowouts are assumed to occur 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. Further, most blowouts occurred without fire (MMS Database). The amount of oil released during these accidents has been small. 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 24 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.

The Breton National Wildlife Refuge and National Wilderness Area of the Mississippi Delta is a Class I air quality area administered by the U.S. Fish and Wildlife Service (see Visual No. 2 for Final EIS 142/143). Impacts to this area can occur from OCS source emissions. However, any impacts to this Class I air quality area will necessarily depend on the location and intensity of the pollutant emissions, which at this time are unknown. The OCS exploration and development scenarios call for 10-20 platforms, but the specific location of these production facilities are not included in the scenario and at this time would be purely speculative. Under the Clean Air Act the MMS will notify the National Park Service and U.S. Fish and Wildlife Service if emissions from proposed projects may impact a Class I air quality area. The MMS will evaluate all activities that could result in potential impacts to this Class I air quality area during the post-lease planning stages. Mitigating measures necessary to reduce the impact levels will be analyzed and addressed at that time.

Ozone is of great concern because of its environmental considerations. A detailed description of ozone in the CPA is presented in Section III.A.3. Recent air modeling there using onshore sources only (Haney et al., 1990) indicates that ozone concentrations peak near 1,600-1,700 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 a study to do a preliminary ozone modeling 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. A 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. 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.

Summary

Emissions of pollutants into the atmosphere from the activities associated with the proposed action are likely to have minimum effects on offshore air quality because of the prevailing atmospheric conditions, emission heights, and pollutant concentrations. Onshore impact on air quality from emissions 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 frequency of onshore winds decreases (37%) and the removal of pollutants by rain increases. 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 onshore air quality classifications. Increases in onshore concentrations of air pollutants are estimated to be about $1 \mu\text{gm}^{-3}$ (box model steady concentrations). The impacts decrease during winter because onshore winds occur only about 37 percent of the time and impacts increase in summer because 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 290 exploration and delineation wells and 450 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. 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)

<u>Activity</u>	<u>NO_x</u>	<u>CO</u>	<u>SO_x</u>	<u>THC</u>	<u>TSP</u>
Service Vessels	9,715.7	1,138.2	153.5	494.4	685.4
LTO Helicopters	75.3	60.8	11.6	3.1	2.9
Cruise Helicopters	243.2	695.0	52.1	56.7	69.5
Blowouts without Fire	0.0	0.0	0.0	150.0	0.0
Spills without Fire	0.0	0.0	0.0	255.0	0.0
Barge Loading	0.0	0.0	0.0	230.2	0.0
Tanker Loading	0.0	0.0	0.0	0.0	0.0
Transit Loss	0.0	0.0	0.0	438.9	0.0
Tanker Exhaust	0.0	0.0	0.0	0.0	0.0
Tug Exhaust	799.0	32.1	10.3	36.0	47.9
Exploratory Wells	2,804.3	748.2	327.7	281.3	81.2
Development Wells	3,078.8	821.3	361.2	309.6	90.3
Platforms	85,492.8	11,136.5	149.5	32,402.5	209.4
Total	102,209.0	14,632.1	1,066.0	34,657.6	1,186.6

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

<u>Pollutant</u>	<u>C-1</u>	<u>C-2</u>	<u>C-3</u>	<u>C-4</u>
NO _x	12,265.1	16,353.4	34,751.1	38,839.4
CO	1,755.9	2,341.1	4,974.9	5,560.2
SO _x	127.9	170.6	362.4	405.1
THC	4,158.9	5,545.2	11,783.6	13,169.9
TSP	142.4	189.9	403.5	450.9

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. Aggregate emissions represent the sum of the peak emissions for vessels, others, and the peak of the platforms and wells. The platforms and wells peak emissions were observed from the super position of their respective temporal distributions.

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

<u>Pollutant</u>	<u>Wells</u>	<u>Platforms</u>	<u>Vessels</u>	<u>Others</u>	<u>Mean</u>	<u>Aggregate</u>
NO _x	614.2	4,287.5	309.5	0.0	2,920.26	4,704.42
CO	163.9	558.5	55.0	0.0	418.06	642.18
SO _x	71.9	7.5	6.5	0.0	30.46	79.70
THC	17.9	1,625.0	16.9	30.7	990.22	1,683.35
TSP	61.7	10.5	23.0	0.0	33.90	42.76

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 lower levels of emissions except for THC.

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, pollutant concentrations reaching onshore will be very low because the pollutants are transported offshore. 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 μgm⁻³. Conditions of onshore winds indicate that concentrations reaching land from Subarea C-3 varied between 0.38 and 0.05 μgm⁻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 1.15 to 0.16 μgm⁻³ under the same wind speeds. For Subarea C-1 the concentrations varied from 0.23 to 0.01 μgm⁻³ with a 900-m mixing height across the entire wind speed range; concentrations varied from 0.03 to 0.68 μgm⁻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 minimal because the concentrations arriving onshore are less than USDOL 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 202.0 tons/yr. Transport of pollutants toward onshore areas has a frequency maximum of 61

percent during summer and only 37 percent during winter. 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 (USDOJ, 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. 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 calculated was $71.89 \mu\text{gm}^{-3}$, while the annual arithmetic mean varied between 0.82 and $1.83 \mu\text{gm}^{-3}$, which is below the national standard of $100 \mu\text{gm}^{-3}$. 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, 50 platforms (59 percent of that used in the model), spread over 193.4 billion m^3 would have a much smaller effect.

Oil-spill effects on air quality are examined below. It is assumed that Size 1 and Size 2 oil spills would cause low pollutant concentrations on air quality because their input of pollutants (it is assumed that 30 percent 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 Size 3 spills, 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 230 tons over the 35-year life of the proposed action. These emissions represent about 0.66 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 $2 \mu\text{m}$ and a third peak with a diameter larger than $2 \mu\text{m}$. Particles with diameters of $2 \mu\text{m}$ or larger settle very close to the source (residence time of approximately $\frac{1}{2}$ day, Lyons and Scott, 1990), so their concentrations would be low. For particles smaller than $2 \mu\text{m}$, which do not settle fast, wind transport determines their impacts. Results from the box model indicate that the largest concentration for TSP will be $0.01 \mu\text{gm}^{-3}$, which is less than the allowable annual increase level of $5 \mu\text{gm}^{-3}$.

Blowouts are accidents related to OCS and State oil and gas activities and are defined as an uncontrolled flow of fluids from a wellhead or wellbore. Five blowouts are assumed to occur 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. 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 150 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.

The Breton National Wildlife Refuge and National Wilderness Area of the Mississippi Delta is a Class 1 air quality area administered by the U.S. Fish and Wildlife Service (see Visual No. 2 for Final EIS 142 and 143). This area is protected by the stringent air quality standards described in Section III.A.3. The MMS will

evaluate all activities that could result in potential impacts to these Class 1 areas during the post-lease planning stages.

Ozone is of great concern because of its environmental considerations. A detailed description of ozone in the CPA is presented in Section III.A.3. 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 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.

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 $1 \mu\text{m}^{-3}$ (box model steady concentrations). The impacts decrease during winter because onshore winds occur only 37 percent of the time and impacts increase in summer because onshore winds occur 61 percent of the time.

(5) Impacts on Marine Mammals

(a) Nonendangered and Nonthreatened Species

This section discusses the possible effects of the proposed action on nonendangered and nonthreatened marine mammals in the Gulf of Mexico. Twenty-two nonendangered species of marine mammals of the taxonomic Order Cetacea (which comprises whales, dolphins, and porpoises) have been identified in the Gulf (Table III-5). The majority of these species are typically found in deeper waters (the continental shelf edge and beyond), with the exception of the bottlenose dolphin and Atlantic spotted dolphin, which commonly inhabit nearshore and shelf waters (Mullin et al., 1991; Mullin, personal communication, 1993).

The predominant impact-producing factors related to the proposed action that may affect nonendangered cetaceans in the Gulf include onshore operational discharges, helicopter and vessel traffic and noise, platform and drillship operations, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service vessels and OCS structures.

Produced waters, operational wastes, drill muds, and drill cuttings can potentially impact cetaceans via displacement or removal of food sources or via the degradation of water quality. Most operational discharges are rapidly diluted and dispersed when released in offshore areas and are not considered to be lethal or detrimental to cetaceans (API, 1989; NRC, 1983; Henwood, personal communication, 1993).

The passage of helicopters and support vessels in proximity to cetaceans can elicit a startle response with subsequent avoidance or evasive behavior. This effect is sublethal, though it could temporarily disrupt ongoing feeding, mating, resting, or migratory behavior, or cause the dispersion of a social group. This behavioral response could be a result of noise and/or visual disturbance. The main source of underwater noise from support vessels making way is from cavitation and irregularities of the propeller(s). Other noises are emitted from the main engine(s) and auxiliary machinery. The response of cetaceans to such noise is somewhat species-specific and appears to be, in part, a function of sound intensity, distance, the fact that the noise source is in motion (compared to a static and nonchanging source), season (primarily mating season), and individual

variability in whale behavior. Evidence suggests that certain whales have reduced their utilization of certain areas heavily used by ships, though continued presence of various whale species in such areas indicates a considerable degree of tolerance to ship noise and disturbance (Richardson et al., 1991). Groups of dolphins and porpoises are often attracted to vessels making way in order to bowride or, in the case of fishing vessels, take advantage of discarded bycatch.

Support vessels involved in survey, service, or shuttle functions could collide with and physically impact cetaceans, especially larger species and those that remain at the surface for extended periods of time (United Press International, 1986). Many of the larger species of nonendangered cetaceans are deep-diving odontocetes, which commonly spend extended periods of time at the surface in order to restore oxygen levels within their tissues. The normal distribution of these mammals appears to be beyond the continental shelf edge, well into the bounds of the continental slope. Cetaceans that inhabit the continental shelf and nearshore waters, most commonly bottlenose and spotted dolphins, are agile swimmers that often approach vessels making way, even when in the confines of narrow navigation passes and waterways, and seem well able to avoid such vessels when deemed necessary. The probability of OCS service-vessel collisions is therefore greater within areas of the Gulf that are off the shelf edge.

Exploration, delineation, and production structures, as well as drillships, produce an acoustically wide range of sounds at frequencies and intensities that can be detected by cetaceans. Some of these sounds could interfere with the cetaceans' reception of their sounds produced for echo-location and communication. Odontocete (toothed) cetaceans use sounds for acoustic echo-location and communication at frequencies that are generally higher than the dominant sounds generated by offshore drilling and production activities. Baleen whales mainly utter low-frequency sounds at frequencies below 1 kHz, which overlap broadly with the dominant frequencies in many industrial sounds (Malme et al., 1989; Richardson et al., 1991). Drilling noise from conventional metal-legged structures and semi-submersibles is not particularly intense, and strongest at low frequencies, averaging 5 Hz and 10-500 Hz, respectively. Drillships produce higher levels of underwater noise than other types of platforms (Richardson et al., 1991).

Removal of offshore platforms by means of explosive charges can directly impact cetaceans. The effects of underwater detonation of explosive charges is dependent upon the amount of explosive used, distance from the charge, and body mass. Hemorrhaging in and around the lungs is the primary source of injury to submerged mammals, as well as injuries from the effects of explosive impact upon gas bubbles within the intestines (Goertner, 1982). The effects of explosives could also damage the ears of submerged cetaceans, and thus affect intraspecific communication, feeding, and navigation. Although death and permanent injuries have been speculated, none have been documented. In order to minimize the likelihood of removals occurring when cetaceans may be nearby, MMS has issued a series of guidelines (NTE 92-02) for explosive platform removal to offshore operators. These guidelines specify platform removal only during daylight hours, staggered detonation of charges, placement of charges 5 m below the seafloor, and extensive pre- and post-detonation surveys of surrounding waters.

Seismic surveys involve the use of an acoustic pulse, generated by compressed air. The effects of these sound pulses may affect cetacean communications and behavior if the pulses exceed ambient noise levels. Although ambient noise levels in the marine environment are highly variable, the effects of noise generated from seismic surveys are limited as a result of the dissipation of sound pressure through seawater. Acoustic pressure thus produced dissipates to levels below 200 dB at distances beyond 30 m from the acoustic source (Gales, 1982). Seismic surveys are systematically executed, and it is assumed that cetaceans could easily avoid the presence or approach of the acoustic source within the open waters of the Gulf of Mexico. Thus, the effects on cetaceans from seismic surveys are primarily sublethal and at most constitute short-term avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans. Direct contact with oil and/or tar can lead to irritation and damage of skin and soft tissues (such as mucous membranes of the eyes), fouling of baleen plates so as to hinder the flow of water and interfere with feeding, and incidental ingestion of oil and/or tar. Studies by Geraci and St. Aubin (1982 and 1985) have shown, however, that the cetacean epidermis functions as an effective barrier to noxious substances found in petroleum. Unlike other mammals, penetration of such substances in cetacean skin is impeded by tight intercellular bridges, the vitality of the superficial cells, the thickness of the epidermis, and the lack of sweat glands and hair follicles (Lofflan, personal communication,

1993). Cetacean skin is free from hair or fur, which, in other marine mammals such as pinnipeds and otters, tends to collect oil and/or tar, and effectively reduces its insulative properties (Gieraci, 1990). Inhalation of vapors can lead to irritation of respiratory membranes, lung congestion, and pneumonia; subsequent absorption of volatile hydrocarbons into the bloodstream may accumulate into such tissues as the brain and liver, causing neurological disorders and liver damage (Gieraci and St. Aubin, 1982; Hansen, 1985; Gieraci, 1990). Gieraci and St. Aubin (1982) determined that toxic vapor concentrations just above the water's surface (where cetaceans draw breath) could reach critical levels for the first few hours after a spill, prior to evaporation of volatile aromatic hydrocarbons and other light fractions. The lack of olfactory ability in cetaceans suggests that sense of smell might not be used to detect, and thus allow them to avoid such slicks. The probable effects on cetaceans swimming through the area would depend on a number of factors, including ease of escape from the vicinity, the health of the individual animal, and its immediate response to stress (Davis, personal communication, 1993; Wursig, personal communication, 1993). Spilled oil can also lead to the reduction or contamination of prey and temporary displacement from migratory routes. Feeding strategies of cetaceans could lead to ingestion of oil-contaminated food or incidental ingestion of floating or submerged oil or tar. Baleen whales from the Gulf of Mexico that are not listed as endangered feed on small pelagic fishes (such as herring, mackerel, and pilchard) and cephalopods (Cummings, 1985). An analysis of stomach contents from captured and stranded odontocetes suggest that they are deep-diving animals, feeding predominantly on mesopelagic fish and squid or deep-water benthic invertebrates (Heyning, 1989; Mead, 1989). Delphinids feed on fish and/or squid, depending upon the species (Mullin et al., 1991). Zooplankton may become contaminated by direct contact and/or by ingesting oil droplets and tainted food. Marine fish also take up petroleum hydrocarbons from both water and food, though apparently do not accumulate high concentrations of hydrocarbons in tissues and transfer them to predators (Neff, 1990b). Reactions of cetaceans to spilled oil are varied, with evidence of both direct avoidance and obvious indifference in even heavily oiled areas. Several observations of cetaceans confronting spilled oil show them in the vicinity, and in some cases in the midst of a spill, behaving quite normally. At present, it is unknown whether these animals in such cases are simply not affected by the presence of oil, or perhaps are even drawn to the area in search of prey organisms attracted to the oil's protective surface shadow (Gieraci, 1990). Controlled experiments on detection and avoidance response of bottlenose dolphin to oil films showed that dolphins can see oil at the surface and that they prefer to avoid it (Gieraci et al., 1983; Smith et al., 1983; St. Aubin et al., 1985).

Oil-spill response activities include the application of dispersant chemicals to the affected area designed to break up oil on the water's surface into minute droplets which then break down in seawater. Virtually nothing is known about the effects of oil dispersants on cetaceans, except that removal of the oil from the surface would reduce the risk of contact and render it less likely to adhere to skin, baleen plates, or other body surfaces (Neff, 1990b). The acute toxicity of most oil dispersant chemicals is considered to be low, when compared to the constituents and fractions of crude oils and refined products, and studies have shown that the rate of biodegradation of dispersed oil is equal to or greater than that of undispersed oil (Wells, 1989). Biodegradation is another process used for removing petroleum hydrocarbons from the marine environment, utilizing chemical fertilizers to augment the growth of naturally occurring hydrocarbon-degrading microorganisms. Toxic effects of these fertilizers on cetaceans is presently unknown.

Pollution of the marine environment with nonbiodegradable plastic debris discarded from offshore sources (structures, and vessels) and coastal sources (litter and solid waste disposal) has become an issue of increasing concern, especially with regard to entanglement of and ingestion by marine mammals. Typically, marine mammals become entangled in various types of debris (mostly lines of various types) and inactive or active fishing gear. Plastic debris has also been reported from gut contents of several stranded marine mammals; in some cases ingestion of such material is believed to be the cause of death (Barros and Odell, 1990; Sadove and Morreale, 1990; Tarpley, 1990). It is believed that the animals either mistake the plastic material, which is in suspension in the water column, as a food item, or in the case of larger baleen whales, it is ingested along with prey species (Sadove and Morreale, 1990). The MMS prohibits the disposal of equipment, containers, and other materials into coastal and offshore waters by lessees (30 CFR 250.40). Prohibition of the discharge and disposal of vessel- and offshore structure-generated garbage and solid waste items into both offshore and coastal waters was established January 1, 1989, via the enactment of MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which is enforced by the U.S. Coast Guard.

Base Case Analysis

The major impact-producing factors analyzed below are related to the proposed action and include degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil spill response activities, and discarded trash and debris from service vessels and OCS structures.

An estimated 2.3 MMbbl of drilling fluids, 0.71 MMbbl of drill cuttings, and 243 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; indirect effects via 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/or affect nonendangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis, averaging about 7,620 trips per year. The FAA (Advisory Circular 91-36C) and corporate helicopter policy state that helicopters maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. It is expected that cetaceans will not be affected by routine OCS helicopter traffic operating at these altitudes. It is also expected that 10 percent of helicopter trips will occur at altitudes below the specific minimums listed above as a result of inclement weather. Such incidents are very short term and may elicit a startle reaction from cetaceans closely.

It is assumed that about 240 OCS related oil/gas service vessel and 6 barge trips will occur annually and that no 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 and/or avoidance reaction from cetaceans or mask their sound reception. This effect is sublethal and constitutes a short-term and temporary impacts. Survey data show that most cetacean species of the Gulf are distributed within deeper waters, on or beyond the continental shelf break. It is estimated that annual service vessel trips occurring (by offshore subarea) within water depths greater than 100 m are as follows: C-2: 741, C-3: 2,201, and C-4: 2,800. The probability of collisions is higher within these deeper waters. It is expected that service vessel traffic will seldom contact and affect nonendangered cetaceans, although such collisions would be fatal.

It is assumed that 130 exploration and delineation wells and 220 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 be relatively constant and 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 echolocate and 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 and may elicit some degree of avoidance behavior in the open Gulf. It is expected that drilling noise will seldom disturb and affect nonendangered cetaceans.

Explosive platform removals can temporarily interfere with communication, elicit a pronounced startle reaction with subsequent avoidance or flight behavior, temporarily or permanently reduce hearing sensitivity, or cause hemorrhaging and death in cetaceans. It is estimated that eight 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 (Table IV-2). It is expected that structure removals will cause only sublethal effects on cetaceans, as a result of the implementation of MMS guidelines for explosive removals (USDOL, MMS, 1990a, Appendix B). It is expected that structure removals will seldom disturb and affect nonendangered cetaceans.

Seismic surveys use airguns to generate sound 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.a.(1)). It is expected that effects of noise on cetaceans from seismic surveys are entirely sublethal, constituting short-term startle response and avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans, causing skin and soft tissue irritation, fouling of baleen/plates, respiratory stress from inhalation of toxic fumes, food reduction or

contamination, the direct ingestion of oil and/or tar, and temporary displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from sale-related Size 3 oil spills (one spill is assumed), the effects would primarily be sublethal; few deaths are expected. The effects of sale-related Size 1 and Size 2 oil spills are expected to be solely sublethal due to the small areas affected and their rapid dispersion.

Section IV.A.3.h. estimates the mean number of Size 1 and Size 2 spills from the proposed action in the CPA. It is assumed that 18 Size 1 spills will occur during the 35-year life of the proposed action. It is estimated that the 18 spills will occur offshore, though none will contact land. It is assumed that 1 Size 2 spill 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 nearshore areas and resident dolphin populations. Although an interaction with Size 1 and Size 2 offshore spills may occur, only sublethal effects are expected as a result of avoidance and natural dispersion/weathering of a spill in the offshore environment. It is estimated that small offshore Size 1 and Size 2 spills will rarely contact and affect nonendangered cetaceans.

Section IV.A.3.h. estimates the mean number of Size 3 spills resulting from the proposed action in the CPA. It is assumed that one Size 3 crude oil spill will occur from a pipeline in the Central Gulf during the 35-year life of the proposed action. Table IV-10 identifies the estimated risk of one or more Size 3 oil spills occurring and contacting areas within 10 days where many cetaceans have been sighted during surveys. There is a 5 percent probability that a Size 3 oil spill will occur and contact within 10 days cetacean habitats at or beyond the shelf break of the CPA. There is a 1 percent probability that a Size 3 oil spill will occur and contact areas off the Mississippi Delta (survey blocks in Table IV-10) within 10 days of where many cetaceans have been sighted. Although an interaction with Size 3 spills may occur, infrequent deaths are expected with primarily sublethal effects, as a result of avoidance and natural dispersion/weathering of a spill in the offshore environment. It is expected that a Size 3 oil spill will seldom contact and affect nonendangered cetaceans in the CPA.

Many types of plastic materials are used during drilling and production operations. Some of this material is accidentally lost overboard where it can be consumed, incidentally or accidentally, by cetaceans. The result of plastic ingestion could be lethal, although the probability of occurrence is low.

Summary

Activities resulting from the proposed action have a potential to affect detrimentally nonendangered and nonthreatened cetaceans. These cetaceans could be impacted by the degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil spill response activities, and discarded trash and debris from service vessels and OCS structures. The effects of the majority of these activities are expected to be sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris). Lethal effects are estimated from the chance collisions with OCS service vessels, ingestion of plastic materials, and Size 3 oil spills. Sale-related oil spills of any size are expected to seldom contact nonendangered and nonthreatened cetaceans.

Conclusion

The impact of the proposed action on nonendangered and nonthreatened marine mammals is expected to result in primarily sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that are both chronic and sporadic. These impacts could cause acute or chronic physiological stress, alter normal behavior, and result in some degree of avoidance, either temporary or permanent, of the impacted area(s).

High Case Analysis

The major impact-producing factors analyzed below are related to the proposed action and include degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise,

platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service vessels and OCS structures.

An estimated 4.9 MMbbl of drilling fluids, 1.5 MMbbl of drill cuttings, and 514 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; indirect effects via 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/or affect nonendangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis, averaging about 20,000 trips per year. The FAA (Advisory Circular 91-36C) and corporate helicopter policy state that helicopters maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. It is expected that cetaceans will not be affected by routine OCS helicopter traffic at these altitudes. It is also expected that 10 percent of helicopter trips will occur at altitudes below the specified minimums listed above as a result of inclement weather. Such incidents are very short-term and may elicit a startle reaction from cetaceans closeby.

It is assumed that about 537 OCS-related oil/gas service-vessel trips and 13 barge trips will occur annually as a result of the proposed action and that no 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 and/or avoidance reaction from cetaceans or mask their sound reception. This effect is sublethal and constitutes a short-term and temporary impact. Survey data show that most cetacean species of the Gulf are distributed within deeper waters, on or beyond the continental shelf break. It is estimated that annual service-vessel trips occurring (by offshore subarea) within water depths greater than 100 m are as follows: C-2--1,824; C-3--4,615; and C-4--7,400. The probability of collisions is higher within these deeper waters. It is expected that service-vessel traffic will seldom contact and affect nonendangered cetaceans, although such collisions could be fatal.

It is assumed that 290 exploration and delineation wells and 450 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 be relatively constant and 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 echolocate and 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 and may elicit some degree of avoidance behavior in the open Gulf. It is expected that drilling noise will seldom disturb and affect nonendangered cetaceans.

Explosive platform removals can interfere with communication, elicit a pronounced startle reaction with subsequent avoidance or flight behavior, temporarily or permanently reduce hearing sensitivity, or cause hemorrhaging and/or death in cetaceans. It is estimated that 15 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 (Table IV-2). It is expected that structure removals will cause only sublethal effects on cetaceans as a result of the implementation of the MMS guidelines for explosive removals (USDOJ, MMS, 1990a, Appendix B). It is expected that structure removals will seldom disturb and affect nonendangered cetaceans.

Seismic surveys use airguns to generate sound 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.a.(1)). It is expected that effects of noise on cetaceans from seismic surveys are entirely sublethal, constituting a short-term startle response and avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans, causing skin and soft tissue irritation, fouling of baleen plates, respiratory stress from inhalation of toxic fumes, food reduction or contamination, the direct ingestion of oil and/or tar, and temporary displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from sale-related Size 3 oil spills (one spill is assumed), the effects would primarily be sublethal; few deaths are expected. The effects of sale-related Size 1 and Size 2 oil spills are expected to be solely sublethal due to the small area affected and their rapid dispersion.

Section IV.A.3.h. estimates the mean number of Size 1 and Size 2 spills occurring from the proposed action in the CPA. It is assumed that 41 Size 1 spills will occur during the 35-year life of the proposed action. It is estimated that the 41 spills will occur offshore and that none will contact nearshore areas and resident dolphin populations. It is assumed that two Size 2 spills 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 these offshore spills may occur, only sublethal effects are expected as a result of avoidance and dispersion of a spill in the offshore environment. It is estimated that offshore Size 1 and Size 2 spills less than 1,000 bbl will rarely contact and affect nonendangered cetaceans.

Section IV.A.3.h. estimates the mean number of Size 3 spills resulting from the proposed action in the CPA. It is assumed that one Size 3 crude oil spill will occur from either a platform or pipeline in the Central Gulf during the 35-year life of the proposed action. Table IV-10 identifies the risk of one or more Size 3 oil spills occurring and contacting within 10 days areas where many cetaceans have been sighted during surveys. There is a 10 percent probability that a Size 3 oil spill will occur and contact, within 10 days, cetacean habitats at or beyond the shelf break of the CPA. There is a 1-3 percent probability that a Size 3 oil spill will occur and contact areas off the Mississippi Delta (survey blocks in Table IV-10) within 10 days where many cetaceans have been sighted. Although an interaction with Size 3 spills may occur, infrequent deaths are expected with primarily sublethal effects as a result of avoidance and natural dispersion/weathering of a spill in the offshore environment. It is expected that a Size 3 oil spill will seldom contact and affect nonendangered cetaceans in the CPA.

Many types of plastic materials are used during drilling and production operations. Some of this material is accidentally lost overboard where it can be consumed, incidentally or accidentally, by cetaceans. The result of plastic ingestion would be fatal, though the probability of occurrence is low.

Activities resulting from the proposed action have a potential to affect detrimentally nonendangered and nonthreatened cetaceans. These cetaceans could be impacted by the degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service-vessels and OCS structures. The effects of the majority of these activities are expected to be sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris). Lethal effects are expected from the chance collisions with OCS service-vessels, ingestion of plastic materials, and Size 3 oil spills. 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 marine mammals is expected to result in primarily sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that are both chronic and sporadic. These impacts could cause acute or chronic physiological stress, alter normal behavior, and result in some degree of avoidance, either temporary or permanent, 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. The sperm whale is the only species seen with regularity in the Gulf of Mexico.

The major impact-producing factors related to the proposed action 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 degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service vessels and OCS structures.

An estimated 2.3 MMbbl of drilling fluids, 0.71 MMbbl of drill cuttings, and 243 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, when present in proximity to OCS structures, will have some interaction with these discharges. Direct effects to cetaceans are expected to be sublethal; indirect effects via 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/or affect endangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis, averaging about 7,629 trips per year. The FAA (Advisory Circular 91-36C) and corporate helicopter policy state that helicopters maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. It is expected that cetaceans will not be affected by routine OCS helicopter traffic at these altitudes. It is also expected that 10 percent of helicopter trips will occur at altitudes below the specified minimums listed above as a result of inclement weather. Such incidents are very short-term and may elicit a startle reaction from cetaceans closeby.

It is assumed that about 240 OCS-related oil/gas service-vessel trips and 6 barge trips will occur annually as a result of the proposed action and that no 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 and/or avoidance reaction from cetaceans or mask their sound reception. This effect is sublethal and constitutes a short-term and temporary impact. Survey data show that most cetacean species of the Gulf are distributed within deeper waters, on or beyond the continental shelf break. It is estimated that annual service-vessel trips occurring (by offshore subareas) within water depths greater than 100 m are as follows: C-2--741; C-3--2,201; and C-4--2,800. The probability of collisions is higher within these deeper waters. It is expected that service-vessel traffic will seldom contact and affect endangered cetaceans, although such collisions could be fatal.

It is assumed that 130 exploration and delineation wells and 220 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 be relatively constant and 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, such as the sperm whales, echolocate and 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 and may elicit some degree of avoidance behavior in the open Gulf. It is expected that drilling noise will seldom disturb and affect endangered cetaceans.

Explosive platform removals can temporarily interfere with communication, elicit a pronounced startle reaction with subsequent avoidance or flight behavior, temporarily or permanently reduce hearing sensitivity, or cause hemorrhaging and/or death in cetaceans. It is estimated that eight 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 (Table IV-2). It is expected that structure removals will cause only sublethal effects on cetaceans as a result of the implementation of the MMS guidelines for explosive removals (USDOl, MMS, 1990a, Appendix B). It is expected that structure removals will seldom disturb and affect endangered cetaceans.

Seismic surveys use airguns to generate sound 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.a.(1)). It is expected that effects of noise on cetaceans from seismic surveys are entirely sublethal, constituting a short-term startle response and avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans, causing skin and soft tissue irritation, fouling of baleen plates, respiratory stress from inhalation of toxic fumes, food reduction or

contamination, the direct ingestion of oil and/or tar, and temporary displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from sale-related Size 3 oil spills, the effects would primarily be sublethal; few deaths are expected. The effects of sale-related Size 1 and Size 2 oil spills are expected to be solely sublethal due to the small area affected and their rapid dispersion.

Section IV.A.3.h. estimates the mean number of Size 1 and Size 2 spills occurring from the proposed action in the CPA. It is assumed that 18 Size 1 spills will occur during the 35-year life of the proposed action. It is estimated that the 18 spills will occur offshore, though none will contact land. It is assumed that one Size 2 spill 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 Size 1 and Size 2 spills may occur, only sublethal effects are expected as a result of avoidance and natural dispersion/weathering of a spill in the offshore environment. It is estimated that Size 1 and Size 2 spills will rarely contact and affect endangered cetaceans.

Section IV.A.3.h. estimates the mean number of Size 3 spills resulting from the proposed action in the CPA. It is assumed that one Size 3 crude oil spill 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-10 identifies the estimated risk of one or more Size 3 oil spills occurring and contacting, within 10 days, areas where endangered cetaceans have been sighted during surveys. There is a 5 percent probability that a Size 3 oil spill will occur and contact within 10 days cetacean habitats at or beyond the shelf break of the CPA. There is a 1 percent probability that a Size 3 oil spill will occur and contact areas off the Mississippi Delta (survey blocks in Table IV-10) within 10 days where many sperm whales have been sighted. Although an interaction with Size 3 spills may occur, few deaths are expected with primarily sublethal effects as a result of avoidance and natural dispersion/weathering of a spill in the offshore environment. It is expected that a Size 3 oil spill will seldom contact and affect endangered cetaceans in the CPA.

Many types of plastic materials are used during drilling and production operations. Some of this material is accidentally lost overboard where it can be consumed, incidentally or accidentally, by cetaceans. Despite the general large size of the endangered cetacean species in the Gulf, it is presumed that the effects would be fatal. The probability of this occurrence is low.

Summary

Activities resulting from the proposed action have a potential to affect detrimentally endangered cetaceans. These cetaceans could be impacted by the degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service vessels and OCS structures. The effects of the majority of these activities are expected to be sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris). Lethal effects are estimated from the chance collisions with OCS service vessels, ingestion of plastic materials, and Size 3 oil spills. Sale-related oil spills of any size are expected to seldom contact endangered and threatened cetaceans.

Conclusion

The impact of the proposed action on endangered and threatened marine mammals is expected to result in primarily sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that are both chronic and sporadic. These impacts could cause acute or chronic physiological stress, alter normal behavior, and result in some degree of avoidance, either temporary or permanent, of the impacted area(s). Lethal impacts are expected to be rare for all marine mammals, with the most likely impacts resulting from vessel collisions to lethargic surfaced individual animals. The unexpected and unintentional removal of individuals of any species is considered an incidental take. Such removals have not been documented in the Gulf. Recovery times will vary with species size, gestation period, and rates of reproductive activity. These will vary from two to several (less than ten) years.

High Case Analysis

The major impact-producing factors analyzed below are related to the proposed action and include degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service vessels and OCS structures.

An estimated 4.9 MMbbl of drilling fluids, 1.5 MMbbl of drill cuttings, and 514 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; indirect effects via 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/or affect endangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis, averaging about 20,000 trips per year. The FAA (Advisory Circular 91-36C) and corporate helicopter policy state that helicopters maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. It is expected that cetaceans will not be affected by OCS helicopter traffic at these altitudes. It is also expected that 10 percent of helicopter trips will occur at altitudes below the specified minimums listed above as a result of inclement weather. Such incidents are very short term and may elicit a startle reaction from cetaceans closeby.

It is assumed that about 537 OCS-related oil/gas service-vessel trips and 13 barge trips will occur annually as a result of the proposed action and that no 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 and/or avoidance reaction from cetaceans or mask their sound reception. This effect is sublethal and constitutes a short-term, temporary impact. Survey data show that most cetacean species of the Gulf are distributed within deeper waters, on or beyond the continental shelf break. It is estimated that annual service-vessel trips occurring (by offshore subareas) within water depths of greater than 100 m are as follows: C-2--1,824; C-3--4,695; and C-4--7,400. The probability of collisions is higher within these deeper waters. Endangered cetaceans in the Gulf are large in size, and periodically spend lengths of time at the sea surface. This behavior, along with their general size, makes them more vulnerable for collisions with service vessels than many of the smaller cetaceans. It is expected that service-vessel traffic will seldom contact and affect endangered cetaceans, although such collisions could be fatal.

It is assumed that 290 exploration and delineation wells and 450 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 be relatively constant and 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 echolocate and 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 and may elicit some degree of avoidance behavior in the open Gulf. It is expected that drilling noise will seldom disturb and affect endangered cetaceans.

Explosive platform removals can interfere with communication, elicit a pronounced startle reaction with subsequent avoidance or flight behavior, temporarily or permanently reduce hearing sensitivity, or cause hemorrhaging and/or death in cetaceans. It is estimated that 15 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 (Table IV-2). It is expected that structure removals will cause only sublethal effects on cetaceans as a result of the implementation of the MMS guidelines for explosive removals (USDOJ, MMS, 1990a, Appendix B). It is expected that structure removals will seldom disturb and affect endangered cetaceans.

Seismic surveys use airguns to generate sound 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.a.(1)). It is expected that effects of noise on cetaceans from seismic surveys are entirely sublethal, constituting a short-term startle response and avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans, causing skin and soft tissue irritation, fouling of baleen plates, respiratory stress from inhalation of toxic fumes, food reduction or contamination, the direct ingestion of oil and/or tar, and temporary displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from sale-related Size 3 oil spills (one spill is assumed), the effects would primarily be sublethal; few deaths are expected. The effects of sale-related Size 1 and Size 2 oil spills are expected to be solely sublethal due to the small area affected and their rapid dispersion.

Section IV.A.3.h. estimates the mean number of Size 1 and Size 2 spills occurring from the proposed action in the CPA. It is assumed that 41 Size 1 spills will occur during the 35-year life of the proposed action. It is estimated that the 41 spills will occur offshore and that none will contact land. It is assumed that two Size 2 spills 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 offshore Size 1 and Size 2 spills may occur, only sublethal effects are expected as a result of avoidance and dispersion/weathering of a spill in the offshore environment. It is estimated that offshore Size 1 and Size 2 spills will seldom contact and affect endangered cetaceans.

Section IV.A.3.h. estimates the mean number of Size 3 spills resulting from the proposed action in the CPA. It is assumed that one Size 3 crude oil spill will occur from either a platform or pipeline in the Central Gulf during the 35-year life of the proposed action. Table IV-10 identifies the estimated risk of one or more Size 3 oil spills occurring and contacting within 10 days areas where many cetaceans have been sighted during surveys. There is a 10 percent probability that a Size 3 oil spill will occur and contact, within 10 days, cetacean habitats at or beyond the shelf break of the CPA. There is a 3 percent probability that a Size 3 oil spill will occur and contact within 10 days areas off the Mississippi Delta (survey blocks in Tables IV-10) where many cetaceans, including regularly occurring aggregations of sperm whales, have been sighted. Although an interaction with Size 3 spills may occur, few deaths are expected with primarily sublethal effects as a result of avoidance and natural dispersion/weathering of a spill in the offshore environment. It is expected that a Size 3 oil spill will seldom contact and affect endangered cetaceans in the CPA.

Many types of plastic materials are used during drilling and production operations. Some of this material is accidentally lost overboard where it can be consumed, incidentally or accidentally, by cetaceans. Despite the general large size of the endangered cetacean species in the Gulf, it is presumed that the effects would be fatal. The probability of this occurrence is low.

Conclusion

The impact of the High Case on endangered and threatened marine mammals within the potentially affected area is expected to result in primarily sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that are both chronic and sporadic. These impacts could cause acute or chronic physiological stress, alter normal behavior, and result in some degree of avoidance, either temporary or permanent, of the impacted area(s). Lethal impacts are expected to be rare for all marine mammals, with the most likely impacts resulting from vessel collisions to lethargic surfaced individual animals. The unexpected and unintentional removal of individuals of any species is considered an incidental take. Such removals have not been documented in the Gulf. Recovery times will vary with species size, gestation period, and rates of reproductive activity. These will vary from two to several (less than ten) years.

(6) Impacts on the 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, designated protected species under the Endangered Species Act of 1973 (Section I.B.4.c.). Alabama, Choctawhatchee, and Perdido Key beach mice occupy restricted habitat behind coastal foredunes of Florida and Alabama (Ehrhart, 1978; USDOI, FWS, 1987). Their range is chiefly in Perdido Key State Preserve (Florida), Grayton Beach State Recreational Area (Florida), St. Andrews State Recreation Area and Shell Island (Florida), Gulf Islands National Seashore (Alabama), and Gulf State Park (Alabama). Their range

also includes Escambia County (Florida) and Baldwin County (Alabama); portions of these areas have been designated as critical habitat. The major impact-producing factors related to the proposed action that may affect Alabama, Choctawhatchee, and Perdido Key beach mice include oil spills, oil-spill response activities, beach trash and debris, and coastal habitat degradation.

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 and activity associated with oil-spill cleanup activities can degrade preferred habitat and cause displacement from these areas, or it can attract predators.

Because the preferred habitat of Alabama, Choctawhatchee, and Perdido Key beach mice is 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 designated habitat that receives particular consideration during oil-spill cleanup, as directed by the Oil Pollution Act of 1990. Because of the critical designation and general status of protected species habitats, oil-spill contingency plans include requirements to minimize adverse effects from vehicular traffic during cleanup activities and to maximize protection efforts to prevent spilled oil contact with beach mice habitat.

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. Eleven Size 1 spills are expected to occur onshore during the 35-year life of the proposed action (Table IV-13). Two Size 2 spills are not assumed to breach barrier dunes and contact or affect beach mice or their habitats.

No Size 3 crude oil spills are assumed to occur onshore in the Central Gulf during the 35-year life of the proposed action (Table IV-13). A Size 3 oil spill could breach beach barriers only if the spill coincided with a storm surge strong enough to lift oil over the foredunes. There is less than a 0.5 percent probability of a Size 3 oil spill occurring and contacting coastal areas of the Alabama, Choctawhatchee, and Perdido Key beach mice within 10 days (Table IV-10). Given the low probability of offshore spills, lack of shuttle tanker trips, and direct pipeline landfalls in the habitat area (Table IV-17), no contact is expected with the beach mice. In the unlikely event of oil contact, oil-spill cleanup activities are not expected to disturb beach mice or their habitats. Cleanup operations undertaken to remove marine debris or to restore coastal habitat degradation such as beachfront erosion, may temporarily disturb beach mice or their habitat. However, the Base Case is expected to contribute negligible marine debris or disruption to beach mice areas.

Summary

An impact from the Base Case on the Alabama, Choctawhatchee, and Perdido Key beach mice could occur as a result of oil spills, oil-spill response activities, beach trash and debris, and coastal habitat degradation. Deleterious effects are not expected because of the low probability of spill occurrence and because of the protected species and habitat stipulations for cleanup of the Oil Pollution Act of 1990.

Conclusion

The proposed action is not expected to harm the Alabama, Choctawhatchee, and Perdido Key beach mice or their habitats unless a Size 3 oil spill would occur in conjunction with a strong storm surge. Since this probability is estimated to be less than 0.5 percent, no contact of beach mice or their habitats with oil is expected.

High Case Analysis

The major impact-producing factors analyzed below are related to the proposed action and include oil spills, oil-spill cleanup activities, beach trash and debris, and coastal degradation.

Twenty-five Size 1 spills are expected to occur onshore during the 35-year life of the proposed action (Table IV-13). Five Size 2 spills are assumed to occur but will not breach barrier dunes and contact or affect beach mice or their habitats (Table IV-13).

No Size 3 crude oil spill is expected to occur from either a platform or pipeline in the Central Gulf during the 35-year life of the proposed action (Table IV-13). If a spill were to occur, it would breach beach barriers only if it coincided with a storm surge strong enough to lift oil over the foredunes. There is less than a 0.5 percent probability of a Size 3 oil spill occurring and contacting the coastal areas containing the Alabama, Choctawhatchee, and Perdido Key beach mice within 10 days (Table IV-10). Given the low probability of offshore spills, lack of shuttle tanker trips, and direct pipeline landfalls in the habitat area (Table IV-17), no contact is expected with beach mice. In the unlikely event of oil contact, oil-spill cleanup activities are not expected to disturb beach mice or their habitats.

The High Case has a potential to harm or disturb the Alabama, Choctawhatchee, and Perdido Key beach mice as a result of oil spills, oil-spill response activities, beach trash and debris, and coastal habitat degradation. Deleterious effects are not expected because of the low probability of occurrence and because of protected species and habitat stipulations of the Oil Pollution Act of 1990 and the Endangered Species Act.

Cleanup operations undertaken to remove marine debris and trash or to restore coastal habitat degradation have the potential to disturb beach mice or their habitat. The High Case is expected to contribute 5-10 percent of all marine debris falling on beach mice areas, but no detectable harm is expected to befall the Alabama, Choctawhatchee, or Perdido Key beach mice.

Conclusion

The High Case is not expected to harm the Alabama, Choctawhatchee, and Perdido Key beach mice or their habitats unless a Size 3 oil spill would occur in conjunction with a strong storm surge. Since this probability is estimated to be less than 0.5 percent, no contact is expected to occur.

(7) 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. Major impact-producing factors that may occur as a result of the proposed action are reviewed in detail in *Decline of the Sea Turtles: Causes and Prevention* (NRC, 1990) and are also described in the Biological Opinions (Appendix B).

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

Structure installation and removal, pipeline placement, dredging, and water quality degradation may adversely affect marine turtle habitat through destruction of seagrass beds and live-bottom communities used by marine turtles. Potential impacts on these habitats caused by the proposed actions are discussed in detail in Section IV.D.1.a.(1)-(3).

Noise from service-vessel traffic may elicit a startle reaction from marine turtles and produce a temporary, sublethal stress (NRC, 1990). Service vessels could collide with and harm marine turtles while they are at the sea surface, but this appears to be less than 4 percent of their total time (Byles, 1989; Lohoefer et al., 1990). Vessel-related injuries were noted in 9 percent of stranded marine turtles examined in the Gulf of Mexico during 1988, but this figure includes turtles that may have been struck by boats post mortem (USDOC, NMFS, 1989b).

Explosive platform removals can cause capillary damage, disorientation, and loss of motor control in marine turtles (Duronslet et al., 1986). Although marine turtles far from the site may suffer disorientation, those near detonation sites would likely sustain fatal injuries. Deaths have been suspected but not documented in previous explosive platform removals. Although marine turtles occur near offshore oil and gas structures, aerial surveys in the Central Gulf have shown that the only statistical correlation between marine turtles and offshore

structures occurs near the Chandeleur Islands, Louisiana (Lohofener, personal communication, 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-limited detonation, 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 cause injury or death. Marine turtles, particularly leatherbacks, are known to be attracted to floating plastic debris because it resembles 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 (Carr, 1987; USDOC, NOAA, 1988d; Heneman and the Center for Environmental Education, 1988; USDO, 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), prohibits the disposal of any plastics at sea or in coastal waters.

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. As mandated by the Oil Pollution Act of 1990, these areas are expected to receive individual consideration during oil-spill cleanup. Required oil spill contingency plans include special notices to minimize adverse effects from vehicular traffic during cleanup activities and to maximize protection efforts to prevent contact of these areas with spilled oil.

Oil spills can adversely affect marine turtles by toxic external contact, toxic ingestion or blockage of the digestive tract, disruption of salt gland function, asphyxiation, and displacement from preferred habitats (Vargo et al., 1986; Lutz and Lutcavage, 1989). Turtles may become entrapped by tar and oil slicks and rendered immobile (Witham, 1978; Plotkin and Amos, 1988). Hatchling and small juvenile turtles are particularly vulnerable to contacting or ingesting oil because the currents that concentrate oil spills also form the debris mats in which these turtles are sometimes found (Carr, 1980; Collard and Ogren, 1990). Fritts and McGehee (1982) noted that sea turtle eggs were damaged by contact with weathered oil from the *Ixtoc* spill.

When an oil spill occurs, the severity of effects and the extent of damage to marine turtles are affected by geographic location, oil type, oil dosage, impact area, oceanographic conditions, meteorological conditions, and season (NRC, 1985; USDO, MMS, 1987b). Adult marine turtles may not have the ability to detect and avoid an oil spill (Vargo et al., 1986), and eggs, hatchlings, and small juveniles are particularly vulnerable to contact (Fritts and McGehee, 1982; Lutz and Lutcavage, 1989). Contact with oil may not cause direct or immediate death but cumulative sublethal effects, such as salt gland disruption or liver impairment, could impair the marine turtle's ability to function effectively in the marine environment (Vargo et al., 1986; Lutz and Lutcavage, 1989).

Base Case Analysis

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

The impact from structure installation, pipeline placement, dredging, blowouts, and water quality and habitat degradation on seagrass bed and live-bottom sea turtle habitats are analyzed in detail in Sections IV.D.1.a.(1)-(3). It is expected that 10-15 ha of wetland loss will occur in the CPA as a result of OCS activities included in the proposed action. Up to 5.5 ha of wetlands and estuaries could be eroded along navigation channels in Louisiana and along the north Texas coast as a result of vessel traffic within the channels. The physical integrity, species diversity, and biological productivity of topographic features and live bottoms where marine turtles occur are expected to suffer only temporary damage. Small bottom areas could be disturbed by the proposed action for periods of a few weeks but recovery would be complete within one or two years. Offshore operational discharges are not known to be lethal to marine turtles and are diluted and dispersed rapidly within 1 km of the discharge point. Unfavorable effects on marine turtle food sources by water quality degradation have not been studied (API, 1989; NRC, 1983). Impacts on marine turtles from bottom

disturbance, structure installation, pipeline emplacement, blowouts, and dredging are expected to be indistinguishable from the long-term (25-50 years) natural variability within populations.

Suspended particulate matter in offshore operational discharges and blowouts is expected to reduce visibility, and may displace prey items in the vicinity. Marine turtles within 1 km of the discharge point are expected to be less able to locate prey for the short time period they would spend traversing the discharge plume.

Marine turtles can become entangled in or ingest trash and debris produced by the proposed action. Although leatherback turtles that mistake plastics for jellyfish may be singularly more vulnerable to stomach blockage, the limited amount of marine debris resulting from the proposed action is not expected to substantially harm a detectable number of marine turtles in the Gulf of Mexico.

Explosive platform removals can cause capillary damage, disorientation, loss of motor control, and fatal injuries in marine turtles. It is estimated that eight structures will be removed by explosives from the Central Gulf of Mexico as a result of the proposed action (Table IV-3). These removals are expected to occur during the last 12 years of the life of the proposed action. No more than three structures will be removed in the CPA in any given year, and some removals will occur beyond the continental shelf. While pelagic marine turtles occur in deep-water habitats, there is no correlation between marine turtles and the presence of offshore structures beyond the shelf break. No deaths or serious impacts to marine turtles are expected to result from platform removals because of MMS guidelines for explosive removals (USDOL, MMS, 1990a; and Biological Opinions, Appendix B). Marine turtles are also widely distributed in the CPA, and their densities would not be expected to be high near the vicinity of platform removals.

It is assumed that about 530 OCS-related offshore (Table IV-2) oil and gas service-vessel trips but no shuttle tanker trips, will occur during the peak year of the 35-year life of the proposed action. Noise from service-vessel traffic may elicit a startle reaction from marine turtles, but this is a temporary disturbance. Collision between service vessels and surfaced marine turtles would likely cause fatal injuries. However, service-vessel traffic and marine turtles will seldom be in proximity, and marine vessel operators can avoid marine turtles and reduce potential deaths. The OCS service-vessel traffic's contribution to the total 9 percent estimated marine turtle deaths from this source is expected to vary according to location and trends in OCS waterway use.

Oil spills and oil-spill response activities, such as beach sand removal, can negatively affect marine turtles. Although oil-spill response activities such as vehicular and vessel traffic during nesting season are assumed to contact marine turtle habitats, harm to marine turtles is expected to be minimized because of protection efforts to prevent contact of these areas with spilled oil as mandated by the Oil Pollution Act of 1990. Loggerhead turtle nesting areas in the Chandeleur Islands, Cape Breton National Seashore, and central Gulf States would also be expected to receive special cleanup considerations under these regulations.

Eighteen offshore (Table IV-2) and 11 onshore Size 1 spills are assumed to occur during the 35-year life of the proposed action. One offshore (Table IV-2) and two onshore Size 2 spills (Table IV-13) are assumed to occur during the 35-year life of the proposed action. A few marine turtles may encounter and become fouled by Size 1 and Size 2 oil spills at sea or in coastal waters, and the biological and behavioral effects identified above could occur.

One Size 3 crude oil spill is expected to occur offshore within 10 days from either a platform or pipeline in the Central Gulf during the 35-year life of the proposed action (Table IV-2). The highest estimated probability of this oil spill contacting coastal areas where marine turtles occur is 1 percent (Plaquemines coastal area, Table IV-10). No spills of this size are expected onshore in the CPA (Table IV-13). Since marine turtle habitat in the Gulf includes both inshore and offshore areas, marine turtles could possibly be contacted by a spill-related spill of this size. Few deaths are expected because of the small area of contact involved, the rapid dispersion and loss of oil, and the low density of marine turtles in the area. However, nonlethal biological and behavioral impacts could temporarily disturb oiled marine turtles.

It is expected that the extent and severity of effects from any spill-related oil spill will be lessened by coastal oil-spill contingency planning and by possible avoidance of oil spills by marine turtles.

Summary

Structure installation, dredging, water quality and habitat degradation, operational discharges, blowouts, OCS-related trash and debris, vessel traffic, explosive platform removals, oil-spill response activities, and oil spills resulting from the proposed action may be expected to harm or debilitate marine turtles. The threat of impacts from oil spills, oil spill response activities, and explosive platform removals are greatly reduced by spill contingency planning and the Oil Pollution Act of 1990. Marine turtles may avoid OCS disturbances by shifting their feeding and resting areas to an undisturbed area.

Conclusion

The proposed action is expected to temporarily disturb some marine turtles and their habitats, but deaths are expected to be rare. All disturbances are expected to be temporary, and marine turtles are expected to recover from within a period of weeks to months.

High Case Analysis

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

Impacts from structure installation, pipeline placement, dredging, blowouts, and habitat and water quality degradation on seagrass bed and live-bottom sea turtle habitat is analyzed in detail in Sections IV.D.1.a.(1) and (2).

Up to 10-15 ha of wetlands are projected to be lost in the CPA as a result of all activities under the proposed action. Up to 11 ha of wetlands and estuaries could be eroded along navigation channels in Louisiana and along the north Texas coast. Little or no damage is expected to befall the physical integrity, species, diversity, or biological productivity of topographic features or live bottoms.

Offshore operational discharges are diluted and dispersed rapidly within 1 km of the discharge point. Disturbance and degradation in water quality effects on marine turtle food sources are not expected to be detectable (API, 1989; NRC, 1983). Disturbances to marine turtle behavior and movements caused by operational discharges from the High Case are not expected to be distinguishable from those produced by long-term (25-50 years) alteration of Gulf water quality and coastal habitat degradation. Marine turtles may avoid disturbed live-bottom areas for up to a month and shift their foraging areas; however, this avoidance of impoverished foraging areas will have no distinguishable effect on marine turtles. Suspended particulate matter in operational discharges and blowouts may reduce marine turtles' ability to visually locate their prey. Marine turtles may avoid this disturbance by shifting their foraging or resting areas.

The OCS-related trash and debris will be accidentally lost into the Gulf and will pose a threat to marine turtles, but this risk is minimized by offshore dumping prohibitions (30 CFR 250.40).

The 15 structures will be removed from the Gulf of Mexico using explosives (Table IV-2). These removals are expected to occur during the last 12 years of the life of the proposed action. No more than eight removals are expected in any single year. Some of the removals will occur in habitats beyond the continental shelf. No marine turtle deaths are expected because of the MMS' explosive removals guidelines that require prior survey and minimum explosives (USDOL, MMS, 1990a, Appendix B).

It is assumed that about a maximum of 1,240 OCS-related oil and gas service-vessel trips and no shuttle tanker trips will occur annually in a peak year during the 35-year life of the proposed action (Table IV-2). Disturbances will occur as described in the Base Case and the impact of service-vessel traffic is expected to comprise a greater fraction of the 9 percent total of all marine turtle vessel-related deaths in the Gulf of Mexico.

It is expected that oil-spill response activities will contact and affect marine turtle habitat. The extent and severity of effects from any sale-related oil spill will be lessened by coastal oil-spill contingency planning.

One offshore and no onshore Size 3 oil spills from either a platform or pipeline (Table IV-13) and two offshore and five onshore Size 2 oil spills (Table IV-13) are assumed to occur during the 35-year life of the proposed action (Table IV-2). Forty-one offshore and 25 onshore Size 1 spills are expected to occur during the 35-year life of the proposed action; a few will contact land (Table IV-2). The highest estimated probability of one or more Size 3 oil spills occurring and contacting marine turtle habitat within 10 days in the Central Gulf is 1 percent (West Plaquemines coastal barrier, Table IV-10). The largest spills may contact and harm marine turtles, but impacts are expected to be lessened by oil spill planning and response.

Structure installation, dredging, water quality and habitat degradation, operational discharges, blowouts, OCS-related trash and debris, vessel traffic, explosive platform removals, oil-spill response activities, and oil spills resulting from the proposed action may be expected to harm or debilitate some marine turtles. Impacts from oil spills, oil-spill response activities, and explosive platform removals are expected to be greatly reduced by oil spill contingency planning and by MMS and Biological Opinion stipulations. Marine turtles may avoid OCS disturbances by shifting their feeding and resting areas to an undisturbed area.

Conclusion

The High Case is expected to temporarily disturb some marine turtles and their habitats, but the number of deaths is expected to be low. Most disturbances are expected to be temporary, and marine turtles are expected to recover within a period of weeks to months.

(8) Impacts on Coastal and Marine Birds

This section discusses the possible effects of the proposed action on coastal and marine birds of the Gulf of Mexico and its contiguous waters and wetlands. Major impact-producing factors that could impact marine birds in the offshore environment include oil and fuel spills, spill-response activities, and discarded trash and debris from service vessels and offshore structures. Impact-producing factors in the inshore and coastal environment include oil, fuel, and other pollutant spills and spill-response activities; trash and debris discarded from service vessels, coastal infrastructure, and offshore structures; disturbances from OCS onshore and coastal service and transport operations; habitat loss, modification, and degradation from onshore infrastructure (both existing and planned); and degradation of water quality.

Direct oil contact with birds is usually fatal as a result of hypothermia, shock, drowning, and starvation (Knaus, 1990; Vermeer and Vermeer, 1975; Fry and Lowenstine, 1985). Oil and tar readily fouls and mats plumage, with subsequent loss of water repellency, thermal insulation, buoyancy, and the ability to fly and forage (Ambrose, 1990; Fry et al., 1985; Clark and Gregory, 1971). An oiled bird will preen its contaminated feathers and down in an effort to remove the oil and/or tar, often denuding areas of the body, which accelerates the loss of body heat. Preening also results in incidental ingestion and inhalation of oil with accompanying secondary toxic effects (Butler et al., 1988; Levy, 1983). Oil can also be directly transferred to incubating eggs or chicks by the adult. Consequential toxic effects of ingested oil can be highly variable, depending upon the type of oil and amount ingested. Toxicity can be acute, with resultant physiological changes and damage to internal organs; or can produce long-term effects in exposed adults, chicks exposed to oil or fed contaminated food, and in chicks hatched from eggs of exposed birds (Fry et al., 1985). Birds contaminated during the nesting period typically exhibit a decrease in egg production, fertility, and hatchability in proportion to the concentration of oil (Butler et al., 1988; Lewis and Malecki, 1984; Vangilder and Peterle, 1981; Macko and King, 1980; Szaro et al., 1980; Miller et al., 1978; Albers, 1977; Hartung, 1965). Chicks often show reduced survival and growth rates, with some species-specific differences in sensitivity (Trivelpiece et al., 1986). Chick mortality during the brood phase can also result from temporary desertion by oil-contaminated adults (Butler et al., 1988).

The magnitude of bird mortality following an oil spill depends on the size of the local bird population (oftentimes a function of season), their foraging behavior(s), whether or not the population is aggregated or dispersed into smaller subunits at the time of the spill, and the quantity of oil spilled and its persistence in the environment (NRC, 1985). The birds most vulnerable to direct effects include those species that spend most

of their time swimming on and under the sea surface, and often aggregate in dense flocks (Piatt et al., 1990; Vauk et al., 1989). This group includes loons, grebes, sea ducks and pochards, and cormorants. Coastal birds, including shorebirds, waders, marsh birds, and certain waterfowl, may be the hardest hit indirectly through destruction of their feeding habitat and/or food source (Hansen, 1981; Vermeer and Vermeer, 1975). Direct oiling of coastal birds and certain seabirds is usually minor; as a result of their foraging behaviors many of these birds are merely stained (Vermeer and Vermeer, 1975). Population recovery following destruction of a local breeding colony or a large group of wintering migrants would likely be slow for many species because of their inherently low reproductive potential and/or distance to neighboring colonies, which may act as refugia by attracting recruits (Cairns and Elliot, 1987; Trivelpiece et al., 1986; Samuels and Ladino, 1983/1984). Moreover, oil-induced decreases in reproductive success would probably be masked for at least several seasons as a result of delayed sexual maturity of many coastal and marine species (Butler et al., 1988).

Oil spill clean-up methods often require heavy trafficking of beaches and wetland areas, application of oil dispersant and bioremediation chemicals, and the distribution and collection of oil containment booms and absorbent material. The presence of humans, along with boats, aircraft, and other technological creations, will result in additional disturbance of coastal birds after a spill. Investigations have shown that oil dispersant mixtures pose a threat similar to that of oil to the reduction of productivity in birds (Albers, 1979; Albers and Gay, 1982). The external exposure of adult birds to oil/dispersant emulsions may reduce chick survival more than exposure to oil alone would; however, successful dispersal of a spill will generally reduce the probability of exposure of coastal and marine birds to oil (Butler et al., 1988).

Coastal and marine birds are highly susceptible to entanglement in floating, submerged, and beached marine debris; specifically in plastics discarded from both offshore sources and land-derived litter and waste disposal (Heneman and the Center for Environmental Education, 1988). Studies in Florida reported that 80 percent of brown pelicans showed signs of injury from entanglement with fishing gear (Clapp and Buckley, 1984). In addition, seabirds ingest plastic particles and other marine debris more frequently than do any other taxon (Ryan, 1990a). Ingested debris may have three basic effects on seabirds: irritation and blockage of the digestive tract, impairment of foraging efficiency, and release of toxic chemicals (Ryan, 1990; Sileo et al., 1990a). Long-term effects of plastic ingestion may include physical deterioration due to malnutrition; plastics often cause a distention of the stomach, thus preventing its contraction and simulating a sense of satiation (Ryan, 1988). Some birds also feed plastic debris to their young, which could result in reproductive failure. The chemical toxicity of some plastics can be high and can pose a significant hazard in addition to obstruction and impaction of the gut (Fry et al., 1987). Sileo et al. (1990b) found that the prevalence of ingested plastic found within the gut of examined birds varied greatly among species. Those species that seldom regurgitate indigestible stomach contents are most prone to the aforementioned adverse effects (Ryan, 1990). Within the Gulf of Mexico, these include the phalaropes, petrels, storm-petrels, and shearwaters. The MMS prohibits the disposal of equipment, containers, and other materials into coastal and offshore waters by operators (30 CFR 250.40). Prohibition of the discharge and disposal of vessel- and offshore structure-generated garbage and solid waste into either offshore or coastal waters was established January 1, 1989, via the enactment of MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which is enforced by the U.S. Coast Guard.

The transportation or exchange of supplies, materials, and personnel between coastal infrastructure and offshore oil and gas structures is accomplished with helicopters and a variety of service vessels. Disturbances from OCS-related traffic to coastal birds can result from the mechanical noise or physical presence (or wake) of the vehicle. The degree of disturbance exhibited by groups of coastal birds to the presence of air or vessel traffic is highly variable, depending upon the species in question, type of vehicle, altitude or distance of the vehicle, the frequency of occurrence of the disturbance, and the season. Encounters of this sort can often result in a temporary cessation of feeding, resting, breeding, or nesting activities. Disturbance can also lead to a permanent desertion of active nests or of critical or preferred habitat, which could contribute to the relocation of a species or group to less favorable areas or to a decline of species through reproductive failure.

Pipeline landfalls and terminals, and other onshore OCS-related construction can destroy coastal bird feeding or nesting habitat and can displace coastal bird populations from affected areas. Inshore pipelines cross a wide variety of coastal environments, including freshwater marsh and canals, which can affect certain species generally not associated with marine or estuarine systems. These include certain waders, marsh birds, shorebirds, and waterfowl.

Degradation of coastal and estuarine water quality as a result of OCS-related activities can impact coastal birds directly by means of acute or chronic toxic effects from ingestion or contact, or indirectly through the contamination of food sources. Seabirds (e.g., laughing gulls), which remain and feed in the vicinity of offshore OCS structures and platforms, could also be impacted from operational discharges or runoff in the offshore environment. These impacts could also be both direct or indirect.

(a) Nonendangered and Nonthreatened Species

The Gulf of Mexico is populated by resident and migratory species of coastal and marine birds. This broad category consists of five main groups: seabirds, shorebirds, wading birds, marsh birds, and waterfowl. The major impact-producing factors analyzed below are related to the proposed action and include oil spills, oil spill-response activities, degradation of water quality resulting from OCS discharges, OCS helicopter and service-vessel traffic and noise, habitat loss and modification resulting from pipeline landfalls and coastal facility construction, and discarded trash and debris from service-vessels and OCS structures.

Base Case Analysis

Section IV.A.3.h.(2) estimates the mean number of Size 1 and Size 2 spills occurring from the proposed action in the CPA. It is assumed that 18 Size 1 offshore spills and 11 Size 1 onshore spills 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 Size 2 spill will occur during the 35-year life of the proposed action and that it will not contact the coastline. Most Size 1 spills related to the proposed action are predicted to occur near or at OCS-related transfer facilities, and will not contact wetlands and other biologically sensitive coastal areas. For the purpose of this analysis, Size 1 and Size 2 onshore spills will rarely contact and affect feeding, resting, or nesting habitats within the CPA. Size 1 onshore spills, which occur away from transfer facilities, and the Size 2 spill are expected to result in some degradation of habitat, physical oiling of birds, and some degree of both acute and chronic physiological stress associated with direct and secondary uptake of oil. Onshore pipeline spills and spills resulting from accidents in navigation waterways can contact and affect many of the different groups of coastal and marine birds, most commonly marsh birds, waders, waterfowl, and certain shorebirds. Some bird death from these groups are to be expected; recruitment through successful reproduction is expected to take several years, depending upon the species and existing conditions.

Section IV.A.3.h.(2) estimates the mean number of Size 3 oil spills resulting from the proposed action in the CPA. It is assumed that one Size 3 crude oil spill 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). No spills are projected from OCS tankering. Table IV-10 identifies the estimated risk of one or more Size 3 oil spills occurring and contacting within 10 days feeding, resting, or nesting habitats of coastal and marine birds in the CPA. The highest estimated probability of one or more Size 3 spills occurring and contacting within 10 days deltaic marshes is 1 percent. For the purpose of this analysis, a Size 3 oil spill will rarely contact and affect the feeding, resting, or nesting habitats in the CPA. The effect from a Size 3 oil spill on coastal and marine birds is expected to be negligible.

Degradation of coastal and inshore water quality resulting from OCS-related discharges is expected to impact coastal and marine birds within these areas.

Helicopter and service-vessel traffic related to OCS activities could sporadically disturb feeding, resting, or nesting behavior of birds or cause abandonment of preferred habitat. This impact-producing factor could contribute to indirect population loss through reproductive failure resulting from nest abandonment. The FAA (Advisory Circular 91-36C) and corporate helicopter policy states that helicopters must maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. When flying over land, the specified minimum altitude is 1,000 ft over unpopulated areas or across coastlines, and 2,000 ft over populated areas and biologically sensitive areas such as wildlife refuges and national parks. Many undisturbed coastal areas and refuges provide preferred and/or critical habitat for feeding, resting (or staging), and nesting birds. The effects of low-flying aircraft within the vicinity of aggregations of birds on the ground or on the

water typically results in mass disturbance and abandonment of the immediate area. Compliance to the specified minimum altitude requirements is expected to significantly reduce effects of aircraft disturbance on coastal and marine birds. It is expected, however, that approximately 10 percent of helicopter trips will occur at altitudes somewhat below the minimums listed above as a result of inclement weather. Although these incidents are very short term in duration and sporadic in frequency, they can disrupt coastal bird behavior and, at worst, possibly result in habitat or nest abandonment. Birds in flight over water typically avoid helicopters; temporary disruption of feeding or flight paths is expected when encountering low-flying helicopters. It is estimated that there will be about 4,300 helicopter flights across coastal areas annually, with 430 flying at altitudes somewhat below specified minimums. For this analysis, helicopter traffic will periodically disturb coastal and marine birds, but will maintain general adherence to FAA and corporate helicopter protocol on service altitudes.

It is assumed that about 240 OCS-related oil and gas service-vessel trips, 12 barge trips, and no shuttle tanker trips will occur during the 35-year life of the proposed action (Tables IV-2 and IV-13). Service vessels will use selected nearshore and coastal (inland) navigation waterways, or corridors, and adhere to protocol set forth by the Coast Guard for reduced vessel speeds within these inland areas. Routine presence and low speeds of service vessels within these waterways diminishes the effects of disturbance from service vessels on nearshore and inland populations of coastal and marine birds. For the purpose of this analysis, service-vessel traffic will seldom disturb populations of coastal and marine birds existing within these areas. The effects of service-vessel traffic on birds offshore are negligible.

The greatest negative impact to coastal and marine birds is the extent of preferred or critical habitat loss or degradation. The extent of bird displacement resulting from habitat loss is highly variable between different species, based upon specific habitat requirements and availability of similar habitat in the area. Generally, destruction of habitat from OCS pipeline landfalls and onshore construction displaces localized groups or populations of these species. As these birds move to undisturbed areas of similar habitat, their presence augments habitat utilization pressure on these selected areas as a result of intra- and interspecific competition for space and food. It is assumed that no new OCS oil- and gas-related pipeline landfalls or coastal facilities will be constructed within the CPA. For the purpose of this analysis, it is estimated that OCS pipeline landfalls and onshore construction will not interact with feeding, resting, or nesting habitats of Gulf coastal and marine birds.

Coastal and marine birds are commonly entangled and snared in discarded trash and debris. In addition, many species will readily ingest small plastic debris, either intentionally or incidentally. Interaction with plastic materials is therefore very serious, and can lead to permanent injuries and death. It is expected that coastal and marine birds will seldom become entangled in or ingest OCS-related trash and debris as a result of MMS prohibitions on the disposal of equipment, containers, and other materials into offshore waters by lessees (30 CFR 250.40). In addition, MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. For the purpose of this analysis, OCS oil- and gas-related plastic debris will seldom interact with coastal and marine birds, and therefore, the effect will be negligible.

Summary

Activities resulting from the Base Case are expected to affect coastal and marine birds of the CPA. It is expected that the majority of effects from the major impact-producing factors on coastal and marine birds are sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris), causing temporary disturbances and displacement of localized groups onshore. Chronic sublethal stress, however, is often undetectable in birds. It can serve to weaken individuals (which is especially serious for migratory species), and expose them to infection and disease. Lethal effects result primarily from uncontained onshore oil spills and associated spill-response activities. Spills occurring in biologically sensitive areas are expected to kill a number of individuals from any or all groups. The net effect will be the alteration of the species composition of the affected area(s) and possibly the reduction of the overall carrying capacity of these area(s) in general. Recovery of affected areas is expected to take up to several years.

Conclusion

Nonendangered and nonthreatened coastal and marine birds may encounter periodic disturbance and temporary displacement of localized groups and individuals from proposed activities. Decreases in numbers of adults and/or nests could occur as a result of oil spills and spill related coastal habitat loss or degradation. Groups experiencing the loss of individuals would require up to several years to recover to a pre-disturbance condition, depending on the species and existing conditions.

High Case Analysis

Nonendangered and nonthreatened coastal and marine birds may be effected by various sale-related activities. The major impact-producing factors analyzed include oil spills and oil spill-response activities, degradation of water quality resulting from OCS discharges, OCS helicopter and service-vessel traffic and noise, habitat loss or modification resulting from pipeline landfalls and coastal facility construction, and discarded trash and debris from service-vessels and OCS structures.

Section IV.A.3.h.(2) estimates the mean number of Size 1 and Size 2 spills occurring from the proposed action in the CPA. It is assumed that 41 Size 1 offshore spills and 25 Size 1 onshore spills will occur during the 35-year life of the proposed action. None of the offshore spills will contact the coastline. It is assumed that two Size 2 offshore spills and five Size 2 onshore spills will occur during the 35-year life of the proposed action. One of the offshore spills will contact the coastline. Many of the onshore spills are expected to occur in direct association with transfer facilities and will not, as a result, impact wetlands and other biologically sensitive habitats. For the purpose of this analysis, Size 1 and Size 2 offshore spills will seldom contact and affect feeding, resting, or nesting habitats within coastal areas. The effect on these species is expected to be minor.

Section IV.A.3.h.(2) estimates the mean number of Size 3 offshore oil spills resulting from the proposed action in the CPA. It is assumed that one Size 3 crude oil spill will occur from either a platform or pipeline and none will originate from OCS tankering in the Central Gulf during the 35-year life of the proposed action (median size is 6,500-bbl). Table IV-10 identifies the estimated risk of one or more Size 3 oil spills occurring and contacting within 10 days feeding, resting, or nesting habitats in coastal areas. The highest probability of one or more Size 3 spills occurring and contacting a coastal bay in the Central Gulf is 1 percent (Timbalier Bay). The probability of occurrence for deltaic marshes is 2 percent. Therefore, a Size 3 offshore oil spill will rarely contact and affect critical or preferred coastal habitats for birds in the CPA. The effect from Size 3 oil spills on Gulf coastal and marine birds is expected to be negligible.

Helicopter and service-vessel traffic related to OCS activities could sporadically disturb feeding, resting, or nesting behavior of birds or cause abandonment of preferred habitat. This could contribute to indirect population loss through reproductive failure resulting from nest abandonment. The FAA (Advisory Circular 91-36C) and corporate helicopter policy states that helicopters must maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. When flying over land, the specified minimum altitude is 1,000 ft over unpopulated areas or across coastlines, and 2,000 ft over populated areas and biologically sensitive areas such as wildlife refuges and national parks. Many undisturbed coastal areas and refuges provide important and/or critical habitat for feeding, resting (or staging), and nesting birds. The effects of low-flying aircraft within the vicinity of aggregations of birds on the ground typically results in mass disturbance and abandonment of the immediate area. Compliance to the specified minimum altitude requirements is expected to significantly reduce effects of aircraft disturbance on coastal and marine birds. It is expected, however, that approximately 10 percent of helicopter trips will occur at altitudes somewhat below the minimums listed above as a result of inclement weather. Although these incidents are very short term in duration and sporadic in frequency, they can disrupt coastal bird behavior and, at worst, possibly result in habitat or nest abandonment. Birds in flight over water typically avoid helicopters; temporary disruption of feeding or flight paths is expected when encountering low-flying helicopters. It is estimated that there will be about 11,000 helicopter flights across coastal areas annually, with about 1,100 flying at altitudes somewhat below specified minimums. For this analysis, it is assumed that this extent of helicopter traffic will periodically disturb coastal and marine birds; general adherence to FAA and corporate helicopter protocol on service altitudes will serve to reduce the level of disturbance.

It is assumed that 537 OCS-related oil and gas service-vessel trips, 13 barge trips, and no shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-2). Service vessels will use selected nearshore and coastal (inland) navigation waterways, or corridors, and adhere to protocol set forth by the Coast Guard for reduced vessel speeds within inland areas. Routine presence and low speeds of service vessels within these waterways effectively diminishes the effects of disturbance from service vessels on nearshore and inland populations of coastal and marine birds. For the purpose of this analysis, service-vessel traffic will seldom disturb coastal and marine birds occurring within these areas. The effects on birds offshore are negligible.

The greatest negative impact to these species is the extent of preferred or critical habitat loss and degradation within coastal areas. The extent of bird displacement resulting from habitat loss is highly variable between species, based upon specific habitat requirements and availability of similar habitat in the area. Generally, destruction of habitat from OCS pipeline landfalls and onshore construction displaces localized groups or populations of these species. As these birds move to undisturbed areas of similar habitat, their presence augments habitat utilization pressure on these selected areas as a result of intra- and interspecific competition for space and food. 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 OCS pipeline landfalls and onshore construction will not interact with feeding, resting, or nesting habitats of coastal and marine birds within the CPA.

Coastal and marine birds are commonly entangled and snared in discarded trash and debris. In addition, many species will readily ingest small plastic debris, either intentionally or incidentally. Interaction with plastic materials is therefore very serious, and can cause permanent injuries and death. It is expected that coastal and marine birds will seldom become entangled in or ingest OCS-related trash and debris as a result of MMS prohibitions on the disposal of equipment, containers, and other materials into offshore waters by lessees (30 CFR 250.40). In addition, MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. For the purpose of this analysis, OCS oil- and gas-related plastic debris will seldom interact with Gulf coastal and marine birds, and therefore, the effect will be negligible.

Conclusion

Nonendangered and nonthreatened coastal and marine birds may encounter periodic disturbance and temporary displacement of localized groups and individuals from proposed activities. Decreases in numbers of adults and/or nests could occur as a result of OCS-related oil spills and spill related coastal habitat loss. Groups experiencing the loss of individuals would require up to several years to recover to a pre-disturbance condition, depending on the species and existing conditions.

(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, piping plover, and least tern. It summarizes and incorporates the discussion of the effects on the coastal and marine birds in Section IV.D.1.a.(8)(a) (nonendangered and nonthreatened birds) and additional information as cited. Oil spills, oil spill-response activities, degradation of water quality resulting from OCS discharges, OCS helicopter and service-vessel traffic and noise, habitat loss or modification resulting from pipeline landfalls and coastal facility construction, and discarded trash and debris from service-vessels and OCS structures 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.(8)(a)).

Base Case Analysis

Section IV.A.3.h.(2) estimates the mean number of Size 1 and Size 2 spills occurring from the proposed action in the CPA. It is assumed that 18 Size 1 offshore spills and 11 Size 1 onshore spills 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 Size 2 spill will occur during the 35-year life of the proposed action and that it will not contact the coastline. Most Size 1 spills related to the proposed action are predicted to occur near or at OCS-related transfer facilities, and will not contact wetlands and other biologically sensitive coastal areas. For the purpose of this analysis, it is assumed that Size 1 and Size 2 onshore spills will rarely contact and affect feeding, resting, or nesting habitats for endangered species of birds within wetland or other inland areas. Size 1 onshore spills away from transfer facilities and the Size 2 spill are expected to result in some degradation of habitat (such as spoil banks that provide nesting and feeding habitats for congregations of pelicans and plovers, respectively), physical oiling of individuals or local groups of birds, and some degree of both acute and chronic physiological stress associated with direct and secondary uptake of oil. Raptors, such as the bald eagle and peregrine falcon, feed upon weakened or dead birds (and fish, in the case of the eagle) and may as a result become physically oiled or affected by the ingestion of the oiled prey. Pelicans are active swimmers, and plunge dive for prey. They are, therefore, very susceptible to both physical oiling and secondary effects via ingestion of oiled prey, i.e., fish. Plovers congregate and feed along tidally exposed banks and shorelines. They can be physically oiled while foraging on oiled shores, or secondarily affected through ingestion of oiled intertidal sediments and prey. The least tern captures fish by means of shallow splash diving and surface dipping techniques. Some physical oiling could occur during these dives, as well as secondary toxic effects through the uptake of prey. It is possible that some death of endangered species could occur, especially if the onshore spill(s) occur during winter months when raptors and plovers are most common along the coastal Gulf, or if spills occur within preferred or critical habitat for all representatives.

Section IV.A.3.h.(2) estimates the mean number of Size 3 oil spills resulting from the proposed action in the CPA. It is assumed that one Size 3 crude oil spill 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). No spills are projected from OCS tankering. Table IV-10 identifies the estimated risk of one or more Size 3 oil spills occurring and contacting within 10 days feeding, resting, or nesting habitats of endangered coastal and marine birds in the CPA. The highest estimated probability of one or more Size 3 spills occurring and contacting within 10 days deltaic marshes is 1 percent. For the purpose of this analysis, a Size 3 oil spill will rarely contact and affect the feeding, resting, or nesting habitats in the CPA. The effect from a Size 3 oil spill on endangered birds is expected to be negligible.

Degradation of coastal water quality through OCS discharges is expected to impact endangered bird species of the CPA.

Helicopter and service-vessel traffic related to OCS activities could sporadically disturb feeding, resting, or nesting behavior of birds or cause abandonment of preferred habitat. This impact-producing factor could contribute to indirect population loss through reproductive failure resulting from nest abandonment. The FAA (Advisory Circular 91-36C) and corporate helicopter policy states that helicopters must maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. When flying over land, the specified minimum altitude is 1,000 ft over unpopulated areas or across coastlines, and 2,000 ft over populated areas and biologically sensitive areas such as wildlife refuges and national parks. Many undisturbed coastal areas and refuges provide preferred and/or critical habitat for feeding, resting (or staging), and nesting birds. The effects of low-flying aircraft within the vicinity of aggregations of birds on the ground or on the water typically results in mass disturbance and abandonment of the immediate area. Compliance to the specified minimum altitude requirements is expected to significantly reduce effects of aircraft disturbance on coastal and marine birds. It is expected, however, that approximately 10 percent of helicopter trips will occur at altitudes somewhat below the minimums listed above as a result of inclement weather. Although these incidents are very short term in duration and sporadic in frequency, they can disrupt bird behavior within coastal areas and, at worst, possibly result in habitat or nest abandonment. Birds in flight over water typically avoid helicopters; temporary disruption of feeding or flight paths is expected when encountering low-flying helicopters. It is estimated that there will be about 4,300 helicopter flights across coastal areas annually, with 430 flying at altitudes somewhat below specified minimums. For this analysis, helicopter traffic will periodically disturb endangered birds, but will maintain general adherence to FAA and corporate helicopter protocol on service altitudes.

It is assumed that about 240 OCS-related oil and gas service-vessel trips and 12 barge trips will occur annually as a result of the proposed action. It is also assumed that no shuttle tanker trips will occur during the

35-year life of the proposed action (Tables IV-2 and IV-13). Service vessels will use selected nearshore and coastal (inland) navigation waterways, or corridors, and adhere to protocol set forth by the Coast Guard for reduced vessel speeds within these inland areas. Routine presence and low speeds of service vessels within these waterways diminishes the effects of disturbance from service vessels on nearshore and inland populations of coastal and marine birds. For the purpose of this analysis, service-vessel traffic will seldom disturb populations of endangered birds existing within these areas. The effects of service-vessel traffic on birds offshore are negligible.

The greatest negative impact to endangered coastal and marine birds is the extent of preferred or critical habitat loss. Effects from habitat loss are highly variable between different species, based upon specific habitat requirements and availability of similar habitat in the area. Destruction of habitat from OCS pipeline landfalls and onshore construction displaces localized groups or populations of coastal and marine birds, including endangered species. As these birds move to undisturbed areas of similar habitat, their presence augments habitat utilization pressure on these selected areas as a result of intra- and interspecific competition for space and food. 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 OCS pipeline landfalls and onshore construction will not interact with feeding, resting, or nesting habitats of endangered birds.

Coastal and marine birds are commonly entangled and snared in discarded trash and debris. In addition, many species such as the brown pelican and least tern will readily ingest small plastic debris, either intentionally or incidentally. Interaction with plastic materials is therefore very serious, and can lead to permanent injuries and death. It is expected that endangered birds will seldom become entangled in or ingest OCS-related trash and debris as a result of MMS prohibitions on the disposal of equipment, containers, and other materials into offshore waters by lessees (30 CFR 250.40). In addition, MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. For the purpose of this analysis, OCS oil- and gas-related plastic debris will seldom interact with endangered birds within the Central Gulf, and therefore, the effect will be negligible.

Summary

Activities resulting from the Base Case are expected to affect endangered species of birds along coastal areas of the Central Gulf. It is expected that the majority of effects from the major impact-producing factors on these species are sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris), causing temporary disturbances and displacement of individuals or localized groups onshore. Chronic sublethal stress, however, is often undetectable in birds, and can be masked for some period of time. It can serve to weaken individuals (which is especially serious for migratory species), and expose them to infection and disease. Lethal effects result primarily from uncontained onshore oil spills and associated spill-response activities, and are especially serious for endangered species. Any reductions in population size represents a threat to their existence. The net effect will be the alteration of species composition and possibly the reduction of the overall carrying capacity of disturbed area(s) in general.

Conclusion

Endangered and threatened birds may encounter periodic displacement of individuals and/or localized groups from proposed activities. Decreases in numbers of adults and/or nests could occur as a result of OCS-related oil spills and spill-related coastal habitat loss. The loss of individuals represents a serious loss to the regional population(s); restoration of numbers to a pre-disturbance state would require up to several years, depending on the species and existing conditions.

High Case Analysis

Endangered and threatened coastal and marine birds may be affected by various sale-related activities. The major impact-producing factors analyzed include oil spills and oil spill-response activities, degradation of water quality resulting from OCS discharges, OCS helicopter and service-vessel traffic and noise, habitat loss

or modification resulting from pipeline landfalls and coastal facility construction, and discarded trash and debris from service-vessels and OCS structures.

Section IV.A.3.h.(2) estimates the mean number of Size 1 and Size 2 spills occurring from the proposed action in the CPA. It is assumed that 41 Size 1 offshore spills and 25 Size 1 onshore spills will occur during the 35-year life of the proposed action. None of the offshore spills will contact the coastline. It is assumed that two Size 2 offshore spills and five Size 2 onshore spills will occur during the 35-year life of the proposed action. One of the offshore spills will contact the coastline. Many of the onshore spills are expected to occur in direct association with OCS-related transfer facilities and will not, as a result, impact wetlands and other biologically sensitive coastal areas. For the purpose of this analysis, Size 1 and Size 2 spills will seldom contact and affect feeding, resting, or nesting habitats in coastal areas of the CPA. Uncontained Size 1 onshore spills are expected to result in some degradation of habitat (such as spoil banks that provide resting or feeding habitat for congregations of pelicans and plovers, respectively), physical oiling of individuals or local groups of birds, and some degree of both acute and chronic physiological stress associated with direct and secondary uptake of oil. Raptors, such as the bald eagle and peregrine falcon, feed upon weakened or dead birds (and fish, in the case of the eagle), and may as a result become physically oiled or affected by the ingestion of the oiled prey. Pelicans are active swimmers, and plunge dive for prey. They are, therefore, very susceptible to both physical oiling and secondary effects via ingestion of oiled prey, i.e., fish. Plovers congregate and feed along tidally exposed banks and shorelines. They can be physically oiled while foraging on oiled shores, or secondarily affected through the ingestion of oiled intertidal sediments and prey. The least tern captures fish by means of shallow splash diving and surface dipping techniques. Some physical oiling could occur during these dives, as well as secondary toxic effects through the uptake of prey. It is possible that some death of endangered species could occur, especially if the onshore spill(s) occur during winter months when raptors and plovers are most common along the coastal Gulf, or if spills occur, within preferred or critical habitat for all representatives.

Section IV.A.3.h.(2) estimates the mean number of Size 3 offshore oil spills resulting from the proposed action in the CPA. It is assumed that one Size 3 crude oil spill will occur from either a platform or pipeline and none will originate from OCS tankering in the Central Gulf during the 35-year life of the proposed action (median size is 6,500-bbl). Table IV-10 identifies the estimated risk of one or more Size 3 oil spills occurring and contacting feeding, resting, or nesting habitats in the CPA within 10 days. The highest probability of one or more Size 3 oil spills occurring and contacting within 10 days a coastal bay in the Central Gulf is one percent (Timbalier Bay). This probability of occurrence for deltaic marshes is 2 percent. For the purpose of this analysis, a Size 3 offshore oil spill will rarely contact and affect the feeding, resting, or nesting habitats of endangered species in the CPA. Therefore, the effect from Size 3 oil spills on endangered species is expected to be negligible.

Degradation of water quality resulting from OCS discharges is expected to affect endangered bird species of the CPA.

Helicopter and service-vessel traffic related to OCS activities could sporadically disturb feeding, resting, or nesting behavior of birds or cause abandonment of preferred habitat. This impact-producing factor could contribute to indirect population loss through reproductive failure resulting from nest abandonment. The FAA (Advisory Circular 91-36C) and corporate helicopter policy states that helicopters must maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. When flying over land, the specified minimum altitude is 1,000 ft over unpopulated areas or across coastlines, and 2,000 ft over populated areas and biologically sensitive areas such as wildlife refuges and national parks. Many undisturbed coastal areas and refuges provide important and/or critical habitat for feeding, resting (or staging), and nesting birds, including groups of endangered species. The effects of low-flying aircraft within the vicinity of aggregations of birds on the ground typically results in mass disturbance and abandonment of the immediate area. Compliance to the specified minimum altitude requirements is expected to significantly reduce effects of aircraft disturbance on endangered birds. It is expected, however, that approximately 10 percent of helicopter trips will occur at altitudes somewhat below the minimums listed above as a result of inclement weather. Although these incidents are very short term in duration and sporadic in frequency, it is assumed that they would disrupt coastal bird behavior and, at worst, possibly result in habitat or nest abandonment. Birds in flight over water typically avoid helicopters; temporary disruption of feeding or flight paths is expected when encountering low-flying helicopters. It is estimated that there will be about 11,000 helicopter flights across

coastal areas annually, with about 1,100 flights at altitudes somewhat below specified minimums. For this analysis, helicopter traffic will seldom disturb endangered birds through the general adherence to FAA and corporate helicopter protocol on service altitudes.

It is assumed that 537 OCS-related oil and gas service-vessel trips, 13 barge trips, and no shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-2). Service vessels will use selected nearshore and coastal (inland) navigation waterways, or corridors, and adhere to protocol set forth by the Coast Guard for reduced vessel speeds within inland areas. Routine presence and low speeds of service vessels within these waterways effectively diminishes the effects of disturbance from service vessels on nearshore and inland populations of coastal and marine birds, including endangered species. For the purpose of this analysis, it is thus assumed that service-vessel traffic will seldom disturb endangered birds occurring within these areas. The effects on birds offshore are negligible.

The greatest negative impact to endangered coastal and marine birds is the extent of preferred or critical habitat loss within coastal areas. Effects of habitat loss are highly variable between species, based upon their specific habitat requirements and availability of similar habitat in the area. Destruction of habitat from OCS pipeline landfalls and onshore construction displaces individuals and localized groups or populations of coastal and marine birds, including endangered species. As these birds move to undisturbed areas of similar habitat, their presence augments habitat utilization pressure on these selected areas as a result of intra- and interspecific competition for space and food. This is especially critical for piping plovers, whose feeding habitat requirements are fairly strict. 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 OCS pipeline landfalls and onshore construction will not interact with feeding, resting, or nesting habitats of endangered birds within the CPA.

Coastal and marine birds can easily become entangled and snared in discarded trash and debris. In addition, some species such as the brown pelican and least tern will readily ingest small plastic debris, either intentionally or incidentally. Interaction with plastic materials is therefore very serious, and can lead to permanent injuries and death. It is expected that endangered birds will seldom become entangled in or ingest OCS-related trash and debris as a result of MMS prohibitions on the disposal of equipment, containers, and other materials into offshore waters by lessees (30 CFR 250.40). In addition, MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. For the purpose of this analysis, OCS oil- and gas-related plastic debris will seldom interact with endangered birds, and therefore, the effect will be negligible.

Conclusion

Endangered and threatened birds may encounter periodic displacement of individuals and/or localized groups from proposed activities. Decreases in numbers of adults and/or nests could occur as a result of OCS oil spills and spill-related coastal habitat loss. Onshore spills are expected to contact some individuals, with associated sublethal and lethal effects. The loss of individuals represents a serious loss to the regional population(s); restoration of numbers to a pre-disturbance state would require up to several years, depending on the species and existing conditions.

(9) Impacts on the Gulf Sturgeon

Extant occurrences of Gulf sturgeon in 1992 extended from Lake Pontchartrain in southeastern Louisiana to Charlotte Harbor in western Florida (Patrick, personal communication, 1992). Although spawning may occur from the Pearl River in western Mississippi eastward, the most important spawning populations occur within the Florida Panhandle in the Apalachicola and Suwannee Rivers (Barkuloo, 1988; Clugston, 1991). Oil spills associated with the proposed action are the activity most likely to impact the Gulf sturgeon. Oil can affect Gulf sturgeon by direct ingestion or ingestion of oiled prey or by the absorption of dissolved petroleum products through the gills. Upon any exposure to spilled oil, liver enzymes of adult fish oxidize soluble hydrocarbons into compounds that are easily excreted in the urine (Spies et al., 1982). Adult fish must experience continual

exposure to relatively high levels of hydrocarbons over several months before secondary toxicological compounds that represent biological harm are detected in the liver (Payne et al., 1988). Behavior studies of other fish species suggest that adult sturgeon are likely to actively avoid an oil spill, thereby limiting the effects and lessening the extent of damage (Baker et al., 1991; Malins et al., 1982). Linden et al. (1979) note that early life stages of fish are very sensitive to the toxic effects of hydrocarbons. Fish eggs and larvae, with their limited physiology and mobility are killed when contacted by oil (Longwell, 1977). The analysis examines spills of different sizes because of differences in spill location with reference to the geographic range of Gulf sturgeon, differences in spill frequency, and differences in spill dispersion rates.

Base Case Analysis

Contact with or ingestion/absorption of spilled oil can result in death or nonfatal physiological irritation, especially of gill epithelium and liver function in adult Gulf sturgeon. Tables IV-2 (Section IV.A.3.h.(2)) and IV-13 (Section IV.B.2.d.(1)) project the number of Size 1 and Size 2 offshore and onshore spills expected to occur in the CPA as a result of the proposed action.

It is estimated that 36 onshore spills of 1 bbl or less will occur at a frequency of about 2 per year. It is assumed that spills of this volume will affect a very small area and dissipate rapidly. Eighteen offshore and 11 onshore Size 1 spills are estimated to occur at a respective frequency of about 1 offshore spill per year and 1 onshore spill every other year in the CPA. It is assumed that none of the offshore Size 1 spills will contact the coast. The onshore spills will originate near terminal locations in the coastal zone of Louisiana, well away from inshore migration routes and spawning populations of Gulf sturgeon.

A total of three Size 2 spills (1 offshore and 2 onshore) are estimated to occur in the CPA. The single offshore spill will originate from areas with the greatest density of platforms and largest volume of pipeline flow, and it is assumed that it will not contact the coast. The onshore spills will originate as above and will not contact inshore migration routes and spawning populations of Gulf sturgeon.

Based on the number, frequency, and location of Size 1 and Size 2 onshore spills, it is assumed that a few errant adult Gulf sturgeon will contact one of these spills. It is expected that contact will cause nonfatal irritation of gill epithelium and an increase in liver function for less than a month.

Table IV-2 estimates that one Size 3 spill of about 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 of this size would occur and contact within 10 days coastal Plaquemines Parish in Louisiana. All other coastal areas have less than a 0.5 percent probability of an occurrence and contact. This analysis assumes that hydrocarbons from Size 3 spills, because of their number, frequency, and location, will not contact Gulf sturgeon.

Summary

The Gulf sturgeon could be impacted by oil spills resulting from the proposed action. However, sale-related oil spills of any size will rarely contact Gulf sturgeon.

Conclusion

The impact of the proposed action on the Gulf sturgeon could cause nonfatal irritation of gill epithelium and an increase of liver function in a few adults for less than a month.

High Case Analysis

Tables IV-2 and IV-13 project the number of Size 1 and Size 2 offshore and onshore spills expected to occur in the CPA as a result of the proposed action.

It is estimated that 81 onshore spills of 1 bbl or less will occur at a frequency of about 4 per year. It is assumed that spills of this volume will affect a very small area and dissipate rapidly. Forty-one offshore and 25 onshore Size 1 spills are estimated to occur at a respective frequency of about 2 offshore per year and 1 onshore per year in the CPA. It is assumed that none of the offshore Size 1 spills will contact the coast. The

onshore spills will originate near terminal locations in the coastal zone of Louisiana, well away from inshore migration routes and spawning populations of Gulf sturgeon.

A total of seven Size 2 spills (2 offshore and 5 onshore) are estimated to occur in the CPA. The offshore spills will originate from areas with the greatest density of platforms and largest volume of pipeline flow, and it is assumed that one will contact the coast. Because of the location of origin, contact is assumed to occur along central Louisiana. The onshore spills will originate near terminal locations in the coastal zone of Louisiana. Both the offshore and onshore spills will contact areas well away from inshore migration routes and spawning populations of Gulf sturgeon to the East.

Based on the number, frequency, and location of Size 1 and Size 2 spills, it is assumed that a few errant adult Gulf sturgeon will contact one of these spills. It is expected that contact will cause nonfatal irritation of gill epithelium and an increase of liver function for less than a month.

Table IV-2 estimates that one Size 3 spill of about 6,500-bbl will occur in the CPA during the 35-year life of the proposed action. There is a 2 percent probability that an oil spill of this size would occur and contact within 10 days coastal Plaquemines Parish in Louisiana. The percent probability that a Size 3 oil spill would occur and contact Timbalier Bay, Louisiana, is 1 percent; all other coastal areas have less than a 0.5 percent probability of an occurrence and contact. This analysis assumes that hydrocarbons from Size 3 spills, because of their number, frequency, and location, will not contact Gulf sturgeon.

Conclusion

The impact of the High Case on the Gulf sturgeon could cause nonfatal irritation of gill epithelium and an increase of liver function in a few adults for less than a month.

(10) Impacts on Commercial Fisheries

Effects on commercial fisheries from activities associated with the proposed action could come from coastal environmental degradation, emplacement of production platforms, underwater OCS obstructions, production platform removals, seismic surveys, oil spills, subsurface blowouts, pipeline trenching, and offshore discharges of drilling muds, produced waters, and naturally occurring radioactive material (NORM). Potential effects from these impact-producing factors are described below.

Sections providing supportive material for the commercial fisheries analysis include Sections III.B.7. (description of fish resources), III.C.3. (commercial fisheries), IV.D.1.a.(1) (impacts on sensitive coastal environments), IV.D.1.a.(3) (impacts on water quality), IV.A.3.b.(2) (space-use conflicts), IV.A.2.a.(4) (structure removals), IV.A.2.a.(1) (seismic surveying operations), IV.A.3.h.(2) (offshore oil spills), IV.B.2.d.(1) (onshore oil spills), IV.A.3.h.(1) (subsurface blowouts), IV.A.2.b.(1) (pipelines), IV.A.3.d. (offshore discharges), and IV.B.2.c. (onshore disposal).

Since approximately 92 percent of commercially harvested species are estuary dependent, coastal environmental degradation resulting from the proposed action, although indirect, has the potential to adversely affect commercial fisheries. The environmental deterioration and effects on commercial fisheries result from the loss of Gulf wetlands as nursery habitat and from the functional impairment of existing habitat through decreased water quality. The conversion of wetlands into open water may initially cause an appreciable increase in the population of a commercially harvested shellfish, such as shrimp (Louisiana Dept. of Wildlife and Fisheries, 1992).

Wetlands and estuaries within the CPA may be affected by OCS-related activities resulting from the proposed action. These include construction of new onshore facilities in wetland areas; pipeline placement in wetland areas; vessel usage of navigation channels and access canals; maintenance of navigation channels; onshore disposal of OCS-generated, oil-field wastes; and, oil and chemical spills from both onshore and offshore OCS support activities.

Water quality in coastal and estuarine areas adjacent to the CPA may be altered by OCS-related activities resulting from the proposed action. These activities include construction of new onshore support facilities; routine point and nonpoint source discharges from onshore facilities; discharges from associated support vessel traffic; canal maintenance dredging and pipeline emplacement actions; onshore disposal of OCS-generated, oil-

field wastes; oil and chemical spills from both onshore and offshore OCS support activities; and OCS-related trash and debris.

The emplacement of a production platform, with a surrounding 100-m navigation safety zone, in water depths less than 152 m, results in the loss of approximately 6 ha of bottom trawling area to commercial fishermen and causes space-use conflicts. Underwater OCS obstructions, such as pipelines, cause gear conflicts that result in losses of trawls and shrimp catch, business downtime, and vessel damage. However, all pipelines in water depths less than 61 m will be buried, and their locations made public knowledge (Alpert, 1990). Nearly 97 percent of trawl fishing in the CPA occurs in water depths less than 61 m (Louisiana Dept. of Wildlife and Fisheries, 1992). Although Gulf fishermen are experiencing some economic loss from gear conflicts, the economic loss for a fiscal year has historically been less than 0.1 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. Approximately 100 and 125 structures were removed from the Gulf of Mexico in 1991 and 1992, respectively. Eighty percent of multi-leg platforms in water depths less than 156 m are removed by severing their pilings with 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 (Scarborough Bull and Kendall, 1992; Young, 1991). Within the past decade, stocks of reef fish 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 entered into a formal Interagency Agreement with NOAA and NMFS and is investigating fish death associated with structure removal. This study will attempt to relate the role of fish deaths from platform removals to the status of reef fish stocks in the Gulf of Mexico (USDOL, 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 (Chamberlain, 1991; 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).

Chronic low-level pollution is a persistent and recurring event resulting in frequent but nonfatal physiological irritation to those resources that lie within the range of impact and that are likely to be adversely affected by the pollution. The geographic range of the pollutant effect depends on the mobility of the resource, the characteristics of the pollutant, and the tolerance of the resource to the pollutant in question (in this case hydrocarbons). Adult fish must experience continual exposure to relatively high levels of hydrocarbons over several months before secondary toxicological compounds that represent biological harm are detected in the liver (Payne et al., 1988). Adult fish are likely to actively avoid an oil spill, thereby limiting the effects and lessening the extent of damage (Baker et al., 1991; Malins et al., 1982).

The primary objective of a recently awarded MMS contract is to document any fundamental detoxification responses, which have resulted from exposure to low-level contaminants associated with long-term OCS activities, in the resident fauna at OCS production sites. Documentation at this biochemical level will serve as an early warning signal of possibly more serious pathologies before any changes that are secondary in nature appear. An ancillary objective of the study is to identify any secondary changes in order to document the indirect impacts of any contaminant exposure at the population or community level. By examining differences in both time and space of the reproductive patterns of the resident biota, it should be possible to detect the effects of chronic exposure to low-level contaminants.

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 death of eggs and decreased survival of larvae (NRC, 1985). Upon exposure to spilled oil, liver enzymes of fish oxidize soluble hydrocarbons into compounds that are easily excreted in the urine (Spies et al., 1982). When contacted by spilled oil, floating eggs and larvae, with their limited mobility and physiology, 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 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 pelagic eggs and larvae are present have the greatest potential to affect commercial fishery resources. Migratory species, such as mackerel, cobia, and crevalle, could be impacted if oil spills contact nearshore open waters. An oil spill contacting a low-energy inshore area would affect localized populations of commercial fishery resources, such as menhaden, shrimp, and blue crabs. Chronic oiling in an inshore area would affect all life stages of a localized population of a sessile fishery resource such as oysters.

For OCS-related oil spills to have an effect on a commercial fishery resource, whether estuary dependent or not, eggs and larvae would have to be abnormally concentrated in the immediate spill area. Oil components also would have to be present in highly toxic concentrations when both eggs and larvae are in the pelagic stage (Longwell, 1977). There is no evidence at this time that commercial fisheries in the Gulf have been adversely affected on a regional population level by spills or chronic oiling.

Observations at oil spills around the world, including the *Exxon Valdez* spill in Prince William Sound, consistently indicate that free-swimming fish are rarely at risk from oil spills (Anon., 1991c; NRC, 1985). Fish swim away from spilled oil, and this behavior explains why there has never been a commercially important fish-kill on record following an oil spill. The only adult fish-kill on record following an oil spill was on the French coast when several tons of small rock-clinging fish (not commercially harvested) were killed at the site of the *Amoco Cadiz* wreck. In addition, concerns about the possible impact of spilled oil on the breeding cycle of commercial fishery resources have proved to be false (Anon., 1991c; Baker et al., 1991).

Large numbers of fish eggs and larvae have been killed by oil spills. However, fish over-produce eggs on an enormous scale and the overwhelming majority of them die at an early stage, generally as food for predators. Even a heavy death from an oil spill has no detectable effect on the adult population, which is exploited by a commercial fishery. This has been confirmed during and after the *Torrey Canyon* spill off southwest England and the *Argo Merchant* spill off Nantucket. In both cases a 90 percent death of fish eggs and larvae, pilchard and pollack, respectively, was observed in the affected area, but this had no impact on the regional commercial fishery (Baker et al., 1991).

Development abnormalities in juveniles occur naturally in wild fish populations, and the frequency of these abnormalities is increased in populations chronically exposed to oil. These abnormal fish do not survive long in the struggle for existence. Such delayed death is likely to have an equally negligible impact on commercial fisheries as are the immediate deaths following an oil spill.

Benthic disturbance from subsurface blowouts of both oil and natural gas wells in water depths less than 152 m and trenching (burial) of pipelines in water depths less than 61 m may be detrimental to commercial fisheries. Trenching and blowouts can resuspend sediments, and the loss of oil-well control can release varying amounts of hydrocarbons into the water column (USDOL, MMS, 1987c). 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. However, sandy sediments are quickly redeposited within 400 m of the blowout site. Finer sediments are widely dispersed and redeposited over a period of 30 days or longer within a few thousand meters. Released hydrocarbons are diluted to background levels within a few thousand meters of the blowout site and degrade quickly without major biological effect. Gas-well blowouts are even less of an environmental risk, resulting in little resuspended sediments and increased levels of natural gas for a few days very near the source of the blowout. Natural gas consists mainly of nontoxic methane, which rapidly disperses upward into the air (Van Buuren, 1984). Loss of well control and resultant subsurface blowouts seldom occur on the Gulf of Mexico OCS. Only 0.6 percent of all wells experience an uncontrolled loss of pressure and no more than 23 percent of those result in the release of some oil (Fleury, 1983).

Drilling muds contain materials toxic to commercial fishery resources; 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; Parrish and Duke, 1990). 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; Proni, 1984).

In addition to toxic trace elements and hydrocarbons in produced waters, there are additional components and properties, such as hypersalinity and organic acids, 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). Produced water will be disposed of onshore by reinjection or discharge into the Mississippi River (Section IV.B.2.c.).

The fate and effects of NORM from the discharge of produced water on seafood available for commercial harvest has become an issue of environmental concern. The NORM occurs in some produced waters because oil is extracted from reservoir rock where NORM is formed by the radioactive decay of naturally occurring uranium and thorium. Radium isotopes comprise over 90 percent of the total radioactivity in produced waters (Laul et al., 1985; Snavely, 1989). Animals are able to reject radium in favor of calcium; marine fish and shellfish reject 70-90 percent; man rejects 98 percent (De Bartoli and Gaglione, 1972; Snavely, 1989). When metabolized by animals, radium follows calcium in the body and thus will accumulate mostly in the skeleton or shell, which are inedible to man (Mulino and Rayle, 1992). In shellfish, 90 percent of the radium is in the shell; in fish, 80-90 percent is in the skeleton (Snavely, 1989).

Fish and shellfish require at least a year for their body radium to equilibrate with the radium content of the surrounding water (Iyengar, 1984). During any continuous time period substantial variations in radium intake are caused by variations in the volume and radioactivity of discharged produced water, tidal and river flow, and rainfall (Snavely, 1989).

Data collected from offshore platforms discharging NORM in produced waters show that epifaunal and associated organisms within 3 m of the discharge are not accumulating radium to high levels (Mulino and Rayle, 1992). The levels of radioactivity measured in soft tissue and hard parts of all biota tested (barnacles, molluscs, fish, and blue crabs) were near the lower limit of detection (LLD). Any radium concentrations above the LLD were in inedible hard parts (shell or bone).

An investigation concerning the health risk for radium in seafood harvested near onshore produced water outfalls in 1990 was performed by Hamilton et al. (1992). The study concluded that the health risks associated with the discharge of produced water are comparable to those expected to result from background concentrations of radium in Louisiana coastal waters. The authors state that they were purposely conservative and overestimated the concentration of radium in fish and shellfish and the amount of seafood harvested near outfalls. In addition, the authors admit to using USEPA risk factors that they believe overestimate the health risks associated with small amounts of radium.

The likelihood of consuming seafood available for commercial harvest containing higher than normal radium for a sufficient period of time to present a risk is minimal. The prospect that NORM discharged in offshore produced water will affect commercial fishery species and subsequently increase man's intake of radium is virtually zero.

Base Case Analysis

The major impact-producing factors analyzed below are related to the proposed action and include coastal environmental degradation, production platform emplacement, underwater OCS obstructions, production platform removal, seismic surveys, oil spills, subsurface blowouts, pipeline trenching, and OCS discharge of drilling muds, produced waters, and NORM.

The effect of the proposed action on wetlands and inshore water quality in the CPA is analyzed in detail in Sections IV.D.1.a.(1) and (3), respectively. The indirect effect on commercial fisheries is considered below.

To summarize the effects on wetlands and estuarine areas, it is expected that 67.5 ha of coastal areas will be affected by onshore oil spills as a result of the proposed action. The productivity of 25 ha will be suppressed for 4 years from barge spills; the productivity of 35 ha will be suppressed for 10 years from pipeline spills. Up to 17.5 ha of wetlands could be eroded as a result of vessel usage of navigation channels and access canals in coastal Louisiana and Texas. Up to 1.7 ha of wetlands could be eroded as a result of pipeline canal widening in coastal Louisiana and Texas. Overall, 80.2 ha of wetlands in the CPA will be converted to open water as a result of the proposed action.

To summarize the effects on coastal and estuarine water quality, it is expected that coastal waters in the Central Gulf of Mexico would be degraded from periodic point source discharges and bottom disturbances (elevated turbidity) from OCS support activities--occurring in an area within 1,000 m of the source and persisting for several days to weeks after the activity has concluded. Further decrease in water quality would occur from chronic low-level contamination (elevated levels of hydrocarbons, trace metals, salinity, temperature,

organic compounds, and lower dissolved oxygen) resulting from OCS-associated site runoff and maritime traffic activities occurring over the life of the proposal. Significant increases in water concentrations of dissolved and particulate hydrocarbons and trace metals are not expected beyond 1,000 m of any discharge site.

It is expected that coastal environmental degradation from the proposed action will affect commercial fishery resources. The impact of coastal degradation in the CPA is expected to cause less than a 1 percent decrease in commercial fishery populations, in essential habitats, or in commercial fishing. Recovery of commercial fishery resources can occur from more than 90 percent, but not all, of the expected coastal environmental degradation. However, at the expected level of effect the resultant influence on Central Gulf fisheries is negligible and will be undistinguishable from natural population variations.

Seven platform emplacements in water depths less than 152 m (Table IV-2) are expected to result from the proposed action, eliminating 42 ha of the trawling area in the CPA. In Subarea C-1, the area of concentrated bottom trawl fishing, five platforms will be installed, eliminating 30 ha. 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.

Underwater OCS obstructions such as pipelines cause gear conflicts. Table IV-2 gives estimates of the length of offshore pipeline resulting from the proposed action in the CPA. It is expected that 275 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, less than 20 percent, or 50 km, of pipeline will be installed during the 35-year life of the proposed action, with no more than 5 km installed during any one year. Gear conflicts are mitigated by the ECF. During FY 91, 128 claims were processed, with 91 percent being approved for a total of \$512 thousand (Jackson, written communication, 1992). This economic loss from gear conflicts for FY 91 was less than 0.1 percent of the value (\$641 million) of Gulf commercial fisheries landings for 1991. For the purpose of this analysis, it is assumed that installed pipelines will seldom conflict with bottom trawl fishing, and it is expected to have a negligible effect on Central Gulf fisheries.

Structure removal results in artificial habitat loss and causes fish kills when explosives are used. Table IV-2 estimates that eight 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. For the purpose of this analysis, it is expected that structure removals will have a negligible effect on Central Gulf fisheries because of the inconsequential number of removals and the considerations that removals kill only those fish proximate to the removal site.

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

Oil spills that contact coastal bays, estuaries, and waters of the OCS when pelagic eggs and larvae are present have the greatest potential to affect commercial fishery resources. In the event that sale-related oil spills should occur in coastal bays, estuaries, or waters of the OCS proximate to mobile adult finfish or shellfish, the effects are expected to be nonfatal and the extent of damage are expected to be limited and lessened due to some capability of adult fish and shellfish to avoid an oil spill, to metabolize hydrocarbons, and to excrete both metabolites and parent compounds. For floating eggs and larvae contacted by spilled oil, the effect is expected to be lethal. Tables IV-2 (Section IV.A.3.h.(2)) and IV-13 (Section IV.B.2.d.(1)) project the number of offshore and onshore spills expected to occur in the CPA as a result of the proposed action.

It is estimated that 36 onshore spills of 1 bbl or less will occur at a frequency of about two per year. It is assumed that spills of this volume will affect a very small area and dissipate rapidly. Eighteen offshore and 11 onshore Size 1 spills (average size, 3 bbl) are estimated to occur at a respective frequency of about 1 offshore per year and 1 onshore every other year in the CPA. It is assumed that spills of these volumes will affect a very small area and dissipate rapidly and that none of the offshore Size 1 spills will contact the coast.

A total of three Size 2 spills (1 offshore and 2 onshore) (average size, 500 bbl) are estimated to occur in the CPA during the life of the proposed action. The single offshore spill will originate from areas with the greatest density of platforms and largest volume of pipeline flow; it is assumed that it will not contact the coast. The onshore spills will originate near terminal locations in the coastal zone of Louisiana. For the purpose of this analysis, it is assumed that Size 2 spills will seldom contact and affect the coastal bays and marshes critical to the well-being of commercial fisheries in the CPA.

Table IV-2 estimates that one Size 3 spill of about 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 of this size would occur and contact within 10 days coastal Plaquemines Parish in Louisiana. All other coastal areas have less than a 0.5 percent probability of an occurrence and contact. For the purpose of this analysis, it is estimated that a Size 3 spill 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 of migratory species in the CPA is comparatively small, these species are of high value. Migratory species could be affected by oil spills occurring in the coastal area. There is a 2 percent probability that a Size 3 spill would occur and contact within 10 days nearshore and coastal areas along the Central Gulf. For the purpose of this analysis, it is estimated that a Size 3 spill will seldom contact and affect nearshore and coastal areas of migratory Gulf fisheries.

The effect of sale-related oil spills on commercial fisheries is expected to cause less than a 1 percent decrease in commercial populations or in commercial fishing. At the expected level of effect, the resultant influence on Central Gulf fisheries is negligible and will be undistinguishable from natural population variations.

Subsurface blowouts of both oil and natural gas wells and pipeline trenching have the potential to adversely affect commercial fishery resources. Loss of well control and resultant blowouts seldom occur on the Gulf OCS (6 blowouts per 1,000 well starts; 23 percent will result in some spilled oil). It is assumed that there will be two blowouts in the CPA resulting from the proposed action during the 35-year life of the proposed action. Table IV-2 estimates the resuspension of some 0.523 million m³ of sediment during the installation of 275 km of pipelines in water depths less than 61 m. Offshore Subarea C-3, an area of minimal bottom trawl fishing and consolidated sediments, will support the greatest portion of sale-related pipeline burial activities (120 km) and associated sediment resuspension (0.25 million m³) (Table IV-2). Sandy sediments will be quickly redeposited within 400 m of the trench and finer sediments will be widely dispersed and redeposited over a period of 30 days or longer within a few thousand meters of the trench. For the purpose of this analysis, it is expected that the infrequent subsurface blowout that may occur on the Gulf OCS will have a negligible effect on Gulf commercial fisheries. The effect on commercial fisheries from pipeline trenching in the CPA is expected to cause less than a 1 percent decrease in commercial fishery populations or in commercial fishing.

Any affected population is expected to recover to predisturbance condition in one generation. At the expected level of effect, the resultant influence on Central Gulf fisheries is negligible and will be undistinguishable from natural population variations.

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.

Produced-water discharges (Table IV-2) contain components and properties detrimental to commercial fishery resources; however, toxic compounds are undetectable beyond 1,000 m from the discharge point. Offshore discharges of produced water will rapidly disperse and dilute to background levels and will have a negligible effect on Central Gulf fisheries.

The NORM discharged offshore in produced water has the potential to affect adversely commercial fishery species and subsequently increase man's intake of radium; however, this is only at concentrations 10-12 orders of magnitude higher than those found within 3 m from the discharge point. The NORM component of offshore discharges of produced water will rapidly dilute to background levels, will have no effect on commercial fishery resources, and will have no effect on commercial fishing in the CPA.

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 will be inconsequential and rare. At the expected level of effect, the resultant influence on Central Gulf fisheries is negligible and will be undistinguishable from natural population variations. As a result, there will be little discernible disturbance to Gulf commercial fisheries.

Conclusion

The proposed action is expected to result in less than a 1 percent decrease in commercial fishery populations, in essential habitat, or in commercial fishing. It will require less than six months for fishing activity and one generation for fishery resources to recover from 99 percent of the impacts.

High Case Analysis

The major impact-producing factors analyzed in the High Case include coastal environmental degradation, production platform emplacement, underwater OCS obstructions, production platform removal, seismic surveys, oil spills, subsurface blowouts, pipeline trenching, and OCS discharge of drilling muds, produced waters, and NORM.

The effect of the proposed action on wetlands and inshore water quality in the CPA is analyzed in detail in Sections IV.D.1.a.(1) and (3), respectively. The indirect effect on commercial fisheries is considered below.

It is expected that 167.4 ha of coastal areas will be affected by onshore oil spills as a result of the proposed action. The productivity of 62 ha will be suppressed for 4 years from barge spills; the productivity of 86.8 ha will be suppressed for 10 years from pipeline spills. Up to 35 ha of wetlands could be eroded as a result of vessel usage of navigation channels and access canals in coastal Louisiana and Texas. Up to 3.4 ha of wetlands could be eroded as a result of pipeline canal widening in coastal Louisiana and Texas. Overall, 162.7 ha of wetlands in the CPA will be converted to open water as a result of the proposed action.

It is expected that coastal waters in the Central Gulf of Mexico would be degraded from periodic point source discharges and bottom disturbances (elevated turbidity) from OCS support activities--occurring in an area within 1,000 m of the source and persisting for several days to weeks after the activity has concluded. Further decrease in water quality would occur from chronic low-level contamination (elevated levels of hydrocarbons, trace metals, salinity, temperature, organic compounds, and lower dissolved oxygen) resulting from OCS associated site runoff and maritime traffic activities occurring over the life of the proposal. Significant increases in water concentrations of dissolved and particulate hydrocarbons and trace metals are not expected beyond 1,000 m of any discharge site.

It is expected that coastal environmental degradation from the proposed action will affect commercial fishery resources. The impact of coastal degradation in the CPA is expected to cause less than a 1 percent decrease in commercial fishery populations, in essential habitats, or in commercial fishing. Recovery of commercial fishery resources can occur from more than 90 percent, but not all, of the expected coastal environmental degradation. However, at the expected level of effect, the resultant influence on Central Gulf fisheries is negligible and will be undistinguishable from natural population variations.

Eleven platform emplacements in water depths less than 152 m (Table IV-2) are expected to result from the proposed action, eliminating 66 ha of the trawling area in the CPA. In Subarea C-1, the area of concentrated bottom trawl fishing, six platforms will be installed, eliminating 36 ha. 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.

Underwater OCS obstructions such as pipelines cause gear conflicts. Table IV-2 gives estimates of the length of offshore pipeline resulting from the proposed action in the CPA. It is expected that 515 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, less than 12 percent, or 60 km, of pipeline will be installed during the 35-year life of the proposed action, with no more than 6 km installed during any one year. Gear conflicts are mitigated by the FCF. During FY 91, 128 claims were processed, with 91 percent being approved for a total of \$512 thousand (Jackson, written communication, 1992). This economic loss from gear conflicts for FY 91 was less than 0.1 percent of the value (\$641 million) of Gulf commercial fisheries landings for 1991. For the purpose of this analysis, it is assumed that installed pipelines will seldom conflict with bottom trawl fishing, and it is expected to have a negligible effect on Central Gulf fisheries.

Structure removal results in artificial habitat loss and causes fish kills when explosives are used. Table IV-2 estimates that 15 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

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proposed action. For the purpose of this analysis, it is expected that structure removals will have a negligible effect on Central Gulf fisheries because of the inconsequential number of removals and the considerations that removals kill only those fish proximate to the removal site.

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

Oil spills that contact coastal bays, estuaries, and waters of the OCS when pelagic eggs and larvae are present have the greatest potential to affect commercial fishery resources. In the event that sale-related oil spills should occur in coastal bays, estuaries, or waters of the OCS proximate to mobile adult finfish or shellfish, the effects are expected to be nonfatal and the extent of damage is expected to be limited and lessened due to some capability of adult fish and shellfish to avoid an oil spill, to metabolize hydrocarbons, and to excrete both metabolites and parent compounds. For floating eggs and larvae contacted by spilled oil, the effect is expected to be lethal. Tables IV-2 (Section IV.A.3.h.(2)) and IV-13 (Section IV.B.2.d.(1)) project the number of offshore and onshore spills expected to occur in the CPA as a result of the proposed action.

It is estimated that 81 onshore spills of 1 bbl or less will occur at a frequency of about 4 per year. It is assumed that spills of this volume will affect a very small area and dissipate rapidly. Forty-one offshore and 25 onshore Size 1 spills (average size, 3 bbl) are estimated to occur at a respective frequency of about 4 offshore and 1 onshore per year in the CPA. It is assumed that spills of these volumes will affect a very small area and dissipate rapidly and that none of the offshore Size 1 spills will contact the coast.

A total of seven Size 2 spills (2 offshore and 5 onshore) (average size, 500 bbl) are estimated to occur in the CPA during the life of the proposed action. The offshore spills will originate from areas with the greatest density of platforms and largest volume of pipeline flow; it is assumed that one will contact the coast. The onshore spills will originate near terminal locations in the coastal zone of Louisiana. For the purpose of this analysis, it is assumed that Size 2 spills will seldom contact and affect the coastal bays and marshes critical to the well-being of commercial fisheries in the CPA.

Table IV-2 estimates that one Size 3 spill of about 6,500-bbl will occur in the CPA during the 35-year life of the proposed action. There is a 2 percent probability that an oil spill of this size would occur and contact within 10 days coastal Plaquemines Parish in Louisiana. All other coastal areas have a 1 percent or less probability of an occurrence and contact. For the purpose of this analysis, it is estimated that a Size 3 spill 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 of migratory species in the CPA is comparatively small, these species are of high value. Migratory species could be affected by oil spills occurring in the coastal area. There is a 4 percent probability that a Size 3 spill would occur and contact within 10 days nearshore and coastal areas along the Central Gulf. For the purpose of this analysis, it is estimated that a Size 3 spill will seldom contact and affect nearshore and coastal areas of migratory Gulf fisheries.

The effect of sale-related oil spills on commercial fisheries is expected to cause less than a 1 percent decrease in commercial populations or in commercial fishing. At the expected level of effect, the resultant influence on Central Gulf fisheries is negligible and will be undistinguishable from natural population variations.

Subsurface blowouts of both oil and natural gas wells and pipeline trenching have the potential to adversely affect commercial fishery resources. Loss of well control and resultant blowouts seldom occur on the Gulf OCS (6 blowouts per 1,000 well starts; 23 percent will result in some spilled oil). It is assumed that there will be five blowouts in the CPA resulting from the proposed action during the 35-year life of the proposed action. Table IV-2 estimates the resuspension of some 0.921 million m³ of sediment during the installation of 515 km of pipelines in water depths less than 61 m. Offshore Subarea C-3, an area of minimal bottom trawl fishing and consolidated sediments, will support the greatest portion of sale-related pipeline burial activities (200 km) and associated sediment resuspension (0.407 million m³) (Table IV-2). Sandy sediments will be quickly redeposited within 400 m of the trench and finer sediments will be widely dispersed and redeposited over a period of 30 days or longer within a few thousand meters of the trench. For the purpose of this analysis, it is expected that the infrequent subsurface blowout that may occur on the Gulf OCS will have a negligible effect on Gulf commercial fisheries. The effect on commercial fisheries from pipeline trenching in the CPA is expected to cause less than a 1 percent decrease in commercial fishery populations or in commercial fishing. Any affected population is expected to recover to predisturbance condition in one generation. At the expected

level of effect, the resultant influence on Central Gulf fisheries is negligible and will be undistinguishable from natural population variations.

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 will have a negligible effect on Central Gulf fisheries.

Produced-water discharges (Table IV-2) contain components and properties detrimental to commercial fishery resources; however, toxic compounds are undetectable beyond 1,000 m from the discharge point. Offshore discharges of produced water will rapidly disperse and dilute to background levels and will have a negligible effect on Central Gulf fisheries.

The NORM discharged offshore in produced water has the potential to affect adversely commercial fishery species and subsequently increase man's intake of radium; however, this is only at concentrations 10-12 orders of magnitude higher than those found within 3 m from the discharge point. The NORM component of offshore discharges of produced water will rapidly dilute to background levels, will have no effect on commercial fishery resources, and will have no effect on commercial fishing in the CPA.

Conclusion

The High Case is expected to result in less than a 1 percent decrease in commercial fishery populations, in essential habitat, or in commercial fishing. It will require less than six months for fishing activity and one generation for fishery resources to recover from 99 percent of the impacts.

(11) Impacts on Recreational Resources and 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 (USDOL, 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.3.b.(3)), and noise from aircraft can disturb the ambience of a beach-related recreation experience (Sections IV.A.2.c.(2) and IV.A.3.g.). 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 Size 3 oil spills 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. It was 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.

Assumptions concerning the characteristics and fates of a Gulf of Mexico oil spill indicate 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 Size 3 spills 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.3.c.). 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.3.b.(3)), and noise associated with vessels and aircraft (Section IV.A.3.g.) 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 Size 3 oil spills (14% probability) (Table IV-10) throughout the 35-year life of the proposed action (1994-2028). Wind, waves, and currents could result in spills reaching major shoreline recreational beaches throughout the coastal area potentially affected by Sale 147.

Estimates based on OSRA (Table IV-10) indicate the proposed action has an estimated probability less than 0.5 percent chance to result in a Size 3 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 a Size 3 oil spill will not impact recreational beaches in the CPA from operations resulting from proposed Sale 147.

As noted in Section IV.A.3.h.(2) no Size 1 or Size 2 offshore spills from the proposal are assumed to occur and contact land during the 35-year project life. Transportation of oil to shore will result in an assumed 13 onshore Size 1 and Size 2 spills; however, only two Size 2 and Size 3 spills are assumed (Table IV-13). Should these spills interact with recreational beaches, the portions impacted will be closed during cleanup.

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 LA-1 and LA-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 147, they will be visible for an extended period of time (1-20 years) from portions of the seaward beaches and wilderness areas within 16 km 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 147 may also stimulate and redirect additional vessel and helicopter traffic. Over 3,000 vessel traffic trips and 110,000 helicopter trips are projected to result in coastal Subarea LA-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 30 vessel trips are projected to use the Pascagoula/Bayou Casotte ship channel (Table IV-18) 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 147. On the assumption that vessels use established nearshore traffic lanes and helicopters comply with areal clearance restrictions 90 percent of the time, 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

One or two small onshore spills are assumed to affect portions of Louisiana or Mississippi beaches with little disruption of recreational activities. Marine debris will be lost from time to time from OCS operations associated with drilling 350 new wells and producing oil and gas from 20 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 minimal. 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 pollution events and nearshore operations that may adversely affect the enjoyment of some beach uses on Louisiana and Mississippi beaches. However, these will have little effect on the number of beach users.

High Case Analysis

The causes and severity of impacts associated with the High Case would be derived from the same impact-producing factors identified under the Base Case, 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-10) indicate that, even with more optimistic oil and gas finds from this proposal, the estimated probability of a Size 3 oil spill occurring and contacting a major recreational beach anywhere in the Gulf region within 10 days is estimated as less than 0.5 percent chance. One Size 2 offshore spill is assumed to contact land (Section IV.A.3.h.(2)) and may temporarily remove portions of a recreational beach from public use until cleanup operations are complete. Likewise, one or two of the assumed Size 1 and Size 2 onshore spills (Table IV-13) could impact coastal recreational beaches and temporarily remove affected portions from recreational use until cleanup is complete. With the number of wells drilled and the number of vessel traffic trips doubling, it is likely the level of accidental and irresponsible trash loss will also increase. Although the decibel level of noise impacting wilderness beach uses 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 High Case is expected to result in pollution events and nearshore operations that may adversely affect the enjoyment of beach uses on Mississippi and Louisiana beaches, although the number of pollution incidences adversely affecting the ambience of recreational beaches is likely to increase throughout the 35-year life of the proposed action. Despite this, these will have little effect on the number of beach users.

(12) Impacts on Archaeological Resources

Lease blocks with a high probability for the occurrence of prehistoric, prehistoric and historic, or historic archaeological resources may be 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 were redefined as a result of an MMS-funded study (Garrison et al., 1989; LTL dated November 30, 1990).

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. (archaeological resources), IV.A.2.a. (offshore infrastructure), IV.B.1.a. (onshore infrastructure), and IV.A.3.h. and IV.B.2.d. (oil spills).

Several OCS-related, impact-producing factors may cause adverse impacts to 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 in less than 457 m of water will directly disturb 1.5 ha of soft bottom; the average platform under the same conditions, 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 must be buried. Burial depths of 1 m are required with the exception of shipping fairways and anchorage areas, where the requirements are 3.0 and 4.6 m, 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 is assumed that no channels in the Central Gulf will have to be deepened to provide access for larger offshore boats serving deeper waters under the Base and High Cases.

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 the 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, 1984c) 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, 350 exploration, delineation, and development wells will be drilled, and 20 production platforms and 275-km of pipelines will be installed in the Central Gulf. Of this number, 155 exploration, delineation, and development wells will be drilled, and 13 platforms and 170 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 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 historic period 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 147. 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-18 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 traffic as a result of the proposed action is negligible. While the specific example falls within onshore Subarea TX-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, maintenance dredging, in general, is responsible for impacts to a historic shipwreck. 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-18, 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.

The loss or toss of ferromagnetic debris during exploration and production activities has the potential to mask the magnetic signatures of historic shipwrecks. Under the Base Case, it is expected that hundreds of tons of ferromagnetic debris will be lost or tossed as a result of OCS activities. It has been noted that such debris has the potential to be moved from the area of initial deposition as a result of trawling activities (Garrison et al., 1989). It is expected that most ferromagnetic debris associated with emplaced structures will be removed from the seafloor during site clearance activities. Site clearance, however, takes place after the useful life of the structure is complete. Also, no site clearance activities occur in association with pipeline emplacement. Therefore, there remains the potential for masking the signatures of historic shipwrecks as a result of ferromagnetic debris from OCS oil and gas activities.

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-10, the probability of a Size 3 spill occurring and contacting within 10 days the coast of the CPA is 2 percent under the Base Case. This impact is expected to be temporary and reversible. It is assumed that onshore spills will occur as a result of OCS oil being transported to shore. In the CPA, it is assumed that an average of less than one Size 1 spill per year will occur. Should such an oil spill contact an historic site, the effects would 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, 1987a).

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. An 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 not expected to impact historic archaeological resources. No new onshore infrastructure construction or pipeline landfalls are expected as a result of the proposed action. Ferromagnetic debris has the potential to mask the magnetic signatures of historic shipwrecks. Historic cultural resources, therefore, will not be affected by these activities. There is a small chance of contact from an oil spill associated with the proposed action. 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. Maintenance dredging of navigation channels may result in impacts to historic shipwrecks; however, the percentage of OCS use of these channels under the proposed action ranges from less than 0.1 percent to 2.2 percent use.

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 low probability 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.

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. It should also be noted that a proposed new regulation under 30 CFR 250.25 will incorporate the stipulation into operational regulations. The OCSLA, 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. Archaeological surveys are the only means to determine whether objects of historical or archaeological interest would be impacted by geological exploration. These surveys would still be required by the OCSLA even without the stipulation in place. The effects of the impact-producing factors on historic archaeological resources without the Archaeological Resource Stipulation should, 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 percent 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. An 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 a Size 3 oil spill occurring and contacting land is 2 percent. 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. Loss or loss of ferromagnetic debris has the potential to mask the magnetic signatures of historic shipwrecks. The amount of dredging activities directly attributable to OCS activities is 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

According to Table IV-2, under the High Case, 740 exploration, delineation, and development wells will be drilled, and 50 production platforms and 515 km of pipelines will be installed in the Central Gulf. Of this number, 315 exploration, delineation, and development wells will be drilled and 23 platforms and 260 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 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 would 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.

The loss or loss of ferromagnetic debris during exploration and production activities has the potential to mask the magnetic signatures of historic shipwrecks. Under the High Case, it is expected that hundreds of tons of ferromagnetic debris will be lost or tossed as a result of OCS activities. It has been noted that such debris has the potential to be moved from the area of initial deposition as a result of trawling activities (Garrison et al., 1989). It is expected that most ferromagnetic debris associated with emplaced structures will be removed from the seafloor during site clearance activities. Site clearance, however, takes place after the useful life of the structure is complete. Also, no site clearance activities occur in association with pipeline emplacement. Therefore, there remains the potential for masking the signatures of historic shipwrecks as a result of ferromagnetic debris from OCS oil and gas activities.

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. The probability of a Size 3 oil spill occurring and contacting land under the High Case is 4 percent. This impact is expected to be temporary and reversible. It is assumed that onshore spills will occur as a result of OCS oil being transported to shore. In the CPA, it is assumed that an average of less than two Size 1 spills per year will occur under the High Case. Should such oil spills contact an historic site, the effects would 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, 1987a).

Conclusion

There is a very low probability 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 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, 350 exploration, delineation, and development wells will be drilled, and 20 production platforms and 275 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 210 exploration, delineation, and development wells; 16 production platforms; and 220 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 147. 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 Size 3 spill occurring and contacting within 10 days the CPA coast within 10 days is 2 percent (Table IV-10). Based on this low probability, the assumption is that no Size 3 spills will affect prehistoric archaeological resources. It is assumed that onshore spills will occur as a result of OCS oil being transported to shore. In the CPA, it is assumed that an average of less than one Size 1 spill per year will occur under the Base Case. It is further assumed that the majority of such spills would occur around terminals and be contained in the vicinity of the spill. There is a low probability of these spills contacting a prehistoric archaeological site. However, should such oil spills contact a prehistoric site, the carbon-14 dating of organic matter would be affected along those portions of the site that were contacted by the oil.

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* (USDOL, MMS, 1987a).

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 would 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 proposed action.

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 Size 3 spill occurring and contacting land within 10 days is 2 percent. It is assumed that no contact would occur. There is a small possibility of onshore oil spills contacting a prehistoric site; however, should such contact occur, carbon-14 dating of organic materials would be affected in those portions of the site that were contacted.

Conclusion

There is a very low probability of an impact between OCS 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 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. 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. Archaeological surveys are the only means to determine whether objects of historical or archaeological interest would be impacted by geological exploration. These surveys should still be required by the OCSLA, even without the stipulation in place. 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 Size 3 spill occurring and contacting within 10 days a coastal prehistoric site is very low, and it is assumed that no contact will occur. There is a small possibility of onshore

oil spills contacting prehistoric sites; however, should such contact occur, carbon-14 dating of organic materials would be affected along those portions of the site that were contacted by the oil.

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, 740 exploration, delineation, and development wells will be drilled, and 50 production platforms and 515-km of pipelines will be installed in the Central Gulf. Removing Subarea C-4 from the projected impacts resulting from the High Case leaves 445 exploration, delineation, and development wells, 31 production platforms; and 340 km of pipelines installed. 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 for proposed Sale 147. 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 Size 3 spill occurring and contacting within 10 days the CPA coast within 10 days is 4 percent (Table IV-10). Based on this low probability, the assumption is that no Size 3 spills will affect prehistoric archaeological resources. Furthermore, it is estimated that no Size 1 spill will occur and contact the coastline during the 35-year life of the proposed action. Under the High Case, one Size 2 spill is assumed to contact land during the lease life. It is assumed that onshore spills will occur as a result of OCS oil being transported to shore. In the CPA, it is assumed that an average of less than two Size 1 spills per year will occur under the High Case. It is further assumed that the majority of such spills would occur around terminals and be contained in the vicinity of the spill. There is a low probability of these spills contacting a prehistoric archaeological site. However, should such oil spills contact a prehistoric site, the carbon-14 dating of organic matter would be affected along those portions of the site that were contacted by the oil.

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, 1987a).

Conclusion

There is a very low probability of an impact between OCS 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 prehistoric archaeological information.

(13) 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 seismic surveying, 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 eight wells per year with approximately 133 workers.

Development Activity - One platform rig can drill an average of nine 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 computerized population and employment spreadsheet 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 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 environment, 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 Sections IV.A.3.h., IV.B.2.d., and IV.C.5.

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 0.66.

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 resulting from 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-4. Displayed also on this figure are baseline employment projections excluding jobs generated

Figure IV-4. Base Case Employment Impacts from Central Gulf Sale 147 (USDOI, MMS, Gulf of Mexico OCS Region estimates, 1992).

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 28,737 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 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 1,239 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 within the first 11 years of the life of the proposed action, are the largest contributor to peak-year direct impacts 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 2012, as employment resulting from production activities offshore reaches its peak of 1,177 workers. 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 53 percent of total employment impacts due to Central Gulf activity.

Table IV-20 displays the model projections of total OCS-related employment impacts (direct, indirect, and induced) from proposed Sale 147 in the Central Gulf to the coastal subareas of the CPA and WPA throughout the life of the proposed action. Table IV-21 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 LA-1 and LA-2, with peak-year impact estimates for 1999 of 0.13 percent and 0.11 percent, respectively. Coastal Subareas LA-1 and LA-2 collectively provide over 63 percent of the total employment required in support of the proposed action in the Central Gulf. Coastal Subarea LA-3 contributes approximately 30 percent of the employment. The least impacted coastal subarea in the CPA is Subarea MA-1, accounting for about 5 percent of the employment projected for the proposal in the coastal impact area. In the Western Gulf only coastal Subarea TX-2 is affected by the proposed action in the CPA. The Western Gulf is expected to provide less than 2 percent of total employment for proposed Sale 147 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.A.3.h. 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 Size 3 offshore spills will occur and contact land within 10 days of the accident is 2 percent (Table IV-10). 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 Size 2 spill is assumed to occur (Table IV-2); however, it is not assumed to contact the coastline. Eighteen Size 1 spills are assumed to occur in the CPA over the life of the proposed action. None are estimated to contact land.

In addition to the offshore spills referenced above, a number of small onshore spills are expected to occur. The level of cleanup action associated with these spills will be minimal.

Table IV-20

Base Case OCS-Related Employment Projections (Direct+Indirect+Induced)
Central Gulf Sale 147
(Person-Years)

Year	TX-1	TX-2	LA-1	LA-2	LA-3	MA-1	WGOM*	CGOM**
====	=====	=====	=====	=====	=====	=====	=====	=====
1994	0	0	0	0	0	0	0	0
1995	0	2	42	82	50	8	2	181
1996	0	7	127	240	154	24	7	545
1997	0	12	212	399	259	39	12	910
1998	0	13	223	416	273	42	13	953
1999	0	17	287	530	351	53	17	1,222
2000	0	16	256	464	315	48	16	1,084
2001	0	17	267	481	329	50	17	1,127
2002	0	19	289	513	358	54	19	1,215
2003	0	18	269	464	336	51	18	1,120
2004	0	19	280	481	350	53	19	1,164
2005	0	17	218	350	278	42	17	888
2006	0	17	218	350	278	42	17	888
2007	0	18	229	366	292	44	18	932
2008	0	19	240	382	306	46	19	976
2009	0	20	251	399	321	49	20	1,019
2010	0	20	251	399	321	49	20	1,019
2011	0	20	262	415	335	51	20	1,063
2012	0	21	273	431	349	53	21	1,106
2013	0	21	273	431	349	53	21	1,106
2014	0	21	273	431	349	53	21	1,106
2015	0	21	273	431	349	53	21	1,106
2016	0	22	284	448	363	55	22	1,150
2017	0	21	273	431	349	53	21	1,106
2018	0	19	230	354	294	45	19	924
2019	0	16	187	277	240	36	16	741
2020	0	15	176	261	226	34	15	697
2021	0	14	165	245	212	32	14	654
2022	0	13	154	228	198	30	13	610
2023	0	11	132	196	169	26	11	523
2024	0	9	110	163	141	21	9	436
2025	0	7	88	131	113	17	7	349
2026	0	5	55	82	71	11	5	218
2027	0	2	22	33	28	4	2	87
2028	0	0	0	0	0	0	0	0
	=====	=====	=====	=====	=====	=====	=====	=====
	0	510	6,896	11,304	8,705	1,321	510	28,227

* Western Gulf of Mexico

** Central Gulf of Mexico

Source: USDOl, MMS, Gulf of Mexico OCS Region estimates, 1992.

Table IV-21

Population and Employment Percentage Impact Levels for the Base Case Scenario (Sale 147)

IV-179

Year	TX-1	TX-2	LA-1	LA-2	LA-3	MA-1
====	=====	=====	=====	=====	=====	=====
Employment Impacts						
1994	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1995	0.00%	0.00%	0.02%	0.02%	0.01%	0.00%
1996	0.00%	0.00%	0.06%	0.05%	0.03%	0.01%
1997	0.00%	0.00%	0.10%	0.09%	0.05%	0.01%
1998	0.00%	0.00%	0.10%	0.09%	0.05%	0.01%
1999	0.00%	0.00%	0.13%	0.11%	0.06%	0.01%
2000	0.00%	0.00%	0.12%	0.10%	0.05%	0.01%
2001	0.00%	0.00%	0.12%	0.10%	0.06%	0.01%
2002	0.00%	0.00%	0.13%	0.10%	0.06%	0.01%
2003	0.00%	0.00%	0.12%	0.09%	0.06%	0.01%
2004	0.00%	0.00%	0.12%	0.09%	0.06%	0.01%
2005	0.00%	0.00%	0.09%	0.07%	0.04%	0.01%
2006	0.00%	0.00%	0.09%	0.07%	0.04%	0.01%
2007	0.00%	0.00%	0.10%	0.07%	0.05%	0.01%
2008	0.00%	0.00%	0.10%	0.07%	0.05%	0.01%
2009	0.00%	0.00%	0.10%	0.07%	0.05%	0.01%
2010	0.00%	0.00%	0.10%	0.07%	0.05%	0.01%
2011	0.00%	0.00%	0.11%	0.08%	0.05%	0.01%
2012	0.00%	0.00%	0.11%	0.08%	0.05%	0.01%
2013	0.00%	0.00%	0.11%	0.08%	0.05%	0.01%
2014	0.00%	0.00%	0.11%	0.08%	0.05%	0.01%
2015	0.00%	0.00%	0.11%	0.08%	0.05%	0.01%
2016	0.00%	0.00%	0.11%	0.08%	0.05%	0.01%
2017	0.00%	0.00%	0.10%	0.07%	0.05%	0.01%
2018	0.00%	0.00%	0.09%	0.06%	0.04%	0.01%
2019	0.00%	0.00%	0.07%	0.05%	0.03%	0.01%
2020	0.00%	0.00%	0.07%	0.04%	0.03%	0.01%
2021	0.00%	0.00%	0.06%	0.04%	0.03%	0.01%
2022	0.00%	0.00%	0.06%	0.04%	0.03%	0.01%
2023	0.00%	0.00%	0.05%	0.03%	0.02%	0.01%
2024	0.00%	0.00%	0.04%	0.03%	0.02%	0.00%
2025	0.00%	0.00%	0.03%	0.02%	0.01%	0.00%
2026	0.00%	0.00%	0.02%	0.01%	0.01%	0.00%
2027	0.00%	0.00%	0.01%	0.01%	0.00%	0.00%
2028	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Population Impacts						
1994	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1995	0.00%	0.00%	0.02%	0.02%	0.01%	0.00%
1996	0.00%	0.00%	0.06%	0.05%	0.03%	0.01%
1997	0.00%	0.00%	0.10%	0.09%	0.05%	0.01%
1998	0.00%	0.00%	0.11%	0.09%	0.05%	0.01%
1999	0.00%	0.00%	0.14%	0.11%	0.06%	0.01%
2000	0.00%	0.00%	0.12%	0.10%	0.06%	0.01%
2001	0.00%	0.00%	0.13%	0.10%	0.06%	0.01%
2002	0.00%	0.00%	0.14%	0.11%	0.06%	0.01%
2003	0.00%	0.00%	0.13%	0.10%	0.06%	0.01%
2004	0.00%	0.00%	0.13%	0.10%	0.06%	0.01%
2005	0.00%	0.00%	0.10%	0.07%	0.05%	0.01%
2006	0.00%	0.00%	0.10%	0.07%	0.05%	0.01%
2007	0.00%	0.00%	0.10%	0.07%	0.05%	0.01%
2008	0.00%	0.00%	0.11%	0.08%	0.05%	0.01%
2009	0.00%	0.00%	0.11%	0.08%	0.05%	0.01%
2010	0.00%	0.00%	0.11%	0.08%	0.05%	0.01%
2011	0.00%	0.00%	0.12%	0.08%	0.06%	0.01%
2012	0.00%	0.00%	0.12%	0.08%	0.06%	0.01%
2013	0.00%	0.00%	0.12%	0.08%	0.06%	0.01%
2014	0.00%	0.00%	0.12%	0.08%	0.06%	0.01%
2015	0.00%	0.00%	0.12%	0.08%	0.06%	0.01%
2016	0.00%	0.00%	0.12%	0.08%	0.06%	0.01%
2017	0.00%	0.00%	0.12%	0.08%	0.06%	0.01%
2018	0.00%	0.00%	0.10%	0.07%	0.05%	0.01%
2019	0.00%	0.00%	0.08%	0.05%	0.04%	0.01%
2020	0.00%	0.00%	0.08%	0.05%	0.04%	0.01%
2021	0.00%	0.00%	0.07%	0.04%	0.03%	0.01%
2022	0.00%	0.00%	0.07%	0.04%	0.03%	0.01%
2023	0.00%	0.00%	0.06%	0.04%	0.03%	0.01%
2024	0.00%	0.00%	0.05%	0.03%	0.02%	0.01%
2025	0.00%	0.00%	0.04%	0.02%	0.02%	0.00%
2026	0.00%	0.00%	0.02%	0.01%	0.01%	0.00%
2027	0.00%	0.00%	0.01%	0.01%	0.00%	0.00%
2028	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Source: USDOl, MMS, Gulf of Mexico OCS Region estimates, 1992.

The greatest impact on population from activities associated with Sale 147 is expected in coastal Subareas LA-1 and LA-2 with peak-year estimates for both 1999 and 2002 of 0.14 and 0.11 percent, respectively (Table IV-21). 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 result in 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. Less than 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 impact of the proposed action 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 more than twice those expected in the Base Case. A total of 67,715 person-years of employment (direct, indirect, and induced) are required in the Central and Western Gulf coastal subareas in support of the proposed action. Peak-year impacts occur in 2014 with approximately 2,798 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. Production activities are the main contributor to peak-year direct impacts and total employment impacts. A smaller yet noteworthy peak will occur in 1999 in association with exploration activities. The greatest contributor to overall employment impacts for the High Case is production operations. Employment related to oil and gas production activities accounts for 60 percent of total employment impacts resulting from Central Gulf activity.

Table IV-22 displays the model projections of total OCS-related employment impacts (direct, indirect, and induced) from Sale 147 in the Central Gulf to the coastal subareas of the CPA and WPA throughout the life of the proposed action. Table IV-23 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 existing population and labor force in the area or with immigrants and new labor force from other areas.

Table IV-22

High Case OCS-Related Employment Projections (Direct+Indirect+Induced)
 Central Gulf Sale 147
 (Person Years)

Year	TX-1	TX-2	LA-1	LA-2	LA-3	MA-1	WGOM*	CGOM**
====	=====	=====	=====	=====	=====	=====	=====	=====
1994	0	0	0	0	0	0	0	0
1995	0	4	82	159	105	16	4	363
1996	0	16	293	562	363	55	16	1,273
1997	0	21	377	723	466	71	21	1,637
1998	0	26	470	902	583	89	26	2,044
1999	0	28	513	980	631	96	28	2,219
2000	0	35	630	1,203	772	117	35	2,723
2001	0	33	590	1,121	715	109	33	2,536
2002	0	34	603	1,139	723	110	34	2,574
2003	0	32	563	1,057	666	101	32	2,387
2004	0	32	564	1,054	662	100	32	2,381
2005	0	26	451	831	514	78	26	1,873
2006	0	27	472	869	538	81	27	1,961
2007	0	29	504	927	574	87	29	2,093
2008	0	31	536	986	610	92	31	2,224
2009	0	33	568	1,044	646	98	33	2,356
2010	0	33	568	1,044	646	98	33	2,356
2011	0	35	600	1,102	682	103	35	2,488
2012	0	37	632	1,160	718	109	37	2,619
2013	0	37	632	1,160	718	109	37	2,619
2014	0	39	665	1,222	757	115	39	2,759
2015	0	35	600	1,098	680	103	35	2,480
2016	0	37	632	1,156	716	108	37	2,612
2017	0	35	588	1,074	665	101	35	2,429
2018	0	33	567	1,036	641	97	33	2,341
2019	0	30	513	935	579	88	30	2,114
2020	0	29	492	896	555	84	29	2,026
2021	0	28	470	857	531	80	28	1,938
2022	0	25	416	756	468	71	25	1,711
2023	0	23	395	717	444	67	23	1,623
2024	0	21	363	659	408	62	21	1,492
2025	0	18	299	543	336	51	18	1,229
2026	0	13	213	388	240	36	13	878
2027	0	6	107	194	120	18	6	439
2028	0	0	0	0	0	0	0	0
	=====	=====	=====	=====	=====	=====	=====	=====
	0	921	15,970	29,555	18,471	2,798	921	66,794

* Western Gulf of Mexico

** Central Gulf of Mexico

Source: USDOJ, MMS, Gulf of Mexico OCS Region estimates, 1992.

Table IV-23

IV-182

Population and Employment Percentage Impact Levels for the High Case Scenario (Sale 147)

Year	TX-1	TX-2	LA-1	LA-2	LA-3	MA-1
====	=====	=====	=====	=====	=====	=====
Employment Impacts						
1994	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1995	0.00%	0.00%	0.04%	0.04%	0.02%	0.00%
1996	0.00%	0.00%	0.14%	0.12%	0.06%	0.02%
1997	0.00%	0.00%	0.18%	0.16%	0.08%	0.02%
1998	0.00%	0.00%	0.22%	0.19%	0.10%	0.02%
1999	0.00%	0.00%	0.23%	0.20%	0.11%	0.03%
2000	0.00%	0.00%	0.28%	0.25%	0.13%	0.03%
2001	0.00%	0.00%	0.26%	0.23%	0.12%	0.03%
2002	0.00%	0.00%	0.27%	0.23%	0.12%	0.03%
2003	0.00%	0.00%	0.25%	0.21%	0.11%	0.03%
2004	0.00%	0.00%	0.24%	0.21%	0.11%	0.03%
2005	0.00%	0.00%	0.19%	0.16%	0.08%	0.02%
2006	0.00%	0.00%	0.20%	0.17%	0.09%	0.02%
2007	0.00%	0.00%	0.21%	0.18%	0.09%	0.02%
2008	0.00%	0.00%	0.22%	0.19%	0.09%	0.02%
2009	0.00%	0.00%	0.23%	0.20%	0.10%	0.02%
2010	0.00%	0.00%	0.23%	0.19%	0.10%	0.02%
2011	0.00%	0.00%	0.24%	0.20%	0.10%	0.02%
2012	0.00%	0.00%	0.25%	0.21%	0.11%	0.03%
2013	0.00%	0.00%	0.25%	0.21%	0.11%	0.03%
2014	0.00%	0.00%	0.26%	0.22%	0.11%	0.03%
2015	0.00%	0.00%	0.23%	0.19%	0.10%	0.02%
2016	0.00%	0.00%	0.24%	0.20%	0.10%	0.02%
2017	0.00%	0.00%	0.22%	0.19%	0.09%	0.02%
2018	0.00%	0.00%	0.21%	0.18%	0.09%	0.02%
2019	0.00%	0.00%	0.19%	0.16%	0.08%	0.02%
2020	0.00%	0.00%	0.18%	0.15%	0.08%	0.02%
2021	0.00%	0.00%	0.17%	0.14%	0.07%	0.02%
2022	0.00%	0.00%	0.15%	0.12%	0.06%	0.02%
2023	0.00%	0.00%	0.14%	0.12%	0.06%	0.01%
2024	0.00%	0.00%	0.13%	0.11%	0.05%	0.01%
2025	0.00%	0.00%	0.11%	0.09%	0.04%	0.01%
2026	0.00%	0.00%	0.07%	0.06%	0.03%	0.01%
2027	0.00%	0.00%	0.04%	0.03%	0.02%	0.00%
2028	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Population Impacts						
1994	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1995	0.00%	0.00%	0.04%	0.04%	0.02%	0.00%
1996	0.00%	0.00%	0.14%	0.12%	0.07%	0.02%
1997	0.00%	0.00%	0.18%	0.16%	0.08%	0.02%
1998	0.00%	0.00%	0.23%	0.20%	0.10%	0.02%
1999	0.00%	0.00%	0.24%	0.21%	0.11%	0.03%
2000	0.00%	0.00%	0.30%	0.26%	0.14%	0.03%
2001	0.00%	0.00%	0.28%	0.24%	0.13%	0.03%
2002	0.00%	0.00%	0.28%	0.24%	0.13%	0.03%
2003	0.00%	0.00%	0.26%	0.22%	0.12%	0.03%
2004	0.00%	0.00%	0.26%	0.22%	0.12%	0.03%
2005	0.00%	0.00%	0.21%	0.17%	0.09%	0.02%
2006	0.00%	0.00%	0.22%	0.18%	0.09%	0.02%
2007	0.00%	0.00%	0.23%	0.19%	0.10%	0.02%
2008	0.00%	0.00%	0.24%	0.20%	0.10%	0.02%
2009	0.00%	0.00%	0.26%	0.21%	0.11%	0.03%
2010	0.00%	0.00%	0.26%	0.21%	0.11%	0.02%
2011	0.00%	0.00%	0.27%	0.22%	0.12%	0.03%
2012	0.00%	0.00%	0.28%	0.23%	0.12%	0.03%
2013	0.00%	0.00%	0.28%	0.22%	0.12%	0.03%
2014	0.00%	0.00%	0.29%	0.23%	0.13%	0.03%
2015	0.00%	0.00%	0.26%	0.21%	0.11%	0.03%
2016	0.00%	0.00%	0.28%	0.22%	0.12%	0.03%
2017	0.00%	0.00%	0.26%	0.20%	0.11%	0.02%
2018	0.00%	0.00%	0.24%	0.19%	0.10%	0.02%
2019	0.00%	0.00%	0.22%	0.17%	0.09%	0.02%
2020	0.00%	0.00%	0.21%	0.16%	0.09%	0.02%
2021	0.00%	0.00%	0.20%	0.16%	0.09%	0.02%
2022	0.00%	0.00%	0.18%	0.14%	0.07%	0.02%
2023	0.00%	0.00%	0.17%	0.13%	0.07%	0.02%
2024	0.00%	0.00%	0.15%	0.12%	0.06%	0.01%
2025	0.00%	0.00%	0.12%	0.10%	0.05%	0.01%
2026	0.00%	0.00%	0.09%	0.07%	0.04%	0.01%
2027	0.00%	0.00%	0.04%	0.03%	0.02%	0.00%
2028	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Source: USDOL, MMS, Gulf of Mexico OCS Region estimates, 1992.

The greatest impact to employment is expected in coastal Subareas LA-1 and LA-2, with peak-year impact estimates for 2000 of 0.28 percent and 0.25 percent, respectively. Coastal Subareas LA-1 and LA-2 collectively provide over 67 percent of the total employment required in support of the proposed action in the Central Gulf. Coastal Subarea LA-3 contributes approximately 27 percent of the total employment impacts to the Central and Western Gulf coastal impact area. The least impacted coastal subarea in the CPA is MA-1, accounting for only 4 percent of the total employment impact from Sale 147. In the Western Gulf only coastal Subarea TX-2 is affected by the proposed action in the CPA. The Western Gulf is expected to provide slightly over 1 percent of total employment for Sale 147 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.A.3.h. presents estimates of the mean number of offshore spills assumed to result from the proposed action (High Case) in the CPA. The probability that one or more Size 3 offshore spills will occur and contact land within 10 days of the accident is 4 percent (Table IV-10). 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. 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 Size 2 spills are assumed to occur (Table IV-2); however, it is not expected that they will contact the coastline. Forty-one Size 1 spills are assumed to occur in the CPA over the life of the proposed action. None are estimated to contact land.

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 these spills will be minimal.

The greatest impact on population from activities associated with Sale 147 is expected in coastal Subareas LA-1 and LA-2 with peak year impact estimates for 2000 of 0.30 and 0.26 percent, respectively (Table IV-23). The coastal communities of the Western Gulf have no noticeable peak population impacts.

The level of OCS-related employment expected to result from the High Case is more than twice 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 result in positive net migration to any given area. None of the coastal subareas is projected to experience population impacts greater than 1 percent. 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.

Peak annual changes in the population, labor, and employment of all coastal subareas in the Central and Western Gulf resulting from the proposed action 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 impact of the High Case 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.a. (offshore infrastructure), IV.B.1.a. (onshore infrastructure), IV.A.3.h.(2) and IV.B.2.d.(1) (oil spills), and IV.D.1.a.(13)(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 workforce 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.(13)(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.(13)(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 predicted and cannot be presumed for this analysis.

An estimated 28,737 person-years of employment (direct, indirect, and induced) are required to sustain the proposed action throughout its 35-year life (Table IV-20). Less than 2 percent of total employment in support of the proposed action is expected to affect the Texas coastal area (Subarea TX-2). The remaining employment is expected to lie within coastal Subareas LA-1 (24%), LA-2 (40%), LA-3 (30%), and MA-1 (5%). In the peak year of 1999, approximately 1,239 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 LA-2. The expected population and employment impacts for the coastal subareas as a result of the proposed action are shown in Table IV-21. The greatest impact to employment is expected to occur in coastal Subareas LA-1 and LA-2, with peak-year impact estimates in 1999 of 0.13 and 0.11 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 workforce 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 workforce 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. Table IV-21 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 TX-1 and TX-2. None of the CPA coastal subareas is expected to experience population impacts greater than 0.14 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.(13)(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, with resulting 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 result in positive net migration into a given area. Table IV-21 indicates that population impacts are not expected to exceed this figure. 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 28,737 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 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 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. 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 in the CPA as a result of the proposed action. Specific impact-producing factors examined in this analysis include workforce 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 result in positive net migration into a given area. Population impacts are not expected to exceed the peak year impacts of 0.14 percent. No positive net migration into the coastal subareas 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 by the unemployed, 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.

Conclusion

Population and employment impacts that result from the proposed action 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.(13)(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 predicted and cannot be presumed for this analysis.

Approximately 67,715 person-years of employment (direct, indirect, and induced) are required to sustain the proposal throughout its 35-year life (Table IV-22). Less than 2 percent of total employment is expected to affect the Texas Gulf coastal area (Subarea TX-2). The remaining employment is expected to occur within coastal Subareas LA-1 (24%), LA-2 (44%), LA-3 (28%), and MA-1 (4%). In the peak year of 2014, approximately 2,798 person-years of total employment are estimated. The greatest amount of this employment is expected to lie within Subarea LA-2. The expected population and employment impacts for the coastal subareas as a result of the High Case are shown in Table IV-23. The greatest impact to employment is expected to occur in coastal Subareas LA-1 and LA-2 with peak-year impact estimates in 2000 of 0.28 and 0.25 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 workforce 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 workforce could result in net positive migration and cause a scarcity of housing, a shortage of municipal personnel (i.e., policemen, engineers, etc.), and an increase in the cost of living. Table IV-24 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 TX-1 and TX-2. No coastal subarea is expected to experience population impacts greater than 0.30 percent (2000-peak year). It is expected that employment will not require importation of labor and that the existing labor pool will be adequate to supply labor needs. The proposal is expected to provide jobs for the unemployed, 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.(13)(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 result in positive net migration into a given area. Table IV-23 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 67,715 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 amount of out-migration will be reduced 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. Employment needs 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. 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 in the CPA as a result of the High Case. Specific impact-producing factors examined in this analysis include workforce 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 result in positive net migration into a given area. Population impacts are not expected to exceed the peak-year impacts of 0.30 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 by the unemployed, 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.

Conclusion

Population and employment impacts would not result in disruptions to community infrastructure and public services beyond what is anticipated by in-place planning and development agencies.

(c) Sociocultural Issues

This impact analysis includes the coastal parishes and counties of the Central and Western Gulf of Mexico. Sociocultural issues, 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, sociocultural changes within the analysis area. However, the present analysis will consider only the effects of OCS-related oil and gas activity on the social and cultural patterns of the Central and Western Gulf coastal subareas.

Sections providing supportive material for this analysis include Sections III.C.2. (description of socioeconomic issues), IV.A.2.(a) (offshore infrastructure), IV.C.5. (oil spills), IV.D.1.a.(1)(b) (impacts on sensitive coastal environments), IV.D.1.a.(10) (impacts on commercial fisheries), IV.D.1.a.(13)(a) (impacts on population, labor, and employment), and IV.D.1.a.(13)(b) (impacts on public services and infrastructure).

For the purpose of this analysis, OCS-related impact-producing factors to sociocultural issues will include OCS-related employment and workforce fluctuations, population and demographic change, relative income, wetlands loss, oil spills, and work scheduling. Adverse effects to social and cultural patterns could arise if disruption of these patterns occurred and resulted in changes in traditional occupations, disruption in the viability of extant subcultures, social and community dysfunction, and detrimental effects on individual or family life.

The OCS-related employment and workforce fluctuations may result in positive and/or negative effects on social and cultural patterns. The OCS-related employment may occur from exploration, delineation and

development of reservoirs, from secondary and tertiary industries serving OCS activities, and from construction of infrastructure necessary to service OCS activities. The obvious positive benefit of OCS oil and gas activity lies in the availability of jobs (or continuity of existing jobs) for persons in the analysis area. This can allow for the economic stability of those persons who are already working in OCS-related positions, and for the incorporation of persons into OCS-related jobs who are unemployed or underemployed. Large numbers of short-term layoffs in OCS oil and gas industry personnel could result in large numbers of persons returning to more traditional ways of employment (i.e., fishing, trapping, farming, etc.). This could stress the carrying capacity of local ecosystems and diminish the various resources that would be exploited, which, in turn, would have economic impacts on resource exploiters as the ability to sustain the activity decreased. An additional effect could be increased economic stress placed on families and individuals with concomitant social problems. A large increase in the hiring of oil and gas industry personnel could result in increases in populations of small communities highly involved in the OCS oil and gas industry with attendant social and cultural effects.

In-migration and out-migration may be considered resultants of rapid increases and decreases in the rate of OCS activity. During periods of rapid increases in OCS activity, it is reasonable to assume that persons move into the coastal areas to take part in the increased opportunity for employment in the OCS oil and gas industry. The rapid influx of persons into coastal communities could effect community function and cohesion, quality of life, and cultural identity. During periods of rapid decreases in OCS activity, out-migration of persons from coastal communities could occur. This could result in fiscal and sociocultural effects. Adverse impacts could include effects on community cohesion and function following departure of long-term residents, emotional stress in individuals and families as a result of the departure of family members, and the departure of persons who are engaged in traditional occupations.

Jobs associated with the OCS oil and gas industry in the Gulf of Mexico have generally been viewed as higher paying jobs. This is true at both the professional and blue collar levels. The impacts associated with the higher paying jobs in the OCS oil and gas industry include possible destabilization of small businesses which cannot compete with salaries and benefit packages of larger OCS-related companies, possible lack of incentives for increased business efficiency (particularly during "boom" times), and dependancy on these relatively higher wages which can lead to individual and family economic stress (particularly if layoffs occur and the wage-earner cannot find work at comparable pay).

The loss of wetlands has the potential to impact many traditional occupations associated with the coastal parishes and counties of the analysis area. Wetlands loss could result in the loss of productivity of the estuarine marshes. This could diminish the availability of biological resources and have an adverse economic effect on individuals engaged in resource fishing, trapping, and other exploitative efforts. This could eventually result in a loss of or diminution of traditional occupations.

Oil spills have the potential to damage wetlands and adversely effect persons engaged in fishing, trapping, etc. Aesthetic enjoyment and recreational use of those areas impacted by an oil spill would be adversely effected. Cleanup of oil spills could result in short-term, adverse effects on communities. The problems would be similar to those associated with a large influx of strangers into small, coastal communities.

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 of time on duty (or at site) followed by a large block of time off duty. The scheduled may range from 7 days on followed by 7 days off to a 30 day-on/30 day-off schedule. This extended work schedule necessitates adjustment by the family and the working family member to changes in traditional roles (e.g., when the family member, usually the husband, is away other members must perform those duties which would ordinarily be done by the absent person). In those families which cannot adjust to this absence, adverse effects (such as divorce or family dysfunction) could occur.

Base Case Analysis

Baseline employment projections and information related to the model analysis used to arrive at these projections are presented in Section IV.D.1.a.(13)(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 predicted and cannot be presumed for this analysis.

The proposed action will result in 28,737 person-years of direct, indirect, and induced employment throughout its 35-year life (Table IV-20). Less than 2 percent of total employment in support of the proposed

action is expected to affect the Western Gulf coastal areas (Subarea TX-2). The remaining employment is expected to lie within coastal Subareas LA-1 (24%), LA-2 (40%), LA-3 (30%), and MA-1 (5%). In the peak year of 1999, approximately 1,239 person-years of total employment will be required to support the proposed action. The greatest amount of this employment is expected to occur in Subarea LA-2. The expected population and employment impacts for the coastal subareas as a result of the proposed action are shown in Table IV-21. The greatest impact to employment is expected to occur in coastal Subareas LA-1 and LA-2, with peak-year impact estimates in 1999 of 0.13 and 0.11 percent, respectively. Subarea LA-1 experiences bimodal maximum impacts with a second peak year in 2002, also with a 0.13 percent impact. The employment projected to occur in association with the proposed action is expected to be filled by persons already engaged in OCS oil- and gas-related employment, unemployed persons living in the area, and underemployed persons living in the area. Inasmuch as jobs will be provided for persons living in the coastal subareas, some positive impact is expected.

Given the present amount of OCS-related jobs in the coastal subareas, the proposed action is not expected to result in workforce fluctuations. The creation of jobs associated with the proposed action (i.e., 28,737 person-years of employment over the life of the proposed action) is expected to reduce the amount of workforce fluctuations which would occur without the proposed action. It is therefore 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.

Projected population impacts in the Central and Western Gulf coastal subareas are presented in Table IV-21. Peak impacts are expected to occur in 1999 and 2002 at 0.14 percent. 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 are projected to experience population impacts greater than 0.14 percent as a result of the proposed action. It is assumed that employment as a result of the proposed action will decrease the amount of out-migration compared to that which would occur without the proposed action. Social and cultural problems typically associated with in-migration and out-migration are not expected to occur as a result of the proposed action.

It is reasonable to expect that some persons engaged in lower-paying occupations will seek employment in OCS-related oil and gas activities. It is also reasonable to expect that some persons engaged in traditional occupations will seek employment in OCS-related activities. Employment projections for the life of the proposed action indicate that peak-year employment will occur in 1999 and will total 1,239 person-years. The relatively small amount of employment associated with the proposed action, in comparison with the total employment in the affected Western and Central Gulf coastal subareas, is not expected to result in deleterious impacts to small businesses.

The proposed action is assumed to result in an impact to approximately 67.5 ha of wetlands from oil spills in the CPA over the 35-year life of the proposed action. Four and 10 years after each spill, 25 and 35 ha will, respectively, recover. Other sources of wetlands loss related to the proposed action include secondary impacts from OCS-related pipelines and erosion of wetlands from OCS vessel wakes. Total wetlands loss as a result of the proposed action is projected to be approximately 80 ha, with suppressed productivity of an additional 25 and 35 ha (for 4 and 10 years, respectively). The projected amount of wetlands loss is not sufficient to effect the practice of traditional occupations in the CPA, given the total amount of coastal marsh available for exploitation.

Section IV.A.3.h. 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 Size 3 offshore spills will occur and contact land within 10 days of the accident is 2 percent (Table IV-10). 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 Size 2 spill is assumed to occur (Table IV-2); it is not assumed to contact the coastline. Eighteen Size 1 spills are assumed to occur in the CPA over the 35-year life of the proposed action. None of these spills are assumed to contact land. A number of Size 1 onshore spills are expected to occur. The level of cleanup action associated with these spills will be minimal. As mentioned above, wetlands impacted by oil spills will recover in large part. Therefore, the practice of traditional occupations will not be impacted given the total amount of coastal marsh which is available for exploitation.

In the peak year of 1999, approximately 1,239 person-years of total employment are projected to be required to support the proposed action. A total of 601 person-years of direct, offshore employment in OCS activities will be required to support the proposed action. These persons will likely encounter the extended work schedule which is typically associated with OCS offshore activities. The extended work schedule will allow for part time participation in more traditional occupations (fishing, trapping, etc.). The relationship between OCS oil and gas activities and traditional culture in the coastal subareas of Louisiana has been mostly positive (Forsythe, written communication, 1992). The extended work schedule changes the practice of traditional familial roles, in an adaptive response to absence. In the majority of cases, it is expected that the familial adaptations to the extended work schedule will be successful. However, it is expected that in a small number of cases, successful adaptation of the family to the extended work schedule will not occur. In these cases, some deleterious impacts to family are expected.

Summary

The employment projected to occur in association with the proposed action is expected to be filled by persons already engaged in OCS oil and gas related employment, unemployed persons living in the area, and underemployed persons living in the area. Inasmuch as jobs will be provided for persons living in the coastal subareas, some positive impact is expected. Given the present amount of OCS-related jobs in the coastal subareas, the proposed action is not expected to result in workforce fluctuations. None of the coastal subareas are projected to experience population impacts greater than 0.14 percent as a result of the proposed action. It is assumed that employment as a result of the proposed action will decrease the amount of out-migration compared to that which would occur without the proposed action. Social and cultural problems typically associated with in-migration and out-migration are not expected to occur as a result of the proposed action. The relatively small amount of employment associated with the proposed action, in comparison with the total employment in the affected Western and Central Gulf coastal subareas, is expected to result in no deleterious impacts to small businesses. The projected amount of wetlands loss is not sufficient to effect the practice of traditional occupations in the CPA, given the total amount of coastal marsh available for exploitation. Based on the low probability of an offshore spill occurring and contacting land, the assumption is that no significant employment requirements will result from the clean-up of offshore spills. Employment requirements for cleanup of onshore spills is expected to be minimal. It is expected that in a small number of cases, successful adaptation of the family to the extended work schedule will not occur. In these cases, some deleterious impacts to family are expected.

Conclusion

Sociocultural impacts are expected to be minimal, with some deleterious impacts to family life in a small number of cases resulting from the extended work schedule.

High Case Analysis

The High Case will result in approximately 67,715 person-years of direct, indirect, and induced employment throughout its 35-year life (Table IV-24). Less than 2 percent of total employment in support of the High Case is expected to affect the Western Gulf coastal subareas (Subarea TX-2). The remaining employment is expected to lie within coastal Subareas LA-1 (24%), LA-2 (44%), LA-3 (28%), and MA-1 (4%). In the peak exploration year of 2000, approximately 2,758 person-years of total employment will be required. In the peak production year of 2014, approximately 2,798 person-years of total employment are required to support the High Case. The greatest amount of exploration and production employment is expected to occur in Subarea LA-2. The expected population and employment impacts for the coastal subareas as a result of the High Case are shown in Table IV-23. The greatest impact to employment is bimodal and expected to occur in coastal Subareas LA-1 and LA-2, with peak-year impact estimates in 2000 of 0.28 percent and 0.25 percent, respectively. The projected employment is expected to be filled by persons already engaged in OCS oil and gas related employment, unemployed persons living in the area, and underemployed persons living in the area. Inasmuch as jobs will be provided for persons living in the coastal subareas, some positive impact is expected.

Given the present amount of OCS-related jobs in the coastal subareas, the High Case is not expected to result in workforce fluctuations. The creation of jobs (i.e., 67,715 person-years of employment over the life of the proposed action) is expected to reduce the amount of workforce fluctuations which would occur without the proposed action. It is therefore expected that no large increases or decreases in OCS-related employment would occur within the Central and Western Gulf coastal subareas.

Projected population impacts in the Central and Western Gulf coastal subareas are presented in Table IV-23. Peak impacts are expected to occur in Subarea LA-1 in 2000 at 0.30 percent. 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 are projected to experience population impacts greater than 0.30 percent. It is assumed that employment as a result of the proposed action will decrease the amount of out-migration compared to that which would occur without the proposed action. Social and cultural problems typically associated with in-migration and out-migration are not expected to occur.

It is assumed that some persons engaged in lower-paying occupations will seek employment in OCS-related oil and gas activities. It is also assumed that some persons engaged in traditional occupations will seek employment in OCS-related activities. In the peak exploration year of 2000, approximately 2,758 person-years of total employment are estimated. In the peak production year of 2014, approximately 2,798 person-years of total employment are estimated. The greatest amount of exploration and production employment is expected to occur in Subarea LA-2. The relatively small amount of employment associated with the proposed action, in comparison with the total employment in the affected Western and Central Gulf coastal subareas, is not expected to result in deleterious impacts to small businesses.

Approximately 167.4 ha of wetlands are assumed to be impacted from oil spills in the CPA over the 35-year life of the proposal. Four and 10 years after each spill, 62 and 86.8 ha will, respectively, recover. Other sources of wetlands loss include secondary impacts from OCS-related pipelines and erosion of wetlands from OCS vessel wakes. Total wetlands loss as a result of the High Case is projected to be approximately 163 ha, with suppressed productivity of an additional 62 and 86.8 ha (for 4 and 10 years, respectively). The projected amount of wetlands loss is not sufficient to effect the practice of traditional occupations in the CPA, given the total amount of coastal marsh available for exploitation.

Section IV.A.3.h. presents estimates of the mean number of offshore spills assumed to result from the High Case. The probability that one or more Size 3 offshore spills will occur and contact land within 10 days of the accident is 4 percent (Table IV-10). 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.

Two Size 3 spills are assumed to occur (Table IV-2); they are not assumed to contact the coastline. Forty-one Size 2 spills are assumed to occur in the CPA over the 35-year life of the proposal. None of these spills are assumed to contact land. A number of Size 1 onshore spills are expected to occur. The level of cleanup action associated with these spills will be minimal. As mentioned above, wetlands impacted by oil spills will recover in large part. Therefore, the practice of traditional occupations will not be impacted given the total amount of coastal marsh which is available for exploitation.

In the peak exploration year of 2000, approximately 2,758 person-years of total employment are estimated. In the peak production year of 2014, approximately 2,798 person-years of total employment are estimated. The greatest amount of exploration and production employment is expected to occur in Subarea LA-2. Approximately 1,331 person-years of direct, offshore employment in OCS activities is required to support peak exploration. Approximately 1,349 person-years of direct, offshore employment in OCS activities is required to support peak production. These persons will likely encounter the extended work schedule which is typically associated with OCS offshore activities. The extended work schedule will allow for part time participation in more traditional occupations (fishing, trapping, etc.). The relationship between OCS oil and gas activities and traditional culture in the coastal subareas of Louisiana has been mostly positive (Forsythe, written communication, 1992). The extended work schedule changes the practice of traditional familial roles, in an adaptive response to absence. In the majority of cases, it is expected that the familial adaptations to the extended work schedule will be successful. However, it is expected that in a small minority of cases, successful adaptation of the family to the extended work schedule will not occur. In these cases, some deleterious impacts to family are expected.

Conclusion

Sociocultural impacts associated with the High Case are expected to be minimal, with some deleterious impacts to family life in a small number of cases resulting from the extended work schedule.

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

Description of the Alternative

Alternative B would offer for lease approximately 5,630 unleased blocks in the CPA. It differs from Alternative A (the proposed action) by not offering the 71 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 (including the four potential mitigating measures) and estimates are the same as in the Base Case of Alternative A. Details are presented in Sections I.A. and II.A.2.

Effects of the Alternatives

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 adjacent coastal region is divided into four coastal subareas (LA-1, LA-2, L-3, and MA-1). These subareas are delineated on Figure IV-1.

(1) Impacts on Sensitive Coastal Environments

(a) Coastal Barrier Beaches and Associated Dunes

No oil spill is expected to contact a barrier beach. Should an unforeseen contact occur, it is expected that resulting oiling will be very light.

Onshore and nearshore construction of new infrastructure (pipeline landfalls, navigation channels, service bases, platform yards, etc.) as a result of Alternate B are not expected to occur.

Some maintenance dredging is expected to occur, but it has not been shown to have an appreciable negative impact on barrier beaches. The need for dredging cannot be attributed to the small percentage of vessel traffic in these channels, traffic that is accounted for by Alternative B activities.

Deepening of the channel to Port Fourchon is expected to maintain continuing adverse impacts on nearby barrier features. Strategic placement of dredged material from this project and subsequent maintenance dredging is expected to benefit barrier beaches of the CPA.

Conclusion

Alternative B is expected to result in alteration of barrier beach configurations in localized areas downdrift from navigation channels that are jettied and maintained or deepened. Strategic placement of dredged material resulting from these actions can mitigate their adverse impacts upon those localized areas.

(b) Wetlands

Only spills from pipelines and navigational accidents are expected to result in high-enough concentrations of oil contacting wetlands to result in impacts. Several onshore barge and pipeline accidents are expected to occur, impacting approximately 68 ha of wetlands over the course of 35 years. For 4 and 10 years after each spill, 25 and 35 ha will cumulatively recover, respectively. Cumulatively, 8 ha of wetlands will be converted to open water. Seagrass beds will be contacted by low concentrations of oil, if any, from these spills. No impacts to seagrass beds are expected.

As a secondary impact of OCS-related pipeline canals attributable to Alternative B, 61 ha of wetlands are estimated to be lost over 35 years.

Deepening one channel to accommodate larger service vessels is expected to occur within a saline marsh environment and affords the opportunity for the creation of 6 ha of wetlands.

Insignificant adverse impacts from maintenance dredging are expected. Alternative dredged material disposal methods can be used to enhance coastal wetlands.

Erosion of wetlands from OCS vessel wakes is not expected to result in more than 18 ha of wetlands loss during the 35-year life of the proposed action.

Conclusion

Alternative B is expected to result in the loss of up to 87 ha, suppressed productivity of up to 25 ha for 4 years and 35 ha for 10 years, and a gain of up to 6 ha due to the beneficial use of dredged material.

(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. For purposes of this analysis, it is presumed that the Live Bottom (Pinnacle Trend) Stipulation, as presented in Section II.A.1.c.(2), would be applied for all pinnacle trend areas under Alternative B.

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), discharges of produced waters and sanitary domestic wastes (through toxicity), 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.

Table IV-2 provides information regarding the level of OCS-related activities in the vicinity of the pinnacles. The pinnacles are located within offshore Subarea C-3. The information in the following discussion is based on the levels of activity derived from Table IV-2. Approximately 818,000 MMbbl of drilling muds, 251,000 MMbbl of drill cuttings, 72,000 m³ of domestic and sanitary wastes, and 62 MMbbl of produced waters will be discharged from 125 exploration or delineation and production wells over the 35-year life of the proposed action in offshore Subarea C-3. Approximately 120 km of pipeline will be installed to transport production from the eight platforms projected to be emplaced. Only one blowout is projected. Based on an MMS in-house analysis of proprietary data, only low levels of these activities are projected to take place in the

actual vicinity of the pinnacle trend. None of the excluded blocks of Alternative B are in areas in which pinnacle trend live-bottom communities may be found, because the excluded blocks are located near the topographic features that lie west of the pinnacle trend. None of the excluded blocks of Alternative B are in areas in which pinnacle trend live-bottom communities may be found, because the excluded blocks are located near the topographic features that lie west of the pinnacle trend.

Activities resulting from the proposed action are expected to have only minor adverse impacts 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 low levels of anticipated operations in the vicinity of the pinnacles and the small size of many of the features. Potential adverse impacts from blowouts, pipeline emplacement, muds and cuttings discharges, discharges of produced waters and domestic and sanitary wastes, and structure removals would be minor because the analysis includes the proposed Live Bottom Stipulation. Potential impact from Size 3 oil spills would be minor because of the depth of the features, the currents in the area, and the low level of pipeline activities in the area. Impacts to the pinnacles would be infrequent, and the severity is judged to be slight because of the widespread nature of the features.

Conclusion

The impact of Alternative B is expected to be such that any changes in the regional physical integrity, species diversity, or biological productivity of the pinnacle features 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

Alternative 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 damage as a result of physical disturbance 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 proposed action. As noted in Section IV.D.1.a.(2)(c), 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; one 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. It should be noted that 100 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 14 percent chance of a Size 3 oil spill 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-9). It is assumed that 18 Size 1 spills will occur during the 35-year program and 1 Size 2 spill and 1 Size 3 spill (6,500 bbl) is assumed to occur during the 35-year life of the proposed action (Section IV.A.). In addition, it is assumed there will be nine 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 localized areas would be impacted by operational discharges (i.e., muds and cuttings), and recovery 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

Expected future water quality degradation associated with discharges and spills due to Sale 147 operations under Alternative B will not differ from Alternative A because there are no expected changes in onshore infrastructure, vessel traffic, and spill occurrences. Impacts from discharges occurring from the use of onshore facilities is expected to be very minor, but will be widespread and continuous, especially in the Mississippi Deltaic area of Louisiana, where support facilities are concentrated. Onshore disposal and storage of offshore operational wastes will only result in some minor localized degradation around a few temporary storage sites in Louisiana. There will be minor, localized, long-term changes in water quality characteristics from current

levels in the confined portions of 18 channels. These changes will result from OCS vessel traffic usage of the channels, usage that causes bank erosion and contributes chronic, bilge and sanitary wastes discharges. Thirty-seven maintenance and deepening dredging operations will result in localized impacts (primarily elevated water column turbidities) during the duration (up to several months). Low-level petroleum hydrocarbon contamination of coastal waters will occur from onshore spills associated with Sale 147 operations and will affect localized, confined areas for up to 6 months in 11 locations along the Louisiana coast, up to 6 weeks in 26 locations along the Louisiana coast, and will persist for up to 5 years in 2 locations along the coast, affecting 54 ha of marsh waters.

Conclusion

Alternative B will result in the same level of water quality degradation as Alternative A because there are no changes expected in onshore support infrastructure usage from that projected for Alternative A. Coastal water quality degradation will be minor, long-term changes in water characteristics within, or in the vicinity of, navigation channels and support complexes. These changes will not preclude future uses of the waters affected. Also, Alternative B is not expected to result in decreased oil spill occurrences from those projected for Alternative A. Therefore, Alternative B will also result in localized, short-term changes in water quality during dredging operations or from spill occurrences, which will alter uses of the affected waters for up to 6 months or up to 5 years in two incidences.

Marine Waters

Expected future regional water quality degradation associated with discharges and spills occurring as a result of Alternative B will not differ from Alternative A. It is assumed that if industry does not drill near sensitive offshore areas that they will invest in development of resources elsewhere in the Gulf; therefore, projections of operations for Alternative B do not differ from Alternative A. Sediment disturbance from the emplacement of 20 platforms and 515 km of pipeline and from the drilling of 350 wells over a 35-year period will result in minor, localized, temporary impacts on water quality. The drilling of the wells, construction of the platforms, and laying of the pipe will result in increased water-column turbidities in offshore waters. Such bottom disturbance of sediments will result in resuspension of any settled pollutants, such as trace metals, chlorinated hydrocarbons, and excess nutrients, that may have accumulated in the sediments. The resuspension of significant quantities of contaminants from bottom-disturbance operations is not expected to occur due to a lack of contaminants in deep-water sediments and the infrequency of the operations. Given the low frequency of platform removals (maximum is 3 in the peak year), minimum impacts on water quality due to resuspension of sediments, especially resulting from explosive removals, are expected from these operations.

One 6,500-bbl spill, 1 Size 2 spill, and 18 Size 1 spills are projected. Given the infrequent nature of these spills, especially the larger sizes, impacts on offshore water quality from oil-spill events related to Alternative B are projected to be negligible, to be of short-duration (2-3 months), and to only affect a small area of offshore waters at any one time.

The area around each of the 20 projected platforms can be contaminated from the discharge of 36,000 bbl of drilling muds and cuttings at each site. These discharges may be released continuously for about a year and a half (assuming 3 exploratory wells and 9 development wells were drilled at one site) and then other quantities discharged intermittently when old wells become depleted and new wells are drilled. These discharges of drilling wastes will affect an area several thousand meters around a platform. Sediment contamination can be expected out to 3 km from the discharge point in the primary direction of the current and will last up to 1 year after drilling ceases. Benthic marine organisms will be affected out to 1,000 m. Water quality criteria are expected to be exceeded within 100 m from the discharge. Moderate petroleum and metal contamination of sediments and water column from the discharge of 243 MMbbl of produced water at 10 platforms will occur out to several hundred meters from the discharge point and will have small-scale, localized effects on benthic organisms out to 200-500 m. If, for analytical purposes, an assumption is made that the regional, long-term contamination of Gulf waters and sediments by the OCS industry makes up 50 percent of the total water quality degradation that occurs, then discharges resulting from Alternative B operations would contribute a little more than 1 percent of the Gulf water quality cumulative contamination (Section IV.D.1.d.).

Conclusion

As a result of Alternative B, marine waters will be degraded from discharges, oil spills, and bottom disturbances. Bottom disturbances (platform and pipeline emplacements and removals) and oil spills are expected to result in minor, localized, temporary impacts to water quality. Changes in water quality parameters will return to background within months from the disturbance. Operational discharges are primarily muds and cuttings and produced waters. Drilling muds and cuttings, which are discharged intermittently throughout the life of a platform, are expected to contaminate a localized area around platforms out to 3,000 for up to 1 year after drilling ceases. Production wastes, which are discharged continuously throughout the life of most of the platforms, will change some water quality and sediment parameters within several hundred meters downcurrent from the discharge point for an average of 20 years. These discharges will also contribute, to a very small extent, to the long-term, regional contamination of Gulf waters and sediments.

(4) Impacts on Air Quality

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 61 blocks would be withheld from proposed Sale 147 if Alternative B were adopted, it is expected that activities, infrastructure, and other factors described in that analysis will not change appreciably. Table IV-2 indicates the number of wells and platform complexes related to Alternative A. It is assumed that, given the level of activities produced by Alternative B is comparable to those of Alternative A, the analyses described in Alternative A will not change.

It is assumed under the proposed action that 130 exploration and delineation wells and 220 development wells will be drilled, and 20 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	10,448.6	6,269.2	16,717.8	8,358.9
CO	1,606.1	903.7	2,409.7	6,024.3
SO _x	120.2	72.1	192.3	480.8
THC	3,520.3	2,112.2	5,632.4	14,081.1
TSP	129.9	78.0	207.9	519.7

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 about 3 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 μm^3 (box model steady concentrations). The impacts decrease during winter because onshore winds occur only 37 percent of the time and impacts increase in summer when onshore winds occur 61 percent of the time.

(5) Impacts on Marine Mammals

(a) Nonendangered and Nonthreatened Species

The level of activity associated with the Alternative B 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 sources of impact include degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service vessel and OCS structures. The effects of these activities are expected to be primarily sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) and the probability of an interaction is unlikely.

Conclusion

The impact of Alternative B on nonendangered and nonthreatened marine mammals is expected to result in primarily sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that are both chronic and sporadic. These impacts could cause acute or chronic physiological stress, alter normal behavior, and reduce some degree of avoidance, either temporary or permanent, of the impacted area(s).

(b) Endangered and Threatened Species

The level of activity associated with the Alternative B 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 sources of impact include degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills,

oil-spill response activities, and discarded trash and debris from service vessels and OCS structures. The effects of these activities are expected to be primarily sublethal and the probability of an interaction is unlikely.

Conclusion

The impact of Alternative B on endangered and threatened marine mammals is expected to result in primarily sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that are both chronic and sporadic. These impacts could cause acute or chronic physiological stress, alter normal behavior, and result in some degree of avoidance, either temporary or permanent, of the impacted area(s). Lethal impacts are expected to be rare for all marine mammals, with the most likely impacts resulting from vessel collisions to lethargic surfaced individual animals. The unexpected and unintentional removal of individuals of any species is considered an incidental take. Such removals have not been documented in the Gulf. Recovery times will vary with species size, gestation period, and rates of reproductive activity. These will vary from two to several (less than ten) years.

(6) Impacts on the Alabama, Choctawhatchee, and Perdido Key Beach Mice

The major impact-producing factors analyzed below are related to the proposed action and include oil spills and oil-spill response activities. Eleven Size 1 spills are expected to occur onshore during the 35-year life of the proposed action (Table IV-13). Two Size 2 spills are not assumed to breach barrier dunes and contact or affect beach mice or their habitats.

No Size 3 crude oil spills are assumed to occur onshore in the Central Gulf during the 35-year life of the proposed action (Table IV-13). A Size 3 oil spill could breach beach barriers only if the spill coincided with a storm surge strong enough to lift oil over the foredunes. There is less than a 0.5 percent probability of a Size 3 oil spill occurring and contacting coastal areas of the Alabama, Choctawhatchee, and Perdido Key beach mice within 10 days (Table IV-10). Given the low probability of offshore spills and lack of shuttle tanker trips and direct pipeline landfalls in the habitat area (Table IV-17), no contact is expected with the beach mice. In the unlikely event of oil contact, oil-spill cleanup activities are not expected to disturb beach mice or their habitats.

Cleanup operations undertaken to remove marine debris or to restore coastal habitat degradation such as beachfront erosion, may temporarily disturb beach mice or their habitat. However, the proposed alternative is expected to contribute negligible marine debris or disruption to beach mice areas.

An impact from the proposed action on the Alabama, Choctawhatchee, and Perdido Key beach mice could occur as a result of oil spills, oil-spill response activities, beach trash and debris, and coastal habitat degradation. Deleterious effects are not expected because of the low probability of spill occurrence, and because of protected species and habitat stipulations for protection and cleanup of the Oil Pollution Act of 1990.

Conclusion

The impacts of Alternative B are not expected to harm the Alabama, Choctawhatchee, and Perdido Key beach mice or their habitats unless a Size 3 oil spill would occur in conjunction with a strong storm surge. Since this probability is estimated to be less than 0.5 percent, no contact of beach mice or their habitats with oil is expected.

(7) Impacts on Marine Turtles

The level of activity associated with Alternative B 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.(7)). The impacts include habitat alteration by physical disturbance and chemical discharges, and direct impacts by trash and debris, vessel traffic, explosive structure removals, blowouts, water quality and habitat degradation, and oil or oil-spill

response activities. The effects of these activities are expected to be primarily nonlethal and to result in few deaths; the probability of an interaction is low.

Conclusion

The impact of Alternative B on marine turtles is expected to temporarily disturb marine turtles or their habitats, but deaths are expected to be rare. All disturbances are expected to be temporary, and marine turtles are expected to recover within a period of weeks to months.

(8) Impacts on Coastal and Marine Birds

(a) Nonendangered and Nonthreatened Species

The sources and severity of impacts to coastal and marine birds associated with Alternative B are identical to those discussed for the Base Case (Table IV-2). As noted in Section IV.D.1.a.(8) for the Base Case, effects that may result from this alternative include oil spills and oil-spill response activities, degradation of coastal water quality from OCS discharges, disturbance from OCS helicopters and service vessels near coastal areas, loss or modification of preferred or critical habitat, onshore pipeline landfalls and facility construction, and entanglement and ingestion of offshore oil- and gas-related plastic debris.

It is expected that the effects from most of the major impact-producing factors on coastal and marine birds are negligible and of nominal occurrence. It is expected that uncontained oil spills and oil-spill response activities within coastal areas will occasionally contact and thus affect local groups and individuals.

Conclusion

Nonendangered and nonthreatened coastal and marine birds may encounter periodic disturbance and temporary displacement of localized groups and individuals from activities associated with Alternative B. Decreases in numbers of adults and/or nests could occur as a result of OCS-related oil spills and spill-related coastal habitat loss or degradation. Groups experiencing the loss of individuals would require up to several years to recover to a pre-disturbance condition, depending on the species and existing conditions.

(b) Endangered and Threatened Species

The sources and severity of impacts to these species associated with Alternative B are identical to those discussed for the Base Case. The endangered and threatened birds include the piping plover, brown pelican, bald eagle, Arctic peregrine falcon, and least tern. 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 these species are the same as those discussed for the Base Case (Section IV.D.1.a.(8)). The impacts include oil spills and oil-spill response activities, degradation of coastal water quality from OCS discharges, disturbance from OCS helicopters and service vessels near coastal areas, loss or modification of preferred or critical habitat, onshore pipeline landfalls and facility construction, and entanglement and ingestion of offshore oil- and gas-related plastic debris. The effects of these activities are expected to be primarily sublethal; lethal effects stem primarily from contact with uncontained oil spills in coastal areas. The probability of this interaction is unlikely, based upon scenario estimates for the proposed action.

Conclusion

Endangered and threatened birds may encounter periodic disturbance and temporary displacement of localized groups and individuals from activities associated with Alternative B. Decreases in numbers of adults and/or nests could occur as a result of OCS-related oil spills and spill-related coastal habitat loss or degradation. The loss of individuals represents a serious loss to the regional population(s); restoration of

numbers to a pre-disturbance state could require up to several years, depending on the species and existing conditions.

(9) Impacts on the Gulf Sturgeon

The level of activity associated with Alternative B is the same as the summary of infrastructure and activity described for the Base Case in Tables IV-2 and IV-13. 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.(9)). The impacts include oil spills. The effects of these activities are expected to be primarily nonfatal, affecting a few adults.

Conclusion

The impact of Alternative B on the Gulf sturgeon could cause nonfatal irritation of gill epithelium and an increase in liver function in a few adults for less than a month.

(10) 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.(10) for the Base Case effects that may result from this alternative include coastal environmental degradation, emplacement of production platforms, underwater OCS obstructions, production platform removals, seismic surveys, oil spills, subsurface blowouts, pipeline trenching, and offshore discharges of drilling muds, produced waters, and naturally occurring radioactive material (NORM).

It is expected that the effects from the major impact-producing factors on commercial fisheries in the CPA are inconsequential and of nominal occurrence. At the expected level of effect, the resultant influence on Central Gulf fisheries is negligible and will be undistinguishable from natural population variations. As a result, there will be little discernible disturbance to Gulf commercial fisheries.

Conclusion

Alternative B is expected to result in less than a 1 percent decrease in commercial fishery populations, in essential habitat, or in commercial fishing. It will require less than six months for fishing activity and one generation for fishery resources to recover from 99 percent of the impacts.

(11) Impacts on Recreational Resources and Activities

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.(11) 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.(11).

Under the proposed alternative, no Size 3 oil spills and up to one Size 2 spill 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 pollution events and nearshore operations that may adversely affect the enjoyment of some beach uses on Mississippi and Louisiana beaches. However, they will have little effect on the number of beach users.

(12) 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.(12)(a)).

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 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 low probability 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 low probability 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.

(13) 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. The sources and severity of impacts to population, labor, and employment are, therefore, the same as those assessed for Central Gulf Sale 147 in the Base Case. A total of approximately 28,737 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 less than 2 percent of the total employment generated by proposed Sale 147 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.

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) Sociocultural Issues

Impacts on sociocultural issues would be related to dramatic changes in population, employment, and the disruption of environmental resources, as well as conditions inherent to OCS-related employment (i.e., work scheduling and rate of pay). 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 in the Base Case for the proposed action. The sources and severity of impact to sociocultural issues are, therefore, the same as those assessed for the Base Case. No positive net migration into coastal areas of the Central and Western Gulf is expected to occur as a result of the proposal. It is expected that employment will be filled 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. 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 minimal displacement from traditional occupations will occur as a result of Alternative B. The extended work schedule is expected to have some deleterious effects on family life in pertinent, individual cases.

Conclusion

Sociocultural impacts associated with the Alternative B in the CPA are expected to be minimal, with some deleterious impacts to family life in a small number of cases resulting from the extended work schedule.

c. 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 proposed Sale 147, the opportunity is postponed or foregone for development of the estimated 0.12 BBO and 1.21 tcf of gas.

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 is replacing the resources lost through cancellation of the proposed action.

Strategies that could provide replacement resources for lost domestic OCS oil and gas production include a combination of energy conservation; onshore domestic oil and gas supplies; alternative energy sources; and imports of oil, natural gas, and liquefied natural gas (LNG). These are discussed in some detail in Appendix D. 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.

Market forces are assumed to be the predominant factor in determining substitutes for OCS oil and gas. Based on this, increased imports of foreign oil are assumed to be the largest replacement source. Much of this imported oil would enter the United States through the Gulf of Mexico, thus increasing the risks due to tanker spills. This is thoroughly analyzed in the Final EIS for the OCS Comprehensive Program (1992-1997).

d. Cumulative Actions

This section analyzes "cumulative" impacts, defined as the impacts on the environment from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions, both Federal and nonfederal (40 CFR 1508.7). 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 and Associated Dunes

This Cumulative Analysis for the CPA 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 reduced sediment impact, 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 biological resources, 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 more than 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 LA-1, LA-2, and LA-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 adverse impacts on barrier features during the life of the proposed action.

The barrier landforms to the east of the Mississippi River delta (coastal Subarea MA-1) are not dependent on a fluvial source of sand. Rather, these islands appear to be nourished by the sandy barrier platforms beneath them (Olivos, 1980). Reduced discharges of fluvial sediment into the coastal zone will not affect these barriers.

Table IV-3 estimates that 825 offshore spills will occur as a result of the OCS Program in the CPA over 35 years. Section IV.A.3.h. and Table IV-10 indicate that a few Sizes 1 and 2 spills and one Size 3 spill should be expected to contact barrier shorelines. As described in Section IV.A.3.h., oil slick weathering and dissipation should significantly reduce slick volume and resulting concentration on beaches. From this information, it is assumed that the only significant land contact will result from a Size 3 offshore oil spill, which will generally follow the dissipation and contact characteristics described in Table IV-12. The probabilities of offshore spills contacting various shoreline segments (Figure IV-7) are provided in Table IV-10. The large majority of oil slicks that contact land will come ashore on barrier landforms, as discussed in Sections IV.D.1. and 2.

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. For Sizes 1 and 2 spills, cleanup crews are expected to remove the oil from the beach manually with no resulting removal of sand from the littoral environment. No Size 2 spills are assumed to occur and contact barriers. The offshore occurrence of seven Size 3 spills are assumed as a result of OCS Program activities. According to Table IV-10, the probability of occurrence and contact within 10 days from one or more Size 3 spills 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 volume loss from weathering and offshore cleanup efforts for Size 3 spills making contact within 10 days, 1,950 bbl of oil will contact the coast. Assuming that the percentage of this oil 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. Therefore, approximately 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 by any of 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 concentrations on the beach and the unit area impacts to vegetation, assuming a direct relationship between oil concentration and effects on vegetation.

Long-term impacts to contacted beaches from these spills could occur if significant volumes of 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. Spill cleanup is difficult in the inaccessible setting of coastal Louisiana. This analysis assumes that the State would require that the responsible party clean the beach without removing significant volumes of contacted sand or by replacing the sand removed, regardless of the specialized equipment and crews that would be needed to accomplish the task.

It is assumed that cleanup operations would be accomplished with no permanent effects on the stability of barrier beaches. 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 resuspend or flush through the beach sediments.

Onshore spills could also occur from OCS operations and contact coastal barriers. Table IV-14 predicts that 1,656 onshore oil spills will occur as a result of the OCS Program in the CPA. These spills could occur as a result of pipeline accidents and barge or shuttle tanker accidents during transit or oilloading as described in Section IV.D.2.a. Most oil terminals are located inland from barrier islands, so an accident there would not likely result in contact to a barrier feature. Under this scenario, it is more likely that a spill will contact the landward, rather than the ocean side, of a barrier beach. No onshore spills are assumed to contact barrier beaches, under the OCS Program (Section IV.B.2.b.).

Non-OCS spills can occur as a result of import tankering, tidelands oil activities, and petroleum product transportation. It is assumed that numerous Sizes 1 and 2 spills will occur and contact barrier beaches. 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 Size 3 spills, averaging 6,500 bbl each, are assumed to occur over the 35-year life of the proposed action from both 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 Size 3 onshore spills, 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 elevation 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. The MMS study has investigated the geological, hydrological, 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 adjoining the canals is diminishing because of Gulf and bay erosion. No pipelines cross barrier features along the Mississippi Sound.

Numerous pipelines have been installed on the bayside of barrier islands and parallel to the barrier beach. With overwash and Gulf shoreline retreat, these pipeline canals serve as sediment sinks, resulting in narrowing and lowering of barrier islands. Such islands and beaches are more susceptible to breaching and overwash. This type of pipeline placement is most common in Louisiana.

As a result of the OCS Program, the construction of three new pipelines is expected and is described in Sections IV.A.2.b., IV.B.1., and IV.B.2. One landfall will be at Freshwater Bayou in Louisiana and two will be at Pascagoula, Mississippi. Pipeline landfall sites on barrier islands have been identified as potential causes of accelerated beach erosion and island breaching.

Studies have showed little to no impact to barrier beaches as a result of modern techniques for pipeline crossings. Hence, adverse impacts of new pipeline landfalls upon coastal barrier beaches is not anticipated. 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 contribution of the OCS Program to vessel traffic in navigation canals is estimated at 12 percent. Correspondingly, 12 percent of impacts attributable to maintenance dredging and wake erosion of those channels is also accredited to the OCS Program. Sediments from maintenance dredging of bar channels and tidal inlets can be of considerable benefit to barrier beaches. If dredged material is placed strategically in the interrupted longshore sediment drift, i.e., downdrift of the interruption, it would help mitigate adverse impacts caused by jetties and artificially deepened channels. A corresponding percentage of this benefit is attributable to the OCS Program. Stabilization of navigation 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 of jetties constructed in the Belle Pass area, and 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. However, they noted in their studies that the downdrift erosional effects of the jetty were reduced 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 and jetties.

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.B.1.b. states that the channel leading to Port Fourchon, Louisiana (Belle Pass), will be deepened to provide access for larger service vessels used for deep-water operations. Ninety percent of the impacts caused by deepening the Port Fourchon Channel is attributed to OCS Program activities. An adequate analysis of the project cannot be performed concerning impacts until a final project description is developed. Based on a previous proposal, more than 23 million m³ of dredged material are expected to be displaced when the Fourchon Channel is deepened. An as yet undetermined portion of that dredged material is expected to be used to refurbish the barrier beach downdrift of the channel's jetties. Beneficial use of the dredged material is expected to offset adverse impacts of the project as well as mitigate adverse impacts of the existing jetties.

Coastal barriers are eroding very rapidly in Louisiana as a result of alterations of the sediment dynamics of the Mississippi River deltaic system, limited source of sand-sized sediment, high coastal subsidence rates, and storm erosion. Efforts to stabilize the Gulf shoreline have adversely impacted barrier landscapes. Greater application of stabilization techniques has been mainly along the Louisiana coast. Structures constructed to stabilize the beach by fixing its location deprives sediment from beaches downdrift, thereby accelerating erosion

downdrift. Over the last 15 years, dune and beach stabilization have been accomplished more successfully by using more natural applications such as sand dunes, beach nourishment, and vegetative plantings.

Most barrier beaches in the CPA are relatively inaccessible for recreational use 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 in the CPA have been, or are likely to be, substantially altered for construction projects to accommodate recreational use. Further, damage to dune vegetation and other sensitive beach areas by recreational users, such as dune buggy operators or hikers, has not been, and will not likely be, significant in most areas.

Summary

Sediment input reduction and rapid submergence have resulted in rapid erosion of most of the barrier landforms along the Louisiana coast. Impacts from these factors have been severe in Louisiana.

Several spills of all three sizes from coastal 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 landforms 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.

Three new pipeline landfalls are projected under the Cumulative Scenario. In addition, new pipeline landfalls may be installed to transport production from State waters to land. Pipeline landfalls and placement on islands have been examined as possible sites of accelerated shore erosion and island breaching. Little to no impacts of pipeline landfalls have been documented. One study did note, however, that pipeline landfalls could be future sites of island breaching. However, placement of pipelines on and parallel to barrier islands and beaches have caused barrier beaches to narrow and breach. Modern pipeline installation techniques that do not result in noticeable impacts to barrier beaches will be used.

Wicker et al. (1989) have documented localized, accelerated erosion downdrift from jetties installed to stabilize navigation channels. Beneficial use of dredged materials is expected to mitigate this impact.

Beach stabilization projects, such as groins, jetties, and seawalls, are considered by coastal geomorphologists to cause accelerated coastal erosion.

Recreational use of beaches in the Central Gulf is not expected to result in impacts because of the inaccessibility of the barrier coast to humans.

The incremental contribution of the proposed action associated with the Cumulative Scenario to coastal barrier beach impacts is expected to be negligible because oil-spill cleanup operations, pipeline landfalls, and navigation channel deepening and maintenance projects will not result in large-scale changes of barrier beaches.

Conclusion

Coastal barrier beaches have received severe cumulative adverse impacts from both natural processes and human activities. Although natural processes are considered to be the major contributor to these impacts, human activities significantly accelerate coastal barrier deterioration. Human activities that have caused the greatest adverse impacts are pipelines and channel jetties. Deterioration of barrier beaches is expected to continue in the future.

(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, 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.

Submergence of coastal Louisiana, due primarily to subsidence and secondarily to sea-level rise, is a historically documented geodynamic process, which is expected to continue. Up until the Mississippi River was channelized and leveed during the early 1900's, flood waters layered sediment over the active deltaic plain, countering ongoing submergence and also building new land. Areas that did not receive sediment laden flood waters continually lost elevation. Human intervention interrupted this process of renewal. Further compounding this impact, the suspended sediment load in 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).

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 0.48 to 1.3 cm (Baumann, 1980; Ramsey et al., 1991). Expert consensus is that sediment deprivation and submergence are the major factors that have caused up to 130 km²/yr of land loss in coastal Louisiana. Current estimates of land loss in coastal Louisiana are 60 km²/yr on the Deltaic Plain (Britsch and Kemp, 1990) and 21 km²/yr on the Chenier Plain (Dunbar et al., 1990).

Leveeing and deepening of the Mississippi River also affect seagrass beds in Mississippi and Chandeleur Sounds, causing them to move farther inland due to reduced regular flooding. During high water stages of the river, the Bonnet Carré 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). More regular flooding events reduced such large impacts.

Wetland oil-spill contacts can occur from a number of sources. 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 both offshore and onshore sources will be considered.

As expressed in Table IV-3, as many as 825 offshore spills may occur as a result of the OCS Program in the CPA over 35 years. Section IV.A.3.h. and Table IV-10 show that the probability of offshore spills contacting land is very high. In Section IV.A.3.h., it has been assumed that a few Size 1, a few Size 2, and two Size 3 spills may contact land. Section IV.A.3.h. and Table IV-12 provide an explanation of oil-spill slick weathering and dissipation. From this information, it is assumed that the only significant land contact may result from Size 3 offshore oil spills. The probabilities of Size 3 offshore spills contacting various shoreline segments (Figure IV-2) are provided in Table IV-10. Given these probabilities, two 6,500-bbl spills are assumed to make landfall on the western deltaic plain of the Mississippi River, within 10 days.

The large majority of oil slicks that contact land are expected to come ashore on barrier landforms (Section IV.D.1.d.(1)(a)). Flood tides are expected to bring some oil through tidal inlets into areas landward of barrier beaches. If oiling of vegetated wetlands occurs, it is expected to be light--less than 0.1 l/m² on wetland surfaces. No oil is expected to contact inland seagrass beds.

Assuming a 70 percent loss from weathering, dissipation, 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.

Given the assumptions of Section IV.D.1.a., approximately 70.2 ha of wetlands will be impacted by the two Size 3 spills. Within 4 and 10 years, 26 ha and 36.4 ha, respectively, are expected to recover and 7.8 ha are expected to be converted to open water due to wetland erosion and submergence accelerated by plant mortality.

Onshore OCS spills could occur as a result of pipeline accidents and barge or shuttle tanker accidents during transit or offloading. Table IV-14 predicts that 1,656 onshore oil spills will occur as a result of the OCS Program in the CPA. Seventy-two percent of these spills will be less than 1 bbl and are assumed to occur at transfer facilities where they will be contained without significant impacts on wetlands. Three hundred ninety spills (24%) are listed as Size 1 spills (the smallest), 50 percent of which are assumed to occur in direct association with transfer facilities where effective spill recovery plans are in place. The remaining 50 percent of Size 1 spills and all Sizes 2 and 3 spills are assumed to result from pipeline or navigation accidents away from transfer facilities. For the purpose of analyses in this EIS, typical Sizes 1, 2, and 3 spills are considered

to be 50, 500, and 6,500 bbl, respectively. Hence, it is estimated that over 35 years, a total of 83,750 bbl of oil will be spilled by the 271 events, thereby impacting approximately 4,523 ha of wetlands. After 4 and 10 years, 1,675 and 2,345 ha will recover, respectively. Converted to open water will be 503 ha of wetlands.

Non-OCS spills can occur as a result of import tankers, tidelands oil activities, and petroleum product spills. In Section IV.C.5, it was estimated that 21,800 non-OCS-related oil spills may occur over the 35-year period. Of the total and as described in Section IV.D.1.d.(1), approximately 2,226 spills averaging 50 bbl each, 8 spills averaging 7,665 bbl, 42 spills averaging 5,000 bbl, and 60 spills averaging 10,000 bbl will contact wetlands. Hence, it is estimated that, over 35 years, a total of 982,620 bbl of oil will be spilled by the 2,336 events, thereby impacting approximately 53,060 ha of wetlands over the course of 35 years. After 4 and 10 years, approximately 19,650 and 27,510 ha are expected to recover, respectively. Converted to open water will be 5,895 ha of wetlands.

Under this 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 MA-1 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 Section IV.D.1.a.(1)(b), oil-spill impacts to seagrasses are usually buffered by the subtidal position of seagrasses and the micro-tidal environments, resulting in the absence of direct contact to the seagrass vegetation and supported epifauna 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 and supported epifauna, 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 with wetlands on barrier islands within the Gulf National Seashore. These wetlands occur within embayments and ponds that connect with 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. Only Size 1 and Size 2 spills are assumed to occur in these locations; therefore, 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.

According to Table IV-10, more than 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.

Proposed new onshore facilities for the CPA are described in Section IV.B.1. and Table IV-14 and include a gas processing plant, a pipeline terminal, a separation facility, and three pipelines. Proposed new facilities are attributed to the OCS Program because of their direct association with proposed pipelines. Because none of the proposed facilities, except pipelines, are water or wetland dependent, it is assumed that the Federal and State permitting programs will not allow them to be sited in wetlands, to the maximum extent practicable. Two of the pipelines are proposed for Jackson County, Mississippi, where ample nonwetland construction sites exist for the associated facilities. If facility siting in a wetland is unavoidable, adequate mitigation of all unavoidable adverse impacts will be required. Therefore, no significant impacts to wetlands are expected from construction of new facilities, other than pipelines.

The three new pipelines described in Sections IV.B. and IV.D. are anticipated to adversely impact 0.68 ha of wetlands per kilometer of pipeline. Consequently, 27 ha of wetlands in LA-1 and 22 ha in MA-1 are estimated to be adversely impacted. After backfilling, the pipeline right-of-way may revegetate or remain as a shallow waterbody (Tabberer et al., 1985; Turner and Cahoon, 1987; Wicker et al., 1989). Turner and Cahoon (1987) determined that 77 percent of all existing OCS-related pipeline canals have been backfilled, partially filling the canal. In areas where soils have high organic content, a canal is not usually filled completely after backfilling. In areas with soils containing low organic content, most of the canal length is usually filled and naturally revegetated after backfilling. Most of the disturbances described in Section IV.B.2.a. are anticipated to result in temporary adverse impacts that are assumed to be partially corrected after 5 years in LA-1 and after 2 years in MA-1.

For the purposes of this EIS, it is assumed that after pipelines are constructed and backfilled in LA-1, 50 percent of the length of the right of way will contain a shallow 2.25-m wide channel. For a pipeline in Texas or Subarea MA-1, it is assumed that 30 percent of the length of the right-of-way will contain a shallow 1.5 m wide channel.

After backfilling the 32 km of pipelines in Subarea MA-1, the remaining canal is estimated to be 9.6 km long, 1.5 m wide, and cover 1.4 ha. After backfilling the estimated 40 km of canal projected for construction in LA-1, 50 percent of the pipeline route is assumed to result in a 20 km long, 2.25-m wide pipeline canal covering 4.5 ha. Of the 49 ha impacted by pipeline construction, approximately 22.5 and 20.6 ha are expected to revegetate in approximately 5 and 2 years, respectively.

Pipeline construction 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). The proposed pipelines do not impact seagrass beds.

Secondary impacts of canals are considered to be more damaging to coastal wetlands and associated habitats than primary construction impacts (Tabberer et al., 1985). Secondary impacts include expansion of tidal influence, saltwater intrusion, hydrodynamic alterations, erosion, sediment export, and habitat conversion (Gosselink, 1984). During reviews of pipeline projects for Federal and State permits, agencies consistently comment with concern upon the extent of these secondary impacts. As a result, structures engineered to mitigate secondary adverse impacts are included as permit requirements for canal construction through wetlands.

Widening of pipeline canals over time is one of the more obvious secondary impacts that can be assessed. Craig et al. (1980) studied a series of canals in Louisiana and determined that the canals widened at rates that ranged from 2 to 14 percent per year. Dead-end canals that conducted no traffic or significant flow were shown to widen at rates within this range. Due to their shallow nature, it is assumed that OCS-related pipeline canals will widen on the average at a rate of 4 percent per year over the 35 years considered in this EIS.

Once the 72 km of new OCS pipelines are constructed, the remaining 29.6 km of canal will widen at an estimated rate of 4 percent per year, resulting in the loss of 16.4 ha after 35 years. Widths and lengths of canals associated with the existing 4,449 km of OCS-related pipelines in the CPA are unknown. For the purpose of this EIS, it is assumed that existing average canal width is 4 m and that canals are associated with 40 percent of the pipeline length, or cumulatively 1,780 km. Therefore, existing OCS pipeline canals in the CPA, estimated to widen at the 4 percent rate, will result in the loss of 1,994 ha after 35 years. Estimated total wetland loss due to OCS-related pipeline canal widening is estimated at 2,010 ha after 35 years. The length of non-OCS pipelines is unknown.

Pipeline maintenance activities that disturb wetlands are very infrequent and are considered to be insignificant. Structures constructed for the purpose of mitigating adverse impacts of pipeline construction fail very frequently (Gosselink, 1984). Decisions to not maintain mitigative structures allow deterioration and eventual failure. Those significant, indirect, and adverse impacts on wetlands that the structures were designed to prevent or mitigate then proceed. These adverse impacts include saltwater intrusion, reduction of freshwater head, sediment erosion and export, expansion of tidal influence, and habitat conversion. The length of OCS-related pipeline canals and the number of related mitigative structures in the CPA are unknown. Although the extent of impacts caused by failure to maintain mitigation structures is unknown, such impacts are believed to be significant (Gosselink, 1984; Tabberer et al., 1985; Turner and Cahoon, 1987).

The 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 of coastal navigation routes, only about 800 km (10%) are used by OCS traffic.

Most canal dredging in coastal Louisiana has occurred as a result of onshore oil and gas activities. Approximately 41,190 wells had been completed in coastal Louisiana as of 1984 (USDOL, GS, 1984). Access canals and pipelines to service onshore development are pervasive throughout the coastal area; 15,285 km of pipeline canals have been installed there to carry onshore production. In 1988, the U.S. Army Corps of Engineers received applications for the installation of 123 km of pipelines through wetland areas. The average direct loss of wetlands due to backfilled pipeline canals in LA-1 is 0.68 ha/km and in LA-2 and LA-3 is 1.05 ha/km; 0.87 ha/km is used to derive that approximately 3,500 ha of wetlands will be impacted, of which approximately 1,000 ha will be converted to open water. Widening of these canals during the first 35 years will account for the loss of up to 1,070 ha. This estimate 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 ship at the end. In 1988, the COE received applications for dredging more than 11 km of new 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 of more than 1,300 ha of wetlands to open water. In addition, wetland acreage is buried by spoil banks along the channel margins, and often the weight of a spoil bank will cause flank subsidence. 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 LA-1, LA-2, and LA-3).

As discussed in Section IV.A.2.c, OCS activities in deep water are requiring larger service vessels for efficient operations. Currently, service bases in Corpus Christi and Galveston, Texas, and Berwick, Louisiana, are accessible to the larger vessels; Empire and Cameron, Louisiana, are considered marginally useable.

The emphasis of OCS oil development is expected to be directed to deeper water in the future. Hence, it is assumed that there will be a trend to using deeper draft vessels as time progresses. To satisfy this anticipation, no need for a new navigational channel is expected, although the COE has proposed deepening the Port Fourchon Channel (Belle Pass) to 8.5 or 9.1 m National Geodetic Variable Datum (NGVD). A previous proposal by COE (1991) for a 6.7-m deep, 8.5-km long channel at Port Fourchon was abandoned in favor of a deeper channel, for which a design and feasibility report is not yet available.

From the original report, it is expected that the dredged material will be placed for the creation of at least 192 ha (479 ac) of saline marsh over the 50 year project life. Because 192 ha is given as a minimum size and because the vast majority of the material will be dredged in the beginning of the project, the entire 192 ha is attributed to the 35 years under consideration by this EIS. The abandoned feasibility report did not anticipate significant saltwater intrusion effects on wetlands as a result of the deepening project, probably because the project will only extend approximately 8.5 km inland and will be performed in a saline environment where the existing vegetation is salt-tolerant.

Based on the assumption that 90 percent of the need for deepening the Fourchon Navigational Channel is attributed to OCS activities, the creation of possibly 173 ha of wetlands is attributed to the proposed action. Impoundment sites adjacent to Louisiana Hwy. 3090 may later be further filled to provide additional commercial sites for this developing port facility. In this event, accredited wetland gains will be lost.

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-19, which projects that more than 563,500 service-vessel trips 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 23 channels associated with OCS activities in the CPA are listed in Table IV-19. As established in Section IV.B.2., 811 km of navigational canals, bayous, and rivers are found in the coastal regions of the CPA (derived from Wicker et

al., 1989). Hence, 121.7 ha/yr of wetlands, or 4,258 ha during the 35-year life of the proposed action, will be lost. Losses accredited to the OCS Program are 14.6 ha/yr or 511 ha over 35 years.

The non-OCS navigational channels are believed to conduct lower traffic volumes and, hence, are assumed to widen at the lower rate of 0.95 m/yr (Johnston and Gosselink, 1982). The remaining 7,055 km of navigational channels in Louisiana are associated with the loss of approximately 670 ha/yr, or 23,460 ha over 35 years.

Maintenance dredging of existing channels can also contribute to wetland problems. In 1988, the COE 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 4.5 million m³ 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.

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 km² 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. In oil and gas fields, access canal spoil banks impound large areas of wetlands. 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 (Section 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). Due to changes in regulatory actions, wetland destruction for agricultural, commercial, and residential purposes will be reduced over the life of the proposed action.

Land-use impacts on wetlands in coastal Alabama have been 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

Submergence of coastal Louisiana is principally due to subsidence and reduced sediment input from the Mississippi River and secondarily to sea-level rise. Submergence is expected to continue. Up until the Mississippi River was channelized and leveed during the early 1900's, flood waters layered sediment over the active deltaic plain, countering ongoing submergence and also building new land. Areas that did not receive sediment-laden flood waters continually lost elevation. Human intervention interrupted this process of renewal. The decreased volume of sediment transported by the Mississippi River to wetlands of Louisiana will continue as a major factor of wetland loss. Flood control and channelization of the river have contributed significantly to saltwater intrusion and movement of seagrass beds and oyster reefs inland. Freshwater diversions during flood stages into areas of seagrass beds. These diversions will result in very high impacts to seagrass beds.

The OCS-related oil spills are expected to adversely impact as much as 4,593 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 511 ha of wetlands and as temporary (up to four growing seasons) dieback and reduced vigor of wetland vegetation. Non-OCS-related spills are expected to adversely impact as much as 14,800 ha of wetlands and to cause the loss of up to 1,650 ha of wetlands over 35 years.

No impacts to wetlands from produced-water discharges into coastal water bodies are expected to occur.

Indirect impacts from new canal dredging for State onshore oil and gas development and from the indirect impacts of the existing canal network are expected to continue. Disappearance of wetlands along navigation channels as a result of vessel wake erosion is expected to result in 27,718 ha of wetlands loss, of which 511 ha is accredited to the OCS Program.

Only minor amounts of new onshore infrastructure construction are projected under the Cumulative Scenario. These facilities are projected for coastal Subarea MA-1 and will likely be constructed on coastal uplands, given the ample amounts of such land near the coast in Subarea MA-1 and the regulatory difficulties involved in construction projects on wetlands.

Anticipated construction of three OCS pipelines is expected to adversely impact up to 49 ha of wetlands initially. Secondary adverse impacts of pipelines are much more significant, causing an estimated loss of up to 2,010 ha of wetlands. A lack of maintenance for OCS-related structures built to mitigate adverse impacts of pipeline and canal construction is believed to be a significant source of adverse impacts upon wetlands through beneficial use of dredged material.

Deepening one channel to accommodate larger service vessels is expected to occur within a saline marsh environment and may afford the opportunity for the creation of 173 ha of wetlands.

Insignificant adverse impacts from maintenance dredging are expected. Alternative dredged material disposal methods can be used to enhance coastal wetlands.

Impacts from State onshore oil and gas activities are expected to occur as a result of dredging for new canals and for maintenance, usage of existing rig access canals and drill slips, and preparation of new well sites. Impacts from residential, commercial, and agricultural and silvicultural developments are expected to continue in coastal Louisiana and Alabama.

The incremental contribution of the proposed action (as analyzed in Section IV.D.1.a.(1)(b)) to the cumulative adverse impact upon wetlands is small in comparison to natural and other man-made impacts.

Cumulatively, OCS-related activities may adversely impact approximately 7,165 ha of wetlands; 3,040 ha may be converted to open water and approximately 173 ha of open water will be converted to wetland. For non-OCS activities, approximately 48,900 ha of wetlands will be adversely impacted; 32,227 ha may be converted to open water and approximately 19 ha of open water will be converted to wetlands.

Conclusion

Cumulative impacts to wetlands are primarily due to subsidence, channelization, and levees. Cumulative impacts are expected to result in the loss of up to 35,300 ha, suppressed productivity for 2-10 years of up to 21,000 ha, and a gain of up to 192 ha due to beneficial use of dredged material.

(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 OCS-related 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 pinnacle trend area 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 assumed that the biota of the pinnacle trend is well adapted to natural events such as storms, turbidity plumes, and hypoxia conditions. A severe event could result in localized or widespread damage to pinnacle trend biota. It is projected that this damage to one or more components of a few regionally common habitats or communities could result in changes to physical integrity, species diversity, or biological productivity that exceeds natural variability observed prior to the damage. If such an event were to occur, recovery to pre-impact conditions could take 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 116 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 365 ha (902 ac) of bottom in offshore Subarea C-3 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 to pinnacle features. For this reason, the damage from support boats and ships would be minimal. The impact from rigs and associated anchors on the pinnacle features of this region as a result of the OCS Program would be such that any changes in the regional physical integrity, species diversity, or biological productivity of the pinnacle features 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 5 m below the mudline, thus restricting impacts to very close to the structure being removed (USDOL, MMS, 1987a). As previously discussed, the platforms will not be constructed directly over the pinnacle features because of the biological stipulation. Impacts to the pinnacle trend from structure removal are expected to be minimal because of the restricted regions affected by the shock wave 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 the pinnacle trend 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 (impacts to growth and reproduction) may take place. Oil and gas operations will routinely discharge drilling muds and cuttings. (Some 8.7 MMbbl of drilling muds and 8.2 MMbbl of drill cuttings are assumed to be discharged as a result of all OCS activities in offshore Subarea C-3.) The current biological stipulation would prevent drilling activities and drilling discharges from occurring directly over a pinnacle feature. Deposition of drilling muds and cuttings on the pinnacle trend 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 only within 1,000 m of the discharge point, and have little biological toxicity except within several meters of the discharge point. Such an event would rarely impact the resource because of the depth of the communities (73-101 m [240-330 ft]). 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 pinnacle trend region would recover to pre-impact conditions in less than two years, more probably on the order of 2-8 weeks.

The discharge of produced waters and domestic and sanitary wastes has the potential to impact adversely the live-bottom organisms of the pinnacle trend due to the toxicity of these wastes. Estimates presented in Table IV-3 project that 2,105,000 m³ of domestic and sanitary wastes and 1,607 MMbbl of produced water will be discharged in Subarea C-3 as a result of all OCS activities. The proposed Live Bottom Stipulation would prevent the placement of oil and gas facilities upon (and consequently would prevent the discharge of produced water and domestic and sanitary wastes from occurring directly over) the pinnacle-trend, live-bottom areas. The depth of the pinnacle features, the prevailing currents in the area, and the offset of the discharges from the pinnacle features (provided through enforcement of the Live Bottom Stipulation) would cause produced waters and domestic and sanitary wastes to be diluted to harmless levels before reaching the live-bottom organisms of the pinnacle trend. The discharge of produced water and domestic and sanitary wastes are not expected to cause adverse impacts to the pinnacle-trend, live-bottom areas. Adverse impacts to regional physical integrity, species diversity, or biological productivity of the pinnacle trend would be such that these impacts would allow recovery to pre-impact conditions in less than 2 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. For the purposes of this analysis, it is presumed that pipeline-laying activities would be prohibited directly upon pinnacle trend live-bottom communities by the Live Bottom Stipulation. The effect of pipeline-laying activities on the biota of these communities would be restricted to the resuspension of sediments. Approximately 2,015 km of pipelines are expected to be installed under the Cumulative Scenario in offshore Subarea C-3. Because the Live Bottom Stipulation would limit pipeline installation activities in the immediate vicinity of the pinnacle features, these areas would be subjected to turbidity plumes of a temporary nature. Existing currents in the area and rapid dilution of resuspended sediments would prevent the occurrence of any serious impacts to the pinnacle-trend, live-bottom communities as a result of pipeline construction. 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 pinnacle trend 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 are described in Section IV.C. 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 20 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 20 m. No impact from surface oil spills on the communities is expected.

It is assumed that four Size 3 pipeline spills will occur in the Central 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 in the immediate vicinity of these features. 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 pinnacle trend community. However, for the purpose of this analysis, it is assumed that a Size 3 spill (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 2 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 pinnacle-trend communities. Subsurface blowouts can pose a threat to the biota of these communities if a blowout were to occur near one of these habitats. It is assumed that 6 blowouts will occur for every 1,000 wells drilled, or approximately 20 blowouts in offshore Subarea C-3 as a result of the Cumulative Scenario. Twenty-three percent of these will spill some oil. 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. Blowouts outside the zone protected by the stipulation 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 the biological stipulation in the vicinity of the biologically productive hard-bottom communities. Should that protection not be provided, adverse impacts resulting from the OCS activities, particularly anchor damage to localized pinnacle-trend features, are expected. The OCS activities have the potential to destroy some of the biological communities and damage one or several individual pinnacle features. 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 pinnacle trend and the small size of many of the features. Potential impacts from Size 3 oil spills, 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 pinnacle-trend region.

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 pinnacle-trend 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, damage caused by underwater oil spills, blowouts, anchoring, structure emplacement and removal, drilling discharges, discharges of produced waters and domestic and sanitary wastes, and pipeline emplacement. These activities may threaten the sessile and pelagic communities associated with the crest and flanks of the live-bottom and low-relief features of the pinnacle-trend region. Because protection from the biological stipulation 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 region. 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 400 m of a hard-bottom community could result in the smothering of the biota within a very limited area of a pinnacle feature 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. The toxicity of produced-water discharges of domestic and sanitary wastes could also have adverse impacts on pinnacle-trend, live-bottom organisms. 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 stipulation. Because the biological stipulation 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. Potential impact from Size 3 oil spills would be minor because of the depth of the features, currents in the area, and physical distance that pipeline construction would be maintained (because of the stipulation) away from pinnacle features. Since impacts due to oil and gas operations are expected to be largely mitigated by the Live Bottom (Pinnacle Trend) Stipulation and other natural characteristics of the area, cumulative impacts to the biota of the pinnacles will, as noted, mostly be due to non-OCS activities.

The incremental contribution of the proposed action (as analyzed in Section IV.D.1.a.(2)(a)) to the cumulative impact is expected to be slight due to effects of the possible impacts, such as physical disturbance of the bottom, discharges of drilling muds and cuttings, other OCS discharges, structure removals, and oil spills. Negative impacts will be limited by implementation of the Live Bottom (Pinnacle Trend) Stipulation, the widespread nature of the communities, the depths of the features, the currents in the area, and the low level of OCS activities in the pinnacle trend expected to result from the sale.

Conclusion

The cumulative impacts are expected to be such that 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 Gulf are minimal and impacts are minimal. Oil- and gas-related activities include pipeline and platform emplacement activities, anchoring, and accidental seafloor blowouts. 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, associated anchoring activities, and seafloor blowout accidents. The impacts to deep-water benthic communities from these activities are discussed in detail in Section IV.D.1.a.(2)(b). Because of the great water depths at which chemosynthetic communities are found, routine discharges from oil and gas operations, such as muds and cuttings, sanitary wastes, and produced waters, are not expected to have adverse impacts to chemosynthetic communities. These effluents would have to undergo a great deal of dilution and dispersion before contacting these benthic communities. In addition, oil spills would not impact chemosynthetic communities because the communities are often seen growing among oil-saturated sediments and natural gas bubbles, using these hydrocarbons as an energy source. 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-3 indicates that in offshore Subareas C-2, C-3, and C-4 (where these communities would be found) an

estimated 2,830 exploration and delineation wells and 4,260 development wells will be drilled and 277 platforms and 3,980 km (2,468 mi) of pipelines will be installed. Approximately 47 blowout accidents are estimated. 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. Bottom disturbance is considered to be a threat only to the high-density (Bush Hill-type) communities; the widely distributed low-density communities would not be at risk. The provisions of NTL 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 impact chemosynthetic communities.

Cumulative impacts are expected to be due entirely to activities of the OCS Program (past and future sales, as well as the proposed action (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 impact chemosynthetic communities.

The incremental contribution of the proposed action (as analyzed in Section IV.D.1.a.(2)(b)) to the cumulative impact is expected to be slight due to effects of the possible impacts caused by physical disturbance of the seafloor. Negative impacts will be limited but not completely eliminated by adherence to NTL 88-11 (currently in effect).

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

For purposes of this analysis, the Topographic Features Stipulation is included in the analysis below. Oil and gas operations covered by the stipulation 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 effects resulting from 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 effects resulting from 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. Other effects include those from 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. 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 some localized and occasionally severe 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 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 operators of a lease to perform certain measures, such as shunting, that would keep discharged materials at depths below sensitive biota. 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 on the order of 2-4 weeks.

There is an estimated 99+ percent chance of a Size 3 oil spill occurring in the Central Gulf as a result of the OCS Program (Table IV-9). It is also assumed that 793 Size 1 spills will occur each year and that 31 Size 2 spills will occur during the 35-year life of the proposed action (Section IV.A.3.h.). It is assumed that seven Size 3 oil spills will occur on the OCS from OCS oil and gas operations. Because of the water depths in which topographic features are found, no oil from surface spills will reach the biota of concern. A total of 58 blowouts are expected to occur in the CPA under the OCS Program; it is expected that subsurface oil spilled into the water column from a blowout could reach the biota of a topographic feature.

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.(4) 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, discharges are not expected to reach topographic features.

Impacts from natural occurrences such as hurricanes occasionally result in damage to the biota of the banks. Massive corals are toppled, and resuspended sand can scour coral tissue. 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 anchoring and treasure-hunting activities, described in detail above). These activities include hurricanes, activities of scuba divers (including treasure hunting), 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, may have local effects on 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 incremental contribution of the proposed action (as analyzed in Section IV.D.1.a.(2)(c)) to the cumulative impact level is negligible 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. It is expected that any damage inflicted on these areas would be small, 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

This Cumulative Analysis addresses the changes in water quality from contamination of coastal waters of the northern Gulf of Mexico resulting from point- and nonpoint-source discharges, and from both chronic low-level and large petroleum and other chemical spills.

Point sources of discharges are numerous along the Gulf of Mexico, and include both municipal and industrial inputs, OCS support facility discharges, vessel operational discharges, dredged material disposal, and State oil and gas operations. Major industrial sources operating in the coastal area of the central Gulf include petroleum refineries, chemical manufacturing industries, pulp and paper mill plants, dredge and fill activities, hard mineral mining, fish processing facilities, State oil and gas production, and onshore support facilities that service all OCS Program operations. In addition to land sources, discharges into coastal waters occur from vessels associated with an extensive maritime shipping industry, in particular the tanker transport of crude oil, petroleum products, and hazardous wastes, and commercial and recreational fishing. Of the 460 municipalities and major industrial facilities identified that discharge pollutants through pipelines directly into coastal waters of the Gulf in a comprehensive report by USEPA on the environmental quality of the Gulf, 113 were municipalities, which discharge primarily sewage wastes (USEPA, 1990). Louisiana had 79 major industrial dischargers, Mississippi had 30, and Alabama 29. These were primarily petroleum refineries and petrochemical plants, although some were fish processing industries.

The existing OCS onshore infrastructure base in Louisiana is expected to be sufficient to support future OCS oil and gas operations (Table IV-14), and no new infrastructure are expected to be constructed. In Mississippi and Alabama, one new gas plant, one new terminal, and one separation facility are expected to be constructed. These new facilities will be discussed separately. Table IV-14 lists 274 facilities in Louisiana expected to support all future OCS operations. Not included in these numbers are the 10 onshore transfer stations and 5 disposal sites used to landfarm OCS-generated wastes (Section IV.B.1.a.(3)(c)). Routine point-source discharges, nonquantified but characterized in Section IV.B.2.b.(1), occurring from these existing onshore support facilities will continue to impact coastal and nearshore water quality as long as the facilities are in operation. Because the number and types of existing onshore support facilities is expected to remain the same or decline over time in Louisiana and Texas (discussed in Section IV.B.1.a.), historical trends in surrounding water quality conditions are assumed to be indicative of future conditions. Of these support facility types, only refineries were identified by USEPA in their summary report (USEPA, 1990) as major sources of point-source discharges in the coastal zone. Utilization capacities of these refineries are projected to only provide 21 percent support to the offshore oil industry. This being the case, the contribution to water quality problems from onshore OCS onshore support facilities is expected to be minor and impacts from discharges associated with refineries are not directly attributable to OCS oil production.

One exception to the use of historical trends to project future trends might be in Mississippi and Alabama. There, one gas processing plant, one terminal, one separation facility, and two pipeline landfalls are projected to be constructed to support future OCS operations. There may be more construction to support Alabama State oil production that began in 1988. Given this, it is expected that there will be low-level, localized increases in coastal water contamination from discharges related to these oil and gas support facilities in the future.

Vessels traversing the coastal zone act as point sources, dumping galley wastes, sewage, and bilge and ballast waters into waterways. 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. Impacts will occur along the Gulf's coastal waterways, the Gulf Intracoastal Waterway (GIWW), and within bays and coastal rivers from discharges from vessel traffic associated with maritime commerce, and commercial and recreational fishing activities.

Vessel traffic associated with OCS oil and gas industry activities in the CPA is expected to be extensive in the Louisiana coastal areas, especially within the Mississippi Delta area where the support industry is concentrated. Approximately 587,000 service-vessel trips and 8,500 barge trips carrying crews and supplies between offshore facilities and shorebases are estimated to occur in support of future OCS operations in the CPA (Table IV-19). Eighteen navigation channels, 12 located in Louisiana, will be used to various degrees. The average usage of these channels by the OCS oil industry has been estimated to be about 12 percent (Turner and Cahoon, Appendix B, 1987), but can be as high as 69 percent for Bayou Teche, Louisiana, or 42 percent for Bayou Lafourche, Louisiana. The Calcasieu Ship Channel to Cameron (LA-1), Atchafalaya River waterway to Morgan City (LA-2), Freshwater Bayou to Intracoastal City (LA-1), and Mississippi River passes (particularly the reach to Venice (LA-3)) are expected to receive the bulk of OCS support vessel trips from the CPA in the future (Table IV-19). Besides barge trips to and from platforms, about 18 percent of the barge traffic carrying oil from terminals to other terminals or refineries is expected to be OCS-related (Section IV.B.1.b.(2)). Also shuttle tankers transporting OCS crude oil from deep-water floating production systems will make 46 trips from the CPA, 45 trips from the EPA, and 18 trips from the WPA, all to Mississippi River terminals (Table IV-19).

Over the 35-year analysis period, about 185 million liters of bilge water are estimated to be discharged into the waters of the 18 navigation channels by the projected OCS Program service-vessel traffic in the CPA (Table IV-14), especially into the four channels in Louisiana receiving the bulk of sale-related traffic. If one assumes that 80 percent of the bulk of the discharges (173 million liters) will occur in the estimated 811 km of confined channels in Louisiana (Section IV.B.1.b.(4)), there will be about 6,000 liters discharged per km of channel per year on an average, or about 17 liters per km per day. Bilge waters can contain petroleum and metallic compounds leaked from machinery. New MARPOL regulations severely restricting the levels of oil and grease in bilge water discharges in coastal areas (40 CFR 110) should diminish the types of impacts noted historically from such discharges. If one compares total daily estimates of the discharges of bilge from all OCS service traffic (about 5,000 gal per day) to estimates of sewage effluents discharged into Gulf waters (estimated at 1

billion gal per day) (USEPA, 1990), the contribution from bilge water discharges are negligible. MARPOL regulations now require that large vessels discharge their operational wastes into onshore receptacle facilities. It is assumed that all large vessels inclusive of OCS-related shuttle tankers and barges will comply. Smaller vessels, such as recreational fishing vessels, will still discharge their bilge water into coastal waters. No estimates of these quantities are available. Certainly this will be significantly larger than quantities discharged from OCS service vessels.

The discharge of sewage and wastes from boats and vessels in coastal waters may also impact water quality by increasing the biological oxygen demand (BOD) locally and introducing pathogens into the water column. The FWPCA (Section 1.B.3.d.(3)(e)) requires recreational boats to be equipped with approved marine sanitation devices; however, boats still legally discharge treated waste, and illegally discharge untreated waste, into coastal water bodies. Although the wastewater generated by such boats is small, the organic compounds 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 dissolved oxygen concentrations of the water may decrease. 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 shellfish taken from such waters. Bacteria, viruses, and other water-borne diseases can be attributed to vessel sewage pollution. Although no total estimates are available, for each person working or traveling in Gulf waters on a vessel, about 0.227 m³ of sanitary wastes are discharged into coastal waters per day.

Another major type of point-source pollution in Gulf coastal waters is the dumping of dredged materials. Over 75 million tons of dredged materials are disposed of in Gulf estuarine waters every year (USEPA, 1990). It is assumed that between 9 million and 10 million m³ of dredged material will be generated and disposed of during the peak year in Louisiana as a result of tideland oil and gas operations (Section IV.C.3.c.). Dredged disposal can result in changes in the natural flow or circulation of surface waters, which will result in secondary water quality affects; and the addition of pollutants to the water in excess quantities resulting in water quality degradation of surrounding waters. Dredged materials are often contaminated with toxic heavy metals, organic chemicals, pesticides, oil and grease, and other pollutants originating from municipal and industrial discharges and nonpoint sources, and thus result in contamination of areas formerly isolated from major anthropogenic sources (USEPA, 1979).

Since March 1991, the State of Louisiana has restricted the direct discharge of waste drilling mud and produced water from State oil and gas operations into its bays and estuaries. Both Mississippi and Alabama do not allow the discharge of produced waters or drilling wastes directly into the coastal waters. Furthermore, the USEPA is proposing more restrictive discharge of such wastes through their coastal NPDES permitting program (Section 1.B.3.d.(3)(e)) and is expected to prohibit completely the discharge of drilling muds and cuttings, produced waters, and produced sands into surface waters. These contaminants will no longer be a source of pollution in Louisiana coastal waters.

Before a characterization of Gulf contamination from chronic pollution can be provided, the contribution from nonpoint-source pollution must be considered. Sources of nonpoint-source pollution examined include runoff from municipal, industrial, and agricultural operations; vessel traffic alterations; and waste disposal practices. The major cause of nonpoint-source contamination in Louisiana is related to the population growth in the coastal zone. Section 319 State of Louisiana Nonpoint-source Pollution Assessment Report (Louisiana Dept. of Environmental Quality, 1990) identifies agriculture, general construction in the coastal zone, water resource developments, forestry, septic tank leakage, and urban runoff (Louisiana Dept. of Environmental Quality, 1988) as major sources of contamination, all of which are related to population growth and development. Urban runoff, especially, puts substantial quantities of oil and grease, lead, and chromium into the Gulf coastal zone, although decreases in lead inputs have been documented since the 1970's (USEPA, 1990). Agricultural runoff along the Gulf Coast is contributing large quantities of nutrients, herbicides, pesticides, and fecal coliform bacteria. In Mississippi and Alabama, 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.

Dredging operations can cause increased turbidity and resuspension of contaminants from sediments. This type of water-quality degradation can also result from bank erosion and runoff caused by extensive vessel

channel usage. It is estimated that 61 ha will erode from canals, bayous, and river banks due to OCS Program service-vessel and barge trip use in Louisiana, Mississippi, and Alabama. This erosion averages 1.75 ha/yr for the 811 km of confined channels. If we assume that OCS Program channel usage is 12 percent of the total vessel usage of these channels, then about 15 ha per year will erode from the major channels of the Central Gulf due to vessel traffic alone.

State and OCS-generated oil-field wastes disposed of in the Louisiana coastal area have contaminated groundwater and coastal water quality through nonpoint source runoff. As of November 1989, the State of Louisiana Department of Natural Resources (DNR), Conservation Division, has identified 13,000 oil-field pits, most unlined, 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. There are documented cases of environmental damage to oyster beds and water quality from this practice (USEPA, 1988). According to the 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 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). In 1990, the State of Louisiana passed comprehensive oil-field waste management regulations that require the cleanup of these pits as well as establish strict future disposal practices (LAC title 43: Part XIX Amendment to Statewide Order No. 29-B). However, it is expected that these pits, which will take years to clean up, will continue to impact, to some degree, localized coastal water quality.

It is assumed that 20 MMbbl of drilling muds and cuttings and 3 MMbbl of produced sand will be brought ashore for disposal from future OCS operations. Improper storage and disposal of such oil-field wastes and contaminated oil-field equipment could result in adverse impacts to surface waters and groundwater in proximity to disposal facilities, cleaning sites, and scrap yards. This type of impact has been documented in the past (USEPA, 1988). Many of these wastes may be contaminated by NORM. Improper design and maintenance of such facilities is expected to result in adverse low-level, localized impacts to surrounding waters at a few locations.

The types of impacts described above have been documented historically to be occurring in Louisiana. The State of Louisiana, in the 1988 Nonpoint-source Pollution Assessment Report (Louisiana Dept. of Environmental Quality, 1990), determined that a substantial percentage of the Louisiana coastal area is significantly affected by both point- and nonpoint-source pollution so that identified areas do not support fully designated uses of surrounding water. The oyster industry is a good indicator of impacts from septic tank runoff pollution. During northerly winds in winter, about half of the harvestable shellfish beds in Louisiana are closed because of E-coli bacteria contamination (Dugas, 1988).

Another consequence of nonpoint-source pollution may be hypoxia, or recurring areas of oxygen-depleted waters. Hypoxia in the Gulf of Mexico has been most noticeable in shallow (less than 20 m (65 ft)) Louisiana waters. Low oxygen levels have been measured in Lake Pontchartrain, east of the Mississippi River Delta inshore of barrier islands and in inland bays and offshore of Mobile Bay, Alabama (Renaud, 1986).

It is expected that the current level of contamination of coastal waters will continue over the 35-year analysis period, but will not increase. This assumption is based on the fact that although urban and industrial growth is expected to increase in the coastal area and thereby result in increased discharge levels, improved environmental regulatory programs adopted by the Gulf Coast States (such as tougher water quality standards) and USEPA should result in discharge contaminant levels decreasing (USEPA, 1988)--and on balance--result in steady state conditions. Given the above, chronic discharges into Louisiana, Mississippi, and Alabama coastal waters, caused primarily by urban growth, will result in continued low-level, regionally distributed degradation of coastal waters. The contribution of discharges from OCS onshore support facilities and vessel traffic is considered to be very small. One exception to this will be in Mississippi and Alabama where there will be an increase in the onshore support infrastructure and therefore a slight increase in contamination, which is expected to remain localized around these facilities.

The oil and gas industry's coastal and onshore operations have contributed to the hydrocarbon contamination of Gulf waters to a small degree, according to the results of NOAA's Status and Trends Program, a program that measures national trends in chemical contamination in space and time (USDOC,

NOAA, NOS, 1990). 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 large point sources, such as large cities and industrial areas. The following conclusions about hydrocarbon contamination were made by the study scientists: 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 water quality degradation from oil and gas operations 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.

The Gulf Coast is particularly susceptible to crude oil, petroleum product, and hazardous wastes spills. Much of the hazardous wastes produced in this country is transported into Louisiana for disposal, and the risk of spills from such transportation is great (The Times Picayune, 1991). In 1986, almost 20 percent of all hazardous, and other substances spills occurred in the Gulf area (U.S. Dept. of Transportation, Coast Guard, 1989). An even larger portion of crude oil and petroleum product spills occur each year. Approximately 44 percent of all spills causing a sheen occur in the Gulf area according to USCG statistics (Oil Spill Intelligence Report, 1992). This is primarily due to the extensive petroleum industry that exists in the Gulf. About 60 percent of the Nation's imported crude comes into the Gulf for refining, and the Gulf and surrounding areas produce most of the Nation's crude oil. Much of this oil either makes landfill in Louisiana or is barged or tankered along its coastline. Projections of the numbers of spills occurring in the coastal zone over the 35-year analysis period are 8 Size 3 crude oil spills from import tanker operations near Louisiana ports; 2 crude oil spills in the Mississippi Sound area; 42 Size 3 spills from coastwise movement of crude oil, primarily in coastal Louisiana; 60 Size 3 petroleum product spills (average size, 10,000 bbl) in restricted waters of Louisiana, and another 670 Size 2, Size 1, and smaller spills (many less than 1 bbl) each year in Louisiana waters (based on an analysis of 6 years of USCG data). Causes of spills greater than 238 bbl (10,000 gal) in Louisiana include State oil production mishaps (77%), collisions and groundings of barges and tankers (32%), refinery failures and storage tanker mishaps (20%), and pipeline leaks (26%) (Oil Spill Intelligence Report, 1992). The portion these spills are attributable to the OCS program is minor. About 47 spills of less than 1,000 bbl per year are expected to be OCS support facility related (about 7 percent of all onshore spills). Most of these are expected to occur near terminal areas where they can be confined within protection levees.

In addition to onshore spills, spills occurring offshore may reach restricted waters and affect coastal water quality. One Size 3 spill from import operations and two Size 3 spills from OCS operations in the CPA are expected to occur offshore and reach land, most likely in Plaquemines Parish (Table IV-10). A few spills (Sizes 1 and 2) occurring offshore are projected to reach land (Section IV.A.3.h.(2)). For analysis purposes, it is assumed that 10 spills will reach shore.

Combining the number of onshore and offshore spills that will contact coastal resources, a total of 23,460 Size 2, Size 1, and smaller spills and 113 Size 3 spills are expected to occur during the 35-year analysis period in the CPA coastal zone and, depending on the factors affecting spill impact, to alter coastal water quality in some way. For purposes of analysis, it is assumed that 90 percent of these spills will remain in open bay areas, nearshore, or leveed waterways, such as the Mississippi River, and these spills will be 50 bbl (a conservative size estimate). If one applies the open water area of potential contact for a 50 bbl spill described in Section IV.B.2.d.(1) of 8,000 m² per Size 1 and Size 2 spill, and 1 million m² per Size 3 spill, projected spills would contact about 270 million m² of open water during the next 35 years. Acknowledging that contaminant levels are expected to reach background levels in 6 months (Section IV.B.2.d.(1)), the frequency, number, and areal extent of the projected spills is such that these spills represent a chronic petroleum contamination source for open coastal water.

Applying the assumptions regarding area of potential contact and contaminant residence times described in Section IV.B.2.d.(1) to spills occurring in marsh areas, about 2,350 spills assumed to average 50 bbl each will get into marsh areas, affecting a total of 6,300 ha (15,561 ac) of marsh waters, each spill remaining a maximum of 6 months; and about 11 Size 3 spills will reach marsh waters, affecting a total of about 4,000 ha (9,880 ac) for as long as 10 years for each event. Again this level of interaction with coastal waters will add a low-level, chronic, regional input of hydrocarbons to coastal waters. This chronic input will be in addition to inputs of routine point- and nonpoint-source discharges and will result in increased water quality degradation of CPA coastal waters.

Summary

Routine point- and nonpoint source discharges from non OCS activities, such as agriculture, general construction projects, water resource developments, forestry, septic tank leakage, urban runoff, and, to a small extent, oil and gas activities, are degrading 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. All existing onshore infrastructure and associated coastal activities occurring in support of OCS Program operations will contribute to the degradation of regional coastal 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 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 domestic and sanitary discharges. Because of improved regulations, the 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 to a minor extent at a few locations. The incremental contribution of the proposed action to the cumulative changes in regional water quality is expected to be much less than 3 percent because the proposed action contributes 3 percent of the OCS Program's contribution.

Chronic discharges into Louisiana, Mississippi, and Alabama coastal waters, caused primarily by urban growth, will result in continued low-level, regionally distributed degradation of coastal waters. Some uses of the waters will be partially lost, such as recreational uses and oyster farming. The contribution of discharges from OCS onshore support facilities in Louisiana is considered to be very small. In Mississippi and Alabama, there will be a significant increase in the onshore support infrastructure and therefore a slight increase in contamination. This contamination is expected to remain localized around these support complexes.

Accidental spills will introduce oil usually into open bays and waterways, and sometimes (10% of the time) into marshes creating elevated hydrocarbon levels within affected waters up to 6 months for Size 1 and Size 2 spills and up to 10 years for Size 3 spills. Much of the oil would be dispersed throughout the water column over several days to weeks. The number of spills is increasing primarily due to increased levels of transport of crude oil and petroleum products in the coastal zone between refineries and importers and consumers. Oil spills, expected at about 670 per year, will continue to add to coastal water quality degradation as a result of increased petroleum contamination.

Conclusion

Chronic discharges and runoff into Louisiana, Mississippi, and Alabama coastal waters, resulting primarily from urban growth, will maintain the water quality problems currently facing these States. There will continue to be low-level, regionally distributed degradation of a substantial percentage of coastal waters. The extensive oil and gas industry operating in the Gulf area has caused low-level, chronic, petroleum contamination of coastal waters. In Mississippi and Alabama, there will be an increase in the onshore support infrastructure, which will cause increased contamination, localized around the new sites.

Marine Waters

This Cumulative Analysis considers the effects of the OCS oil and gas leasing program, OCS sulfur mining program, oil tankering and other vessel traffic, ocean dumping, and shoreline development on offshore water quality. Specific impact-producing factors considered in the analysis include the discharge of oil and gas drilling and production wastes, bottom disturbances from platform and pipeline emplacement and removal, offshore dredging and dredged material dumping, accidental oil and hazardous substance spills, operational and human-waste discharges from vessels, ocean disposal of hazardous material and industrial waste, and municipal and industrial effluents and runoff.

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

anchorage 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. 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. Bilge waters must now be discharged at onshore receptacles. 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 two 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.

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+ ft from the source. Accidental spills of molten sulphur would have a minimal impact on offshore water quality. Impacts to water quality within the Gulf are expected to be negligible.

Historically, most oil spills have impacted water quality during the life of the spill and for a short time afterwards (Neff, 1990a). Most of the components of oil are insoluble in water, and most of the spilled oil floats. A number of weathering processes act on an oil spill to remove oil from the water column and surface of the water within several months. Section IV.C.2. of the Final EIS for Sales 142 and 143 (USDOL, MMS, 1992b) provides more detail on weathering processes. The frequency of occurrence and the area of contact of spilled oil is the major factors determining water quality degradation. Sections IV.A.3.h.(2) and IV.C.5. provide projections on spill occurrence, the average size of each spill, and the areal coverage of projected spills. Any one spill is not expected to result in significant long term changes in offshore water quality; impacts will be of short duration (2-3 months) and only affect a small area of offshore waters at any one time. However, occurrence of future spills are expected to be quite numerous. Approximately 60 percent of all crude oil imported into this nation comes through Gulf waters (Ramey, 1991). Spills may occur from vessels that are importing crude oil and petroleum products from other countries, from vessels that are transporting oil and its products through Gulf waters between States, from vessels carrying other commodities when accidents result in the loss of fuel oil from their tanks, and from OCS oil and gas production operations. It is estimated that 37 Size 3 crude oil spills will occur from import tankering (median size, 7,665 bbl); 60 crude oil spills from coastwise movement (average size, 5,000 bbl), and 104 spills (60 in the CPA) from import or coastwise movement of petroleum products (average size, 10,000 bbl) in the Gulf of Mexico during the 35-year life of the proposal. Seven Size 3 crude oil spills are expected to occur from offshore pipelines and platforms. Although no estimates are available, there may also be oil spills from State oil and gas operations, from non-oil carrying vessels, and many more smaller sized spills occurring in the next 35 years. Given the frequency of these spills, they are expected to add to the regional petroleum contamination of Gulf waters, besides resulting in localized changes to water quality conditions in the area affected by the spill.

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 hazardous materials enter the marine environment as a result of accidental spills. 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.

Besides the contribution from spills and oil and gas operational discharges, petroleum hydrocarbon contamination of the Gulf of Mexico is occurring from natural seeps, atmospheric inputs, discharges from coastal municipalities and industries, and urban and river runoff. Onshore sources of hydrocarbons to Gulf waters far outweigh the contribution from offshore sources. The Mississippi River is the major source of petroleum contamination into the Gulf (Southwest Research Institute, 1981; Brooks and Giammona, 1988).

Contaminants and high levels of nutrients found in land-based effluents and runoff have been identified as potential causes of hypoxia in Gulf waters. Hypoxia occurs in some areas of the Gulf bottom waters because of high summer temperatures combined with freshwater runoff from the Mississippi River and/or phytoplankton blooms in surface waters caused by excess nutrients. A zone about 30 mi wide has been found to occur in August in the central Louisiana shelf, and mass mortalities of the bottom organisms have been documented. Some researchers have identified nutrient inputs from river runoff and sewerage as responsible for this condition; others believe it is a natural condition that occurs during hot summers. Most believe that the cause is a combination of these factors.

Of particular concern are impacts from all future OCS Program operations in the Gulf. Impacts from spills are discussed above. Table IV-3 indicates that, under the OCS Program, 3,330 exploration and delineation wells, 5,060 development wells, 330 platforms, and 4,550 km of pipelines supporting future operations will be installed in the next 35 years. Over 2,000 platforms will be removed explosively during the 35-year analysis period. No projections are available for pipeline removal.

The drilling of the wells, construction of the platforms, and laying of the pipe will result in increased water-column turbidities in overlying offshore waters. Using average rig and platform sizes, the total bottom area disturbed by the pile-driving, anchoring, or dredging needed for the temporary presence of rigs during drilling and by all pipeline and platform installation operations is estimated at 3,297 ha. For those pipelines laid in water depths shallower than 61 m, burial below the seafloor is required. Pipeline burial activities will result in the resuspension of some 9 million m³ of sediment during the installation of pipelines in water depths of 61 m and less. Such bottom disturbance of sediments will result in resuspension of any settled pollutants, such as trace metals, chlorinated hydrocarbons, and excess nutrients, that may have accumulated in the sediments. Major sources of these contaminants are coastal or land based, and sediment contamination is a function of distance from shore. Examining the extent of these operations in each subarea (Table IV-3) and based on proprietary information, a majority of operations in the future will occur at a substantial distance from shore; therefore, any sediments disturbed are not as likely to be contaminated. The resuspension of significant quantities of contaminants from bottom disturbance operations will only occur when the operation is very close to shore. Looking at peak-year estimates for Subarea C-1, the subarea nearest to the shore, about 80 wells will be drilled, 4 platforms installed, and 35 km of pipeline laid. Such level of activity is somewhat greater than the level of operations examined in a study researching water quality effects from platform installation discussed above (Arthur D. Little, Inc., 1985). The conclusion of the study can therefore be applied to each installation operation. Sediment disturbance and suspension resulting from pile-driving, anchoring, and associated dredging will result in minor, localized, and temporary impacts on water quality lasting up to 6 months at each operation. Because of the frequency of the operations, the area affected may be larger than that discussed in the study when more than one operation occurs simultaneously or in proximity to each other.

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. Explosive removal operations are projected to occur often in the future, as production at existing platforms ends. The peak-year estimate is 105 platforms (Table IV-3). The consensus of research on explosive removals is that such resuspension will have a short-term local effect of a very limited nature. Given the frequency of occurrence, minor impacts on water quality are expected from this operation.

About 26 MMbbl of drilling fluids and 25 MMbbl of drilling cuttings will be discharged from the drilling of 8,390 exploratory and development wells (Table IV-3). The discharge from each exploratory well will last for approximately 40 days, and about three exploratory wells will be drilled per block. On an average, about 14 development wells are typically drilled from each platform (12 of these wells will go into production) (Section IV.A.2.). The discharge from each development well will last for approximately 35 days. If

development wells are all drilled immediately, a maximum number of wells in any one year from any one platform will be nine. Applying the above scenario to information on discharge quantities, it is possible that the area around each of the 330 new platforms can be contaminated from the discharge of 36,000 bbl of drilling discharges continuously for about a year and a half (if 3 exploratory wells and 9 development wells were drilled at one site) and then intermittently afterwards when old wells become depleted and new wells are drilled. These quantities are consistent with the level and frequency of discharges studied. Therefore, the impacts that were summarized in the general discussion are expected to result from these future discharges. In general, discharges of drilling wastes will affect an area several thousand meters around a platform. Sediment contamination can be expected out to 3 km from the discharge point in the direction of the primary flow and will last up to 1 year after drilling ceases. Benthic marine organisms will be affected out to 1,000 m. Water quality criteria may be exceeded within 100 m from the discharge twice; sediment-pore water quality criteria will be exceeded 3-9 times. Regional contamination from these discharges are discussed below.

About 9 Bbbl of produced water will be discharged from about 50 percent of the projected and existing platforms equipped with three-phase separators; the other 50 percent will pipe their water to these platforms. These quantities are consistent with historical operations, for the most part, and it is expected that the documented impacts summarized above will be applicable to future conditions. Moderate petroleum and metal contamination of sediments and water column will occur around OCS platforms out to several hundred meters and will have small-scale, localized effects on benthic organisms out to 200-500 m.

In open water conditions, the factors that enhance local dispersion also contribute to regional, low-level contamination. Historically, it has been shown that discharges from operations in the Gulf associated with the OCS oil and gas industry have contributed to some cumulative, regional contamination of waters and sediments in the Central Gulf of Mexico shelf, primarily from barium, low-boiling aromatic hydrocarbons, and radium. This contamination is expected to continue but decrease somewhat over time because of two factors: new limitations on oil and grease in produced waters and barium in drilling muds by the USEPA, and a general decline in offshore operations.

Summary

Major activities degrading marine waters include the discharge of oil and gas drilling and production wastes, bottom disturbances from platform and pipeline emplacement and removal, offshore dredging and dredged material dumping, accidental oil and hazardous substance spills, operational and human-waste discharges from vessels, ocean disposal of hazardous material and industrial waste, and municipal and industrial effluents and runoff. The OCS sulphur mining operations off Louisiana have been ongoing since 1954 and have not been identified as causing any measurable water quality degradation. Data from years of testing at the Grand Isle Mine indicate that bleedwater, the major discharge from this operation, is not measurable at 300+ ft from the source. Perhaps the most publicized source of oil pollution is the operational discharge of bilge and ballast waters by tankers and other vessels. New regulations limit oil content in the bilge waters, require tanker designs for minimizing contamination of ballast water, and require that most bilge waters be disposed of at onshore receptacles.

Sediment disturbance from the emplacement of 330 platforms, the explosive removal of 2,110 platforms, the installation of 4,550 km of pipeline, and the drilling of 8,390 wells over a 35-year period will result in minor, localized, temporary impacts on water quality. The drilling of the wells, construction of the platforms, and laying of the pipe will result in increased water-column turbidities and possible resuspension of pollutants when the activities occur close to shore.

The area around each of the 330 projected platforms can be contaminated from the discharge of 36,000 bbl of drilling muds and cuttings at each site. These discharges may be released continuously for about a year and a half (assuming 3 exploratory wells and 9 development wells were drilled at one site) and then other quantities discharged intermittently when old wells become depleted and new wells are drilled. These discharges of drilling wastes will affect an area several thousand meters around a platform. Sediment contamination can be expected out to 3 km from the discharge point in the primary direction of the current and will last up to 1 year after drilling ceases. Benthic marine organisms will be affected out to 1,000 m. Water quality criteria are expected to be exceeded within 100 m from the discharge. Moderate petroleum and metal contamination of sediments and water column from the discharge of 9 Bbbl of produced waters at

production platforms will occur out to several hundred meters from the discharge point and will have small-scale, localized effects on benthic organisms out to 200-500 m. These discharges are contributing slightly to the long-term, regional degradation of the Gulf's water quality, particularly related to petroleum and barium contamination.

Over 200 Size 3 spills are projected to occur over the next 35 years in the Gulf from a variety of oil-related operations. Given the frequency of these spills, they are expected to add to the regional petroleum contamination of Gulf waters, in addition to resulting in localized, short-term (2-3 months) changes to water quality conditions in the area affected by the spill. Other offshore sources adding to the petroleum hydrocarbon contamination of the Gulf include natural seepage and atmospheric inputs. Besides petroleum contamination, substantial amounts of hazardous materials enter the marine environment as a result of accidental spills.

Adding to the contribution from offshore sources, contamination of the Gulf of Mexico is occurring from discharges from coastal municipalities and industries, and urban and river runoff. Onshore sources of pollutants to Gulf waters far outweigh the contribution from offshore sources. The Mississippi River is the major source of petroleum contamination into the Gulf (Southwest Research Institute, 1981; Brooks and Giammona, 1988). Contaminants and high levels of nutrients found in land-based effluents and runoff have been identified as the probable cause of hypoxia in Gulf waters.

Conclusion

Land-based municipal and industrial low-level discharges and runoff will contribute to the greatest extent to the long-term degradation of marine waters in the Gulf. The Mississippi River, draining two-thirds of the United States, is the major source of pollution in the northern Gulf. Bottom disturbances resulting from platform and pipeline emplacements, dredging, and dredged material disposal operations are expected to result in minor, localized, temporary impacts to water quality. Operational discharges are primarily muds and cuttings and produced waters. Drilling muds and cuttings, which are discharged intermittently throughout the life of a platform, are expected to contaminate a localized area around platforms, out to 3,000 m for 1 year after drilling ceases. Production wastes, which are discharged continuously throughout the life of most of the platforms, will change some water quality and sediment parameters within several hundred meters downcurrent from the discharge point for an average of 20 years. Operational discharges and spills from future oil and gas development and transportation offshore will also contribute, to a minor extent, to the regional petroleum contamination of Gulf 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 Cumulative Scenario discussed in Section IV.A. (Table IV-3) establishes that 3,330 exploration and delineation wells and 5,130 development wells would be drilled, and 330 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-3 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. 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-3.

Total OCS Emissions in the CPA
(tons over the 35-year life of the Cumulative Scenario)

<u>Activity</u>	<u>NO_x</u>	<u>CO</u>	<u>SO_x</u>	<u>THC</u>	<u>TSP</u>
Service Vessels	303,407.6	35,544.5	4,793.7	15,439.7	21,405.3
LTO Helicopters	3,394.8	2,742.0	522.3	141.9	130.6
Cruise Helicopters	10,967.9	31,337.0	2,350.3	2,554.6	3,133.7
Blowouts without Fire	0.0	0.0	0.0	1,686.0	0.0
Spills without Fire	0.0	0.0	0.0	1,785.0	0.0
Barge Loading	0.0	0.0	0.0	4,191.0	0.0
Tanker Loading	0.0	0.0	0.0	142.3	0.0
Transit Loss	0.0	0.0	0.0	8,089.0	0.0
Tanker Exhaust	98.2	10.7	122.0	0.2	35.3
Tug Exhaust	15,292.1	32.1	197.3	689.3	917.6
Exploratory Wells	32,201.1	8,591.4	3,762.9	3,230.1	932.4
Development Wells	34,368.0	9,168.0	4,032.0	3,456.0	1,008.0
Platforms	1,089,182.5	141,879.5	1,905.3	412,809.7	2,667.4
Totals	1,488,912.4	229,305.2	17,685.7	454,214.7	30,230.3

Total emissions for each subarea in the CPA during the Cumulative Scenario are presented below. Observe that activities in Subarea C-1, which is the closest to land, generates the greatest emissions of all pollutants, while activities in 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 Cumulative Scenario)

<u>Pollutant</u>	<u>C-1</u>	<u>C-2</u>	<u>C-3</u>	<u>C-4</u>
NO _x	239,128.4	428,626.3	523,375.3	297,782.5
CO	36,827.8	66,012.1	80,604.3	45,861.0
SO _x	2,840.4	5,091.4	6,216.8	3,537.1
THC	72,949.6	130,758.8	159,663.4	90,842.9
TSP	4,855.2	8,702.7	10,626.4	6,046.1

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, production, and associated drilling and service-vessel activity decrease.

The following table presents peak emissions of primary pollutants from OCS Program activities in tons per year. It is 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 Cumulative Scenario)

<u>Pollutant</u>	<u>Wells</u>	<u>Platforms</u>	<u>Vessels</u>	<u>Others</u>	<u>Mean</u>	<u>Aggregate</u>
NO _x	7,293.1	181,875.8	9,518.9	0.0	2,540.35	69,397.20
CO	1,945.8	23,691.6	1,990.5	0.0	6,551.58	10,742.13
SO _x	852.9	318.2	228.2	0.0	505.31	1,135.86
THC	211.8	68,932.5	537.9	454.1	2,977.56	21,743.95
TSP	731.9	445.4	732.1	0.0	863.72	1,063.94

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 Scenario 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 when winds are 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 4.86 and 0.69 μgm⁻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 14.60 to 2.08 μgm⁻³ under the same wind speeds. For Subarea C-1 the concentrations varied from 3.37 to 0.26 μgm⁻³ with a 900-m mixing height across the entire wind speed range; concentrations varied from 10.10 to 0.79 μgm⁻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 minimal 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·D^{2/3} and 33.3·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 of 1,725 tons/yr for C-1. The emission level of THC in Subarea C-1 is estimated as 3,492.2 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 (USDOl, 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 μgm^{-3} , which is below the national standard of 100 μgm^{-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 μgm^{-3}) and spread over 193.4 billion m^2 would have a moderate effect.

Oil-spill effects on air quality are examined below. It is assumed that Size 1 and Size 2 oil spills, would have low pollutant concentrations because their input of pollutants (it is assumed that 30 percent 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 Size 3 spills, emissions are about 1,785 tons, which is about 51 tons/yr on the average. 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 4,333 tons of THC over the 35-year life of the proposed action. This represents about 0.10 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 μm and a third peak with a diameter larger than 2 μm . Particles with diameters of 2 μm or larger settle very close to the source (residence time of approximately $\frac{1}{2}$ day, Lyons and Scott, 1990). For particles smaller than 2 μm , 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 μgm^{-3} , which is less than the allowable annual increase level of 5 μgm^{-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. A detailed description of ozone status is presented in Section III.A.3. 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 five other cases that showed local sources as the cause for the ozone exceedance episode. 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.

Results from two ongoing studies concerning the OCS contributions to onshore ozone episodes have become available. These studies are the *Preliminary Scope for a Gulf Coast Ozone Study* conducted by Sonoma Technology Inc. for the American Petroleum Institute and the *Preliminary Assessment of Gulf of Mexico OCS Contributions to Ozone Formation in Onshore Areas using the Regional Oxidant Model* sponsored by MMS as

an Interagency Agreement with USEPA. The results in the following paragraph regarding historical ozone episodes are from a working draft by Sonoma Technology (Blumenthal et al., 1992).

In the CPA the number of ozone exceedance days at the Baton Rouge/New Orleans region varies from 6 to 13 days between 1982 and 1990. The number of ozone exceedance days per year and site-hours per year in the same region show that most ozone episodes peak in May and August with a minimum in June. The number of exceedances declines rapidly after October and before April. The site-hours peak generally during the summer months. Results for Lake Charles (not presented because too few exceedances occurred at the long-term monitoring stations) indicate that exceedances occurred mostly from May to October. To study the influence of OCS emissions, they analyzed the pollutant emissions and meteorological data at Sabine Pass, Texas, which is only 5 km inland. Days were classified as onshore and offshore flow with the meteorological data. Days with onshore flow had lower average and median ozone concentrations over land than days with offshore flow (by 5-8 parts per billion (ppb); the National Ozone Standard is 120 ppb), and maximum over land ozone concentrations were higher during offshore flow than during onshore flows (128 versus 108 ppb). Less than 1 percent of the onshore flow hours had ozone concentrations above 80 ppb. Of five days with ozone concentrations above 95 ppb, two days were associated with northerly flow at Sabine Pass and three days were associated with sea-land breezes. Land breeze (offshore flow) may be transporting ozone and precursors offshore; when the flow is onshore (sea breeze), ozone is transported back onshore. However, additional studies are needed to understand the dynamics of ozone formation and transport in this area. These results are subject to change when the study is completed.

The preliminary ozone assessment using the Regional Oxidant Model was performed to establish, to an order of magnitude, OCS contributions of onshore ozone. This is the first study to analyze OCS contributions to onshore problems. The ROM model (ROM 2.2) includes the following physical and chemical processes: boundary layer photochemistry, carbon bond mechanism IV, dry deposition, cloud and terrain effects, and anthropogenic and natural emissions. Inputs to the model are air quality data, pollutant emissions, meteorological data, land-use information, and topography. The domain used by the USEPA is extensive (26° to 38°N and 81° to 99°W); however, results for the MMS study were calculated for five areas (125 by 125 mi² polygons extending to or beyond the coastline) between Texas and Louisiana. The areas were located around Corpus Christi, Houston, Beaumont-Lake Charles, Baton Rouge, and Baton Rouge-New Orleans. The two ozone episodes analyzed in the study occurred during July 25 to August 6, 1988, and July 6-31, 1990. Observed ozone concentrations during the first episode varied between 40 and 150 ppb in Houston and between 51 and 167 ppb in Baton Rouge. Observed ozone concentrations during the second episode varied between 90 and 190 ppb around Houston and between 63 and 202 ppb around Baton Rouge. The results (Figure IV-5) show that most OCS ozone contributions occur over water with contributions of about 25 ppb, while over land contributions are about 8 ppb. It is worth noting that ozone reached as far as Georgia under southwest winds, although the concentrations are only about 5 ppb. During southeast winds the plume turned west, but the impact levels remained unchanged (Figure IV-6). During the second episode, concentrations were about 29 ppb over water and about 5 ppb over land (Figure IV-7). The OCS ozone impacts can be summarized as contributions between 5 and 8 ppb to onshore ozone concentrations and between 11 and 29 ppb over water. However, several cautions need to be mentioned for these results. First, the OCS emissions inventory employed was from 1985, while the episodes are from 1988 and 1990 and contain large uncertainties. Second, these results are based on only two episodes; thus, variance tends to be large. Third, the model tends to underpredict high ozone concentrations and overpredict low concentrations. Because of these uncertainties, the day-to-day ozone concentrations contributed by the OCS could be larger than the average results presented above. The above results show that the OCS contributions during this episode to onshore areas are small (8 ppb or less); however, this is just an order of magnitude assessment. The three-year study, mandated by Congress, will undoubtedly produce results that have higher resolution over a greater span of meteorological conditions and these results may change.

The results from the Regional Oxidant Model study can be used to assess the potential effects of OCS emissions on the flora of the Breton National Wildlife Refuge and National Wilderness Area of the Mississippi Delta. This Class 1 air quality area is administered by the U.S. Fish and Wildlife Service. Figures IV-5 and IV-7 illustrate that this area lies on the fringe of the ozone plume with concentrations of 0-5 ppb. Figure IV-6,

Figure IV-5. Difference in Ozone Concentrations (ppb) With and Without OCS Emissions (Ozone Episode July 25 - July 31, 1988).

Figure IV-6. Difference in Ozone Concentrations (ppb) With and Without OCS Emissions (Ozone Episode August 1 - August 6, 1988).

Figure IV-7. Difference in Ozone Concentrations (ppb) With and Without OCS Emissions (Ozone Episode July 26 - July 31, 1990).

however, shows that the Refuge/Wilderness Area lies between the ozone plume with low concentrations and the plume of higher concentrations, greater than 10 ppb. The FWS has found that sensitive plants can be affected by ozone concentrations of 30 ppb or higher (Porter, personal communication, 1993). Based on information contained in the figures cited, it may be concluded that OCS emissions have the potential to impact the flora of the previously discussed Class I area. A more comprehensive assessment of the OCS emissions will be performed when the results of the three-year study now underway and the results of the monitoring study become available.

The amount of power generation that occurs during the period 1994-2028 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 SO₂ 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 SO₂ and NO_x and the largest source of carbon monoxide (USDOE, 1990). Emissions of particulate matter and SO₂ 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 and State oil and gas activities and are defined as an uncontrolled flow of fluids from a wellhead or wellbore. Fifty-eight blowouts are assumed to occur 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 blowout duration has decreased. Also, most blowouts occurred without fire (MMS Database) and the amount of oil released during these accidents has been small. The total emission of THC is 1,686 tons during the Cumulative Scenario, which assumes that 58 blowouts will occur. 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 Cumulative Scenario discussed in Section IV.A. (Table IV-3) establishes that 3,330 exploration and delineation wells and 5,060 development wells would be drilled and that 330 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 minimal (about $1 \mu\text{gm}^{-3}$ 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 $14.6 \mu\text{gm}^{-3}$ (box model steady concentrations). The impacts decrease during winter because onshore winds occur only 37 percent of the time and impacts increase in summer because onshore winds occur 61 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 Central Gulf proposed action, prior and future OCS sales, State oil and gas activity, commercial fishing, and pathogens that may occur and adversely affect nonendangered and nonthreatened marine mammals 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 marine mammals analysis include Sections III.B.3. (description of marine mammals), IV.A.2.a.(1) (seismic surveying operations), IV.A.2.a.(4) (structure removal), IV.A.2.c. (support activities), IV.A.3.d. (offshore discharges), IV.A.3.h. (oil spills), and IX.E. (oil-spill response activities).

An estimated 26.2 MMbbl of drilling fluids, 25.3 MMbbl of drill cuttings, and 9 Bbbl of produced waters are assumed to be generated as a result of the proposed action plus prior and future OCS sales (Table IV-3). These effluents are routinely discharged into offshore marine waters and are regulated by the USEPA'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; indirect effects via 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/or affect nonendangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis, averaging about 900,000 trips per year. The FAA (Advisory Circular 91-36C) and corporate helicopter policy state that helicopters must maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. It is expected cetaceans will not be affected by routine OCS helicopter traffic at these altitudes. It is also expected that 10 percent of helicopter trips will occur at altitudes below the specified minimums listed above as a result of inclement weather. Such incidents are very short-term and may elicit a startle reaction from cetaceans close by.

It is assumed that, during the peak year, 31,000 OCS-related oil/gas service-vessel trips, two shuttle tanker trips, and 400 barge traffic trips will occur as a result of the proposed action, plus prior and future OCS sales in the CPA (Table IV-3). Noise from service-vessel traffic may elicit a startle and/or avoidance reaction from cetaceans or mask their sound reception. This effect is sublethal and constitutes a short-term and temporary impact, or "take." Survey data show that most cetacean species of the Gulf are distributed within deeper waters, on or beyond the continental shelf break. It is estimated that annual service-vessel trips occurring within water depths greater than 100 m are as follows: C-2--98,610; C-3--126,309; C-4--36,900. The probability of collisions is higher within these waters. It is expected that the extent of service-vessel traffic predicted in the Cumulative Scenario will result in the incidental take of cetaceans either through active avoidance behavior or displacement of individuals or groups. Collisions, though expected to be rare events, could be fatal.

It is assumed that, during the peak year, 290 exploration and delineation wells and 230 development wells will be drilled as a result of the proposed action, plus prior and future OCS sales in the CPA (Table IV-3), and will produce sounds at intensities and frequencies that could be heard by cetaceans. It is estimated that noise from drilling activities will be relatively constant and 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 echolocate and 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 and may elicit some degree of avoidance behavior and temporary displacement in the open Gulf. It is expected that drilling noise will periodically disturb and affect nonendangered cetaceans.

Explosive platform removals can temporarily interfere with communication, elicit a pronounced startle reaction with subsequent avoidance or flight behavior, temporarily or permanently reduce hearing sensitivity, or cause hemorrhaging and death in cetaceans. It is estimated that, during the peak year, 105 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 only sublethal effects on cetaceans as a result of the implementation of the MMS guidelines for explosive removals (USDOL, MMS, 1990a, Appendix B). It is expected that structure removals will seldom disturb and affect nonendangered cetaceans.

Seismic surveys use airguns to generate sound 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.a.(1)). It is expected that effects of noise on cetaceans from seismic surveys are entirely sublethal, constituting a short-term startle response and avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans, causing skin and soft tissue irritation, fouling of baleen plates, respiratory stress from inhalation of toxic fumes, food reduction or contamination, the direct ingestion of oil and/or tar, and temporary displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from Size 3 oil spills, the effects would primarily be sublethal; few deaths are expected. The effects of Size 1 and Size 2 offshore oil spills are expected to be solely sublethal due to the small area affected and their rapid dispersion.

Section IV.A.3.h. estimates the mean number of Size 1 and Size 2 spills occurring as a result of the proposed action, plus prior and future OCS sales in the CPA. It is assumed that 23 Size 1 spills will occur offshore each year and that a few will contact land. It is assumed that 31 Size 2 spills will occur during the program and that a few will contact nearshore areas and resident dolphin population. Although an interaction with Size 1 and Size 2 spills is expected, primarily sublethal effects are expected as a result of avoidance and natural dispersion/weathering of a spill in the offshore environment. It is expected that Size 2 spills will periodically contact and affect nonendangered cetaceans in both offshore and nearshore areas.

It is assumed that 44 crude oil Size 3 spills 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-3). Table IV-10 identifies the estimated risk of one or more Size 3 oil spills occurring and contacting within 10 days areas of where many cetaceans have been sighted during surveys. There is a 56 percent probability that a Size 3 oil spill will occur and contact within 10 days cetacean habitats at or beyond the shelf break of the CPA. There is a 15-34 percent probability that a Size 3 oil spill will occur and contact within 10 days areas off the Mississippi Delta (survey blocks in Table IV-10) where many cetaceans have been sighted. Although an interaction with Size 3 spills is expected, few deaths are expected with primarily sublethal effects as a result of avoidance and natural dispersion/weathering of a spill in the offshore environment. It is assumed that a Size 3 oil spill will occur and possibly contact and affect nonendangered cetaceans in the CPA.

Many types of plastic materials are used during drilling and production operations. Some of this material is accidentally lost overboard where it can be consumed, incidentally or accidentally, by cetaceans. The result of plastic ingestion could be lethal, especially to smaller species. The probability of this occurrence is low.

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 deaths of cetaceans. It is expected that commercial fishing equipment will periodically 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 deaths in the Gulf in 1989-1990 and along the Atlantic Seaboard in 1988 (USDOD, NMFS, 1990). Naturally occurring and anthropogenic toxins have been the hypothesized cause. Toxicological data from tissues sampled from stranded individuals is forthcoming. Suspected sources include algal blooms, oil spills, ocean dumping, industrial and municipal effluents, and agricultural runoff. These concentrations are not widespread, and deaths 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 will periodically affect nonendangered and nonthreatened cetaceans detrimentally. These cetaceans could be impacted by the degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, discarded trash and debris from service vessels and OCS structures, commercial fishing, capture and removal, and pathogens. The effects of the majority of these activities are expected to be sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris). Lethal effects are expected from Size 3 oil spills, chance collisions with OCS service vessels, ingestion of plastic material, 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 expected to be negligible. Effects of sale-specific operational discharges, helicopter and service-vessel noise, and seismic activity are expected to be sublethal. No deaths are expected from explosive platform removal because of MMS guidelines. Lethal effects are probable from the increased chance of collisions with service vessels, the ingestion of plastic materials, and Size 3 oil spills. Collisions are more apt to occur with large cetaceans and those species which frequently rest on the surface for extended periods of time (e.g., *Kogia* spp.)

Conclusion

The impact of the Cumulative Scenario on nonendangered and nonthreatened cetaceans is expected to result in a number of chronic and sporadic sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that may serve to weaken individuals of a local group or population and make them more susceptible to infection from natural or anthropogenic sources. Some displacement of individuals or groups, either temporary or permanent, is expected. Projected lethal effects will remove individuals from local populations; restoration of which may take several years, depending upon both species and location.

(b) 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 only species seen with regularity 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 marine mammals analysis include III.B.3. (description of marine mammals), IV.A.2.a.(1) (seismic surveying operations), IV.A.2.a.(4) (structure removal), IV.A.2.c. (support activities), IV.A.3.d. (offshore discharges), IV.A.3.h. (oil spills), and IX.E. (oil-spill response activities).

An estimated 26.2 MMbbl of drilling fluids, 25.2 MMbbl of drill cuttings, and 9 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-3). 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 offshore discharges. Direct effects to cetaceans are expected to be sublethal; indirect effects via food sources are not expected due to the rapid offshore dilution and dispersion of operational discharges. It is expected that offshore operational discharges will periodically contact and/or affect endangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis, averaging about 900,000 trips a year. The FAA (Advisory Circular 91-36C) and corporate helicopter policy state that helicopters must maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. It is expected that cetaceans will not be affected by routine OCS helicopter traffic at these altitudes. It is also expected that 10 percent of helicopter trips will occur at altitudes below the specified minimums listed above as a result of inclement weather. Such incidents are very short-term and may elicit a startle reaction from cetaceans closely.

It is assumed that, during the peak year, 31,000 OCS-related oil/gas service-vessel trips, 2 shuttle tanker trips, and 400 barge traffic trips will occur as a result of the proposed action, plus prior and future OCS sales in the CPA (Table IV-3). Noise from service-vessel traffic may elicit a startle and/or avoidance reaction from cetaceans or mask their sound reception. This effect is sublethal and constitutes a short-term, temporary impact. Survey data show that most cetacean species of the Gulf are distributed within deeper waters, on or beyond the continental shelf break. It is estimated that annual service-vessel trips occurring (by offshore sub-area) within water depths greater than 100 m are as follows: C-2--98,610; C-3--126,309; C-4--36,900. All of the endangered species of cetaceans found in the Gulf are large and commonly spend lengthy periods of time on the surface. The probability of collisions is higher within these waters. It is expected that the extent of service-vessel traffic predicted in the Cumulative Scenario will result in the incidental take of cetaceans either through active avoidance behavior or displacement of individuals or groups. Collisions, though expected to be rare events, could be fatal.

It is assumed that, during the peak year, 290 exploration and delineation wells and 230 development wells will be drilled as a result of the proposed action, plus prior and future OCS sales in the CPA (Table IV-3), and will produce sounds at intensities and frequencies that could be heard by cetaceans. It is estimated that noise from drilling activities will be relatively constant and 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, such as the sperm whale, echolocate and 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 and may elicit some degree of avoidance behavior in the open Gulf and possibly cause displacement from the affected area. It is expected that drilling noise will periodically disturb and affect endangered cetaceans.

Explosive platform removals can temporarily interfere with communication, temporarily or permanently reduce hearing sensitivity, or cause hemorrhaging and death in cetaceans. It is estimated, that during the peak year, 105 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 only sublethal effects on cetaceans as a result of the implementation of the MMS guidelines for explosive removals (USDOJ, MMS, 1990a, Appendix B). It is expected that structure removals will seldom disturb and affect endangered cetaceans.

Seismic surveys use airguns to generate sound 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.a.(1)). It is expected that effects on cetaceans from seismic surveys are entirely sublethal, constituting a short-term startle response and avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans, causing skin and soft tissue irritation, fouling of baleen plates, respiratory stress from inhalation of toxic fumes, food reduction or contamination, the direct ingestion of oil and/or tar, and temporary displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from Size 3 oil spills, the effects would primarily be sublethal; few deaths are expected. The effects of Size 1 and Size 2 offshore oil spills 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.A.3.h. estimates the mean number of Size 1 and Size 2 spills occurring as a result of the proposed action, plus prior and future OCS sales in the CPA. It is assumed that 23 Size 1 spills will occur each year, and that a few will contact land. It is assumed that 31 Size 2 spills will occur during the OCS Program and that a few will contact land. Although an interaction with Size 1 and Size 2 spills is estimated, only sublethal effects are expected as a result of avoidance and natural dispersion/weathering of a spill in the offshore environment. It is expected that Size 1 and Size 2 spills will periodically contact and affect endangered cetaceans.

It is assumed that 7 Size 3 crude oil spills 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-3). Table IV-10 identifies the estimated risk of one or more Size 3 oil spills occurring and contacting within 10 days areas of where many cetaceans have been sighted during surveys. There is a 56 percent probability that a Size 3 oil spill will occur and contact within 10 days cetacean habitats at or beyond the shelf break of the CPA. There is a 15-34 percent probability that a Size 3 oil spill will occur and contact within 10 days areas off the Mississippi Delta (survey blocks in Table IV-10) where many cetaceans have been sighted. Although an interaction with Size 3 spills may occur, primarily sublethal effects are expected with few deaths as a result of avoidance and natural dispersion/weathering of a spill in the offshore environment. It is assumed that Size 3 oil spills will periodically contact and affect endangered cetaceans in the CPA.

Many types of plastic materials are used during drilling and production operations. Some of this material is accidentally lost overboard where it can be consumed, incidentally or accidentally, by cetaceans. The result of plastic ingestion could be lethal, despite the large size of the endangered cetaceans of the Gulf. The probability of this occurrence is low.

It is assumed that generalized migratory behavior of the endangered cetaceans found in the Gulf 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, disturb, or collide with whales, no incidents of the latter have been reported. These activities are not commonplace 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 will periodically affect endangered and threatened cetaceans detrimentally. These cetaceans could be impacted by the degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response operations, discarded trash and debris from service vessels and OCS structures, natural and anthropogenic activities contacted during migration, and recreational whale-watching. The effects of the majority of these activities are expected to be sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris). Lethal effects are expected from Size 3 oil spills, chance collisions with OCS service vessels, ingestion of plastic materials, and several factors encountered during migration outside of the Gulf OCS. 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)(b)) to the cumulative impact is expected to be negligible because the effects of the most probable impacts, such as sale-specific operational discharges, helicopter and service-vessel noise, and seismic activity, are expected to be sublethal. No deaths are expected from explosive platform removal because of MMS guidelines.

Conclusion

The impact of the Cumulative Scenario on endangered and threatened cetaceans within the potentially affected area is expected to result in a number of chronic and sporadic sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that may serve to weaken individuals of a local group (e.g., sperm whales) or solitary individuals and make them more susceptible to infection from natural or anthropogenic sources. Activities may displace individuals from specific preferred habitat or disrupt mating behavior. Lethal impacts are expected to be rare for all marine mammals, with the most likely impacts resulting from vessel collisions to lethargic surfaced individual animals. The unexpected and unintentional removal of individuals of any species is considered an incidental take. Such removals have not been documented in the Gulf. Recovery times will vary with species size, gestation period, and rates of reproductive activity. These will vary from two to several (less than ten) years.

(6) Impacts on the 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, beach trash and debris, predation, competition, 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.(6) and are described below. Sections providing supportive material for the Alabama, Choctawhatchee, and Perdido Key beach mice analysis include Sections III.A.2. (meteorological conditions), III.B.4. (description of Alabama, Choctawhatchee, and Perdido Key beach mice), III.B.1.a. (coastal barrier beach and dune systems), IV.A.3.h. (oil spills), and IX.E. (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, increased predation, and displacement from preferred habitat. Beach mice habitat is located behind barrier dunes (Ehrhart, 1978); therefore, an oil spill would have to breach the dunes in order to reach the mice. This could occur only if an oil spill coincided with a storm surge.

Seven offshore Size 3 crude oil spills (Table IV-3) and six onshore spills (Table IV-14) are assumed to occur offshore as a result of import tankering and the proposed action, plus prior and future OCS sales in the Gulf of Mexico. None of these spills are expected to contact beach mice. There is a 1 percent probability of a Size 3 oil spill occurring and contacting the coastal areas of the Alabama, Choctawhatchee, and Perdido Key beach mice (Mobile Bay, Perdido Bay seagrass beds, and Escambia County) within 10 days (Table IV-10). However, an interaction of beach mice with Size 3 spills is not expected to occur.

Vehicular traffic associated with oil-spill and construction activities has the potential to degrade preferred habitat and to cause displacement from these areas. The home ranges of the beach mice are within Perdido Key State Preserve (Florida), Grayton Beach State Recreational Area (Florida), St. Andrews State Recreation Area and Shell Island (Florida), Gulf Islands National Seashore (Alabama), and Gulf State Park (Alabama). Their range also includes Escambia County (Florida) and Baldwin County (Alabama). In the unlikely event of an oil spill, protection efforts to prevent contact of these areas with spilled oil are mandated by the Oil Pollution Act of 1990. The OCS platforms may be detached and blown onshore during powerful hurricanes, but derelict structures would not be expected to breach the dune system where beach mice occur.

Non-OCS operations, including dredge-and-fill activities, coastal construction and beach restoration, beach lighting, and beach trash and debris, could potentially disturb beach mice habitat. Predation from both feral and nonferal domestic cats and dogs and competition with common house mice, also reduce and disturb their populations, but estimates of this mortality are unreliable (USDOL, FWS, 1987; Humphrey and Frank, 1992). Coastal construction and predation can be expected to threaten Alabama, Choctawhatchee, and Perdido Key beach mice populations on a continual basis.

Dredge-and-fill activities occur throughout the nearshore areas of the United States and disrupt beach sand transport, which could affect coastal dune systems where beach mice live. Present beach mice habitats are no longer of optimal quality because of historical beach erosion, residential and commercial construction, and

tropical storm damage (Meyers, 1983). Natural catastrophes including storms, floods, droughts, and hurricanes also have the potential to substantially reduce or eliminate Alabama, Choctawhatchee, and Perdido Key beach mice. Some of these are expected to occur and periodically contact beach mice habitats within the 35-year OCS Program. The beach mouse has a maximum expected lifespan of one year, and disturbances are not expected to last for more than one or two generations, provided some relict population survives.

Summary

Cumulative activities have a potential to harm or reduce the numbers of Alabama, Choctawhatchee, and Perdido Key beach mice. Those activities include oil spills, oil-spill response activities, alteration and reduction of habitat, beach trash and debris, natural catastrophes, predation, and competition. The majority of OCS-related activities, including oil spills stemming from import tankering and prior and future lease sales are not expected to contact beach mice or their habitats. The expected incremental contribution of the OCS Program (as analyzed in Section IV.D.1.a.(6)) to the cumulative impact level is negligible. Non-OCS activities or natural catastrophes could potentially deplete some beach mice populations to unsustainable levels, especially if reintroductions could not occur.

Conclusion

The Cumulative Scenario is not expected to harm Alabama, Choctawhatchee, and Perdido Key beach mice or their habitats. Non-OCS activities or tropical storms may deplete isolated populations of beach mice.

(7) Impacts on Marine Turtles

This Cumulative Analysis considers the effects of impact-producing factors related to Central Gulf prior and future OCS sales, State oil and gas activity, dredge-and-fill operations, water quality degradation, natural catastrophes, agricultural pollution, commercial fishing, hopper dredge operation, recreational boat traffic, migration, and human consumption of the loggerhead, Kemp's ridley, hawksbill, green, and leatherback marine turtles of the Gulf of Mexico.

Major impact-producing factors that may occur are reviewed in detail in Section IV.D.1.a.(7) and are described below. Further discussion of cumulative actions are found in *Decline of the Sea Turtles: Causes and Prevention* (NRC, 1990) and are also described in the Biological Opinions (Appendix B). Sections providing supportive material for the marine turtle analysis include Sections III.A.2. (meteorological conditions), III.B.5. (description of marine turtles), IV.A.3.c.(1) (structure removal), IV.A.3.d. (offshore discharges), IV.B. (other major coastal/onshore activities), IV.A.3.h. (oil spills), and IX.E. (oil-spill response activities).

The major impact-producing factors that are related to the OCS Program and that may affect Gulf marine turtles include structure installation, dredging, operational discharges, vessel traffic, explosive platform removals, OCS-related trash and debris, oil-spill response activities, oil spills, blowouts, and water quality and coastal environmental degradation.

Structure installation and removal, pipeline placement, dredging, and water quality degradation may adversely affect marine turtle habitat through destruction of seagrass beds and live-bottom communities used by marine turtles. Potential impacts on these habitats caused by the OCS Program are discussed in detail in Section IV.D.1.a.(1)-(3). Wetlands and estuaries could be eroded along navigation channels in Louisiana and along the north Texas coast as a result of vessel traffic within the channels. The physical integrity, species diversity, and biological productivity of topographic features and live bottoms where marine turtles occur are expected to suffer temporary damage or disturbance.

Noise from service-vessel traffic may elicit a startle reaction from marine turtles and produce a temporary, sublethal stress (NRC, 1990). It is assumed that about 587,100 OCS-related oil and gas service-vessel trips, 8,460 barge trips, and 43 shuttle tanker trips will occur during the 35-year life of the OCS Program (Table IV-3). Collision between service vessels or barges and surfaced marine turtles would likely cause fatal injuries, but marine vessel operators can avoid marine turtles and reduce potential deaths. Vessel traffic in general is

estimated to cause about 9 percent of all marine turtle deaths in the southeastern United States, and this mortality may grow if fishing, recreational, and OCS Program vessel traffic continues to increase.

Offshore operational discharges are not known to be lethal to marine turtles and are diluted and dispersed rapidly within 1 km of the discharge point. Unfavorable effects on marine turtle food sources by water quality degradation have not been previously demonstrated (API, 1989; NRC, 1983). Impacts on marine turtles from bottom disturbance, structure installation, pipeline emplacement, blowouts, and dredging are expected to be indistinguishable from the long-term (25-50 years) natural variability within populations. Suspended particulate matter in offshore operational discharges and blowouts is expected to reduce visibility and may displace prey items in the vicinity. Marine turtles within 1 km of discharge points are expected to be less able to locate prey for the short time period they would spend traversing discharge plumes.

Explosive platform removals can cause capillary damage, disorientation, and loss of motor control in marine turtles (Duronslet et al., 1986). Although marine turtles far from the site may suffer only disorientation, those near detonation sites would likely sustain fatal injuries. 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-limited detonation, staggered charges, placement of charges 5 m below the seafloor, and pre- and post-detonation surveys of surrounding waters. It is estimated that 2,110 structures will be removed by explosives from the Central Gulf of Mexico as a result of the proposed action, plus prior and future OCS sales (Table IV-3). As many as 105 structures may be removed in the CPA in one year, and some removals will occur beyond the continental shelf. Although a few marine turtle mortalities may occur as a result of oversights during the large number of projected removals, MMS guidelines for explosive platform removals may reduce this likelihood (USDOJ, MMS, 1990a, Appendix B). Also, marine turtles are widely distributed in the CPA, and their densities would not be expected to be high near the vicinity of platform removals.

Marine debris is a well-documented source of deaths and debilitation for marine turtles (NRC, 1990). In addition to the incremental amount of trash and debris generated by the OCS Program, marine debris is carried into the Gulf and Atlantic via oceanic currents from South and Central America, Europe, and North Africa (Plotkin and Amos, 1988; Hutchinson and Simmonds, 1992). The volume of nonbiodegradable materials contributed by these sources is unknown. Turtles that consume or become entangled in debris may die or become debilitated (O'Hara, 1989; USDOC, NMFS, 1989a; Heneman and the Center for Environmental Education, 1988). Marine turtles, particularly leatherbacks, are known to be attracted to floating plastic debris because it resembles their preferred food, the jellyfish. Plastics and other materials may remain in the gut for at least six months and interfere with digestion, growth, and other physiological processes (Lutz and Alfaro-Shulman, 1992). Ingestion of plastic and styrofoam materials could result in drowning, lacerations, and reduced mobility, resulting in starvation (Carr, 1987; USDOC, NOAA, 1988d; Heneman and the Center for Environmental Education, 1988; USDOJ, 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), prohibits the disposal of any plastics at sea or in coastal waters. Despite these safeguards, marine turtles can become entangled in or ingest trash and debris produced by human activity in the Gulf and elsewhere.

Some marine turtles may be expected to consume debris and die following ingestion or immobilization. Leatherback turtles that mistake plastics for jellyfish may be singularly more vulnerable to stomach blockage or other lethal effects. Estimates of these deaths cannot be made at this time.

Oil-spill response activities, such as vehicular and vessel traffic in shallow areas of seagrass beds and live-bottom communities, can adversely affect marine turtle habitat and cause displacement from these preferred areas. As mandated by the Oil Pollution Act of 1990 (Section IV.C.5.), these areas are expected to receive individual consideration during oil-spill cleanup. Required oil spill contingency plans include special notices to minimize adverse effects from vehicular traffic during cleanup activities and to maximize protection efforts to prevent contact of these areas with spilled oil (Section IV.C.5.).

Oil spills can adversely affect marine turtles by toxic external contact, toxic ingestion or blockage of the digestive tract, disruption of salt gland function, asphyxiation, and displacement from preferred habitats (Witham, 1978; Vargo et al., 1986; Lutz and Lutcavage, 1989). Marine turtles may become entrapped by tar and oil slicks and rendered immobile (Witham, 1978; Plotkin and Amos, 1988). In the past, tanker washings

have been the main source of this oil (Van Vleet and Pauly, 1987). Hatchling and small juvenile turtles are particularly vulnerable to contacting or ingesting oil because the currents that concentrate oil spills also form the debris mats in which these turtles are sometimes found (Carr, 1980; Collard and Ogren, 1990). Fritts and McGehee (1982) noted that sea turtle eggs were damaged by contact with weathered oil released from the IXTOC spill.

When an oil spill occurs, the severity of effects and the extent of damage to marine turtles are affected by geographic location, oil type, oil dosage, impact area, oceanographic conditions, and meteorological conditions (NRC, 1985; USDOl, MMS, 1987b). Adult marine turtles do not appear to detect and avoid an oil spill, and eggs, hatchlings, and small juveniles are particularly vulnerable to contact (Fritts and McGehee, 1982; Lutz and Lutcavage, 1989). Contact with oil may not cause direct or immediate mortality, but cumulative sublethal effects such as salt gland disruption could impair the marine turtle's ability to function effectively in the marine environment (Vargo et al., 1986; Lutz and Lutcavage, 1989).

Oil spills and oil-spill response activities can negatively affect marine turtles as outlined above. Seven hundred ninety-three offshore (Table IV-3) and 390 onshore (Table IV-14) Size 1 oil spills are assumed to occur during the 35-year life of the OCS Program. Thirty-one offshore (Table IV-3) and 70 onshore (Table IV-14) Size 2 oil spills are assumed to occur during the 35-year OCS Program. Although marine turtles may encounter these spills in their inshore and offshore habitats, primarily sublethal and minor effects are expected in addition to some deaths that may occur.

Seven offshore (Table IV-3) and six onshore (Table IV-14) Size 3 oil spills are expected to occur and contact marine turtle habitat within 10 days from either a platform or pipeline in the Central Gulf during the OCS Program. Since marine turtle habitat in the Gulf includes both inshore and offshore areas, marine turtles are likely to encounter a few OCS or import tanker spills. Few mortalities are expected because of the small area of contact involved, the rapid dispersion and loss of oil, and the low density of marine turtles in the area. However, sublethal biological and behavioral impacts could temporarily disturb oiled marine turtles.

The estimated probability of one or more OCS Program Size 3 oil spills occurring and contacting marine turtle habitat such as the Western Plaquemines coastal area, is 28 percent from import tankering and 54 percent from Gulfwide OCS Program sources (Table IV-10).

Although oil-spill response activities such as vehicular and vessel traffic stemming from OCS Program or import tankering are assumed to contact marine turtle habitat, harm is expected to be minimized because of contingency plans mandated by the Oil Pollution Act of 1990, and by possible avoidance of oil spills by marine turtles.

It is important to note that during nesting season the Kemp's ridley marine turtle would be particularly vulnerable to harm from a large oil spill occurring in the immediate vicinity of its only known nesting beach--Tamalipas province, Mexico (Lutz and Lutcavage, 1989). The estimated probability for any oil spill, of any origin, at the Tamalipas site is less than 0.5 percent for the 35-year OCS Program (Table IV-10).

Marine turtles are vulnerable to harm from human activities throughout their migratory ranges, particularly because of their wide-ranging movements in coastal waters. Major activities that affect marine turtles in the CPA include commercial fishing, hopper dredging, pollutant discharge, ingestion of or entanglement in debris, nearshore boat traffic, human consumption, and contact with foreign, inshore, or processed oil (reviewed in NRC, 1990).

Capture and drowning in commercial fishing gear, particularly shrimp trawls, is the largest cause of death for sea turtles in the United States and the Gulf of Mexico (NRC, 1990). Turtle Excluder Devices (TED's) on shrimp trawls and seasonal restrictions for other fisheries are legislatively mandated to decrease turtle deaths. However, deaths are believed to occur in association with some inshore shrimping operations that do not presently require TED use (Crouse, 1992). Turtles also drown in driftnet, longline, and set-net fisheries, but these sources of mortality are neither fully documented nor regulated (NRC, 1990). Collisions with boats may also disable or kill sea turtles and is typically associated with about 9 percent of sea strandings identified by the U.S. sea turtle stranding network (Teas and Martinez, 1992).

Dredge-and-fill activities occur in many of the nearshore seasonal habitats of marine turtles in the southeastern U.S. and in other areas. Operations range in scope from propeller dredging by recreational boats to large-scale navigation dredging and fill for land reclamation. Hopper dredging has caused turtle deaths in

coastal areas, including Cape Canaveral Ship Channel in Florida and the King's Bay Submarine Channel in Georgia (Slay and Richardson, 1988), but deaths in the Gulf of Mexico have not been estimated.

Sea turtles frequent coastal areas such as algae and seagrass beds to seek food and shelter (Carr and Caldwell, 1956; Hendrickson, 1980), and these nearshore areas are used by juvenile Kemp's ridleys in Louisiana (Ogren, 1989) and in Texas (Manzella and Williams, 1992) and by green, loggerhead, and hawksbill turtles throughout the Gulf. Submerged vegetated areas may be lost or damaged by activities that alter salinity, increase turbidity, or disturb natural tidal and sediment exchange. Natural catastrophes, including storms, floods, droughts, and hurricanes, can also substantially damage sea turtle habitats and nesting beaches (Agardy, 1990).

Construction, vehicle traffic, beachfront erosion, and artificial lighting are activities that disturb marine turtles or their nesting beaches (Raymond, 1984; Garber, 1985) and that would be of particular concern for Mississippi and Alabama loggerhead turtle nesting areas such as Gulf Shores and the Chandeleur Islands.

Sand mining, beach renourishment, and oil-spill cleanup operations may remove sand from the littoral zone and temporarily disturb onshore sand transport, potentially disturbing marine turtle nesting activities. The main causes of permanent nesting beach loss within the Gulf of Mexico are the reduction in sediment transport, rapid rate of relative sea-level rise, coastal construction and development, and recreational use of accessible beaches near large population centers.

Human consumption of turtle eggs, meat, or byproducts occurs worldwide and depletes turtle stocks (Mack and Duplaix, 1979; Cato et al., 1978). Human take is estimated to be substantial worldwide, but it is not considered to be a serious concern in the Gulf of Mexico.

Chronic pollution, including industrial and agricultural wastes and urban runoff, threatens sea turtles worldwide (Frazier, 1980; Hutchinson and Simmonds, 1991) and may be a particular concern in coastal areas of Texas, Louisiana, and other Gulf States. Some turtle species have lifespans greater than 50 years (Congdon, 1989; Frazer et al., 1989), creating the potential for bioaccumulation of heavy metals (Hillestad et al., 1974; Stoneburner et al., 1980; Davenport et al., 1990), pesticides (Thompson et al., 1974; Clark and Krynitsky, 1980; Davenport et al., 1990), and other toxins (Lutz and Lutcavage, 1989). Chronic pollution from industrial or agricultural sources is linked with immune suppression in some marine mammals and would similarly be a source of concern for marine turtles in the Gulf of Mexico.

Fibropapillomas, debilitating tumors occurring primarily in green turtles, also threaten sea turtles in populated coastal areas (Teas, 1991). Fibropapillomas may be accompanied by trematode and leech infestations and severe anemia (Norton et al., 1990). The disease was documented in the 1930's (Smith and Coates, 1938), but its incidence has increased in the last century, especially from 1985-1990, in Florida, Hawaii, and Puerto Rico turtles. The disease also appears to be increasing in other heavily populated coastal areas (Teas, 1991). The origin of marine turtle fibropapilloma disease is unknown, but viral and toxicological causes and immune suppression are among those under investigation (Jacobson, 1991). At present, the link between water quality degradation and health impacts on migratory marine vertebrates such as marine turtles is poorly understood, and no mortality estimates are available (NRC, 1990).

Summary

Activities resulting from the Cumulative Scenario have a potential to harm marine turtles. Those activities include structure installation, dredging, water quality and habitat degradation, operational discharges, blowouts, OCS-related trash and debris, vessel traffic, explosive platform removals, oil-spill response activities, oil spills, dredge-and-fill operations, natural catastrophes, pollution, hopper dredge operation, recreational boat traffic, commercial fishing, human consumption, and potentially harmful activities contacted during migration. Deaths resulting from OCS-related spills and import tankering, debris ingestion, or explosive platform removals are assumed to occur but are expected to be few in number. The incremental contribution of the proposed action to the cumulative impact is expected to be negligible because most of the probable impacts, disturbances to feeding, disturbances to feeding habitat, and prey availability are expected to be temporary. Marine turtles may avoid OCS Program and other disturbances by shifting their feeding and resting areas to undisturbed areas. Oil spills, oil-spill response activities, and explosive platform removals are potential threats that may be

expected to cause marine turtle deaths, but the risks are greatly reduced by spill contingency planning and by the MMS and Biological Opinion stipulations.

Conclusion

The impact of the Cumulative Scenario on marine turtles is expected to remove some animals from marine turtle populations and to displace temporarily marine turtles from feeding, reproduction, and resting habitats.

(8) Impacts on Coastal and Marine Birds

(a) Nonendangered and Nonthreatened Species

The Gulf of Mexico is populated by resident and migratory species of coastal and marine birds. This broad category consists of five main groups: seabirds, shorebirds, wading birds, marsh birds, and waterfowl.

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 oil spills and spill-response activities; degradation of water quality; aircraft and vessel traffic and noise, including OCS helicopter and service-vessels; habitat loss and modification resulting from coastal construction and development; OCS pipeline landfalls and coastal facility construction; and discarded and beached trash and debris.

Section IV.A.3.h.(2) estimates the mean number of Size 1 and Size 2 offshore spills occurring as a result of the proposed action and prior and future OCS sales in the CPA. Twenty-three offshore spills and 11 onshore spills of Size 1 category are assumed to occur each year; it is predicted that a few offshore spills will contact the coastline. Four Size 2 offshore spills will occur every five years and two Size 2 spills will occur every year. A few offshore spills will contact land in the CPA. Most Size 1 spills related to the proposed action are predicted to occur near or at OCS-related transfer facilities, and will not contact wetland and other biologically sensitive coastal habitats. For the purpose of this analysis, it is estimated that Size 1 and Size 2 spills will periodically contact and affect coastal and marine birds. Effects from Size 1 onshore spills away from transfer facilities and Size 2 spills are expected to result in some degradation of habitat, physical oiling of birds, acute and chronic physiological stress, and mortalities of individuals or localized groups associated with direct and secondary intake of oil. Onshore spills in wetland and other coastal areas can affect most groups of coastal birds, including marsh birds, waders, waterfowl, and certain shorebirds.

Seven Size 3 crude oil spills will occur offshore and six onshore in the CPA for the Cumulative Scenario (Tables IV-3 and IV-14). In the CPA, the probability of Size 3 OCS spills contacting sensitive coastal habitat within 10 days is greater than 20 percent for Barataria Bay, West Plaquemines Coastal Barrier, and East Deltaic Plain marshes (Table IV-10). Imported oil in the CPA has the highest probability of contacting the coast in Plaquemines Parish. These areas are noted for supporting high densities of migratory and resident birds within a broad array of habitats. Thus, contact probabilities strongly suggest that Size 3 oil spills will often contact and affect the Central Gulf coastline and inshore habitats with resultant deleterious effects, including deaths of individuals from all five groups of coastal and marine birds. Coastal and onshore spills not related to the OCS Program constitute the vast majority of the total spills which occur in the CPA. These include inshore crude and petroleum product spills, spills from import tankering, and spills from coastwise movement of petroleum products in restricted waters. It is estimated that the effects of non-OCS spills in coastal areas will far exceed the negative impacts to local populations of coastal and marine birds estimated from the OCS Program, causing the deaths of adults and nestlings, degradation of coastal habitats, and displacement of local populations in proximity to the affected areas.

Degradation of water quality resulting from OCS discharges is expected to affect coastal and marine birds within nearshore and inland areas of the CPA.

Helicopter and service-vessel traffic related to OCS activities could sporadically disturb feeding, resting, or nesting behavior of birds or cause abandonment of preferred habitat. This impact-producing factor could contribute to indirect population loss through reproductive failure resulting from nest abandonment. The FAA (Advisory Circular 91-36C) and corporate helicopter policy states that helicopters must maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. When flying over land, the specified minimum altitude is 1,000 ft over unpopulated areas or across coastlines, and 2,000 ft over populated areas and biologically sensitive areas such as wildlife refuges and national parks. Many undisturbed coastal areas and refuges provide preferred and/or critical habitat for feeding, resting (or staging), and nesting birds. The effects of low-flying aircraft within the vicinity of aggregations of birds on the ground or on the water typically results in mass disturbance and abandonment of the immediate area. Compliance to the specified minimum altitude requirements is expected to significantly reduce effects of aircraft disturbance on coastal and marine birds. It is expected, however, that approximately 10 percent of helicopter trips will occur at altitudes somewhat below the minimums listed above as a result of inclement weather. Although these incidents are very short term in duration and sporadic in frequency, they can disrupt coastal bird behavior and, at worst, possibly result in habitat or nest abandonment. Birds in flight over water are expected to avoid helicopters; temporary disruption of feeding or flight paths is expected when encountering low-flying helicopters. It is estimated that there will be over 501,000 helicopter flights across coastal areas annually, with approximately 50,000 flying at altitudes somewhat below specified minimums. For this analysis, OCS support helicopter traffic will periodically disturb coastal and marine birds; general adherence to FAA and corporate helicopter protocol on service altitudes will serve to reduce the level of disturbance. The net effect of OCS-related flights on coastal and marine birds is expected to result in sporadic disturbances which may result in displacement of localized groups. During nesting periods, this could ultimately result in some reproductive failure from nest abandonment, predation, etc.

It is assumed that about 17,000 OCS-related oil and gas service-vessel trips and 240 barge trips will occur annually for the Cumulative Scenario. It is also assumed that 43 shuttle tanker trips will occur during the 35-year analysis period life of the OCS Program (Tables IV-3 and IV-14). Service vessels will use selected nearshore and coastal (inland) navigational waterways, or corridors, and adhere to protocol set forth by the Coast Guard for reduced vessel speeds within these inland areas. Routine presence and low speeds of service vessels within these waterways diminishes the effects of disturbance from service vessels on nearshore and inland populations of coastal and marine birds. For the purpose of this analysis, service-vessel traffic will seldom disturb populations of coastal and marine birds existing within these areas. Recreational vessel traffic is a much greater source of impact to birds in coastal habitats. These vessels are, in most cases, not required to comply with strict speed/wake restrictions; small recreational fishing boats, ski boats, etc. often flush coastal and marine birds from feeding, resting, and nesting areas. Such disturbances displace local groups from these preferred habitats and could lead to abandonment of the areas in general or reproductive failure. It is estimated that the effects of non-OCS vessel traffic on birds within coastal areas of the CPA are substantial.

The greatest impact to coastal and marine birds is the extent of preferred or critical habitat loss resulting from oil spill and spill response activities, urban and industrial development within coastal areas, erosion of areas bordering navigational channels from vessel usage, and OCS-related activities such as pipeline landfalls and onshore construction. Historic census data shows that many of these species are declining in numbers and are being displaced from areas along the coast (and elsewhere) as a result of the encroachment of their preferred habitat(s) by the aforementioned sources. As these birds move to undisturbed areas of similar habitat, their presence augments habitat utilization pressure on these selected areas as a result of intra- and interspecific competition for space and food. The OCS Program contribution to coastal land loss or modification includes construction of three pipeline landfalls, 72 km (45 mi) of onshore pipeline, one marine terminal, one separation facility, and one gas processing plant (Table IV-14). The contribution of development from urban and other industrial growth will be substantial, causing both the permanent loss of lands and increased levels of disturbance associated with and in proximity to new construction and facilities.

Coastal and marine birds are commonly entangled and snared in discarded trash and debris. Many species will readily ingest small plastic debris, either intentionally or incidentally. Interaction with plastic materials is therefore very serious, and often leads to permanent injuries and death. Much of the floating material discarded from vessels and structures offshore drifts ashore or remains within coastal waters. These materials

include lost or discarded fishing gear such as gill nets and monofilament lines, which cause the greatest damage to birds. It is expected that coastal and marine birds will seldom become entangled in or ingest OCS-related trash and debris as a result of MMS prohibitions on the disposal of equipment, containers, and other materials into offshore waters by lessees (30 CFR 250.40). In addition, MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. For the purpose of this analysis, OCS oil- and gas-related plastic debris will seldom interact with Gulf coastal and marine birds, and therefore, the effect will be negligible. Despite these regulations, quantities of plastic materials are still discarded and lost into the marine environment, and so remain a threat to individual birds within these areas.

Effects outside OCS activities include storms and floods; pollution of coastal waters resulting from municipal, industrial, and agricultural runoff and discharge; and collisions with structures such as power line towers, etc. Coastal storms and hurricanes can often cause deaths to coastal birds through high winds; associated flooding destroys active nests and nesting areas. Elevated levels of municipal, industrial, and agricultural pollutants into coastal wetlands and waters expose resident birds to chronic physiological stress. Collisions with power lines and supporting towers are not atypical during inclement weather and during periods of migration, often causing death or permanent injury to birds (Avery et al., 1980).

Summary

Activities resulting from the Cumulative Scenario will detrimentally affect coastal and marine birds. It is expected that the majority of effects from the major impact-producing factors on coastal and marine birds are sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris), and will cause temporary disturbances and displacement, some permanent, of localized groups onshore. Chronic sublethal stress, however, is often undetectable in birds. It can serve to weaken individuals (which is especially serious for migratory species), and expose them to infection and disease. Lethal effects, resulting primarily from uncontained onshore oil spills and associated spill response activities in wetland and other biologically sensitive coastal habitats, are expected to remove a number of individuals from any or all groups through primary effects from physical oiling and the ingestion of oil, and secondary effects resulting from the ingestion of oiled prey; recruitment of birds through successful reproduction is expected to take up to many years, depending upon the species and existing conditions. The net effect of habitat loss from oil spills, new construction, and maintenance and use of pipeline corridors and navigational waterways will alter species composition and reduce the overall carrying capacity of disturbed area(s) in general.

The incremental contribution of the proposed to the cumulative impact is expected to be negligible because the effects of the most probable impacts, such as sale-specific operational discharges and helicopters and service-vessel noise and traffic, are estimated to be sublethal though some displacement of local individuals or groups is expected. It is assumed that there will be some interaction between sale-related oil spills and coastal and marine birds.

Conclusion

The cumulative effect on coastal and marine birds is expected to result in a discernible decline in the numbers of birds which form localized groups or populations, with associated change in species composition and distribution. Some of these changes are expected to be permanent, as exemplified in historic census data, and to stem from a net decrease in preferred and/or critical habitat.

(b) Endangered and Threatened Species

This Cumulative Analysis considers the effects of the OCS Program for the CPA on endangered and threatened birds, including the brown pelican, Arctic peregrine falcon, bald eagle, piping plover, and least tern. It summarizes and incorporates the discussion of the effects on the coastal and marine birds in Section IV.D.1.a.(8)(a) (nonendangered and nonthreatened birds) and additional information as cited. Oil spills and

spill response activities, degradation of water quality, aircraft and vessel traffic and noise, habitat loss or modification, and discarded trash and 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.(8)(a)).

Section IV.A.3.h.(2) estimates the mean number of Size 1 and Size 2 offshore spills occurring as a result of the proposed action and prior and future OCS sales in the CPA. Twenty-three offshore spills and 11 onshore spills of Size 1 category are assumed to occur each year; it is predicted that a few offshore spills will contact the coastline. Four Size 2 offshore spills will occur every 5 years and two Size 2 spills will occur every year. A few offshore spills will contact land in the CPA. Most Size 1 onshore spills related to the proposed action are predicted to occur near or at OCS-related transfer facilities, and will not contact wetland and other biologically sensitive coastal habitats. Effects from Size 1 onshore spills away from transfer facilities and Size 2 spills are expected to result in some degradation of habitat, physical oiling of individuals or local groups of birds, and some degree of both acute and chronic physiological stress associated with direct and secondary uptake of oil. Raptors, such as the bald eagle and peregrine falcon, feed upon weakened or dead birds (and fish, in the case of the eagle), and may as a result become physically oiled or affected by the ingestion of the oiled prey. Pelicans are active swimmers, and plunge dive for prey. They are, therefore, very susceptible to physical oiling and secondary effects through the ingestion of oiled prey, i.e., fish. Plovers congregate and feed along exposed banks and shorelines. They can be physically oiled while foraging along oiled shores, or secondarily affected through the ingestion of oiled intertidal sediments and prey. The least tern captures fish via shallow splash diving and surface dipping techniques. Some physical oiling could occur during dives, as well as secondary toxic effects through the uptake of prey. It is possible that some deaths of endangered species could occur, especially if the onshore spill(s) occur during winter months when raptors and plovers are most common along the coastal Gulf, or if spills occur within preferred or critical habitat for all representatives. Brown pelicans and piping plovers are most susceptible to oiling, as a result of the nature of their preferred habitats and, in the case of the pelican, highly aquatic nature. For the purpose of this analysis, it is estimated that Size 1 and Size 2 spills will occasionally contact and thus affect endangered species of birds inhabiting coastal areas of the CPA.

It is assumed that seven Size 3 crude oil spills will occur offshore and six onshore in the CPA for the Cumulative Scenario (Tables IV-3 and IV-14). In the CPA, the probability of Size 3 OCS spills contacting sensitive coastal habitat within 10 days is greater than 20 percent for Barataria Bay, West Plaquemines Coastal Barrier, and East Deltaic Plain marshes (Table IV-10). Imported oil in the CPA has the highest probability of contacting the coast in Plaquemines Parish. Thus, contact probabilities strongly suggest that Size 3 oil spills will contact and affect the Central Gulf coastline and inshore habitats. These areas are inhabited by all of the endangered species listed above, providing nesting habitat for large congregations of brown pelicans, least terns, and piping plovers. It is expected that these spills will therefore contact and affect some endangered species within the CPA. Some deaths are highly likely. Coastal and onshore spills not related to the OCS Program constitute the vast majority of the total spills which occur in the CPA. These include inshore crude and petroleum product spills, spills from import tankering, and spills from coastwise movement of petroleum products in restricted waters. It is estimated that the effects of non-OCS spills in coastal areas will far exceed the negative impacts to local populations of coastal and marine birds estimated from the OCS Program, creating a much higher risk for deaths of both adults and young, degradation of preferred and critical habitat for these species, and displacement of individuals or local groups in proximity to affected areas.

Degradation of water quality is expected to affect endangered species of coastal and marine birds within nearshore and inland areas of the CPA.

Helicopter and service-vessel traffic related to OCS activities could sporadically disturb feeding, resting, or nesting behavior of birds or cause abandonment of preferred habitat. This impact-producing factor could contribute to population loss through reproductive failure via nest abandonment. The FAA (Advisory Circular 91-36C) and corporate helicopter policy states that helicopters must maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. When flying over land, the specified minimum altitude is 1,000 ft over unpopulated areas or across coastlines, and 2,000 ft over populated areas and biologically sensitive areas such as wildlife refuges and national parks. Many undisturbed coastal areas and refuges provide preferred and/or critical habitat for feeding, resting (or staging), and nesting birds, including

endangered species. The effects of low-flying aircraft within the vicinity of aggregations of birds on the ground, in trees or structures, or on the water typically results in mass disturbance and abandonment of the area in proximity to the source. Compliance to the specified minimum altitude requirements is expected to significantly reduce effects of aircraft disturbance on endangered birds. It is expected, however, that approximately 10 percent of helicopter trips will occur at altitudes somewhat below the minimums listed above as a result of inclement weather. Although these incidents are very short term in duration and sporadic in frequency, it is assumed that they can disrupt bird behavior and, at worst, possibly result in habitat or nest abandonment. Birds in flight over water are expected to avoid helicopters; temporary disruption of feeding or flight paths is expected when encountering low-flying helicopters. It is estimated that there will be over 501,000 helicopter flights across coastal areas annually, with approximately 50,000 flying at altitudes somewhat below specified minimums. For this analysis, helicopter traffic will periodically disturb endangered birds, but will maintain general adherence to FAA and corporate helicopter protocol on service altitudes. The effect of OCS-related flights on endangered birds is expected to result in sporadic disturbances which may result in displacement of localized groups or individuals. During nesting periods, this could ultimately result in some reproductive failure from nest abandonment, predation, etc.

It is assumed that about 17,000 OCS-related oil and gas service-vessel trips and 240 barge trips will occur annually for the Cumulative Scenario. It is also assumed that 43 shuttle tanker trips will occur during the 35-year analysis period for the OCS Program (Tables IV-3 and IV-14). Service vessels will use selected nearshore and coastal (inland) navigational waterways, or corridors, and adhere to protocol set forth by the Coast Guard for reduced vessel speeds within these inland areas. Routine presence and low speeds of service vessels within these waterways diminishes the effects of disturbance from service vessels on nearshore and inland populations of coastal and marine birds, including endangered species. For the purpose of this analysis, it thus is assumed that service-vessel traffic will seldom disturb populations of endangered birds existing in nearshore and coastal areas. Recreational vessel traffic is a much greater source of impact to birds in coastal habitats. These vessels are, in most cases, not required to comply with strict speed/wake restrictions; small recreational fishing boats, ski boats, etc. often flush coastal and marine birds from feeding, resting, and nesting areas. Such disturbances displace local groups or individuals from these preferred habitats and could lead to abandonment of the areas in general or reproductive failure. It is estimated that the effects of non-OCS vessel traffic on endangered birds within coastal areas of the CPA are substantial.

The greatest impact to endangered birds within the CPA is the extent of preferred or critical habitat loss resulting from oil spill and spill response activities, urban and industrial development within coastal areas, erosion of areas bordering navigational channels from vessel usage, and OCS-related activities such as pipeline landfalls and onshore construction. Destruction or modification of habitat from these sources displaces localized groups or populations of coastal and marine birds. As these birds move to undisturbed areas of similar habitat, their presence augments habitat utilization pressure on these selected areas as a result of intra- and interspecific competition for space and food. The OCS Program contribution to coastal land loss or modification include construction of three pipeline landfalls, 72 km (45 mi) of onshore pipeline, one marine terminal, one separation facility, and one gas processing plant (Table IV-14). The contribution of development from urban and other industrial growth will be substantial, causing both the permanent loss of lands and increased levels of disturbance associated with and in proximity to new construction and facilities.

Coastal and marine birds are commonly entangled and snared in discarded trash and debris. In addition, many species such as the brown pelican and least tern will readily ingest small plastic debris, either intentionally or incidentally. Interaction with plastic materials is therefore very serious, and can lead to permanent injuries and death. Much of the floating material discarded from vessels and structures offshore drifts ashore or remains within coastal waters. These materials include lost or discarded fishing gear such as gill nets and monofilament lines, which cause the greatest damage to birds. It is expected that endangered birds will seldom become entangled in or ingest OCS-related trash and debris as a result of MMS prohibitions on the disposal of equipment, containers, and other materials into offshore waters by lessees (30 CFR 250.40). In addition, MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. For the purpose of this analysis, OCS oil- and gas-related plastic debris will seldom interact with endangered birds within the Central Gulf, and therefore, the effect will

be negligible. Despite these regulations, quantities of plastic materials are still discarded and lost into the marine environment, and so remain a threat to individual birds within these areas.

Effects outside OCS activities include storms and floods; pollution of coastal waters resulting from municipal, industrial, and agricultural runoff and discharge; collisions with structures such as power line towers, etc; and accidental or deliberate shooting. Coastal storms and hurricanes can often cause deaths to coastal birds through high winds; associated flooding often destroys active nests and nesting areas, and preferred feeding habitat, such as barrier islands, spoil banks, etc. Elevated levels of municipal, industrial, and agricultural pollutants into coastal wetlands and waters exposes resident birds to chronic physiological stress. Collisions with power lines and supporting towers are not atypical during inclement weather and during periods of migration, often causing death or permanent injury to birds (Avery et al., 1980).

Summary

Activities resulting from the Cumulative Scenario within the CPA will detrimentally affect endangered birds. It is expected that the majority of effects from the major impact-producing factors on these species are sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris), and will cause temporary disturbances and displacement, some permanent, of individuals or localized groups onshore. Chronic sublethal stress, however, is often undetectable in birds, and can be masked for some period of time. It can serve to weaken individuals (which is especially serious for migratory species), and expose them to infection and disease. Lethal effects, resulting primarily from uncontained onshore oil spills and associated spill response activities, are especially serious for endangered species, as any reductions in population size represents a threat to their existence. Non-OCS spills and OCS onshore spills in wetland or other uncontained areas, plus Size 3 offshore spills which are predicted to reach the coast in the Cumulative Scenario, could contact one or more species of endangered birds, causing deaths of individuals or isolated groups through primary effects from physical oiling and the ingestion of oil, and secondary effects resulting from the ingestion of oiled prey. Recruitment of these birds via successful reproduction is expected to take up to many years, depending upon the species and existing conditions. The net effect of habitat loss from oil spills, new construction, and maintenance and use of pipeline corridors and navigational waterways will alter species composition and reduce the overall carrying capacity of the disturbed area(s) in general.

The incremental contribution of the proposed action to the cumulative impact is expected to be negligible because the effects of the most probable impacts, such as sale-specific operational discharges and helicopter and service-vessel noise and traffic, are estimated to be sublethal though some displacement of local individuals or groups is expected. It is assumed that there will be some interaction between sale-related oil spills and endangered and threatened birds.

Conclusion

The cumulative effect on endangered and threatened birds is expected to result in a discernible decline in the number of individuals, or localized groups or populations of these species, with associated change in species composition and distribution. The decline will represent displacement of these species from their natural habitats, as well as some expected mortalities. Some of these changes are expected to be permanent, as exemplified in historic census data, and to stem from a net decrease in preferred and/or critical habitat loss.

(9) 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. Extant occurrences of Gulf sturgeon in 1992, extended from Lake Pontchartrain in southeastern Louisiana to Charlotte Harbor in western Florida (Patrick, personal communication, 1992). Although spawning may occur from the Pearl River in western Mississippi eastward, the most important spawning populations occur within the Florida Panhandle in the

Apalachicola and Suwannee Rivers. Spawning grounds are located upriver in hardwood areas not within coastal wetlands (Barkuloo, 1988; Clugston, 1991).

The effects from the major impact-producing factors are described below. Sections providing supportive material for the Gulf sturgeon analysis include III.B.8. (description of Gulf sturgeon), IV.A.3.h. (offshore oil spills), IV.B.2.d. (onshore oil spills), and IV.C.3. (other major onshore/coastal activities).

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 by adults and juveniles; and through mortality of eggs and decreased survival of larvae. Contact with or ingestion/absorption of spilled oil can result in mortality or nonfatal physiological irritation; especially of gill epithelium and liver function in adult Gulf sturgeon. It is expected that the extent and severity of effects from oil spills will be lessened by active avoidance of oil spills by adult sturgeon.

Tables IV-3 and IV-14 project the number of Size 1 and Size 2 spills expected to occur in the CPA as a result of the OCS Program (the proposed action, plus prior and future OCS sales).

It is estimated that 1,190 onshore spills of 1 bbl or less will occur at a frequency of about 34 per year; no more than 57 will occur in any one year. It is assumed that spills of this volume will affect a very small area and dissipate rapidly.

Seven hundred and ninety-three offshore and 390 onshore Size 1 spills are estimated to occur at a respective frequency of about 23 offshore and 11 onshore per year in the CPA. The offshore spills will originate from areas with the greatest density of platforms and largest volume of pipeline flow, and it is assumed that a few will contact the coast. Because of the location of origin, contact is assumed to occur along central Louisiana. The onshore spills will originate near terminal locations in the coastal zone of Louisiana, well away from inshore migration routes and spawning populations of Gulf sturgeon to the East.

A total of 101 Size 2 spills (31 offshore and 70 onshore) are estimated to occur at a respective frequency of about 1 offshore spill and 2 onshore spills per year in the CPA. It is assumed that a few of the offshore spills will contact the coast. The offshore and onshore spills will originate from and make contact with areas as described above.

Based on the number, frequency, and location of Size 1 and Size 2 onshore spills, it is assumed that a few errant adult Gulf sturgeon will contact one of these spills. It is expected that contact will cause nonfatal irritation of gill epithelium and an increase in liver function for less than a month.

Table IV-9 estimates that 44 total Size 3 spills (37 import tankering and 7 OCS Program) will occur in the CPA at a respective frequency of about 1 per year from imports and 1 every five years from the OCS Program during the 35-year life of the proposed action. The highest estimated probability of a such a spill occurring and contacting within 10 days coastal areas along the Central Gulf is 84 percent. There is a 4 percent probability that a Size 3 spill will contact within 10 days the coastal areas of Gulf sturgeon (Hancock County, Mississippi; Mobile and Baldwin Counties, Alabama; and Escambia County, Florida).

Based on the number, frequency, and location of Size 3 spills, it is assumed that spawning grounds will not be affected or degraded, but it is assumed that several adult Gulf sturgeon will contact one of these spills. It is expected that contact will cause nonfatal irritation of gill epithelium and an increase in liver function for less than a month.

Non-OCS operations such as dredge and fill activities and natural catastrophes indirectly impact Gulf sturgeon through the loss of spawning and nursery habitat. 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. Loss of habitat is expected to have a substantial effect on the reestablishment and growth of Gulf sturgeon 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. It is estimated that for every 0.5 kg of shrimp harvested, 4 kg of bycatch that includes a number of Gulf sturgeon is discarded (Sports Fishing Institute, 1989a). The death of several Gulf sturgeon is expected from commercial fishing.

Summary

The Gulf sturgeon can be impacted by activities resulting from the Cumulative Scenario such as oil spills, alteration and destruction of habitat, natural catastrophes, and commercial fishing. The effects from contact with spilled oil will be nonfatal and last for less than one month. The deaths of adult sturgeon are expected to occur from commercial fishing, and substantial damage to Gulf sturgeon habitats is expected from inshore alteration activities and natural catastrophes. As a result, it is expected that the Gulf sturgeon will experience a decline in species number and a displacement from their current distribution that will last more than one generation.

The incremental contribution of the proposed action (as analyzed in Section IV.D.1.a.(9)) to the cumulative impact is negligible because the effect of contact between sale-specific oil spills and Gulf sturgeon is expected to be nonfatal and last less than one month.

Conclusion

The impact of the Cumulative Scenario on the Gulf sturgeon is expected to result in a decline in species number and a displacement from their current distribution that will last more than one generation.

(10) Impacts on Commercial Fisheries

This Cumulative Analysis considers commercial fishing activity, the status of commercial fishery stocks, the effects of impact-producing factors related to the Central Gulf OCS Program (proposed action and 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, coastal environmental degradation, emplacement of production platforms, underwater OCS obstructions, production platform removals, seismic surveys, oil spills, subsurface blowouts, pipeline trenching, and offshore discharges of drilling muds, produced waters, and naturally occurring radioactive material (NORM).

Sections providing supportive material for the commercial fisheries analysis include Sections III.B.7. (description of fish resources), III.C.3. (commercial fisheries), IV.D.1.d.(1) (impacts on sensitive coastal environments), IV.D.1.d.(3) (impacts on water quality), IV.A.3.b.(2) (space-use conflicts), IV.A.2.a.(4) (structure removals), IV.A.2.a.(1) (seismic surveying operations), IV.A.3.h.(2) (offshore oil spills), IV.B.2.d.(1) (onshore oil spills), IV.A.3.h.(1) (subsurface blowouts), IV.A.2.b.(1) (pipelines), and IV.B.2.c. (onshore disposal).

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.

Many of the commercially important species harvested from the Gulf of Mexico are believed to be in decline from overfishing (USDOC, NOAA, 1991b). 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 communication, 1989; USDOC, NMFS, 1991b). It is expected that overfishing of targeted species and trawl

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fishery bycatch will adversely affect commercial fishery resources. The impact of overfishing on the commercial fisheries resources is expected to cause less than a 10 percent decrease in commercial fishery populations or in commercial fishing. At the estimated level of effect, the resultant influence on Central Gulf fisheries is expected to be substantial and easily distinguished from effects due to natural population variations.

Because approximately 92 percent of commercially important species are estuary dependent, coastal environmental degradation has the potential to affect adversely commercial fisheries. The environmental deterioration and effects on commercial fisheries result from the loss of Gulf wetlands as nursery habitat and from the functional impairment of existing habitat through decreased water quality.

The effect of the OCS Program and non-OCS Program activities on wetlands and inshore water quality in the CPA is analyzed in detail in Sections IV.D.1.d.(1) and (3), respectively. The indirect effect on commercial fisheries is considered below.

To summarize the effects on wetlands and estuarine areas, it is expected that 4,593 ha of coastal areas will be affected by onshore oil spills as a result of the OCS Program. Approximately 14,800 ha of coastal areas will be affected by onshore oil spills as a result of non-OCS Program activities. The productivity of 511 ha could be permanently lost. Up to 511 ha of wetlands could be eroded as a result of OCS-related vessel usage of navigation channels and access canals in coastal Louisiana and Texas. Up to 27,718 ha of wetlands could be eroded as a result of canal dredging for State onshore oil and gas development. Up to 49 ha of wetlands could be eroded as a result of OCS-related pipeline canal widening in coastal Louisiana and Texas. Up to 48,900 ha of wetlands could be eroded as a result of non-OCS Program activities and sediment deprivation and rapid coastal submergence. Overall, 32,227 ha of wetlands in the CPA will be converted to open water.

To summarize the effects on coastal and estuarine water quality, it is expected that coastal waters in the Central Gulf of Mexico would be degraded from periodic point source discharges and bottom disturbances (elevated turbidity) from OCS Program activities--occurring in an area within 1,000 m of the source and persisting for several days to weeks after the activity has concluded. Further decrease in water quality would occur from chronic low-level contamination (elevated levels of hydrocarbons, trace metals, salinity, temperature, organic compounds, and lower dissolved oxygen) resulting from OCS-associated site runoff and maritime traffic activities occurring over the life of the proposal. Significant increases in water concentrations of dissolved and particulate hydrocarbons and trace metals are not expected beyond 1,000 m of any discharge site. Non-OCS Program factors will degrade water quality--primarily in the north-central Gulf's 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 (nutrient, organic matter, trace metals, hydrocarbons, etc.) may be severe, lasting for months or longer. Chronic low-level pollution will persist in coastal waters.

It is expected that coastal environmental degradation from the OCS Program and non-OCS activities will affect commercial fishery resources. The impact of coastal degradation in the CPA is expected to cause less than a 10 percent decrease in commercial fishery populations, in essential habitats, or in commercial fishing. Recovery of commercial fishery resources can occur from more than 90 percent, but not all, of the expected coastal environmental degradation. At the estimated level of effect, the resultant influence on Central Gulf fisheries is expected to be substantial and easily distinguished from effects due to natural population variations.

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 the OCS Program 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-3 estimates that 2,110 structure removals by explosives will occur in the CPA as a result of the OCS Program during the 35-year life of the proposed action. It is assumed that no more than 105 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 330 additional platforms resulting from the proposed action, plus prior and future OCS sales in the CPA (Table IV-3), are estimated to reduce the trawling area by about 19,158 ha, which 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 when pelagic eggs and larvae are present have the greatest potential to affect commercial fishery resources. In the event that sale-related oil spills should occur in coastal bays, estuaries, or waters of the OCS proximate to mobile adult finfish or shellfish, the effects are expected to be nonfatal and the extent of damage is expected to be limited and lessened due to some capability of adult fish and shellfish to avoid an oil spill, to metabolize hydrocarbons, and to excrete both metabolites and parent compounds. For floating eggs and larvae contacted by spilled oil, the effect is expected to be lethal. Tables IV-3 (Section IV.A.3.h.(2)) and IV-14 (Section IV.B.2.d.(1)) project the number of offshore and onshore spills expected to occur in the CPA as a result of the OCS Program.

It is estimated that 1,190 onshore spills of 1 bbl or less will occur at a frequency of about 34 per year. It is assumed that spills of this volume will affect a very small area and dissipate rapidly. Seven hundred and ninety-three offshore and 390 onshore Size 1 spills (average size, 3 bbl) are estimated to occur at a respective frequency of about 23 offshore and 11 onshore per year in the CPA. The offshore spills will originate from areas with the greatest density of platforms and largest volume of pipeline flow, and it is assumed that a few will contact the coast. The onshore spills will originate near terminal locations in the coastal zone of Louisiana. It is assumed that spills of these volumes will affect a very small area and dissipate rapidly. It is expected that oil spills less than 50 bbl will occasionally affect coastal bays and marshes essential to the well-being of the commercial fishery resources in the CPA.

A total of 101 Size 2 spills (31 offshore and 70 onshore) (average size, 500 bbl) are estimated to occur at a respective frequency of about 1 offshore and 2 onshore per year in the CPA. It is assumed that a few of the offshore spills will contact the coast. The offshore and onshore spills will originate from and make contact with areas as described above. For the purpose of this analysis, it is assumed that Size 2 spills will seldom contact and affect the coastal bays and marshes critical to the well-being of commercial fisheries in the CPA.

A total of 44 Size 3 spills (37 import tankering and 7 OCS Program) will occur offshore in the CPA at a respective frequency of about 1 per year from imports and 1 every five years from the OCS Program during the 35-year life of the proposed action. It is estimated that two offshore spills of this volume will occur and contact within 10 days the coastline in the CPA. A total of six Size 3 spills are estimated to occur onshore at a respective frequency of about one every six years from the OCS Program during the 35-year life of the proposed action.

Plaquemines Parish, Louisiana, is the land segment with the highest probability (54% from OCS activities and 28% from imports) of occurrence and contact within 10 days by a Size 3 spill. Barataria Bay is the coastal inshore bay with the highest probability (35% from OCS activities and 9% from imports) of occurrence and contact within 10 days by a Size 3 spill.

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 a Size 3 spill occurring and contacting within 10 days Gulf menhaden during their winter spawning in coastal waters of the CPA is 25 percent over the next 35 years. The impact of oil spills in the CPA is expected to cause less than a 5 percent decrease in commercial fishery populations or in commercial fishing. At the estimated level of effect, the resultant influence on Central Gulf fisheries is expected to be considerable but not easily distinguished from effects due to natural population variations.

Subsurface blowouts of both oil and natural gas wells and pipeline trenching have the potential to affect adversely commercial fishery resources. Loss of well control and resultant blowouts seldom occur on the Gulf OCS (6 blowouts per 1,000 well starts; 23% will result in some spilled oil). It is assumed that there will be 58 blowouts at a frequency of 2 every 3 years in the CPA resulting from the OCS Program during the 35-year life of the proposed action. Table IV-3 estimates the resuspension of some 9 million m³ of sediment during the installation of 4,550 km of pipelines in water depths less than 61 m. Offshore Subarea C-3, an area of minimal bottom trawl fishing and consolidated sediments, will support the greatest portion of pipeline burial activities

(2,015 km) and associated sediment resuspension (0.36 million m³) (Table IV-3). Sandy sediments will be quickly redeposited within 400 m of the trench, and finer sediments will be widely dispersed and redeposited over a period of 30 days or longer within a few thousand meters of the trench. For the purpose of this analysis, it is expected that the infrequent subsurface blowout that may occur on the Gulf OCS will have a negligible effect on Gulf commercial fisheries. The effect on commercial fisheries from pipeline trenching in the CPA is expected to cause less than a 5 percent decrease in commercial fishery populations or in commercial fishing.

At the estimated level of effect, the resultant influence on Central Gulf fisheries is expected to be considerable but not easily distinguished from effects due to natural population variations.

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 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.

Produced-water discharges (Table IV-3) contain components and properties detrimental to commercial fishery resources; however, toxic compounds are undetectable beyond 1,000 m from the discharge point. Offshore discharges of produced water will rapidly disperse and dilute to background levels and will have a negligible effect on Central Gulf fisheries.

The NORM discharged offshore in produced water has the potential to adversely affect commercial fishery species and subsequently increase man's intake of radium; however, this is only at concentrations 10-12 orders of magnitude higher than those found within 3 m from the discharge point. The NORM component of offshore discharges of produced water will rapidly dilute to background levels, will have no effect on commercial fishery resources, and will have no effect on commercial fishing in the CPA.

Summary

Activities resulting from the OCS Program and non-OCS Program events have the potential to cause detrimental effects to Central Gulf commercial fisheries. Impact-producing factors of the Cumulative Scenario that are expected to substantially affect commercial fisheries in the CPA include coastal environmental degradation, overfishing, oil spills, and pipeline trenching. At the estimated level of effect, the resultant influence on Central Gulf fisheries is expected to be substantial and easily distinguished from effects due to natural population variations.

The incremental contribution of the proposed action (as analyzed in Section IV.D.1.a.(10)) to the cumulative impact is inconsequential. The effects of impact-producing factors (coastal environmental degradation, emplacement of production platforms, underwater OCS obstructions, production platform removals, seismic surveys, oil spills, subsurface blowouts, pipeline trenching, and offshore discharges of drilling muds, produced waters, and NORM) related to the proposed action are expected to be negligible.

Conclusion

The impact of the Cumulative Scenario is expected to result in less than a 10 percent decrease in commercial fishery populations, in essential habitat, or in commercial fishing. It will require 3-5 years for fishing activity and 2-3 generations for fishery resources to recover from 99 percent of the impacts.

(11) Impacts on Recreational Resources and Beach Use

This Cumulative Analysis considers the effects of impact-producing factors related to the proposed action (Section IV.D.1.a.(11)), 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.

Up to six Size 3 spills (Table IV-10) and a few Size 1 spills annually are assumed to occur and contact land as a result of Federal OCS activity and crude-oil import tankering (Section IV.A.3.h.(2)). Such spill contacts will occur between 1994 and 2028 and, according to the OSRA model (Table IV-10), one or two of these spills are most likely to affect major recreational beaches in Texas (Galveston/Bolivar Peninsula) and Louisiana (Cameron beaches). Size 3 spills 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 several of the more than 460 onshore Size 3 spills (Table IV-14) could adversely impact beaches. It is important to realize, especially in the cumulative impact context, that of all chronic hydrocarbon pollution existing in the Gulf, only a small percentage is directly related to Gulf of Mexico oil and gas leasing and production (Section IV.C.5.). 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 adjacent to 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 communication, 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 coastal beaches near the CPA. 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 3,460 platforms on the OCS in the CPA (Table IV-3), and an additional 330 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 LA-1 and LA-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 Size 3 oil spills are 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 onshore and offshore 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 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 additional contribution of beach trash from the proposed action (as analyzed in Section IV.D.1.a.(11)) to the cumulative impact is expected to be minimal because sale-specific operational activities are unlikely to cause beach park 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 coastal areas. 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 from offshore and onshore sources 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 Size 3 oil spills is likely during cleanup operations.

(12) Impacts on Archaeological Resources

The following Cumulative Analysis considers the effects of the impact-producing factors related to the proposed action, OCS activities in the Western Gulf, prior and future OCS sales, trawling, sport diving, commercial treasure hunting, and tropical storms. 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.

(a) Historic

Future OCS exploration and development activities in the CPA are expected to result in the drilling of 3,330 exploration and delineation wells and 5,060 development wells, the installation of 330 platforms, and the laying of 4,550 km of offshore pipelines (Table IV-3). The archaeological surveys are assumed 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 would result in the loss of or damage to significant or unique historic information.

The placement of 4,550 km of pipelines is projected in the CPA. 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 would result in the loss of or damage to 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 587,100 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 or damage to 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-10 there is up to a 84 percent probability of a Size 3 oil spill occurring and contacting the coastal area within 10 days. There is up to a 74 percent probability that a Size 3 imported oil spill will occur and contact the coastal area within 10 days. However, the impacts caused by oil spills to coastal historic archaeological resources are generally short term and reversible. It is assumed that onshore oil spills will come occur as a result of OCS oil being transported to shore. In the CPA, under the Cumulative Scenario, it is assumed that 34 spills less than or equal to 1 bbl will occur each year, 11 Size 1 spills will occur each year, 2 Size 2 spills will occur each year, and less than 2 Size 3 spills will occur every 10 years. It is further assumed that the majority of such spills would occur around terminals and be contained in the vicinity of the spill. Should such oil spills contact an historic site, the effects would be temporary 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. According to Table IV-3, there are currently 29,765 km of pipelines on the Central Planning Area OCS. 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-14, 1 gas processing plant requiring 20-30 ha of land will be constructed in coastal Subarea MA-1. In addition, 1 terminal requiring 7-24 ha, 1 separation facility requiring 6 ha per 100,000 bbl oil equivalents processed, 3 pipeline landfalls, and 72 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 Subareas LA-1 and MA-1. 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, it is reasonable to assume that some of the data lost has been significant or unique.

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 of the coast, 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 (portion), 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 3,300 exploration and delineation wells and 5,060 development wells, the installation of 330 platforms, and the laying of 4,550 km of offshore pipelines (Table IV-3). The archaeological surveys are assumed 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 prehistoric 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 would result in the loss of or damage to significant or unique prehistoric information.

The placement of 4,550 km of pipelines in the CPA is projected. According to Table IV-3, there are currently 29,765 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 would result in the loss of significant or unique archaeological information.

The setting of anchors for drilling rigs, platforms, and pipeline lay barges, and anchoring associated with oil and gas 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 587,100 service-vessel trips are projected for the CPA (Table IV-14). Impacts from anchoring on a prehistoric site 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-10 there is up to a 84 percent probability of a Size 3 oil spill occurring and contacting the CPA coastal area within 10 days. There is up to a 74 percent probability that a Size 3 imported oil spill will occur and contact the CPA coastal area within 10 days. It is assumed that onshore spills will occur as a result of OCS oil being transported to shore. In the CPA, under the Cumulative Scenario, it is assumed that 16 spills less than or equal to 1 bbl will occur each year, 6 Size 1 spills will occur each year, 1 Size 2 spill will occur each year, and 1 Size 3 spill will occur every 10 years. It is further assumed that the majority of such spills would occur around terminals and be contained in the vicinity of the spill. There is a small possibility of these spills contacting a prehistoric site. The impacts caused by oil spills to coastal prehistoric archaeological resources can severely distort information relating to the age of the site. Contamination of the 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, no effect of trawling on prehistoric sites is assumed.

According to Table IV-14, 1 gas processing plant requiring 20-30 ha of land will be constructed in coastal Subarea MA-1. In addition, 1 terminal requiring 7 ha to 24 ha, 1 separation facility requiring 6 ha per 100,000 bbl oil equivalents processed, 3 pipeline landfalls, and 72 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 Subareas LA-1 and MA-1.

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 of the coast, 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.

Dredging and tropical storms are assumed to have caused the loss of significant archaeological information. 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.

(13) 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.(13).

Baseline employment projections for the coastal impact area of the Central Gulf of Mexico can be found in Figure IV-8. 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.(13) provides an in-depth treatment of the development of these projections.

A total of approximately 1.77 million 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 life of the proposed action. Peak-year impacts occur in 1997, with 65,717 workers involved in primary, secondary, and tertiary industries. After this initial peak-year employment, impacts decline rather steadily through the year 2028, 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 1999. Both exploratory and development activities account for approximately 16 percent of the offshore employment resulting from the OCS Program in the Central Gulf during the 35-year life of the proposed action. Employment in oil and gas production activities and workover operations account for almost 84 percent of offshore employment due to activities in the Central Gulf.

Table IV-24 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-25 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 greatest impact to employment occurs in coastal Subareas LA-1 and LA-2, with peak-year impact estimates for 1994 of approximately 9.4 and 6.7 percent, respectively. Coastal Subareas LA-1 and LA-2 collectively provide more than 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 MA-1, accounting for only 4 percent of the total employment impact to the Central Gulf. Coastal Subarea LA-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.

Figure IV-8. Employment Impacts from the OCS Program (Central Planning Area) (USDOI, MMS, Gulf of Mexico OCS Region estimates, 1992).

Table IV-24

Cumulative Scenario OCS-Related Employment Projections (Direct+Indirect+Induced)
Gulf of Mexico
(Person-Years)

Year	TX-1	TX-2	LA-1	LA-2	LA-3	MA-1	WGOM*	CGOM**
====	=====	=====	=====	=====	=====	=====	=====	=====
1994	723	4,316	17,500	28,072	16,895	2,555	5,039	65,022
1995	733	4,374	17,590	28,231	16,944	2,571	5,107	65,337
1996	783	4,594	17,644	28,427	16,783	2,537	5,376	65,392
1997	813	4,733	17,737	28,635	16,766	2,578	5,546	65,717
1998	824	4,774	17,630	28,499	16,592	2,553	5,598	65,274
1999	854	4,909	17,719	28,700	16,560	2,535	5,763	65,514
2000	877	4,982	17,515	28,426	16,271	2,550	5,859	64,762
2001	804	4,556	16,322	26,419	15,307	2,422	5,360	60,470
2002	753	4,245	15,607	25,175	14,785	2,357	4,998	57,925
2003	713	3,984	14,765	23,772	14,066	2,264	4,697	54,867
2004	714	3,945	14,519	23,373	13,824	2,250	4,659	53,967
2005	737	4,008	14,390	23,197	13,616	2,208	4,744	53,411
2006	758	4,072	14,294	23,078	13,445	2,206	4,830	53,022
2007	793	4,211	14,384	23,269	13,427	2,223	5,005	53,303
2008	801	4,201	14,082	22,809	13,073	2,162	5,002	52,125
2009	806	4,197	13,895	22,529	12,843	2,083	5,002	51,349
2010	833	4,281	13,709	22,288	12,549	2,086	5,115	50,631
2011	843	4,305	13,569	22,091	12,342	1,977	5,148	49,978
2012	866	4,382	13,436	21,926	12,104	1,919	5,248	49,384
2013	862	4,337	13,195	21,547	11,864	1,920	5,199	48,526
2014	866	4,308	12,692	20,792	11,283	1,801	5,175	46,569
2015	870	4,313	12,566	20,605	11,123	1,767	5,184	46,060
2016	870	4,294	12,392	20,337	10,946	1,810	5,164	5,486
2017	857	4,209	11,988	19,703	10,528	1,694	5,066	43,913
2018	858	4,198	11,816	19,444	10,325	1,631	5,055	43,217
2019	854	4,170	11,635	19,163	10,137	1,627	5,024	42,563
2020	855	4,160	11,475	18,921	9,953	1,600	5,014	41,949
2021	851	4,133	11,309	18,662	9,775	1,565	4,984	41,311
2022	853	4,131	11,202	18,503	9,649	1,546	4,984	40,900
2023	850	4,112	11,090	18,327	9,526	1,508	4,962	40,452
2024	843	4,069	10,928	18,067	9,364	1,452	4,912	39,810
2025	840	4,049	10,790	17,853	9,220	1,443	4,889	39,306
2026	834	4,004	10,605	17,560	9,033	1,383	4,837	38,582
2027	832	3,990	10,502	17,400	8,924	1,378	4,821	38,204
2028	835	3,990	10,383	17,224	8,784	1,380	4,825	37,771
	=====	=====	=====	=====	=====	=====	=====	=====
	28,658	149,534	480,874	783,025	438,628	69,542	178,192	1,772,070

* Western Gulf of Mexico

** Central Gulf of Mexico

Source: USDOl, MMS, Gulf of Mexico OCS Region estimates, 1992.

Table IV-25

Population and Employment Percentage Impact Levels for the Cumulative Scenario

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Year =====	TX-1 =====	TX-2 =====	LA-1 =====	LA-2 =====	LA-3 =====	MA-1 =====
Employment Impacts						
1994	0.2%	0.2%	9.4%	6.7%	3.2%	0.7%
1995	0.2%	0.2%	9.3%	6.6%	3.1%	0.7%
1996	0.2%	0.2%	9.2%	6.6%	3.1%	0.7%
1997	0.2%	0.2%	9.1%	6.5%	3.0%	0.7%
1998	0.2%	0.2%	8.9%	6.4%	3.0%	0.7%
1999	0.2%	0.2%	8.8%	6.3%	2.9%	0.7%
2000	0.2%	0.2%	8.5%	6.2%	2.8%	0.7%
2001	0.2%	0.2%	7.8%	5.7%	2.6%	0.6%
2002	0.2%	0.2%	7.4%	5.3%	2.5%	0.6%
2003	0.2%	0.2%	6.9%	5.0%	2.4%	0.6%
2004	0.2%	0.2%	6.7%	4.8%	2.3%	0.6%
2005	0.2%	0.2%	6.6%	4.7%	2.2%	0.6%
2006	0.2%	0.2%	6.4%	4.7%	2.2%	0.5%
2007	0.2%	0.2%	6.4%	4.6%	2.2%	0.5%
2008	0.2%	0.2%	6.2%	4.5%	2.1%	0.5%
2009	0.2%	0.1%	6.1%	4.4%	2.0%	0.5%
2010	0.2%	0.2%	5.9%	4.3%	1.9%	0.5%
2011	0.2%	0.1%	5.8%	4.2%	1.9%	0.5%
2012	0.2%	0.1%	5.7%	4.1%	1.8%	0.5%
2013	0.2%	0.1%	5.5%	4.0%	1.8%	0.4%
2014	0.2%	0.1%	5.2%	3.8%	1.7%	0.4%
2015	0.2%	0.1%	5.1%	3.8%	1.6%	0.4%
2016	0.2%	0.1%	5.0%	3.7%	1.6%	0.4%
2017	0.2%	0.1%	4.8%	3.5%	1.5%	0.4%
2018	0.2%	0.1%	4.7%	3.4%	1.5%	0.4%
2019	0.2%	0.1%	4.5%	3.3%	1.4%	0.4%
2020	0.2%	0.1%	4.4%	3.3%	1.4%	0.4%
2021	0.2%	0.1%	4.3%	3.2%	1.3%	0.3%
2022	0.2%	0.1%	4.2%	3.1%	1.3%	0.3%
2023	0.2%	0.1%	4.1%	3.1%	1.3%	0.3%
2024	0.2%	0.1%	4.0%	3.0%	1.3%	0.3%
2025	0.2%	0.1%	3.9%	2.9%	1.2%	0.3%
2026	0.2%	0.1%	3.8%	2.8%	1.2%	0.3%
2027	0.2%	0.1%	3.8%	2.8%	1.2%	0.3%
2028	0.2%	0.1%	3.7%	2.7%	1.1%	0.3%
Population Impacts						
1994	0.2%	0.2%	9.4%	6.7%	3.2%	0.7%
1995	0.2%	0.2%	9.4%	6.7%	3.2%	0.7%
1996	0.2%	0.2%	9.4%	6.7%	3.1%	0.7%
1997	0.2%	0.2%	9.4%	6.7%	3.1%	0.7%
1998	0.2%	0.2%	9.2%	6.6%	3.1%	0.7%
1999	0.2%	0.2%	9.2%	6.6%	3.1%	0.7%
2000	0.2%	0.2%	9.0%	6.4%	3.0%	0.7%
2001	0.2%	0.2%	8.3%	5.9%	2.8%	0.7%
2002	0.2%	0.2%	7.9%	5.6%	2.7%	0.6%
2003	0.2%	0.2%	7.4%	5.2%	2.5%	0.6%
2004	0.2%	0.2%	7.2%	5.1%	2.5%	0.6%
2005	0.2%	0.2%	7.1%	5.0%	2.4%	0.6%
2006	0.2%	0.2%	7.0%	4.9%	2.4%	0.6%
2007	0.2%	0.2%	7.0%	4.9%	2.4%	0.6%
2008	0.2%	0.2%	6.8%	4.8%	2.3%	0.6%
2009	0.2%	0.2%	6.7%	4.7%	2.2%	0.5%
2010	0.2%	0.2%	6.6%	4.6%	2.2%	0.5%
2011	0.2%	0.2%	6.5%	4.5%	2.1%	0.5%
2012	0.2%	0.2%	6.3%	4.5%	2.1%	0.5%
2013	0.2%	0.2%	6.2%	4.3%	2.0%	0.5%
2014	0.2%	0.2%	5.9%	4.1%	1.9%	0.5%
2015	0.2%	0.2%	5.8%	4.1%	1.9%	0.4%
2016	0.2%	0.2%	5.7%	4.0%	1.8%	0.4%
2017	0.2%	0.1%	5.5%	3.8%	1.8%	0.4%
2018	0.2%	0.1%	5.4%	3.7%	1.7%	0.4%
2019	0.2%	0.1%	5.2%	3.7%	1.7%	0.4%
2020	0.2%	0.1%	5.1%	3.6%	1.6%	0.4%
2021	0.2%	0.1%	5.0%	3.5%	1.6%	0.4%
2022	0.2%	0.1%	5.0%	3.5%	1.6%	0.4%
2023	0.2%	0.1%	4.9%	3.4%	1.5%	0.4%
2024	0.2%	0.1%	4.8%	3.3%	1.5%	0.3%
2025	0.2%	0.1%	4.7%	3.3%	1.5%	0.3%
2026	0.2%	0.1%	4.6%	3.2%	1.4%	0.3%
2027	0.2%	0.1%	4.5%	3.1%	1.4%	0.3%
2028	0.2%	0.1%	4.4%	3.1%	1.4%	0.3%

Source: USD01, MMS, Gulf of Mexico OCS Region estimates, 1992.

Section IV.A.3.h. presents estimates of the mean number of offshore spills assumed as a result of the Cumulative Scenario in the Gulf of Mexico. The probability that one or more Size 3 offshore spills 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-10. 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 53 percent for Plaquemines Parish (Land Segment 19) in coastal Subarea LA-3. Terrebonne Parish (Land Segment 16) in coastal Subarea LA-2 carries the second highest probability of occurrence and contact, with a probability of 31 percent. The probability that an offshore spill of this size will occur and contact any particular land segment of coastal Subarea MA-1 in Mississippi or Alabama is less than 5 percent. Every land segment in coastal Subarea LA-1 carries a probability of occurrence and contact of 5-6 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 (USDOL, MMS, 1985). 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 a Size 3 offshore spill will occur from accidents involving import tankering and contact a CPA land segment within 10 days is 21 percent for Plaquemines Parish (Land Segment 19) in coastal Subarea LA-3. Cameron Parish (Land Segment 12), in coastal Subarea LA-1, has a slightly lower probability of occurrence and contact of 17 percent. The probability that an offshore spill will occur and contact any particular land segment of coastal Subareas LA-2 and MA-1 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-one Size 2 spills are assumed to occur in the CPA; however, only a few, if any, will contact the coastline. A total of 793 Size 1 spills are assumed to occur in the CPA over the life of the proposed action. 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, a number of Size 1 and Size 2 spills and Size 3 crude oil spills and petroleum product spills are assumed to occur, primarily in the coastal zone. 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 1994 over the life of the proposed action (Section III.C.2.). Projected changes in the industrial composition of the regional economy are considerable (USDOL, 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 (USDOL, 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 LA-1 and LA-2. Peak year population impacts for coastal Subareas LA-1 and LA-2 occur in 1994 and are estimated to be 9.4 percent and 6.7 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 9.4 percent and 6.7 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 1994 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 1.77 million 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.(13)(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 1.77 million 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 LA-1 and LA-2 along the western and central Louisiana coastline, lower for coastal Subarea LA-3 in southeast Louisiana, and lowest for coastal Subarea MA-1 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 workforce, 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 predicted 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-24, approximately 1.77 million 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 in 1997 with 65,717 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 LA-2 (Table IV-24). Examination of Table IV-25 reveals that the greatest impact to employment occurs in Subareas LA-1 and LA-2, with peak-year 1994 impact estimates of 9.4 and 6.7 percent, respectively. It is expected that the level of OCS-related employment projected for the CPA will diminish as 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 workforce 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 (1994), 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 employment in Louisiana in the mining industry, construction industry, government sector, and manufacturing and wholesale trade industries (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 problematic for new infrastructure needed in response to normal growth. 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 1994. Following the peak-year, total OCS-related oil and gas employment in the CPA is expected to decline. As mentioned above, projected levels of industrial and governmental 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 workforce; 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 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 those in 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 of the coast, 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 coastal parishes and counties of the CPA and the proximity of much infrastructure to relief 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 over the next 35 years. 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 increasing need 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.

The incremental contribution of the proposed action will serve to partially offset declines in the tax base caused by diminishing OCS oil and gas activity. The proposed action will also serve to decrease or eliminate any out-migration associated with decline in offshore activity. Declines in available public services or condition of community infrastructure is not expected to occur as a result of the proposed action.

Conclusion

The cumulative impact is expected to result in deteriorating conditions of existing infrastructure and difficulties in delivering satisfactory levels of public services.

(c) Sociocultural Issues

The Cumulative Analysis considers the effects of OCS-related impact-producing factors on the Central Gulf of Mexico coastal subareas. The effects of prior, current, and future OCS sales on sociocultural issues will be examined. The analysis also considers the effects of certain non-OCS-related impact-producing factors. For the purpose of this analysis, OCS-related impact-producing factors to sociocultural issues will include OCS-related employment and workforce fluctuations, population and demographic change, relative income, wetlands loss, oil spills, and work scheduling. Non-OCS-related impact-producing factors included in this analysis are oil and gas activities in State waters and tropical storms. Adverse effects could arise if disruption of social and cultural patterns occurred and resulted in changes in traditional occupations, disruption in the viability of extant subcultures, social and community dysfunction, and detrimental effects on individual or family life. 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 predicted and will not be considered in this analysis. It should be noted that, should such an event occur, the projections on which the current analysis is based could change markedly.

As stated in Section IV.D.1.d.(13)(a), a total of approximately 1.77 million person-years of employment (direct, indirect, and induced) are required in the coastal subareas of the Central Gulf to support OCS-related activities in the Gulf during the 35-year life of the proposed action. Peak-year impacts occur during 1997, with 65,717 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 by coastal subareas reveals total employment of 27 percent in Subarea LA-1, 44 percent in Subarea LA-2, 25 percent in Subarea LA-3, and 4 percent in Subarea MA-1 (Table IV-25). Examination of Table IV-25 reveals that the greatest impact to employment occurs in Subareas LA-1 and LA-2, with peak-year impact (1994) estimates of 9.4 percent and 6.7 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 OCS-related employment is expected to provide jobs which would not exist without the OCS Program, and therefore provide some positive impacts.

Under the Cumulative Scenario, peak-year employment is projected to occur in 1997 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 employment in Louisiana in the mining industry, construction industry, government sector, and manufacturing and wholesale trade industries (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. Expected growth in the service industry will most likely provide employment for some of the workforce; however, it is assumed that some out-migration will occur among those persons seeking pay comparable to that of OCS-related employment. The quality of family life, in some individual cases, could be adversely effected by layoffs in the OCS oil and gas industry as a result of stress resulting from decreased family income and loss of security. As the level of employment in OCS-related industry decreases, it is likely that more persons will engage in traditional occupations (such as trapping and shrimping) to supplement their income. This could result in overfishing of the resources, which could pose a threat to the continued existence of specific traditional occupations.

An analysis of historical trends indicates that only population impacts greater than 1 percent typically result in positive net migration into a given area. 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 resulting from the overall decline could result in a loss of population, particularly in OCS-related staging centers and administrative centers. Expected impacts would include a diminishment in the number of those persons engaged part-time in traditional occupations, deleterious impacts to family life as a result of the departure of extended family members, and potential loss of community cohesion within some of the communities which serve as staging and administrative centers.

Dependence on the relatively high wages paid to persons in the oil and gas industry (both OCS and non-OCS) may have deleterious impact on family life, if layoffs occur, particularly in view of the projected decline in OCS-related oil and gas activity over the life of the proposed action. Impacts associated with the higher OCS-related salaries also include possible destabilization of small businesses that cannot compete with the high wages and larger benefit packages offered by OCS-related companies and a possible lack of incentive for increased business efficiency. The exodus of relatively high paying OCS-related jobs will allow small businesses to draw from a larger pool of potential employees; however, it is expected that these jobs will generally be lower paying than those associated with OCS activities. As OCS-related employment declines, impacts to small business related to the higher wages associated with OCS employment will decline as well.

In the peak exploration year of 1997, approximately 65,717 person-years of total employment are required to support OCS activities. The number of persons involved in direct offshore employment is projected to decline following the peak year. These persons will likely encounter the extended work schedule typically associated with OCS offshore activities. The extended work schedule will allow for part time participation in more traditional occupations (fishing, trapping, etc.). The relationship between OCS oil and gas activities and traditional culture in the coastal subareas of Louisiana has been mostly positive (Forsythe, written communication, 1992). The extended work schedule changes the practice of traditional familial roles, in an adaptive response to absence. In the majority of cases, it is expected that the familial adaptations to the extended work schedule will be successful. However, it is expected that in a small number of cases, successful adaptation of the family to the extended work schedule will not occur. In these cases, some deleterious impacts to family are expected.

Oil and gas activities within State waters are assumed to result in similar impacts as those found from 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 occupations. This could result in overutilization of resources and threaten the continuation of traditional occupations. Family life could also be impacted by the suite of impact-producing factors associated with activities in State waters.

Under the Cumulative Scenario, approximately 7,165 ha of wetlands may be adversely impacted by OCS-related activities. Of this total, 3,040 ha may be converted to open water. Approximately 48,900 ha of wetlands may be adversely effected by non-OCS activities, including subsidence. Of this total, 32,227 ha may be converted to open water. The projected amount of wetlands loss may result in impact to the practice of traditional occupations, such as trapping, as coastal marsh is converted to open water.

Section IV.A.3.h.(3) presents estimates of the mean number of offshore spills assumed as a result of the Cumulative Scenario. The probability that one or more Size 3 offshore spills will occur as a result of the OCS Program or import tankering and contact land segments of the Central Gulf within 10 days can be found in Table IV-10. 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 53 percent for Plaquemines Parish (Land Segment 19) in coastal Subarea LA-3. Terrebonne Parish (Land Segment 16) in coastal Subarea LA-2 carries the second highest probability of occurrence and contact, with a probability of 31 percent. The probability that an offshore spill of this size will occur and contact any particular land segment of coastal subarea MA-1 in Mississippi and Alabama is less than 5 percent. Every land segment in Subarea LA-1 carries a probability of occurrence and contact of 5-6 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 (USDOL, MMS, 1985). Based on employment statistics from recent spill clean-up operations along the coast, it is assumed that approximately 100 temporary workers will be employed for a maximum of 6 weeks for each kilometer of coastline subjected to heavy oiling. Therefore, an estimated 3,000 workers will spend approximately 6 weeks employed in operations supporting the clean-up of each OCS-related spill of this size that contacts the CPA coastline. It is expected that social and cultural impacts related to clean-up activities of this size would be temporary; however, impacts such as housing shortages, social dysfunction, heightened sense of threat, and other impacts associated with a large influx of workers into small communities could occur for the period of

the clean-up activities. The direct impact of oil on wetlands could result in relocation of traplines or recreational fishing activity for the period of time necessary for the marsh to regenerate.

The highest probability that a Size 3 offshore spill will occur from accidents involving import tankering and contact a CPA land segment within 10 days is 21 percent for Plaquemines Parish (Land Segment 19) in coastal Subarea LA-3. Cameron Parish (Land Segment 12) in Subarea LA-1 has a probability of occurrence and contact of 17 percent. The probability that an offshore spill of this size will occur and contact any particular land segment in Subareas LA-2 and MA-1 is less than 5 percent. Based on these probabilities, it is assumed that one spill of approximately 22,278 bbl will occur from import tankering operations and contact a land segment somewhere in the CPA. A spill of this size is expected to affect approximately 50 km of coastline and require an estimated 5,000 workers in support of clean-up efforts for approximately 6 weeks. The direct impact of oil on wetlands could result in relocation of traplines or recreational fishing activity for the period of time necessary for the marsh to regenerate. It is expected that social and cultural impacts related to clean-up activities of this size would be temporary; however, impacts such as housing shortages, social dysfunction, heightened sense of threat, and other impacts typically associated with a large influx of workers into small communities could occur for the period of the clean-up activities.

Thirty-one Size 2 spills are assumed to occur in the CPA, however only a few, if any, will contact the coastline. A total of 793 Size 1 spills are assumed to occur in the CPA over the life of the proposal. Only a few of these are expected to contact land. Social and cultural impacts resulting from spills of this size are expected to be negligible.

A number of onshore spills, from both OCS and non OCS sources, are assumed to occur primarily in the coastal zone. The level of clean-up activities associated with these spills will vary with the size, timing, and location of the spill. Social and cultural impacts associated with clean-up of these spills will vary as well.

About half of the coast along the Central Gulf was hit with 16-20 tropical cyclones between the years 1901 and 1955 (DeWald, 1980). The other half of the coast, from Atchafalaya Bay in Louisiana to Texas, had a slightly lower incidence of cyclones (11-15). It is assumed that several major storms will impact the Central Gulf coastal subareas over the next 35 years. Experience with major historical hurricanes (cf. Vujnovich, 1974), as well as with Hurricanes Betsy (1965), Camille (1971), and most recently Hurricane Andrew, has demonstrated that major hurricanes can have a devastating effect on both the natural and human environment. Temporary disruption of traditional occupations and severe impairment of community and family life can result from the effects of tropical storms.

Summary

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. While the overall decline in OCS-related employment is expected to impact communities, families, and individuals during the 35-year life of the proposed action, OCS-related employment is expected to provide jobs that would not exist without the OCS Program, and therefore provide some positive impacts. The highest employment 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 effected by layoffs in the OCS oil and gas industry, resulting in stress from decreased family income and loss of security. As the level of employment in OCS-related industry decreases, it is likely that more persons will engage in traditional occupations (such as trapping and shrimping) to supplement their income. This could result in overfishing the resources, which could pose a threat to the continued existence of specific traditional occupations. Little to no in-migration is expected to occur in support of the proposed action. Out-migration resulting from the overall decline could result in a loss of population, particularly in OCS-related staging centers and administrative centers. As OCS-related employment declines, impacts to small business related to the higher wages associated with OCS employment will decline as well. The projected amount of wetlands loss may result in impact to the practice of traditional occupations, such as trapping, as coastal marsh is converted to open water. It is expected that social and cultural impacts related to oil spill clean-up activities assumed in this analysis would be temporary; however, impacts such as housing shortages,

social dysfunction, heightened sense of threat, and other impacts associated with a large influx of workers into small communities could occur for the period of the clean-up activities. The direct impact of oil on wetlands could result in relocation of traplines or recreational fishing activity for the period of time necessary for the marsh to regenerate. It is expected that in a small number of cases, successful adaptation of the family to the extended work schedule will not occur. In these cases, some deleterious impacts to family are expected. Community and family life, and the practice of traditional occupations could be impacted by the suite of impact producing factors associated with activities in State waters. Temporary disruption of traditional occupations and severe impairment of community and family life can result from the effects of tropical storms. The incremental contribution of the proposed action on sociocultural issues is expected to be minimal with some deleterious impacts to family life in a small number of cases resulting from the external work schedule.

Conclusion

The cumulative impact on sociocultural issues is expected to be substantial in the coastal subareas of the CPA, particularly as a result of an expected decline in OCS activity over the life of the proposed action.

2. Proposed Western Gulf Sale 150

Proposed Western Gulf Sale 150 is scheduled to be held in August 1994. 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 IV.B. The three potential mitigating measures (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 adjacent coastal region is divided into two coastal subareas (TX-1 and TX-2). These subareas are delineated on Figure IV-1.

(1) Impacts on Sensitive Coastal Environments and Associated Dunes

(a) Coastal Barrier Beaches

The major impact-producing factors associated with the proposed action that could affect barrier beaches 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 barrier beaches in the WPA. Impacts that affect barrier islands landward of the barrier dune system are considered in the wetland analysis. Impacts to other aspects of the barrier environment, such as animals, the recreational value of beaches, and archaeological resources, are described in other sections.

Oil spills associated with the proposed action can result from offshore platform accidents, barge or tanker collisions, and pipeline breaks. Tables IV-4 and IV-5 present estimates of the number of offshore spills that may occur as a result of various scenarios in the WPA over the 35-year life of the proposed action. Section IV.A.3.h. and Table IV-11 express the probability and anticipated number of offshore oil spills to occur and contact land, during the same 35-year period. The probabilities of offshore spills contacting various segments of the Gulf Coast (Figure IV-2) are provided in Table IV-11.

Spills also occur inshore as a result of barge, tanker, pipeline, and storage tank accidents. Most 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 and most OCS-related waterway segments are not located near barrier features, although in the WPA, several ports are located on the landward side of barrier islands. An accident that occurs during oil transfer operations at a barrier island terminal will not likely affect coastal barrier beaches.

For a barge or pipeline accident to affect a barrier beach, the accident would have to occur in nearshore waters, on a barrier landform, or inshore in the vicinity of a tidal inlet. When transporting cargoes to terminals or refineries, oil barges make extensive use of interior waterways, remote from barrier beaches. The Gulf Intracoastal Waterway in Texas cuts through lagoons and sounds behind the barrier islands. An accident behind barrier islands involving a barge or pipeline carrying crude oil could result in spilled oil contacting the landward side of a barrier island. A spill occurred in Mississippi Sound in September 1989 resulting in the oiling of the landward side, but not the Gulf side, of Horn Island; further indication that coastal barrier beaches will not usually be adversely impacted by inland spills.

Pipeline landfall sites on barrier islands have been identified as potential causes of accelerated beach erosion and island breaching. Studies have shown that little to no impact to barrier beaches occurs as a result of modern techniques for pipeline crossings (Wicker et al., 1989; LeBlanc, 1985; Mendelssohn and Hester, 1988). Some techniques presently used by the industry, such as directional boring, have no impact upon beach topography.

No new navigation channels are expected to be dredged as a result of the proposed action (Section IV.B.2.); therefore, impacts from these activities are precluded. Some periodic maintenance dredging of navigation channels through barrier passes is expected. Maintenance dredging and stabilization of bar channels could affect the stability of the barrier landform if the bar channel serves as a sediment sink, intercepting longshore sediment drift. Dredged material from the sink is often discharged to deeper waters of the Gulf. This impact can be mitigated by discharging dredged material onto barrier beaches or strategically into the longshore sediment current, downdrift of the maintained channel. Misplacement of dredged materials sometimes forms sand bars that impair coastal navigation of shallow water vessels, such as shrimp trawlers.

Section IV.B.2. states that the channel leading to the port of Corpus Christi, Texas, may be deepened to provide access for larger vessels used for deep-water operations. This channel was deepened to -13.7 m NGVD in 1990 and is presently being considered for deepening to -15.2 m NGVD. Preliminary project plans are still being developed. Ninety percent of this activity is attributed to the OCS Program. Existing jetties are not expected to be modified, hence their adverse impacts upon longshore sediment transfer will not be increased. The deepened bar channel through barrier passes could serve as a sediment sink and reduce sediment supply to beach areas downdrift, thereby intensifying existing chronic erosion problems to the west of the inlet jetties, which is largely attributed to those jetties. It is anticipated that the COE's feasibility report for deepening the channel will call for use of dredged material for beach refurbishment in the area down drift of the channel's jetties.

Periodic maintenance dredging of existing bar channels could exacerbate adverse impacts by maintaining channel depth, although dredged material could be placed in the longshore sediment drift such that it refurbishes the downdrift shoreline, thereby mitigating that adverse impact. Based on these assumptions, the expectation is that mitigative use of dredged material, can help abate on-going erosion rates of barrier beaches as a result of artificially deepened and jettied channels.

Some onshore infrastructure used to support OCS operations has been constructed on barrier islands and beaches in Texas. The construction of new facilities would result in the loss of habitat on barrier landforms. Studies have shown that efforts to stabilize and "armor" beaches usually lead to accelerated erosion in areas away from the protected beach. Hence, construction techniques will be employed to preclude disturbance or destabilization of barrier beaches.

Base Case Analysis

As described in Section IV.A.3.h., landfall by Sizes 1, 2, and 3 spills are not expected. Table IV-11 shows less than a 0.5 percent probability of an offshore Size 3 spill resulting from the proposed sale and contacting a coastal barrier beach within 10 days of the spill event, during the 35-year life of the proposed action.

Table IV-15 indicates that no Size 2 or 3 spills are assumed to occur inland under this scenario. No Size 1 or smaller spills are assumed to occur and contact barrier beaches from inshore sources. Should an unforeseen contact occur from an inshore or offshore spill, it is expected that resulting oiling would be very light with insignificant impacts to barrier beaches.

No new pipeline landfalls are projected (Section IV.B.2.). In the event of an unforeseen hydrocarbon discovery that would require a new landfall, modern techniques of pipeline emplacement and planning procedures can eliminate pipeline landfall impacts.

The contribution of the proposed action to vessel traffic in OCS-related navigation canals is 0.4 percent. Correspondingly, 0.4 percent of impacts attributable to maintenance dredging and wake erosion of those channels is also accredited to proposed activities. Sediments from maintenance dredging of bar channels and tidal inlets can be of considerable benefit to barrier beaches. If the dredged material is placed strategically in the interrupted longshore sediment drift, i.e., downdrift of the interruption, it would help mitigate the adverse impacts caused by the jetties. A corresponding percentage of this benefit is attributable to this proposal.

Three percent of OCS-related impacts of deepening the Corpus Christi Channel is attributed to proposed activities. An adequate analysis of the project cannot be performed concerning impacts until a project description is developed. Deepening the Corpus Christi Ship Channel from -13.7 to -15.2 m NGVD is expected to displace approximately 353 million m³. For the purposes of this EIS, it is anticipated that the dredged material will be used to create wetlands, and to refurbish the barrier beach downdrift of the channel jetties.

Summary

No oil spill is expected to contact a barrier beach. Should an unforeseen contact occur, it is expected that resulting oiling will be very light.

Onshore and nearshore construction of new infrastructure (pipeline landfalls, navigation channels, service bases, platform yards, etc.) as a result of the proposed action are not expected to occur, hence no impacts are anticipated.

Some maintenance dredging is expected to occur, but has not been shown to have an appreciable negative impact on barrier beaches, and the need for dredging cannot be attributed to the small percentage of vessel traffic in these channels accounted for by proposed activities.

Deepening of the channel to Corpus Christi, Texas, is not yet described but is not expected to cause any additional or accelerated adverse impact on nearby barrier features. Strategic placement of dredged material from this project and subsequent maintenance dredging is expected to benefit barrier beaches down drift of the channel jetties.

Conclusion

The proposed action is expected to result in alteration of barrier beach configurations in localized areas downdrift from navigation channels that are jettied and maintained or deepened. Strategic placement of dredged material resulting from these actions can mitigate adverse impacts upon those localized areas.

High Case Analysis

As described in Section IV.A.3.h., landfall by Sizes 1, 2, and 3 spills are not expected. Table IV-11 shows a 1 percent or less chance of an offshore Size 3 spill occurring and contacting land within 10 days. Based on this low probability, it is assumed that an offshore Size 3 spill will not contact a coastal barrier as a result of the High Case. No Size 2 or 3 spills are assumed to occur onshore under the High Case (Table IV-15). No

Size 1 or 2 spills, from either onshore or offshore, are assumed to occur and contact coastal barriers under the High Case.

No new pipeline landfalls are projected to occur under this scenario (Section IV.B.2.). 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.

Vessel traffic within navigation channels attributable to the proposed action will be 0.8 percent of total traffic. Correspondingly, 0.8 percent of the maintenance dredging done during the life of the proposed action can be attributed to activities associated with the High Case. Sediments from maintenance dredging of bar channels and tidal inlets can be of considerable benefit to barrier beaches. If the dredged material is placed strategically in the interrupted longshore sediment drift, it would help mitigate adverse impacts caused by the presence of jetties and artificially deepened tidal passes. A corresponding percentage of this benefit is attributable to the proposed action. Adverse and beneficial impacts resulting from channel traffic and maintenance dredging would be negligible.

No new infrastructure construction activity is projected to occur on barrier beaches (Section IV.B.1.a.).

Ninety percent of the impacts caused by deepening the channel to Corpus Christi, Texas, is attributed to the OCS Program, 6 percent of which is attributed to the High Case. An adequate analysis of the project cannot be performed concerning impacts until a project description is developed by the COE. Deepening the Corpus Christi Ship Channel from -13.7 to -15.2 m NGVD is expected to displace approximately 353 million m³. For the purposes of this EIS, it is anticipated that the dredged material will be used to create wetlands, and to refurbish the barrier beach downdrift of the channel jetties.

No oil spill is expected to contact a barrier beach. Should an unforeseen contact occur, it is expected that resulting oiling will be very light.

Onshore and nearshore construction of new infrastructure (pipeline landfalls, navigation channels, service bases, platform yards, etc.) as a result of the proposed action are not expected to occur, hence no impacts are anticipated.

Some maintenance dredging is expected to occur, but has not been shown to have an appreciable negative impact on barrier beaches, and the need for dredging cannot be attributed to the small percentage of vessel traffic in these channels accounted for by proposed activities.

Deepening of the channel to Corpus Christi, Texas, is yet undescribed but is not anticipated to cause any additional or accelerated adverse impact on nearby barrier features. Strategic placement of dredged material from this project and subsequent maintenance dredging is expected to benefit barrier beaches down drift of the channel jetties.

Conclusion

The High Case is expected to result in alteration of barrier beach configurations in localized areas downdrift from navigation channels that are jettied and maintained or deepened. Strategic placement of dredged material resulting from these actions can mitigate adverse impacts upon those localized areas.

(b) Wetlands

Wetlands considered in this analysis include forested wetlands (bottomlands and swamps) and marshes. Seagrass beds will also be included in this analysis. Swamps and marshes occur throughout the coastal zone. Seagrasses are restricted in distribution to small shallow areas behind barrier islands. Seagrass beds in WPA are restricted to shallow water areas behind barrier islands south of Corpus Christi, Texas. The most extensive areas of seagrass beds are in Laguna Madre, Texas.

Impact-producing factors resulting from OCS oil and gas activities that could adversely affect wetlands and seagrass beds include oil spills, pipeline construction and remaining canals, dredging of new navigation channels, maintenance dredging and vessel usage of navigation channels, and construction and maintenance of onshore facilities in wetland areas.

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, pipeline breaks, or navigational accidents. If these spills were to unexpectedly contact wetlands, they are not expected to result in high-enough concentrations of oil (greater than 1.0 l/m² in Texas) to affect adversely wetland vegetation significantly.

Because seagrass beds occur behind barrier islands, it is assumed that no offshore spills will contact them.

Spills can also occur inshore as a result of tanker, barge, or pipeline accidents, or during transfer operations at terminals. Table IV-15 projects the number of oil spills related to the proposed action that are expected to occur onshore for the WPA over 35 years. Most Size 1 spills that occur onshore in the WPA are assumed to occur near or at OCS-related transfer facilities. It is assumed that most oil spills will either be confined within facility containment levees and so will not contact wetlands, or will be contained and managed as a result of SPCC plans required for such facilities, thereby causing little impact on wetlands.

Size 2 and larger Size 1 spills are assumed to result from pipeline or navigation accidents, away from transfer facilities. Spills resulting from navigation accidents will be largely contained in the channel. Slicks will be quickly spread through the channel by tidal, wind, and traffic currents. Most oil contacting wetlands is not expected to have long lasting adverse effects on significant areas of wetland vegetation. Spills that damage wetland vegetation fringing and protecting canal banks will accelerate erosion of those once protected wetlands and spoilbanks (Alexander and Webb, 1987).

Numerous investigators have studied the immediate impacts of oil spills on wetland habitats in the Gulf area. Often, seemingly contradictory conclusions from impact assessments are generated from these studies. Differences can be explained by different oil concentrations contacting vegetation, the kinds of oil spilled (heavy or light crude, diesel, fuel oil, etc.), types of vegetation affected, the season of year, the pre-existing stress level of the vegetation, and numerous other factors. In overview, the data suggest that light-oiling impacts will include plant die-back with recovery within two growing seasons or less without artificial replanting. Therefore, these impacts are considered short term and reversible (Webb et al., 1985; Alexander and Webb, 1987; Lytle, 1975; Delaune et al., 1979; Fischel et al., 1989).

It is assumed that the extent and severity of oil spill impacts are dependent upon oil concentration and wetland type and condition contacted. Critical concentrations of various oils are those concentrations above which impacts to wetlands will be long term and recovery will take longer than two growing seasons and which cause plant mortality and some permanent wetland loss. Critical concentrations of various oils are currently unknown and assumed to be variable. Because some of the oil to be produced as a result of the proposed action is expected to be transported through the CPA, some oil spills are expected to occur there also. 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/m². Concentrations less than this will cause die-back of the above-ground vegetation for one growing season, but only limited mortality to the vegetation. Concentrations above this will cause either 35 percent die-back or mortality of contacted vegetation. Within 4 years, 35 percent of the affected area will recover. Oil will persist in the wetland soil for at least 5 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 indirectly caused by the spill. If a spill contacts wetlands exposed to wave attack, additional accelerated erosion of the wetland fringe will occur, as documented by Alexander and Webb (1987).

Wetlands in Texas occur on a more stable substrate, receive more sediment per unit of wetland area, and have not experienced the extensive alterations caused by canal dredging and rapid subsidence rates that affect 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 critical concentration of oil in coastal wetlands in Texas is assumed to be 1.0 l/m² (Alexander and Webb, 1983). Concentrations below this will result in short-term, above-ground die-back for one growing season. Concentrations above this will result in longer-term impacts to wetland vegetation, including plant mortality which is extensive enough to require recolonization.

Because pipelines traverse wetland areas adjacent to the CPA, 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). Based on data from Mendelsohn et al. (1990), recovered vegetation is expected to be the functional equivalent to unaffected vegetation, ecologically. Impacts from spills will therefore be confined to a reduction in plant density. Because a pipeline spill could occur

within the interior of a wetland, where wave-induced or tidal flushing is not as regular or as complete, oil could persist in the soil for more than five years.

Using these studies as models, it is estimated that for every 50 bbl of oil spilled, approximately 3 ha will experience die-back of wetland vegetation; 1 ha of these damaged wetlands will recover within 4 years and 2 ha will recover in 10 years. About 1 ha of those wetlands are expected to be lost permanently to open-water habitat as a result of the spill. For the purpose of analysis of wetland impacts, Sizes 1, 2, and 3 spills onshore shall be considered to be 50, 500, and 6,500 bbl, respectively.

Seagrass beds generally occur in shallow, high-salinity waterbodies, landward of protective landforms, such as barrier islands and shoals. 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 sub-tidal location in a region with a micro-tidal range. This protects them from direct contact with oil. The degree of impact will depend on water depth and tidal events in the affected area. Seagrasses generally occur at shallow depths of 50 cm or less.

Another reason for seagrass insusceptibility to oil spills is that a large percentage of their biomass is found in the root and rhizome, which are buried in sediment. The large root mass allows plants to regenerate. It is expected that an oil spill that moves into a seagrass area will cause slight damage to the vegetation. Because of the shallow depths, it is expected that a spill in the vicinity of a bed will cause some seagrass die-back for one growing season. No permanent loss of seagrass habitat will result from the spill. In the WPA, few seagrass beds are found near OCS-related navigation channels. A spill will have dissipated before it has moved near seagrass beds.

The major impact to seagrass communities has been to the community composition and numbers of organisms associated with the faunal assemblages.

Neither need nor primary impacts concerning construction of new onshore pipelines are considered for assessment, hence no impacts generated by pipeline construction will be attributed to it. Coastal pipeline construction impacts are attributed to the OCS Program. Pipeline maintenance activities that disturb wetlands are very infrequent and are considered to be insignificant.

After backfilling a pipeline canal, a right-of-way may revegetate or remain as a shallow waterbody (Tabberer et al., 1985; Wicker et al., 1989). In areas where soils have high organic content, backfilling does not usually fill a canal completely. In areas with soils having low organic content, most of the canal length is usually filled and naturally revegetated after backfilling. Most of the disturbances, described in Section IV.B.2.a., are anticipated to result in temporary adverse impacts that are assumed to be partially corrected after two years in Texas and after five years in Louisiana. It is assumed that after pipelines are constructed and backfilled in Texas, 30 percent of the length of the right-of-way will contain a shallow 1.5-m wide channel.

Secondary impacts of these channels are considered to be more damaging to coastal wetlands and associated habitats than primary impacts (Tabberer et al., 1985). Secondary impacts include expansion of tidal influence, saltwater intrusion, hydrodynamic alteration, erosion, sediment export, and habitat conversion. During reviews of pipeline projects for federal and state permits, agencies consistently comment with concern upon the extent of these secondary impacts. As a result, structures engineered to mitigate secondary adverse impacts are included as permit requirements.

Decisions to not maintain structures constructed for the purpose of mitigating adverse impacts of pipeline construction allows such structures to deteriorate and eventually fail. Significant, indirect, and adverse impacts upon wetlands that the structures were designed to prevent or mitigate then proceed. The length of OCS-related pipeline canals and the number of related mitigative structures in the WPA are unknown. The extent of impacts caused by failure to maintain mitigation structures is unknown.

Widening of pipeline canals over time is one of the more obvious and quantifiable secondary impacts. Craig et al. (1980) studied a series of canals in Louisiana and determined that the canals widened at rates that ranged from 2 to 14 percent per year. Dead-end canals that conducted no traffic or significant flow were shown to widen at rates within this range. Due to their shallow nature, it is assumed that OCS-related pipeline canals will widen on average at a rate of 4 percent per year over the 35-year life of the proposal. The length of OCS-related pipelines in Texas and widths and lengths of canals associated with those pipelines are unknown.

In Section IV.B., it was assumed that for every pipeline landfall constructed in Texas, 40 km of pipelines are constructed. Hence, the 16 existing OCS-related pipeline landfalls in Texas indicate that there are 640 km of OCS-related pipelines in Texas. It is assumed that existing average canal width is 4 m, and that canals are associated with 30 percent of the pipeline length estimated for the WPA.

It is assumed that no produced waters generated by this proposal will be transported to land to be treated and discharged to inland waters.

According to Table IV-15, produced sands and drilling fluids will be transported to shore for disposal. An in-house analysis (Section IV.B.2.c.) showed that 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 to establish new disposal sites. Some seepage from waste sites may occur into adjacent wetland areas and result in damage to wetland vegetation. Several state and federal laws are enforced to prevent and correct such occurrences.

No new navigational channels are anticipated to be constructed as a result of the proposed sale. As discussed in Section IV.A.2., deep-water activities are anticipated to increase, requiring use of larger service vessels for efficient operations. When the channel to Corpus Christi, Texas, is deepened to accommodate the deeper draft vessels, dredged material from the channel is expected to be disposed of in shallow water areas to create marsh. Ninety percent of the impacts generated by deepening that channel is attributed to the OCS Program, of which a percentage is attributed to the proposed sale. An adequate analysis of the project's impacts cannot be performed until a project description is developed by the COE. Deepening the Corpus Christi Ship Channel from -13.7 to -15.2 m NGVD is expected to displace approximately 353 million m³. It is assumed that the dredged material will be used to create and refurbish wetlands in the vicinity of the channel. No significant impacts of saltwater intrusion caused by deepening this channel since it was recently dredged to -13.7 m NGVD.

Impacts to wetlands can occur from periodic maintenance dredging of navigation channels. If spoil is deposited onto existing spoil banks, the effects of the spoil banks on wetland drainage is expected to continue unchanged, although there may be some localized and minor aggravation of problems. Typically, some dredged material intended for placement on a spoil bank is placed in adjacent wetlands or shallow water. Wetland loss due to this action is assumed to be offset by wetland creation as adjacent margins of shallow water are filled. In both events, areas impacted are estimated to be small.

Material from maintenance dredging should be considered for use as a sediment supplement in deteriorating wetland areas to enhance and increase wetland acreage, where appropriate. Disposal of dredged material for marsh enhancement has been done only on a limited basis, as of 1988 (Section IV.B.2.). Given the restatement of the "mission" of the COE to take environmental impacts into consideration, increased emphasis has been placed on the use of dredged material for marsh creation. 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.

According to Johnson and Gosselink (1982), canals that have high navigational usage in coastal Louisiana widen about 2.58 m/yr compared to 0.95 m/yr for little used canals. It is assumed that OCS-related navigation canals will widen at an average rate of 1.5 m/yr in Texas. As established in Section IV.B.2., approximately 139 km of navigation canals, bayous, and rivers are found in the coastal regions of the WPA (derived from Wicker et al., 1989).

Prop-wash of vessel traffic in navigation canals resuspends sediments, increasing the turbidity of nearby coastal waters, which has the greatest potential impact on seagrass beds. Navigation routes in the area are not located near seagrass beds.

Various kinds of onshore facilities have been constructed to service OCS development. These facilities are described in Section IV.B.1. and Table IV-16. Construction of proposed new facilities are all attributed to the OCS Program in direct association with proposed pipelines. Hence, no impacts associated with any new facilities will be attributed to the proposed sale.

Base Case Analysis

Table IV-4 provides the number of offshore spills assumed to occur as a result of the proposed action over the 35-year life of the proposed action. Because of the very low probability of occurrence described in Table IV-11, no offshore Size 1, 2, or 3 spills are assumed to contact wetlands.

Ten onshore oil spills may occur as a result of the proposed action (Table IV-15) in the WPA. Eight (80%) of these spills will be less than one barrel and are assumed to occur at transfer facilities where they will be contained without impacts on wetlands. Two (20%) spills are listed to be Size 1 spills, one of which is assumed to occur in direct association with transfer facilities where effective spill recovery plans are in place. One large Size 1 spill is assumed to result from a pipeline or navigation accident, away from transfer facilities. For the purpose of analyses, a typical large Size 1 spill will be 50 bbl. Hence, it is estimated that a total of 50 bbl will be spilled, thereby impacting approximately 3 ha of wetlands during the 35 years. After 4 and 10 years, 1 and 2 ha will recover, respectively. An estimated 1 ha of wetlands will be converted to open water.

Secondary wetland losses resulting from widening of proposed OCS-related pipeline canals is accredited proportionally to the OCS Program and the proposed sale. After the estimated 120 km of proposed pipelines are constructed, the remaining canal, estimated to be 36 km long and 1.5 m wide, will widen at a rate of 4 percent per year, resulting in the loss of 15.1 ha after 35 years; 0.45 ha is accredited to the proposed action. For existing pipeline canals in the WPA, it is estimated that the cumulative length is 192 km, with an average width of 4 m. Widening at an estimated rate of 4 percent per year will result in the loss of approximately 215 ha after 35 years; 6.5 ha is accredited to the proposed action. Estimated total wetland loss due to pipeline canal widening is estimated at 230 ha after 35 years; approximately 7 ha is accredited to the proposed action.

Modern installation methods and planning procedures have reduced levels of impacts on wetlands and seagrass beds associated with pipeline projects.

Ninety percent of the need to deepen the Corpus Christi Navigational Channel is attributed to OCS activities, and 3 percent of the OCS Program is attributable to the proposed action. It will also be assumed that the same impacts from deepening the Fourchon Channel in the CPA will apply to deepening the Corpus Christi Channel. Hence, the creation of 6 ha of wetlands related to the Corpus Christi Ship Channel project can be attributed to this scenario.

On average, only 0.4 percent of channel usage will be attributed to the proposed action. Therefore, only 0.4 percent of maintenance dredging of the channels is attributable to the proposed action. Because of this small percentage of usage and the likelihood that much of the dredged material resulting from maintenance dredging will be placed on existing spoil disposal sites or used to enhance wetland habitats, it is expected that no significant adverse impacts will occur to wetlands from maintenance dredging.

Due to widening of OCS-related navigation channels, it is estimated that 21 ha/yr of wetlands, or 730 ha of wetlands during the 35-year life of the proposed action will be lost. Based on the assumption that the proposed action represents approximately 0.4 percent of the use and widening of OCS-related channels, wetland area lost to widening of canals as a result of the proposed action will be approximately 0.08 ha/yr, or 2.9 ha over the next 35 years.

Summary

Only spills from pipeline and navigation accidents are expected to result in high-enough concentrations of oil contacting wetlands to result in impacts. Several onshore barge and pipeline accidents are anticipated to occur, impacting approximately 3 ha of wetlands over 35 years. For 4 and 10 years after each spill, 1 and 2 ha will cumulatively recover, respectively. Cumulatively, 1 ha of wetlands will be converted to open water.

Seagrass beds are not expected to be contacted by oil from these spills. No impacts to seagrass beds are expected.

As a secondary impact of OCS-related pipeline canals attributable to this proposal, 7 ha of wetlands are estimated to be lost over 35 years.

Deepening one channel (Corpus Christi Ship Channel) to accommodate larger service vessels is expected to occur within a saline marsh environment and affords the opportunity for creation of 6 ha of wetlands.

No appreciable adverse impacts from maintenance dredging are expected. Alternative dredged material disposal methods can be used to enhance coastal wetlands.

Erosion of wetlands from OCS vessel wakes is expected to result in up to 3 ha of wetlands loss during the 35-year life of the proposed action.

Conclusion

The proposed action is expected to result in the loss of up to 11 ha of wetlands, suppressed productivity of up to 1 ha of wetlands for 4 years and 2 ha for 10 years, and a gain of up to 6 ha of wetlands due to the beneficial use of dredged material.

High Case Analysis

Table IV-4 provides the number of offshore spills assumed to occur as a result of the proposed action over 35 years. Because of the very low probability of occurrence described in Table IV-11 and statements in Section IV.A.3.h., no offshore Size 1, 2, or 3 spills are assumed to contact wetlands.

Thirty onshore oil spills may occur as a result proposed activities in the WPA (Table IV-15). Twenty-four (80%) of these spills will be less than 1 bbl and are assumed to occur at transfer facilities where they will be contained without impacts on wetlands. Six (20%) spills are listed as Size 1 spills; three are assumed to occur in direct association with transfer facilities where effective spill recovery plans are in place. Three large Size 1 spills are assumed to result from pipeline or navigation accidents, away from transfer facilities. For the purpose of analyses, a typical large Size 1 spill will be 50 bbl. Hence, it is estimated that a total of 150 bbl will be spilled, thereby impacting approximately 8 ha wetlands during the 35 years. After 4 and 10 years, 3 and 4 ha will recover, respectively. An estimated 0.9 ha of wetlands will be converted to open water.

Secondary wetland losses resulting from widening of proposed OCS-related pipeline canals is accredited proportionally to the OCS Program and the proposed sale. Once the estimated 120 km of proposed pipelines are constructed, the remaining canal, estimated to be 36 km long and 1.5 m wide, will widen at a rate of 4 percent per year, resulting in the loss of 15.1 ha after 35 years; 0.9 ha is accredited to the High Case. For existing pipeline canals in the WPA, it is estimated that the cumulative length is 192 km, with an average width of 4 m. Widening at an estimated rate of 4 percent per year will result in the loss of approximately 215 ha after 35 years; 12.9 ha is accredited to the High Case. Estimated total wetland loss due to pipeline canal widening is estimated at 230 ha after 35 years; approximately 13.8 ha is accredited to the High Case.

It is assumed that 90 percent of the need to deepen the Corpus Christi Navigational Channel is attributed to OCS activities and that 6 percent of the OCS Program is attributable to the High Case. It will be assumed that the same impacts from deepening the Fourchon Channel in the CPA will apply to deepening the Corpus Christi Channel. Hence, the creation of 11 ha of wetlands related to the Corpus Christi Ship Channel project can be attributed to this scenario.

On average, only 0.8 percent of channel usage will be attributed to the High Case. Therefore, only 0.8 percent of the maintenance dredging of the channels is attributable to the High Case. Because of this small percentage of usage and the likelihood that much of the dredged material resulting from maintenance dredging will be placed on existing spoil disposal sites or used to enhance wetland habitats, it is expected that no significant adverse impacts will occur to wetlands from maintenance dredging.

Due to widening of OCS-related navigational channels, it is estimated that 20.8 ha/yr of wetlands, or 730 ha wetlands during the 35-year life of the proposed action will be lost. Based on the assumption that the High Case represents approximately 0.8 percent of the use and widening of OCS-related channels, wetland area lost to the widening of canals as a result of the High Case will be approximately 0.17 ha/yr, or 5.8 ha over the next 35 years.

Conclusion

The High Case is expected to result in the loss of up to 21 ha, suppressed productivity of up to 3 ha for 4 years and 5 ha for 10 years, and a gain of up to 12 ha due to the beneficial use of dredged material.

(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 seafloor blowout accidents. 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.3.b.(1)), and structure emplacement (Section IV.A.3.a.), as well as a seafloor blowout (Section IV.A.3.h.(1)). 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, 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 projected impact-producing factors of Table IV-4. As noted in Table IV-4, in these three subareas a total of 220 wells are assumed to be drilled, 10 platform complexes installed, and 220 km of pipeline installed. One accidental blowout event is estimated.

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 analysis, the frequency of such impact is expected to be once every 6 months to 2 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 6 months to 2 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. Seafloor disturbance is considered to be a threat only to the high-density (Bush Hill-type) communities; the widely distributed low-density communities would not be at risk. The provisions of NTL 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 as a result of physical disturbance is expected to take less than 2 years.

High Case Analysis

In the High Case Analysis, the deep-water benthic communities (e.g., chemosynthetic communities) would be subject to the following impact-producing factors: physical disturbance of the bottom where these communities are found, such as disturbance by rig emplacement, platform and pipeline installation, anchoring, and seafloor blowouts. No other impact-producing factor is expected to present a threat to these deep-water communities. 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, 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-4. As noted in Table IV-4, in these three subareas a total of 560 wells are assumed to be drilled, 30 platform complexes installed, and 380 km of pipelines installed. Approximately three blowout accidents are estimated.

While the opportunities for impact are somewhat higher under the 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 6 months to 2 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 6 months to 2 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 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 as a result of physical disturbance is expected to take less than 2 years.

(b) Topographic Features

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

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-4; the amounts of wastes discharged in the vicinity of a bank will be some very small fraction of those shown in Table IV-4.

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 mi, 3 mi, or 4 mi, 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 would be on the order of 2-4 weeks.

Blowouts do not occur with great frequency (one estimated) (see Section IV.A.3.h.(1) 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 on the order of 2-4 weeks.

There is an estimated 5 percent chance of a Size 3 oil spill occurring in the Western Gulf as a result of the proposed action (Base Case) (Table IV-9), and it is assumed that six Size 1 spills will occur each year and that no Size 2 spills will occur during the 35-year life of the proposed action (Section IV.A.3.h.). It is assumed that no Size 3 oil spills will occur (Section IV.A.3.h.; Table IV-4). 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). If a seafloor oil spill (e.g., pipeline) 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.

A total of four structure removals using explosives is estimated for the WPA Base Case. Effects from explosive removals of platforms on the topographic features of the Gulf are not expected to impact the biota of 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 on the order of 2-4 weeks.

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 on the order of 2-4 weeks.

Oil spills (there is an estimated 5% chance of a Size 3 oil spill 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. Small areas would be impacted by operational discharges (i.e., muds and cuttings), and recovery 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 with released oil, 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.

Surface 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. The biota of the topographic features would be subject to the following impact-producing factors: discharges associated with drilling, blowouts, and oil spills. 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-4; the amounts of wastes discharged in the vicinity of a bank will be some very small fraction of those shown in Table IV-4.

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 on the order of 2-4 weeks.

The three blowouts estimated for the WPA 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 on the order of 2-4 weeks.

There is an estimated 15 percent chance of one or more Size 3 oil spills occurring in the Western Gulf as a result of the High Case (Table IV-9). It is also assumed that 18 Size 1 spills and 1 Size 2 spill 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-4). It is assumed that one Size 3 oil spill will occur (Section IV.A.3.h.). 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.

A total of eight structure removals using explosives is estimated for the High Case. Effects from explosive removals of platforms on the topographic features of the Gulf are not expected to impact the biota of the banks.

Conclusion

The High Case 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 would be impacted by operational discharges (i.e., muds and cuttings), and recovery 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*

Major contaminant sources along the Gulf Coast include the petrochemical industry, hazardous waste disposal operations, agricultural and livestock farming, manufacturing industry activities, fossil fuel and nuclear power plant operations, pulp and paper mills, commercial and recreational fishing, municipal wastewater treatment, and maritime shipping activities. The coastal portion of the north-western Gulf of Mexico experiences 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.A.5.b.

Water quality in coastal and nearshore areas adjacent to the OCS may be altered by a number of OCS-related activities resulting from proposed Sale 150. These include onshore support facility operations, support vessel traffic, channel construction and maintenance dredging, pipeline emplacements, and onshore disposal of OCS-related oil-field wastes. These activities result in spills and discharges into coastal waters. Spills occurring offshore and reaching coastal waters are also expected to affect water quality. Disturbances of the physical surroundings due to these activities can result in degradation of water quality.

Oil spills constitute one of the most visible forms of pollution. Spills of both crude oil and petroleum products can occur onshore from coastal transport of OCS oil by pipelines and barges, near refineries and storage facilities (terminals), during fuel and bulk transfer operations associated with barge and tanker operations, and from barge and tanker accidents along navigation channels and near terminals. Spills can also occur from offshore operations, especially pipelines, and subsequently reach coastal areas. Significant deterioration of nearshore water quality can occur proximate to a continuous source of oil contamination and would continue until the source is removed. If a slick from a Size 3 OCS oil spill 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. Levels 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 from spills 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 the oil coating the sediments and vegetation might be released into the surrounding water for a much longer time period. Because of this, the impact to coastal water quality from Size 3 spills is expected to result in a disturbance of sufficient severity to degrade localized water-quality parameters for up to 10 years after the spill occurs. In the case of Size 1 and Size 2 spills, there would be some change in water-quality parameters lasting up to 5 years. In both cases, the aerial extent of this contamination is expected to decrease significantly over the expected time period and is dependent on the water proximity to oiled vegetation and sediments.

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 and accidental spills. All existing onshore infrastructure and associated operations will contribute to the degradation of regional coastal 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 during the use of the existing infrastructure and facilities. Effluents from onshore infrastructure are commonly discharged into surface waters after treatment. The degree of environmental damage will be related to the level of contamination in the discharge and the characteristics of the receiving waters. Likewise, runoff from existing OCS facilities can have significant impacts to the surrounding area. Runoff from support facilities is likely to contain oil, 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.

Vessel usage of coastal waters may degrade water quality from bilge and ballast water discharges, discharges of treated sanitary and domestic wastes, wake erosion of channel banks, trash and debris loss, and spills. Spills are most likely to occur in connection with the offloading and onloading of crude from shuttle tankers and barges and from fueling activities associated with service boat support.

Dredging operations for navigation channel construction and maintenance release sediments into the water column, resulting in short-term, localized impacts. Navigation channels serve as routes for vessel traffic traveling to and from OCS service and supply bases, for barges carrying oil from the OCS to shore or between coastal terminals, and for the transport of new pipelines and platforms to the OCS. Likewise, pipeline excavation and burial techniques disturb bottom sediments and wetland vegetation, and increase turbidity. These activities can result in the resuspension of settled pollutants, heavy metals, and pesticides, if present. Channel and pipeline canal construction can also result in saltwater intrusion into fresher water habitats, which can result in vegetation die-off and erosion of soils.

A small portion of the wastes generated from offshore oil and gas exploration and production activities is brought ashore for disposal. These generally include oil-based drilling muds and cuttings, liquid wastes (fracking fluids, emulsifiers, workover fluids, biocides, mud additives, etc.), and production solids. Some of these wastes can be contaminated with naturally occurring radioactive material (NORM), toxic or hazardous compounds, heavy metals, and oil and grease. Once ashore, many of these wastes are transported via barge to adjacent parishes or counties for off-site storage and disposal. Section IV.B.2.c. provides more information on onshore disposal practices. Improper storage of drums or incorrect landfarming or landfilling of these

wastes presents a potential for environmental problems, adversely impacting surrounding surface and ground waters and wetland areas. Because of lax disposal requirements, the potential exists for radium-226 and other contaminants to enter both aquatic and terrestrial food chains and groundwater systems. 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 NORM.

Base Case Analysis

The existing onshore infrastructure base in the Western Gulf is expected to be sufficient to support proposed Sale 150 activities, and no new infrastructure will be constructed. Table IV-16 lists 97 facilities expected to support all future OCS operations. The subset that will support Sale 150 activities is not provided. Also, not included in these numbers are the 4 onshore transfer stations and 1 waste treatment facility used to handle wastes generated offshore and brought onshore for disposal (Section IV.B.1.a.(3)(c)). Routine point- and nonpoint-source discharges, nonquantified but characterized in Section IV.B.2.b., and chronic spillage occurring from these existing onshore support facilities will continue to impact coastal and nearshore water quality as long as the facilities are in operation. Because the number and types of existing onshore support facilities is expected to remain the same or decline over time (discussed in Section IV.B.1.a.), historical trends in surrounding water quality are assumed to be indicative of future conditions.

The infrastructure that will support Sale 150 is located in both Louisiana (Table IV-14) and Texas. Historical sediment and water contamination near onshore support facilities has been documented in Louisiana (Louisiana Dept. of Environmental Quality, 1990; Louisiana Dept. of Transportation, 1984). Waters near support complexes have been found to be contaminated with petroleum compounds, heavy metals, NORM, high total suspended sediments and organic carbon, and low dissolved oxygen as a result of inputs from effluent discharges, runoff, and chronic spillage. Such contamination is a result of all oil and gas operations that use the facilities. The percentage utilization of these facilities to support Sale 150 operations is assumed to be very small, about 3 percent of their operating capacities (see Section IV.B.1.a. for individual utilization assumptions). Given this, the proportion of expected future water quality degradation associated with discharges and chronic spills from the use of these facilities for Sale 150 activities would be very small, but will be widespread and continuous, especially in the Chenier Plain area of Louisiana and the Galveston/Houston ship channel area.

The improper storage and treatment of OCS-related oil field waste and contaminated oil field equipment could adversely impact surface and ground waters in proximity to disposal facilities, cleaning sites, and scrap yards. Improper operation or maintenance of such facilities have resulted in adverse impacts to surrounding waters, particularly from elevated concentrations of heavy metals, petroleum hydrocarbons, and NORM (Section IV.B.2.c.). Regulatory restrictions have been passed by the State of Louisiana that provide strict management of oil-field wastes [LAC Title 43: Part XIV (Amendment to Statewide Order No. 29b) and LAC Title 33: Part XV (Regulation and Licensing of Naturally Occurring Radioactive Materials)] to protect worker safety. The oil industry is taking new precautions regarding the storage and disposal of NORM contaminated drums. Because of new State regulations and industry precautions, no impacts are expected at the four landfills in Louisiana, one landfill in Mississippi, and one treatment center in Texas that are projected to receive future OCS wastes (Section IV.B.1.a.(3)(e)) or at any of the pipe cleaning or storage yards. Some impact is expected to occur around a few temporary storage facilities (usually service bases) due to human error. However, historical contamination conditions are not indicative of future trends and will greatly improve over time despite continued oil-field waste disposal operations.

Approximately 5,000 service-vessel trips and 8 barge trips are estimated to result from proposed sale-related activities (Table IV-18). Eight ship channels in Texas and 7 navigation channels in Louisiana will be used to various degrees. The Calcasieu Ship Channel to Cameron (LA-1), Freshwater Bayou to Intracoastal City (LA-1), Aransas Paso to Ingleside (TX-1), Freeport Harbor Channel (TX-2), Houston Ship Channel (TX-2), and Sabine Pass (TX-2) are expected to receive the bulk of sale-related support vessel trips in the WPA (Table IV-18). In addition to barge trips to and from platforms, about 18 percent of the barge traffic carrying oil from terminals to other terminals or refineries is expected to be OCS-related (less than 1% of this will be

linked to oil movement resulting from Sale 150 activities) (Section IV.B.1.b.(2)). All of these vessel operations are expected to result in bilge and ballast water discharges, bank erosion, and spills.

About 1.6 million liters of bilge water are estimated to be discharged over the 35-year analysis period (peak year, 130,000 liters) (Table IV-15) into the waters of the 15 navigation channels projected to be used for Sale 150 service-vessel traffic. Of this total, 1.1 million liters will be discharged into Texas areas (80,000 liters peak year). Operational discharges from barge operations are not quantified. If one assumes that 50 percent of these discharges will occur in the estimated 197 km of confined channels in the WPA (Section IV.B.1.b.(4)), there will be about 200 liters discharged per km of Texas channel during the peak year, or about a half a liter per km per day. Bilge waters can contain petroleum and metallic compounds leaked from machinery. New MARPOL regulations severely restricting the levels of oil and grease in bilge water discharges in coastal areas (40 CFR 110) should diminish the types of impacts that have been rated historically from such discharges.

Channel bank erosion from vessel traffic may also add to water-quality degradation. It is estimated that 2.4 ha will erode from canals, bayous, and river banks both in Louisiana and Texas related to the approximately 5,000 service-vessel and barge trips estimated to occur from the sale. This erosion averages 0.068 ha per year for the 139 km of confined channels in Texas and 811 km in Louisiana, or 0.002 m² per day per km of canal, and will cause increased turbidity and resuspension of contaminants from sediments.

Balancing the acute impacts that are projected to result from (1) the small levels of contaminants resulting from 0.002 m² of sediment input per day per km of channel from bank erosion and 0.5 liters of bilge water input per km per day, (2) decreased contaminant levels due to new restrictions on discharge contaminants, and (3) the assimilative capacity of water bodies, with the long term, continuous nature of the discharges, it is expected that there will be minor, localized, long term changes in water quality in the confined portions of the channels identified above.

No new channel dredging is projected in support of Sale 150 operations. Dredging activities associated with maintenance of the 15 channels that support sale-related service vessel traffic (discussed in Section IV.B.1.b.) are expected to occur every two years and will result in localized impacts (primarily increases turbidity) occurring over the duration of the activities (up to several months). In addition, Corpus Christi is expected to be deepened to support future OCS operations in that area. Three percent of this activity will be attributable to leases resulting from the proposed action. The 31 expected dredging operations will preclude some recreational and commercial uses within the immediate area. The periods between expected dredging operations will generally allow for the recovery of affected areas. Impacts from dredging are expected to be somewhat higher near the mouths of major rivers where sediment quantities are greater.

Spills can occur from both offshore and onshore operations. Section IV.A.3.b.(2) and Table 11 show that offshore spills are not likely to contact land and therefore are not expected to cause impacts to coastal water quality. Onshore spills projected to occur from barge and pipeline operations (Section IV.B.2.d.(1)), and near refineries and terminals, will cause some water quality degradation. Size 1 spills of less than 50 bbl related to the proposed action (estimated at one each year in Louisiana and one every 3-4 years in Texas) will occur more frequently than Size 2 and Size 3 spills but are more likely to be contained at the facilities within the Spill Prevention Control and Countermeasure (SPCC) levee systems. Within these confined water bodies, background water-quality conditions will return to normal in 6 weeks for spills 1 bbl or less, and in 6 months for spills less than 50 bbl. Two Size 2 spills estimated at 500 bbl each are projected to occur in Louisiana (Section IV.B.2.d.(1)). It is assumed that these two larger spills will occur outside of the facility catch systems and will enter coastal waters. As discussed above, in shallow, low energy areas, oil may become entrained in suspended particles and bottom sediments and be subsequently reintroduced into the water column, thereby resulting in longer term effects. In Section IV.B.2.d.(1), each spill this size is assumed to affect up to 27 ha of marsh and to cause changes in water quality for up to 5 years. Applying the acreage, low level hydrocarbon contamination of coastal waters will occur from onshore spills associated with Sale 150 operations and will affect localized, confined areas for up to 6 months in 11 locations along the Louisiana coast and 8 locations along the Texas coast. This low level contamination will persist for up to 5 years in 54 ha of marsh.

Summary

Expected future water-quality degradation associated with discharges and chronic spills from the use of onshore infrastructure supporting Sale 150 operations will be very minor but will be widespread and continuous, especially in the Mississippi deltaic area of Louisiana where support facilities are concentrated. Onshore disposal and storage of offshore operational wastes will only result in some minor localized degradation around a few temporary storage sites in Louisiana. There will be minor, localized, long-term changes in water-quality characteristics in the confined portions of the 15 channels identified above due to bank erosion and barge and sanitary wastes discharges associated with vessel traffic operations. Thirty-one maintenance or deepening dredging operations will result in localized impacts (primarily increased turbidity) during the duration of the operations (up to several months). Low-level hydrocarbon contamination of coastal waters will occur from onshore spills associated with Sale 150 operations and will affect localized, confined areas for up to 6 months in 11 locations along the Louisiana coast and 2 along the Texas coast, and for up to 6 weeks in 26 locations along the Louisiana coast and 8 along the Texas coast. This low-level contamination will persist up to 5 years in two locations in Louisiana affecting 54 ha of marsh.

Conclusion

The proposed action will result in minor, localized, long-term changes in water quality within, or in the vicinity of, navigation channels and support complexes. These changes will not preclude current uses of the waters affected. The proposed action will also result in localized, short-term changes in water quality during dredging operations or from spill occurrences, which will alter uses of the affected waters for up to 6 months.

High Case Analysis

The existing onshore infrastructure base in the Western Gulf is expected to be sufficient to support proposed Sale 150 activities, and no new infrastructure will be constructed. Table IV-16 lists 97 facilities expected to support all future OCS operations. The subset that will support Sale 150 activities is not provided. Also, not included in these numbers are the 4 onshore transfer stations and 1 waste treatment facility used to handle wastes generated offshore and brought onshore for disposal (Section IV.B.1.a.(3)(c)). Routine point and nonpoint source discharges, non quantified but characterized in Section IV.B.2.b., and chronic spillage occurring from these existing onshore support facilities will continue to impact coastal and nearshore water quality as long as the facilities are in operation. Because the number and types of existing onshore support facilities is expected to remain the same or decline over time (discussed in Section IV.B.1.a.), historical trends in surrounding water quality are assumed to be indicative of future conditions.

The infrastructure that will support Sale 150 is located primarily in southwestern Louisiana (Subareas LA-1, LA-2, and LA-3) (Table IV-14) and Texas. Historical sediment and water contamination near onshore support facilities has been documented in Louisiana (Louisiana Dept. of Environmental Quality, 1990; Louisiana Dept. of Transportation, 1984). Waters near support complexes have been found to be contaminated with petroleum compounds, heavy metals, NORM, high total suspended sediments and organic carbon, and low dissolved oxygen as a result of inputs from effluent discharges, runoff, and chronic spillage. Such contamination is a result of all oil and gas operations that use the facilities. The percentage utilization of these facilities to support Sale 150 operations is assumed to be very small, about 6 percent of their operating capacities (see Section IV.B.1.a. for individual utilization assumptions). Given this, the proportion of expected future water-quality degradation associated with discharges and chronic spills from the use of these facilities for Sale 150 activities would be very small, but will be widespread and continuous, especially in the Chenier Plain area of Louisiana and the Galveston-Houston ship channel area.

The improper storage and treatment of OCS-related oil-field waste and contaminated oil-field equipment could adversely impact surface and groundwaters in proximity to disposal facilities, cleaning sites, and scrap yards. Improper operation or maintenance of such facilities have resulted in adverse impacts to surrounding waters, particularly from elevated concentrations of heavy metals, petroleum hydrocarbons, and NORM (Section IV.B.2.c.). Regulatory restrictions have been passed by the State of Louisiana that provide strict

management of oil-field wastes [LAC Title 43: Part XIV (Amendment to Statewide Order No. 29b) and LAC Title 33: Part XV (Regulation and Licensing of Naturally Occurring Radioactive Materials)] to protect worker safety. The oil industry is taking new precautions regarding the storage and disposal of NORM-contaminated drums. Because of new State regulations and industry precautions, no impacts are expected at the four landfarms in Louisiana, one landfarm in Mississippi, and one treatment center in Texas that are projected to receive future OCS wastes (Section IV.B.1.a.(3)(e)) or at any of the pipe cleaning or storage yards. Some impact is expected to occur around a few temporary storage facilities (usually service bases) due to human error. However, historical contamination conditions are not indicative of future trends and will greatly improve over time despite continued oil-field waste disposal operations.

Approximately 13,300 service-vessel trips and 29 barge trips are estimated to result from proposed sale-related activities (Table IV-18). Eight ship channels in Texas and 7 navigation channels in Louisiana will be used to various degrees. The Calcasieu Ship Channel to Cameron (LA-1), Freshwater Bayou to Intracoastal City (LA-1), Aransas Paso to Ingleside (TX-1), Freeport Harbor Channel (TX-2), Houston Ship Channel (TX-2), and Sabine Pass (TX-2) are expected to receive the bulk of sale-related support vessel trips from the WPA (Table IV-18). In addition to barge trips to and from platforms, about 18 percent of the barge traffic carrying oil from terminals to other terminals or refineries is expected to be OCS-related (less than 3% of this will be linked to oil movement resulting from Sale 150 activities) (Section IV.B.1.b.(2)). All of these vessel operations are expected to result in bilge and ballast water discharges, bank erosion, and spills.

About 4.2 million liters of bilge water are estimated to be discharged over the 35-year analysis period (peak year 380,000 l) (Table IV-15) into the waters of the 15 navigation channels projected to be used for Sale 150 service-vessel traffic. Of this total, 2 million liters will be discharged into Texas areas (80,000 liters peak year). Operational discharges from barge operations are not quantified. If one assumes that 50 percent of these discharges will occur in the estimated 197 km of confined channels in the WPA (Section IV.B.1.b.(4)), there will be about 400 liters discharged per km of Texas channel during the peak year, or about 1 liter/km/day. Bilge waters can contain petroleum and metallic compounds leaked from machinery. New MARPOL regulations severely restricting the levels of oil and grease in bilge water discharges in coastal areas (40 CFR 110) should diminish the types of impacts that have been from such discharges.

Channel bank erosion from vessel traffic may also add to water quality degradation. It is estimated that 4.8 ha will erode from canals, bayous, and river banks both in Louisiana and Texas related to the approximately 13,300 service-vessel and barge trips estimated to occur from the sale. This erosion averages 0.136 ha per year for the 139 km of confined channels in Texas and 811 km in Louisiana, or 0.004 m³ per day per km of canal and will cause increased turbidity and resuspension of contaminants from the sediments.

Balancing the acute impacts that are projected to result from (1) the small levels of contaminants resulting from 0.004 m³ of sediment input per day per km of channel from bank erosion and one liter of bilge water input per km per day, (2) decreased contaminant levels due to new restrictions on discharge contaminants, and (3) the assimilative capacity of water bodies, with the long-term, continuous nature of the discharges, it is expected that there will be minor, localized, long-term changes in water quality in the confined portions of the channels identified above.

No new channel dredging is projected in support of Sale 150 operations. Dredging activities associated with maintenance of the 15 channels that support sale-related service-vessel traffic (Section IV.B.1.b.) are expected to occur every two years and will result in localized impacts (primarily increased turbidity) occurring over the duration of the activities (up to several months). In addition, Corpus Christi is expected to be deepened to support future OCS operations in that area. Six percent of this activity will be attributable to leases resulting from the proposed action. The 31 expected dredging operations will preclude some recreational and commercial uses within the immediate area of the activity. The periods between expected dredging operations will generally allow for the recovery of affected areas. Impacts from dredging are expected to be somewhat higher near the mouths of major rivers where sediment quantities are greater.

Spills can occur from both offshore and onshore operations. Section IV.A.3.h.(2) and Table IV-11 show that offshore spills are not likely to contact land and therefore are not expected to cause impacts to coastal water quality. Onshore spills projected (Section IV.B.2.d.(1)) to occur from barge and pipeline operations (Section IV.B.2.d.(1)), and near refineries and terminals, will cause some water-quality degradation. Size 1 spills related to the proposed action (estimated at 2 per year in Louisiana and 1 every other year in Texas) will

occur more frequently than larger spills but are more likely to be contained at the facilities within the SPCC levee systems. Within these confined water bodies, background water-quality conditions will return to normal in 6 weeks for spills 1 bbl or less, and in 6 months for Size 1 spills. Four Size 2 spills estimated at 500 bbl each are projected to occur in Louisiana (Section IV.B.2.d.(1)). It is assumed that these four larger spills will occur outside of the facility catch systems and will enter coastal waters. As discussed above, in shallow, low-energy areas, oil may become entrained in suspended particles and bottom sediments and be subsequently reintroduced into the water column, thereby resulting in longer-term effects. In Section IV.B.2.d.(1), each spill this size is assumed to affect up to 27 ha of marsh and to cause changes in water quality for up to 5 years. Applying this acreage, low-level hydrocarbon contamination of coastal waters will rarely occur from onshore spills associated with Sale 150 operations and will affect localized, confined areas for up to 6 months in 22 locations along the Louisiana coast and 4 locations along the Texas coast, and for up to 6 weeks in 52 locations along the Louisiana coast and 16 locations along the Texas coast. This low-level contamination will persist up to 5 years in 108 ha of marsh.

Expected future water-quality degradation associated with discharges and chronic spills from the use of onshore infrastructure supporting Sale 150 operations will be very minor but will be widespread and continuous, especially in the Mississippi deltaic area of Louisiana where support facilities are concentrated. Onshore disposal and storage of offshore operational wastes will only result in some minor localized degradation around a few temporary storage sites in Louisiana. There will be minor, localized, long-term changes in water-quality characteristics in the confined portions of the 15 channels identified above due to bank erosion and bilge and sanitary wastes discharges associated with vessel traffic operations. Thirty-one maintenance or deepening dredging operations will result in localized impacts (primarily increased turbidity) during the duration of the operations (up to several months). Low-level hydrocarbon contamination of coastal waters will occur from onshore spills associated with Sale 150 operations and will affect localized, confined areas for up to 6 months in 22 locations along the Louisiana coast and 4 locations along the Texas coast, and for up to 6 weeks in 52 locations along the Louisiana coast and 16 locations along the Texas coast. This low-level contamination will persist up to 5 years in two locations in Louisiana marsh affecting 108 ha.

Conclusion

The High Case will result in minor, localized, long-term changes in water quality within, or in the vicinity of, navigation channels and support complexes. These changes will not preclude current uses of the waters affected. The proposed action will also result in localized, short-term changes in water quality during dredging operations or from spill occurrences, which will alter uses of the affected waters for up to 6 months.

Marine Water

Potential impact-producing factors result from offshore OCS oil and gas operations that may lead to water quality degradation and that include the resuspension of bottom sediments through platform and pipeline emplacement and removal, operational wastes discharged overboard, and accidental spills, blowouts, or pipeline leaks. These factors are more thoroughly discussed in Section IV.A.3.h.

Emplacement and removal of platforms and pipelines increase water-column turbidity by resuspending bottom sediments. In addition to 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.

Contaminants from vessels transporting oil or supplies to and from offshore platforms can enter the Gulf through routine operational discharges or accidental spills. Service vessels routinely discharge sanitary and domestic wastes and bilge and ballast waters. Shuttle tankers only discharge sanitary and domestic wastes; bilge waters are taken to onshore receptacles.

Oil spills present a threat to the water quality of any area contacted by the oil. Wind and currents would rapidly disperse oil released on the surface. Section IV.C.2. of the Final EIS for Sales 142 and 143 (USDOL, MMS, 1992b) provides an in-depth discussion on the fate of spilled oil.

The OCS oil and gas industry routinely generates and discharges into open waters a number of wastes that have the potential for degradation of the marine water quality. Section IV.A.3.d. describes these wastes and their major contaminants in substantial detail. Section IV.D.1.a.(3) discusses recent USEPA requirements for regulating OCS oil and gas waste discharges.

The discharge of treated sanitary and domestic wastes and deck drainage from rigs, platforms, and support vessels may increase suspended solids, nutrients, chlorine, and biological oxygen demand (BOD) in a small area near the point of discharge. The constituents of these waste streams are quickly diluted, however, when discharged into the open Gulf.

Impacts to water quality from OCS waste streams occur primarily through the discharge of drilling fluids, cuttings, and produced water. This document will address the impacts to water quality only as it occurs in association with these waste streams. These wastes form the vast majority of effluent discharge volumes from oil and gas development and production facilities and have been identified as having significant potential for producing adverse environmental effects due to their toxicities (USEPA, 1993). The physical fate of drilling discharges have been the subjects of considerable study (e.g., NRC, 1983; Avanti, 1992; Neff, 1981; Petrazzuolo, 1981; Menzie, 1983; Ecomar, Inc., 1980). When discharged into the surrounding offshore waters, drilling muds create turbidity plumes several hundred meters to 3,000 m in length. At a discharge rate of 1,000 bbl/hr and a current speed of 10 cm s^{-1} , dilution of the plume contaminants at 100 m was 400 fold and dispersion close to a 1,600-fold decrease from levels at the discharge point (Avanti Corporation, 1992).

Elevated levels of metals, primarily barium (Ba) and chromium (Cr), in sediments near rigs and platforms occur from drilling fluid and cuttings discharges. Other metals with elevated concentrations around rigs include arsenic, cadmium, copper, mercury, nickel, lead, vanadium, and zinc. Sediment enrichment seldom exceeds a factor of 10, with the exception of Ba and Cr, which have had enrichment factors of up to 300 and 36, respectively (Avanti Corporation, 1992). Levels of Ba and Cr in barite are now limited by the new NPDES permit, and it is assumed that limiting these concentrations in the source barite will decrease historical sediment contamination noted. Metals are generally distributed to 200 to 500 m around a platform, although significant Ba enrichment has been found out to 1,000 to 3,000 m down current from the discharge plume (Boothe and Presley, 1985). In general, drilling discharges are mobile and can spread out over a large area (greater than 3 km) on time scales of about a year.

Acute laboratory toxicity tests of whole drilling fluids and produced water have generally shown low toxicities or limited bioavailability to marine organisms. Petrazzuolo (1983) testing 68 muds and 70 species, found that only 1-2 percent had LC_{50} 's ranging from 100 to 999 ppm (the range of toxicities for priority pollutants). Some of the additives of drilling fluids have been shown to be more toxic (NRC, 1983). Although the new NPDES permit and effluent limitations will reduce the number of exceedances of water quality criteria/toxic values from previous measurements, the USEPA still projects some future exceedances (Avanti Corporation, 1992). Using models of a projected typical plume, the USEPA determined that, at the 100-m mixing zone, four of the 11 metals will be above Federal water-quality criteria (As, Cr, Cu, Hg). Future OCS drilling mud discharges will exceed current water-quality criteria twice in the water column and from 3-9 times in sediment pore water (depending on the number of wells drilled) (USEPA, 1993). Beyond 200 to 500 m from the discharge point, concentrations of contaminants in drilling muds will generally fall below the toxicity limits (USEPA, 1993).

Produced water constitutes the largest single source of materials discharged into the Gulf during normal oil and gas operations. The effects of produced water are difficult to separate out from the other production-related discharges occurring during the life of a field. There is limited data on acute toxicities of produced waters. Testing associated with the Buccaneer Field study found acute toxicities of produced waters ranged from 8,000 to 154,000 ppm for invertebrates and 7,000 to 208,000 for vertebrates (Rose and Ward, 1981). Using modeling, 3 of the 21 pollutant identified in produced waters will fail to meet water-quality criteria at the 100 m mixing zone (anthracene, fluorene, phenanthrene) (Avanti Corporation, 1992). Chronic lethal and sublethal effects of produced waters are occurring in some low energy area where the hydrocarbons are not rapidly being removed from the system and where there is a continuous input (Armstrong, et al., 1979). Discharges of produced water are continuous discharges creating a potential for longer exposure periods for platform-associated organisms located near the outfall (Avanti Corporation, 1992). Numerous studies showed that hydrocarbons discharged with produced waters are bioaccumulated. Low levels of alkylated benzenes,

naphthalenes, alkylated naphthalenes, phenanthrene, alkylated three-ring aromatics, and pyrene were found in various fish and epifauna (Avanti Corporation, 1992).

As indicated in Section IV.D.1.a.(3) a number of studies have investigated the fate and effects of OCS discharges around production platforms in marine waters. In general, the studies showed that only within localized areas around platforms could biological effects and contaminant levels in sediments be directly linked to platform discharges. The broad areas studied were often characterized as contaminated with pollutants. Although some implicated the Mississippi River as the probable source (Bedinger, 1981); others attributed it to the oil and gas industry. Neff et al. (1989) found barium present in sediments in his entire study area at concentrations substantially higher than expected of clean sediments. Neff projected that the excess barium may have been from areawide platform discharges of barium-laden drilling muds and produced waters. In two reports (Brooks, 1979; Brooks et al., 1977), Brooks concluded that produced waters are an important source of light petroleum hydrocarbon contamination in Texas-Louisiana shelf waters, particularly large amounts of low-boiling aromatics such as benzene and toluene. Most recently, the shelf was characterized as potentially being contaminated with low-level NORM from produced water and sand discharges (Randolph et al., 1992).

A summary of the expected fate and effects of routine, operational waste discharges occurring from exploration, development, and production offshore is provided in the marine waters writeup found in Section IV.D.1.a.(3).

Base Case Analysis

Table IV-4 indicates that, under the Base Case scenario, 120 exploration and delineation wells, 100 development wells, 10 platforms, and 220 km of pipeline supporting Sale 150 operations will be installed. Four of these platforms will be removed explosively during the 35-year analysis period. None of the pipelines are projected for removal.

The drilling of the wells, construction of the platforms, and laying of the pipe will result in increased water-column turbidity in overlying offshore waters. Using average rig and platform sizes, the total bottom area disturbed by the pile-driving, anchoring, or dredging needed for the temporary presence of rigs during drilling and by all pipeline and platform installation operations is estimated at 119 ha. For those pipelines laid in water depths shallower than 61 m, burial below the seafloor is required. Pipeline burial activities will result in the resuspension of some 113,000 m³ of sediment during the installation of pipelines in water depths of 61 m and less. Offshore Subarea W-2 is the only subarea where significant burial will take place (Table IV-4). Bottom disturbance of sediments will result in resuspension of any settled pollutants, such as trace metals, chlorinated hydrocarbons, and excess nutrients, that may have accumulated in the sediments. Major sources of these contaminants are both coastal or land-based, and sediment contamination is a function of distance from shore. Examination of the extent of these operations in each subarea (Table IV-4) indicates that the vast majority of the activities projected for Sale 150 will occur at a substantial distance from shore, and therefore, the sediments are not as likely to be contaminated. The resuspension of significant quantities of contaminants from bottom disturbances is not expected to occur. Furthermore, activities resulting in suspension of offshore sediments will occur very infrequently. Looking at peak-year estimates for Subarea W-1, the subarea nearest to the shore, no more than two wells will be drilled, one platform installed, and 7 km of pipeline laid. Such levels of activity are similar to the level of operations examined in a study researching water-quality effects from platform installation discussed above (Arthur D. Little, Inc., 1985). The conclusion of the study can therefore be applied to Sale 150 installation operations. Sediment disturbance and resuspension resulting from pile-driving and anchoring and associated dredging from the emplacement of 10 platforms and 220 km of pipelines and the drilling of 220 wells over a 35-year period will result in minor, localized, temporary impacts on water quality.

In addition to increasing 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. Explosive removal operations related to Sale 150 will occur very infrequently. No more than one platform per year will be removed (Section IV.A.2.a.(4)), and it is unknown if this will be removed explosively. The consensus of research on explosive removals is that resuspension of sediments has only a short-term local effect of a very limited nature. Given the frequency of occurrence, minimum impacts on water quality are expected from these operations.

Historically, most oil spills have impacted water quality during the life of the spill and for a short time afterwards (Neff et al., 1989). Most of the components of oil are insoluble in water, and most of the spilled oil floats. A number of weathering processes act on an oil spill to remove oil from the water column and surface of the water within several months (Neff, 1990a). Section IV.C.2. of the Final EIS for Sales 142 and 143 (USDOl, MMS, 1992b) provides more detail on weathering processes. The frequency of occurrence and the area of contact of spilled oil are the major factors determining water-quality degradation. Sections IV.A.3.h. and IV.B.2.d. provide projections on spill occurrence, average size of each spill, and the areal coverage of projected spills. Only six Size 1 spills are projected. In addition, 3 spills of diesel and oil-based drilling muds are assumed to occur offshore from platforms. Given the infrequent nature of these spills, especially the fact that no large size spills are projected, impacts on offshore water quality from oil-spill events related to Sale 150 are projected to be negligible, to be of short-duration (2-3 months), and to affect only a small area of offshore waters at any one time.

About 1.5 MMbbl of drilling fluids and 485,000 bbl of drilling cuttings will be discharged from the drilling of 120 exploratory wells and 100 development wells (Table IV-4). The exploratory wells will be drilled over a 10-year period, the peak number in any one year being 15 (Table IV-4). About three exploratory wells will be drilled per lease, and the discharge from each well will last for approximately 40 days. The development wells will be drilled throughout the 23-year period, with 5 wells being drilled in the peak year. As wells become depleted during production, new wells will be drilled from the platform. On the average, about 14 wells are typically drilled from each platform, and 12 of these wells will go into production (Section IV.A.2.a.). The discharge from each well will last for approximately 35 days. If the development wells are all drilled immediately, a maximum number of wells in any one year from any one platform will be nine. Applying information on discharge quantities to the above scenario, it is possible that the area around any of the 10 projected platforms can be contaminated from the discharge of 36,000 bbl of drilling discharges continuously for about a year and a half (assuming 3 exploratory wells and 9 development wells were drilled at one site) and then intermittently afterwards when old wells become depleted and new wells are drilled. These quantities are consistent with the level and frequency of discharges studied historically. The introductory section of this analysis summarizes known impacts from past discharges. The same levels and types of impacts are expected to result from these future discharges. In general, discharges of drilling wastes will affect an area several thousand meters around a platform. Sediment contamination can be expected out to 3 km from the discharge point in the direction of the primary flow and will last up to 1 year after drilling ceases. Benthic marine organisms will be affected out to 1,000 m. Water quality criteria may be exceeded twice within 100 m from the discharge; sediment-pore water quality criteria will be exceeded 3-9 times.

Approximately 93 MMbbl of produced water will be discharged from one-half the projected platforms (5) over a 32-year time period. (It is assumed that about 50% of the 20 projected platforms will treat their water; the other 50% will pipe their water to platforms equipped with three-phase separators; and no new platforms will ship their production wastes to existing platforms.) These quantities are consistent with historical operations, for the most part, and it is expected that historical impacts summarized above will be applicable. Moderate petroleum and metal contamination of sediments and water column will occur out to several hundred meters around 5 platforms and will have small scale, localized effects on benthic organisms out to 200-500 m.

Two exceptions to the application of historical impact data for predicting future impacts are projections of future impacts from petroleum and NORM contamination. The new NPDES permit and effluent limitations will significantly decrease the quantities of oil and grease in produced-water effluents. It is expected, therefore, that levels of oil compounds measured in the water column and sediments around the 10 production platforms will be decreased from historical levels.

Most importantly, very little is known about the impacts of NORM in produced water. There have been no historical studies determining what impacts may be occurring. Toxic effects have not been noted in laboratory tests of the toxicities of whole produced-water effluents (Avanti Corporation, 1992). There is very limited data available on the bioaccumulation and sublethal effects of NORM in produced-water discharges. Levels of radionuclides in produced waters are projected by USEPA (based on a small data set) to be about 0.2 lb of radium/Bbbl of produced-water effluent. For the proposed action, therefore, about 0.02 lb of radium will be released into the water column over the production life of the 5 platforms discharging produced water.

The USEPA addresses why they continue to allow discharges of produced waters containing NORM and not set standards. They believe there is not enough information to conclude that radionuclides are a pollutant of concern. The USEPA has the authority under Sections 304(b)(2)(A) and 306(b)(1)(B) of the Clean Water Act to exclude certain pollutants from regulation and have exercised this authority to not set limits on NORM. The USEPA states in their recent effluent limitation regulations (40 CFR 435), which are not yet published, that "while the agency recognizes that it needs additional information concerning radionuclides in produced water effluent . . . and intend to seek such information through monitoring requirements (now imposed in the general permit), EPA believes that without this information, regulation of the entire offshore subcategory is likely to impose unnecessary regulation on a significant number of facilities."

The contribution of operational discharges related to Sale 150 to regional, chronic water-column degradation and sediment contamination must be considered. Activities resulting from Sale 150 will make up about 3 percent of all future OCS oil and gas industry-related operations. If, for analytical purposes, an assumption is made that regional water-quality degradation by the OCS industry makes up 50 percent of the total contamination that occurs, then discharges from Sale 150 operations would contribute a little more than 1 percent of the cumulative contamination (Section IV.D.2.d.).

Summary

Sediment disturbance from the emplacement of 10 platforms and 220 km of pipeline and from the drilling of 220 wells over a 35-year period will result in minor, localized, temporary impacts on water quality. The drilling of the wells, construction of the platforms, and laying of the pipe will result in increased water-column turbidities in offshore waters. Such bottom disturbance of sediments will result in resuspension of any settled pollutants, such as trace metals, chlorinated hydrocarbons, and excess nutrients, that may have accumulated in the sediments. The resuspension of significant quantities of contaminants from bottom-disturbance operations is not expected to occur due to a lack of contaminants in deep water sediments and the infrequency of the operations. Given the low frequency of platform removals (maximum is three in the peak year), minimum impacts on water quality due to resuspension of sediments, especially resulting from explosive removals, are expected from these operations.

Only six size 1 spills are projected. Given the infrequent nature of these spills, especially the fact that no spills larger than 50 bbl are projected, impacts on offshore water quality from oil-spill events related to Sale 150 are projected to be negligible, to be of short-duration (2-3 months), and to only affect a small area of offshore waters at any one time.

The area around each of the 10 projected platforms can be contaminated from the discharge of 36,000 bbl of drilling muds and cuttings at each site. These discharges may be released continuously for about a year and a half (assuming 3 exploratory wells and 9 development wells were drilled at one site) and then other quantities discharged intermittently when old wells become depleted and new wells are drilled. These discharges of drilling wastes will affect an area several thousand meters around a platform. Sediment contamination can be expected out to 3 km from the discharge point in the primary direction of the current and will last up to 1 year after drilling ceases. Benthic marine organisms will be affected out to 1,000 m. Water-quality criteria are expected to be exceeded within 100 m from the discharge. Moderate petroleum and metal contamination of sediments and water column from the discharge of 115 MMbbl of produced water at 5 platforms will occur out to several hundred meters from the discharge point and will have small scale, localized effects on benthic organisms out to 200-500 m. If, for analytical purposes, an assumption is made that the regional, long-term contamination of Gulf waters and sediments by the OCS industry makes up 50 percent of the total water-quality degradation that occurs, then discharges from Sale 150 operations would contribute a little more than 1 percent of the Gulf water-quality cumulative contamination (Section IV.D.2.d.).

Conclusion

As a result of the proposed action, marine waters will be degraded from discharges, oil spills, and bottom disturbances. Bottom disturbances (platform and pipeline emplacements and removals) and oil spills are expected to result in minor, localized, temporary impacts to water quality. Changes in water-quality parameters

will return to background within months from the disturbance. Operational discharges are primarily muds and cuttings and produced waters. Drilling muds and cuttings, which are discharged intermittently throughout the life of a platform, are expected to contaminate a localized area around platforms out to 3,000 m for up to 1 year after drilling ceases. Production wastes, which are discharged continuously throughout the life of most of the platforms, will change some water quality and sediment parameters within several hundred meters downcurrent from the discharge point for an average of 20 years. These discharges will also contribute, to a very small extent, to the long-term, regional contamination of Gulf waters and sediments.

High Case Analysis

Table IV-4 indicates that 310 exploration and delineation wells, 250 development wells, 30 platforms, and 380 km of pipeline supporting Sale 150 operations will be installed. Eight of these platforms will be removed explosively during the 35-year analysis period. None of the pipelines are projected for removal.

The drilling of the wells, construction of the platforms, and laying of the pipe will result in increased water-column turbidity in overlying offshore waters. Using average rig and platform sizes, the total bottom area disturbed by the pile-driving, anchoring, or dredging needed for the temporary presence of rigs during drilling and by all pipeline and platform installation operations is estimated at 264 ha. For those pipelines laid in water depths shallower than 61 m, burial below the seafloor is required. Pipeline burial activities will result in the resuspension of some 380,000 m³ of sediment during the installation of pipelines in water depths of 61 m and less. Offshore Subarea W-2 is the primary subarea where burial will take place (Table IV-4). Bottom disturbance of sediments will result in resuspension of any settled pollutants, such as trace metals, chlorinated hydrocarbons, and excess nutrients, that may have accumulated in the sediments. Major sources of these contaminants are both coastal or land-based, and sediment contamination is a function of distance from shore. Examination of the extent of these operations in each subarea (Table IV-4) indicates that the vast majority of the activities projected for Sale 150 will occur at a substantial distance from shore, and therefore, the sediments are not as likely to be contaminated. The resuspension of significant quantities of contaminants from bottom disturbances is not expected to occur. Furthermore, activities resulting in suspension of offshore sediments will occur very infrequently. Looking at peak-year estimate for Subarea W-1, the subarea nearest to the shore, no more than two wells will be drilled, one platform installed, and 7 km of pipeline laid. Such levels of activity are similar to the level of operations examined in a study researching water-quality effects from platform installation discussed above (Arthur D. Little, Inc., 1985). The conclusion of the study can therefore be applied to Sale 150 installation operations. Sediment disturbance and resuspension resulting from pile-driving and anchoring and associated dredging from the emplacement of 30 platforms and 380 km of pipelines and the drilling of 560 wells over a 35-year period will result in minor, localized, temporary impacts on water quality.

In addition to increasing 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. Explosive removal operations related to Sale 150 will occur very infrequently. No more than 3 platforms per year will be removed (Section IV.A.2.a.(4)), and it is likely that not all of these will be removed explosively. The consensus of research on explosive removals is that resuspension of sediments has only a short-term local effect of a very limited nature. Given the frequency of occurrence, minimum impacts on water quality are expected from these operations.

Historically, most oil spills have impacted water quality during the life of the spill and for a short time afterwards (Neff et al., 1989). Most of the components of oil are insoluble in water, and most of the spilled oil floats. A number of weathering processes act on an oil spill to remove oil from the water column and surface of the water within several months (Neff, 1990a). Section IV.C.2. of the Final EIS for Sales 142 and 143 (USDOL, MMS, 1992b) provides more detail on weathering processes. The frequency of occurrence and the area of contact of spilled oil are the major factors determining water-quality degradation. Sections IV.A.3.h. and IV.B.2.d. provide projections on spill occurrence, average size of each spill, and the areal coverage of projected spills. One subsurface 6,500-bbl spill, 1 Size 2 spill, and 18 Size 1 spills are projected. In addition, 9 spills of diesel and oil-based drilling muds are assumed to occur offshore from platforms. The maximum slick area is projected to be about 1 million m² (Section IV.A.3.h.(2)) for the 6,500-bbl spill. Given the infrequent nature of these spills, especially for the larger size categories, impacts on offshore water quality

from oil-spill events related to Sale 150 are projected to be negligible, to be of short-duration (2-3 months), and to affect only a small area of offshore waters at any one time.

About 3.9 MMbbl of drilling fluids and 1.2 MMbbl of drilling cuttings will be discharged from the drilling of 310 exploratory wells and 250 development wells (Table IV-4). The exploratory wells will be drilled over a 10-year period, the peak number in any one year being 55 (Table IV-4). About three exploratory wells will be drilled per lease, and the discharge from each well will last for approximately 40 days. The development wells will be drilled throughout the 23-year period, with 15 wells being drilled in the peak year. As wells become depleted during production, new wells will be drilled from the platform. On the average, about 14 wells are typically drilled from each platform, and 12 of these wells will go into production (Section IV.A.2.a.). The discharge from each well will last for approximately 35 days. If the development wells are all drilled immediately, a maximum number of wells in any one year from any one platform will be nine. Applying information on discharge quantities to the above scenario, it is possible that the area around any of the 30 projected platforms can be contaminated from the discharge of 36,000 bbl of drilling discharges continuously for about a year and a half (assuming 3 exploratory wells and 9 development wells were drilled at one site) and then intermittently afterwards when old wells become depleted and new wells are drilled. These quantities are consistent with the level and frequency of discharges studied historically. The introductory section of this analysis summarizes known impacts from past discharges. The same levels and types of impacts are expected to result from these future discharges. In general, discharges of drilling wastes will affect an area several thousand meters around a platform. Sediment contamination can be expected out to 3 km from the discharge point in the direction of the primary flow and will last up to 1 year after drilling ceases. Benthic marine organisms will be affected out to 1,000 m. Water quality criteria may be exceeded twice within 100 m from the discharge; sediment pore water quality criteria will be exceeded 3-9 times.

Approximately 242 MMbbl of produced water will be discharged from, about half the platforms projected (15) over a 32-year time period. (It is assumed that about 50% of the projected number platforms will treat their water; the other 50% will pipe their water to platforms equipped with three-phase separators; and no new platforms will ship their production wastes to existing platforms.) These quantities are consistent with historical operations, for the most part, and it is expected that historical impacts summarized above will be applicable. Moderate petroleum and metal contamination of sediments and water column will occur out to several hundred meters around 15 platforms and will have small-scale, localized effects on benthic organisms out to 200-500 m.

Two exceptions to the application of historical impact data for predicting future impacts are projections of future impacts from petroleum and NORM contamination. The new NPDES permit and effluent limitations will significantly decrease the quantities of oil and grease in produced-water effluents. It is expected, therefore, that levels of oil compounds measured in the water column and sediments around the 30 production platforms will be decreased from historical levels.

Most importantly, very little is known about the impacts of NORM in produced water. There have been no historical studies determining what impacts may be occurring. Toxic effects have not been noted in laboratory tests of the toxicities of whole produced-water effluents (Avanti Corporation, 1992). There is very limited data available on the bioaccumulation and sublethal effects of NORM in produced-water discharges. Levels of radionuclides in produced waters are projected by USEPA (based on a small data set) to be about 0.2 lb of radium/Bbbl of produced-water effluent. For the proposed action, therefore, about 0.05 lb of radium will be released into the water column over the production life of the 15 platforms discharging produced water.

The USEPA addresses why they continue to allow discharges of produced waters containing NORM and not set standards. They believe there is not enough information to conclude that radionuclides are a pollutant of concern. The USEPA has the authority under Sections 304(b)(2)(A) and 306(b)(1)(B) of the Clean Water Act to exclude certain pollutants from regulation and have exercised this authority to not set limits on NORM. The USEPA states in their recent effluent limitation regulations (40 CFR 435), not yet published, that "while the agency recognizes that it needs additional information concerning radionuclides in produced water effluent . . . and intend to seek such information through monitoring requirements (now imposed in the general permit), EPA believes that without this information, regulation of the entire offshore subcategory is likely to impose unnecessary regulation on a significant number of facilities."

The contribution of operational discharges related to Sale 150 to regional, chronic water-column degradation and sediment contamination must be considered. Activities resulting from Sale 150 (High Case)

will make up about 6 percent of all future OCS oil and gas industry related operations. If, for analytical purposes, an assumption is made that regional water-quality degradation by the OCS industry makes up 50 percent of the total contamination that occurs, then discharges from Sale 150 operations would contribute about 3 percent of the cumulative contamination (Section IV.D.2.d.).

Conclusion

As a result of the High Case, marine waters will be degraded from discharges, oil spills, and bottom disturbances. Bottom disturbances (platform and pipeline emplacements and removals) and oil spills are expected to result in minor, localized, temporary impacts to water quality. Changes in water-quality parameters will return to background within months from the disturbance. Operational discharges are primarily muds and cuttings and produced waters. Drilling muds and cuttings, which are discharged intermittently throughout the life of a platform, are expected to contaminate a localized area around platforms out to 3,000 m for up to 1 year after drilling ceases. Production wastes, which are discharged continuously throughout the life of most of the platforms, will change some water quality and sediment parameters within several hundred meters downcurrent from the discharge point for an average of 20 years. These discharges will also contribute, to a very small extent, to the long-term, regional contamination of Gulf waters and sediments.

(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. (description of Gulf of Mexico meteorology and coastal counties air quality status), IV.A.3.h.(2) (oil-spill assumptions), and IV.A.3.i. (air emissions). The parameters of this analysis are the emission rates, surface winds, stability of the overlying 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), a toxic gas at very high concentrations, 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. Sulphur 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 suspended particulate matter (TSP).

Ozone is a regulated 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 μgm^{-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.3.f.

The above values show that emissions of NO_x are between 4 and 34 times greater than emissions for other pollutants during drilling activities.

Platform emissions for the Gulf of Mexico region (Section IV.A.3.f.) 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 40-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, mixed layer height, exhaust gas temperature and speed, and wind speed. 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 (USDOL, MMS, 1988b) 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 instability is important because it helps to distribute and diffuse the available energy or momentum of the atmosphere.

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-4) for the 35-year life of the proposed action establishes that 120 exploration and delineation and 100 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-4 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-4. Emissions from other related activities were calculated using information also presented in Table IV-4.

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

<u>Activity</u>	<u>NO_x</u>	<u>CO</u>	<u>SO_x</u>	<u>THC</u>	<u>TSP</u>
Service Vessels	1,685.2	197.4	26.6	85.8	118.9
LTO Helicopters	16.4	13.2	2.5	0.7	0.6
Cruise Helicopters	52.8	151.0	11.3	12.3	15.1
Blowouts without Fire	0.0	0.0	0.0	12.0	0.0
Spills without Fire	0.0	0.0	0.0	0.0	0.0
Barge Loading	0.0	0.0	0.0	3.8	0.0
Tanker Loading	0.0	0.0	0.0	173.5	0.0
Transit Loss	0.0	0.0	0.0	126.3	0.0
Tanker Exhaust	118.8	13.0	147.6	0.2	42.7
Tug Exhaust	14.5	32.1	0.2	0.7	0.9
Exploratory Wells	1,160.4	309.6	135.6	116.4	33.6
Development Wells	644.4	171.9	75.6	64.8	18.9
Platforms	17,493.0	2,278.7	30.6	6,630.0	42.8
Totals	21,185.5	3,166.9	430.0	7,226.3	273.5

Total emissions for each subarea in the WPA during the proposed action are presented below. Observe that activities in Subarea W-1, which is the closest to land, would generate the smallest emissions of all pollutants, while activities in 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)

<u>Pollutant</u>	<u>W-1</u>	<u>W-2</u>	<u>W-3</u>
NO _x	4,237.1	6,355.6	10,592.7
CO	633.4	950.1	1,583.5
SO _x	86.0	129.0	215.0
THC	1,445.3	2,167.9	3,613.1
TSP	54.7	82.1	136.8

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 the combined 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. Aggregate emissions represent the sum of the peak emissions for vessels, others, and the peak of the platform and wells. The platform and well peak emissions were obtained from the superposition of their respective temporal distribution. 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)

<u>Pollutant</u>	<u>Wells</u>	<u>Platforms</u>	<u>Vessels</u>	<u>Others</u>	<u>Mean</u>	<u>Aggregate</u>
NO _x	180.9	857.5	53.9	0.0	605.30	947.23
CO	48.3	111.7	11.6	0.0	90.48	132.87
SO _x	21.2	1.5	5.4	0.0	12.29	27.28
THC	5.3	325.0	2.8	9.0	206.46	340.46
TSP	18.2	2.1	5.1	0.0	7.81	11.39

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.

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 analysis, a uniform distribution of average size sources throughout the planning areas at this stage is assumed. 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]=0.140[NO_x]; [SO_x]=0.029[NO_x]; and [TSP]=0.012[NO_x]. Notice that concentrations of primary pollutants other than NO_x would be smaller by more than 80 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 where winds are blowing offshore, impacts to the onshore air quality from offshore WPA emissions can be neglected because the pollutants are transported offshore. Conditions of onshore winds indicate that concentrations reaching land from Subarea W-1 varied between 0.20 and 0.03 μgm⁻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 0.60 to 0.08 μgm⁻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/D^{2/3} and 33.3/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 emission level of VOC in Subarea W-1 is estimated as 68.1 tons/yr. Transport of pollutants toward onshore areas has a maximum frequency of 85 percent during summer and only 34 percent during winter. 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 (USDOL, 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 μgm⁻³, which is below the NO_x national standard of 100 μgm⁻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 (USDOL, MMS, 1991d). Annual average concentrations peaked around 0.04 μgm⁻³ and the highest 1-hour concentration never exceeded 1.54 μgm⁻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, 10 platforms spread over 145.3 billion m², would have a much smaller effect.

Oil-spill effects on air quality are examined below. It is assumed that Size 1 and Size 2 oil spills would cause low pollutant concentrations 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/hr by the second hour. For Size 3 spills, emissions are about 285 tons/hr or smaller. But no impacts from Size 3 spills will occur because it is assumed that no Size 3 oil spill 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 177 tons for the Base Case over the 35-year life of the proposed action. This represents 2.4 percent of the total VOC emissions. Emissions from surface 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 $2\text{ }\mu\text{m}$ and a third peak with a diameter larger than $2\text{ }\mu\text{m}$. Particles with diameters of $2\text{ }\mu\text{m}$ or larger settle very close to the source (residence time of approximately $\frac{1}{2}$ day, Lyons and Scott, 1990), so their concentration on these areas would be low. For particles smaller than $2\text{ }\mu\text{m}$, which do not settle fast, wind transport determines their impacts. Results from the box model indicate that the largest concentration for TSP will be $0.01\text{ }\mu\text{gm}^{-3}$, which is less than the allowable annual increase level of $5\text{ }\mu\text{gm}^{-3}$. Section III.A.3. indicates that in coastal areas the PM_{10} is around $50\text{ }\mu\text{gm}^{-3}$ and the national standard is $150\text{ }\mu\text{gm}^{-3}$, 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 and State oil and gas activities and are defined as an uncontrolled flow of fluids from a wellhead or wellbore. One blowout is assumed to occur 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. 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 12 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 was awarded 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 frequency of onshore winds decreases and the removal of pollutants by rain increases.

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 $1 \mu\text{gm}^{-3}$ (box model steady concentrations). The impacts decrease during winter because onshore winds occur only about 34 percent of the time, and impacts increase in summer because onshore winds occur 85 percent of the time.

High Case Analysis

The scenario discussed in Section IV.A. (Table IV-4) for the High Case establishes that 310 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 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-4 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. 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-4. Emissions from other related activities were calculated using information presented in Table IV-4 and emission factors from Jacobs Engineering Group Inc. (1989) or USEPA (1985).

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

<u>Activity</u>	<u>NO_x</u>	<u>CO</u>	<u>SO_2</u>	<u>THC</u>	<u>TSP</u>
Service Vessels	4,482.6	525.1	70.8	228.1	316.2
LTO Helicopters	49.0	39.6	7.5	2.0	1.9
Cruise Helicopters	158.2	452.0	33.9	36.8	45.2
Blowouts without Fire	0.0	0.0	0.0	54.0	0.0
Spills without Fire	0.0	0.0	0.0	255.0	0.0
Barge Loading	0.0	0.0	0.0	11.3	0.0
Tanker Loading	0.0	0.0	0.0	520.4	0.0
Transit Loss	0.0	0.0	0.0	378.8	0.0
Tanker Exhaust	349.6	38.2	434.2	0.6	125.6
Tug Exhaust	52.4	32.1	0.7	2.4	3.1
Exploratory Wells	2,997.7	799.8	350.3	300.7	86.8
Development Wells	1,646.8	439.3	193.2	165.6	48.3
Platforms	52,479.0	6,836.0	91.8	19,890.0	128.5
Totals	62,215.2	9,162.2	1,182.5	21,845.7	755.7

Total emissions for each subarea in the WPA during the High Case are presented below. Observe that activities in Subarea W-1, which is the closest to land, generate the smallest emissions of all pollutants, while activities in Subarea W-3, the farthest from land, generate the greatest amounts of emissions.

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

<u>Pollutant</u>	<u>W-1</u>	<u>W-2</u>	<u>W-3</u>
NO _x	4,147.7	12,443.0	45,624.5
CO	610.8	1,832.4	6,718.9
SO _x	78.8	236.5	867.1
THC	1,456.4	4,369.1	16,020.2
TSP	50.4	151.1	554.2

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. Aggregate emissions represent the sum of the peak emissions for vessels, others, and the peak of the platform and wells. The platform and well peak emissions were obtained from the superposition of their respective temporal distributions.

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

<u>Pollutant</u>	<u>Wells</u>	<u>Platforms</u>	<u>Vessels</u>	<u>Others</u>	<u>Mean</u>	<u>Aggregate</u>
NO _x	639.3	2,572.5	145.5	0.0	1,777.58	2,789.58
CO	170.6	335.1	31.1	0.0	261.78	385.26
SO _x	74.8	4.5	15.6	0.0	33.78	88.13
THC	18.6	975.0	7.7	34.8	624.16	1,024.75
TSP	64.1	6.3	14.1	0.0	21.59	34.29

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.

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 when winds are blowing offshore, impacts to the onshore air quality from offshore WPA emissions can be neglected because the pollutants are transported offshore. Conditions of onshore winds indicate that concentrations reaching land from Subarea W-1 varied between 0.67 and 0.09 μgm^{-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 2.08 to 0.28 μgm^{-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 minimal because the only ambient concentration reported (94 μgm^{-3}) was below the national standard (100 μgm^{-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 emission level of VOC in Subarea W-1 is estimated at 68.3 tons/yr. Transport of pollutants toward onshore areas have a frequency maximum of 85 percent during summer and only 34 percent during winter. 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 (USDOl, 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 μgm^{-3} , which is below the national standard of 100 μgm^{-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 (USDOl, MMS, 1991d). Annual average concentrations peaked around 0.04 μgm^{-3} and the highest 1-hour concentration never exceeded 1.54 μgm^{-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 m^3 , would have a much smaller effect.

Oil-spill effects on air quality are examined below. It is assumed that Size 1 and Size 2 oil spills would have low pollutant concentrations 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 Size 3 spills emissions are about 285 tons/hr or smaller. A single Size 3 spill 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 532 tons during the 35-year life of the proposed action. These emissions represent 2.4 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 μm and a third peak with a diameter larger than 2 μm . Particles with diameters of 2 μm or larger settle very close to the source (residence time of approximately $\frac{1}{2}$ day, Lyons and Scott, 1990), so their concentrations on these areas would be low. For particles smaller than 2 μm , which do not settle fast, wind transport

determines their impacts. Results from the box model indicate that the largest concentration for TSP will be $0.02 \mu\text{gm}^{-3}$, which is less than the allowable annual increase level of $5 \mu\text{gm}^{-3}$. Besides, Section III.A.3. indicates that in the coastal areas the suspended particulate matter is around $50 \mu\text{gm}^{-3}$ and the national 24-hour standard is $150 \mu\text{gm}^{-3}$, making the OCS contribution unimportant.

Blowouts are accidents related to OCS and State oil and gas activities and are defined as an uncontrolled flow of fluids from a wellhead or wellbore. Three blowouts are assumed to occur 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. 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/day (BPD) will be assumed. No statistics exist on the amount of gas released during a blowout; however, for this analysis, a rate of 1 Bcf/day will be assumed. The emission rate for a blowout without fire is 2,000 lb/hr of THC for a 1,000 bbl/day and 1 Bcf/day blowout accident. Using our assumption of oil released, we estimate the rate could then be reduced by half, or 1,000 lb/hr of THC. The total emission of THC is 54 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 experience low emission concentrations 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 $1 \mu\text{gm}^{-3}$ (box model steady concentrations). The impacts decrease during winter because onshore winds occur only about 34 percent of the time, and impacts increase in summer because onshore winds occur 85 percent of the time.

(5) Impacts on Marine Mammals

(a) Nonendangered and Nonthreatened Species

This section discusses the possible effects of the proposed action on nonendangered and nonthreatened marine mammals in the Gulf of Mexico. Twenty-two nonendangered species of marine mammals of the taxonomic Order Cetacea (which comprises whales, dolphins, and porpoises) have been identified in the Gulf (Table III-5). The majority of these species are typically found in deeper waters (the continental shelf edge and beyond), with the exception of the bottlenose dolphin and Atlantic spotted dolphin, which commonly inhabit nearshore and shelf waters (Mullin et al., 1991; Mullin, personal communication, 1993).

The predominant impact-producing factors related to the proposed action that may affect nonendangered cetaceans in the Gulf include onshore operational discharges, helicopter and vessel traffic and noise, platform

and drillship operations, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service vessels and OCS structures.

Produced waters, operational wastes, drill muds, and drill cuttings can potentially impact cetaceans via displacement or removal of food sources or via the degradation of water quality. Most operational discharges are rapidly diluted and dispersed when released in offshore areas and are not considered to be lethal or detrimental to cetaceans (API, 1989; NRC, 1983; Henwood, personal communication, 1993).

The passage of helicopters and support vessels in proximity to cetaceans can elicit a startle response with subsequent avoidance or evasive behavior. This effect is sublethal, though it could temporarily disrupt ongoing feeding, mating, resting, or migratory behavior, or cause the dispersion of a social group. This behavioral response could be a result of noise and/or visual disturbance. The main source of underwater noise from support vessels making way is from cavitation and irregularities of the propeller(s). Other noises are emitted from the main engine(s) and auxiliary machinery. The response of cetaceans to such noise is somewhat species-specific and appears to be, in part, a function of sound intensity, distance, the fact that the noise source is in motion (compared to a static and nonchanging source), season (primarily mating season), and individual variability in whale behavior. Evidence suggests that certain whales have reduced their utilization of certain areas heavily used by ships, though continued presence of various whale species in such areas indicates a considerable degree of tolerance to ship noise and disturbance (Richardson et al., 1991). Groups of dolphins and porpoises are often attracted to vessels making way in order to bowride or, in the case of fishing vessels, take advantage of discarded bycatch.

Support vessels involved in survey, service, or shuttle functions could collide with and physically impact cetaceans, especially larger species and those that remain at the surface for extended periods of time (United Press International, 1986). Many of the larger species of nonendangered cetaceans are deep-diving odontocetes, which commonly spend extended periods of time at the surface in order to restore oxygen levels within their tissues. The normal distribution of these mammals appears to be beyond the continental shelf edge, well into the bounds of the continental slope. Cetaceans that inhabit the continental shelf and nearshore waters, most commonly bottlenose and spotted dolphins, are agile swimmers that often approach vessels making way, even when in the confines of narrow navigational passes and waterways, and seem well able to avoid such vessels when deemed necessary. The probability of OCS service-vessel collisions is therefore greater within areas of the Gulf that are off the shelf edge. Some of these sounds could interfere with the cetaceans' reception of sounds produced for echo-location and communication.

Exploration, delineation, and production structures, as well as drillships, produce an acoustically wide range of sounds at frequencies and intensities that can be detected by cetaceans. Odontocete (toothed) cetaceans use sounds for acoustic echo-location and communication at frequencies that are generally higher than the dominant sounds generated by offshore drilling and production activities. Baleen whales mainly utter low-frequency sounds at frequencies below 1 kHz, which overlap broadly with the dominant frequencies in many industrial sounds (Malme et al., 1989; Richardson et al., 1991). Drilling noise from conventional metal-legged structures and semi-submersibles is not particularly intense, and strongest at low frequencies, averaging 5 Hz and 10-500 Hz, respectively. Drillships produce higher levels of underwater noise than other types of platforms (Richardson et al., 1991).

Removal of offshore platforms by means of explosive charges can directly impact cetaceans. The effects of underwater detonation of explosive charges is dependent upon the amount of explosive used, distance from the charge, and body mass. Hemorrhaging in and around the lungs is the primary source of injury to submerged mammals, as well as injuries from the effects of explosive impact upon gas bubbles within the intestines (Goertner, 1982). The effects of explosives could also damage the ears of submerged cetaceans, and thus affect intraspecific communication, feeding, and navigation. Although deaths and permanent injuries have been speculated, none have been documented. In order to minimize the likelihood of removals occurring when cetaceans may be nearby, MMS has issued a series of guidelines (NTL 92-02) for explosive platform removal to offshore operators. These guidelines specify platform removal only during daylight hours, staggered detonation of charges, placement of charges 5 m below the seafloor, and extensive pre- and post-detonation surveys of surrounding waters.

Seismic surveys involve the use of an acoustic pulse, generated by compressed air. The effects of these sound pulses may affect cetacean communications and behavior if the pulses exceed ambient noise levels.

Although ambient noise levels in the marine environment are highly variable, the effects of noise generated from seismic surveys are limited as a result of the dissipation of sound pressure through seawater. Acoustic pressure thus produced dissipates to levels below 200 dB at distances beyond 30 m from the acoustic source (Gales, 1982). Seismic surveys are systematically executed, and it is assumed that cetaceans could easily avoid the presence or approach of the acoustic source within the open waters of the Gulf of Mexico. Thus, the effects on cetaceans from seismic surveys are primarily sublethal and at most constitute short-term avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans. Direct contact with oil and/or tar can lead to irritation and damage of skin and soft tissues (such as mucous membranes of the eyes), fouling of baleen plates so as to hinder the flow of water and interfere with feeding, and incidental ingestion of oil and/or tar. Studies by Geraci and St. Aubin (1982 and 1985) have shown, however, that the cetacean epidermis functions as an effective barrier to noxious substances found in petroleum. Unlike other mammals, penetration of such substances in cetacean skin is impeded by tight intercellular bridges, the vitality of the superficial cells, the thickness of the epidermis, and the lack of sweat glands and hair follicles (Lavis, personal communication, 1993; Wursig, personal communication, 1993). Cetacean skin is free from hair or fur, which, in other marine mammals such as pinnipeds and otters, tends to collect oil and/or tar, and effectively reduces its insulative properties (Geraci, 1990). Inhalation of vapors can lead to irritation of respiratory membranes, lung congestion, and pneumonia; subsequent absorption of volatile hydrocarbons into the bloodstream may accumulate into such tissues as the brain and liver, causing neurological disorders and liver damage (Geraci and St. Aubin, 1982; Hansen, 1985; Geraci, 1990). Geraci and St. Aubin (1982) determined that toxic vapor concentrations just above the water's surface (where cetaceans draw breath) could reach critical levels for the first few hours after a spill, prior to evaporation of volatile aromatic hydrocarbons and other light fractions. The lack of olfactory ability in cetaceans suggests that sense of smell might not be used to detect, and thus allow them to avoid such slicks. The probable effects on cetaceans swimming through the area would depend on a number of factors, including ease of escape from the vicinity, the health of the individual animal, and its immediate response to stress. Spilled oil can also lead to the reduction or contamination of prey and temporary displacement from migratory routes. Feeding strategies of cetaceans could lead to ingestion of oil-contaminated food or incidental ingestion of floating or submerged oil or tar. Baleen whales from the Gulf of Mexico that are not listed as endangered feed on small pelagic fishers (such as herring, mackerel, and pilchard) and cephalopods (Cummings, 1985). An analysis of stomach contents from captured and stranded odontocetes suggest that they are deep-diving animals, feeding predominantly on mesopelagic fish and squid or deep-water benthic invertebrates (Heyning, 1989; Mead, 1989). Delphinids feed on fish and/or squid, depending upon the species (Mulling et al., 1991). Zooplankton may become contaminated by direct contact and/or by ingesting oil droplets and tainted food. Marine fish also take up petroleum hydrocarbons from both water and food, though apparently do not accumulate high concentrations of hydrocarbons in tissues and transfer them to predators (Neff, 1990b). Reactions of cetaceans to spilled oil are varied, with evidence of both direct avoidance and obvious indifference in even heavily oiled areas. Several observations of cetaceans confronting spilled oil show them in the vicinity, and in some cases in the midst of a spill, behaving quite normally. At present, unknown whether these animals in such cases are simply not affected by the presence of oil, or perhaps are even drawn to the area in search of prey organisms attracted to the oil's protective surface shadow (Geraci, 1990). Controlled experiments on detection and avoidance response of bottlenose dolphin to oil films showed that dolphins can see oil at the surface and that they prefer to avoid it (Geraci et al., 1983; Smith et al., 1983; St. Aubin et al., 1985).

Oil-spill response activities include the application of dispersant chemicals to the affected area designed to break up oil on the water's surface into minute droplets which then break down in seawater. Virtually nothing is known about the effects of oil dispersants on cetaceans, except that removal of the oil from the surface would reduce the risk of contact and render it less likely to adhere to skin, baleen plates, or other body surfaces (Neff, 1990b). The acute toxicity of most oil dispersant chemicals is considered to be low, when compared to the constituents and fractions of crude oils and refined products, and studies have shown that the rate of biodegradation of dispersed oil is equal to or greater than that of undispersed oil (Wells, 1989). Biodegradation is another process used for removing petroleum hydrocarbons from the marine environment,

utilizing chemical fertilizers to augment the growth of naturally occurring hydrocarbon-degrading microorganisms. Toxic effects of these fertilizers on cetaceans is presently unknown.

Pollution of the marine environment with nonbiodegradable plastic debris discarded from offshore sources (structures, and vessels) and coastal sources (litter and solid waste disposal) has become an issue of increasing concern, especially with regard to entanglement of and ingestion by marine mammals. Typically, marine mammals become entangled in various types of debris (mostly lines of various types) and inactive or active fishing gear. Plastic debris has also been reported from gut contents of several stranded marine mammals; in some cases ingestion of such material is believed to be the cause of death (Barros and Odell, 1990; Sadove and Morreale, 1990; Tarpley, 1990;). It is believed that the animals either mistake the plastic material, which is in suspension in the water column, as a food item, or in the case of larger baleen whales, it is ingested along with prey species (Sadove and Morreale, 1990). The MMS prohibits the disposal of equipment, containers, and other materials into coastal and offshore waters by lessees (30 CFR 250.40). Prohibition of the discharge and disposal of vessel- and offshore structure-generated garbage and solid waste items into both offshore and coastal waters was established January 1, 1989 via the enactment of MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which is enforced by the U.S. Coast Guard.

Base Case Analysis

The major impact-producing factors analyzed below are related to the proposed action and include degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service vessels and OCS structures.

An estimated 1.52 MMbbl of drilling fluids, 0.48 MMbbl of drill cuttings, and 9.3 MMbbl of produced waters are assumed to be generated offshore as a result of the proposed action (Table IV-4). 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; indirect effects via 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/or affect nonendangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis averaging about 4,300 trips per year. The FAA (Advisory Circular 91-36C) and corporate helicopter policy state that helicopters maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. It is estimated that cetaceans will not be affected by routine OCS helicopter traffic operating at these altitudes. It is also expected that 10 percent of helicopter trips will occur at altitudes below the specified minimums listed above as a result of inclement weather. Such incidents are very short-term and may elicit a startle reaction from cetaceans closeby.

It is assumed that about 143 OCS-related oil/gas service vessel trips will occur annually as a result of the proposed action and that 52 total shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-4). Noise from service-vessel traffic may elicit a startle and/or avoidance reaction from cetaceans or mask their sound reception. This effect is sublethal and constitutes a short-term and temporary impact. Survey data show that most cetacean species of the Gulf are distributed within deeper waters, on or beyond the continental shelf break. It is estimated that the number of service-vessel trips occurring within water depths greater than 100 m in the WPA by offshore subarea are as follows: 3 in Subarea W-1; 17 in Subarea W-2; and 100 in Subarea W-3. The probability of collisions is higher within these deeper waters. It is estimated that service-vessel traffic will rarely contact and affect nonendangered cetaceans, although collisions could be fatal.

It is assumed that 120 exploration and delineation wells and 100 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 be relatively constant and 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 echolocate and 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 and may elicit some degree of

avoidance behavior in the open Gulf. It is estimated that drilling noise will rarely disturb and affect nonendangered cetaceans.

Explosive platform removals can interfere with communication, elicit a pronounced startle reaction with subsequent avoidance or flight behavior, temporarily or permanently reduce hearing sensitivity, or cause hemorrhaging and death in cetaceans. It is estimated that four 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. It is expected that structure removals will cause sublethal effects on cetaceans as a result of the implementation of the MMS guidelines for explosive removals (USDOL, MMS, 1990a, Appendix B). It is estimated that structure removals will rarely disturb and affect nonendangered cetaceans.

Seismic surveys use airguns to generate sound 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.a.(1)). It is expected that effects of noise on cetaceans from seismic surveys are entirely sublethal, constituting a short-term startle response and avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans, causing skin and soft tissue irritation, fouling of baleen plates, respiratory stress from inhalation of toxic fumes, food reduction or contamination, the direct ingestion of oil and/or tar, and temporary displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from sale-related Size 3 oil spills, the effects would primarily be sublethal; few deaths are assumed. The effects of sale-related Size 1 and Size 2 offshore oil spills are assumed to be solely sublethal due to the small areas affected and their rapid dispersion.

Section IV.C.1. estimates the mean number of Size 1 and Size 2 spills occurring from the proposed action in the WPA. It is assumed that six Size 1 spills will occur during the 35-year life of the proposed action. It is estimated that the six spills will occur offshore and that none will contact nearshore areas and resident dolphin populations. It is assumed that no Size 2 spills will occur during the 35-year life of the proposed action. Although an interaction with Size 1 and Size 2 offshore spills may occur, only sublethal effects are assumed as a result of avoidance and natural dispersion/weathering of a spill in the offshore environment. It is estimated that Size 1 and Size 2 spills will rarely contact and affect nonendangered cetaceans.

Section IV.C.1. estimates the mean number of Size 3 spills resulting from the proposed action in the WPA. It is assumed that no crude oil Size 3 spill 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 Size 3 oil spill will not contact or affect nonendangered cetaceans in the WPA.

Many types of plastic materials are used during drilling and production operations. Some of this material is accidentally lost overboard where it can be consumed, incidentally or accidentally, by cetaceans. The result of plastic ingestion could be lethal, although the probability of occurrence is low.

Summary

Activities resulting from the proposed action have a potential to detrimentally affect nonendangered and nonthreatened marine mammals. These marine mammals could be impacted by the degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service vessels and OCS structures. The majority of these activities are estimated to be sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or debris). Lethal effects are estimated from the chance collisions with OCS service vessels and ingestion of plastic materials. Sale-related oil spills of any size are estimated to be extraordinary events that will rarely contact nonendangered and nonthreatened marine mammals.

Conclusion

The impact of the proposed action on nonendangered and nonthreatened marine mammals is expected to result in primarily sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or debris) that are both chronic and sporadic. These impacts could cause acute or chronic

physiological stress, alter normal behavior, and result in some degree of avoidance, either temporary or permanent, of the impacted area(s).

High Case Analysis

The major impact-producing factors analyzed below are related to the proposed action and include degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service vessels and OCS structures.

An estimated 3.9 MMbbl of drilling fluids, 1.2 MMbbl of drill cuttings, and 2 MMbbl of produced waters are assumed to be generated offshore as a result of the proposed action (Table IV-4). These effluents are routinely discharged into offshore marine waters and are regulated by the USEPA'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; indirect effects via 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/or affect nonendangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis, averaging about 13,000 trips each year. The FAA (Advisory Circular 91-36C) and corporate helicopter policy state that helicopters maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. It is estimated that cetaceans will not be affected by OCS helicopter traffic at these altitudes. It is also expected that 10 percent of helicopter trips will occur at altitudes below the specified minimums listed above as a result of inclement weather. Such incidents are very short-term and may elicit a startle reaction from cetaceans closeby.

It is assumed that about 380 OCS-related oil/gas service vessel trips will occur annually as a result of the proposed action and that 153 total shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-4). Noise from service-vessel traffic may elicit a startle and/or avoidance reaction from cetaceans or mask their sound reception. This effect is sublethal and constitutes a short-term and temporary impact. Survey data show that most cetacean species of the Gulf are distributed within deeper waters, on or beyond the continental shelf break. It is estimated that the number of service-vessel trips occurring within water depths greater than 100 m in the WPA by offshore subarea are as follows: 108 in Subarea W-1; 1,160 in Subarea W-2; and 10,900 in Subarea W-3. The probability of collisions are higher within these deeper waters. It is estimated that service-vessel traffic will rarely contact and affect nonendangered cetaceans, although collisions could be fatal.

It is assumed that 310 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 estimated that noise from drilling activities will be relatively constant and 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 echolocate and 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 and may elicit some degree of avoidance behavior in the open Gulf. It is estimated that drilling noise will rarely disturb and affect nonendangered cetaceans.

Explosive platform removals can interfere with communication, elicit a pronounced startle reaction with subsequent avoidance or flight behavior, temporarily or permanently reduce hearing sensitivity or cause hemorrhaging and death in cetaceans. It is estimated that eight 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 (Table IV-4). It is expected that structure removals will cause sublethal effects on cetaceans as a result of the implementation of the MMS guidelines for explosive removals (USDOJ, MMS, 1990a, Appendix B). It is estimated that structure removals will rarely disturb and affect nonendangered cetaceans.

Seismic surveys use airguns to generate sound 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 of noise on cetaceans from seismic surveys are entirely sublethal, constituting a short-term startle response and avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans, causing skin and soft tissue irritation, fouling of baleen plates, respiratory stress from inhalation of toxic fumes, food reduction or contamination, the direct ingestion of oil and/or tar, and temporary displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from sale-related Size 3 oil spills, the effects would primarily be sublethal; few deaths are assumed. The effects of sale-related Size 1 and Size 2 offshore oil spills are assumed to be solely sublethal due to the small areas affected and their rapid dispersion.

Section IV.A.3.h. estimates the mean number of Size 1 and Size 2 spills occurring from the proposed action in the WPA. It is assumed that 18 Size 1 spills will occur during the 35-year life of the proposed action. It is estimated that the 18 spills will occur offshore and that none will contact land (Section IV.A.3.h.). It is assumed that one Size 2 spill 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 nearshore areas and resident dolphin populations. Although an interaction with Size 1 and Size 2 offshore spills may occur, only sublethal effects are assumed as a result of avoidance and natural dispersion/weathering of a spill in the offshore environment. It is estimated that Size 1 and Size 2 spills will rarely contact and affect nonendangered cetaceans. Section IV.A.3.h. estimates the mean number of Size 3 spills resulting from the proposed action in the WPA. It is assumed that one crude oil Size 3 spill will occur from either a platform or pipeline in the Western Gulf during the 35-year life of the proposed action. Table IV-11 identifies the estimated risk of one or more Size 3 oil spills occurring and contacting areas within 10 days where many cetaceans have been sighted during surveys. There is a 5 percent probability that a Size 3 oil spill 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 a Size 3 oil spill will occur and contact within 10 days coastal areas of Texas (Table IV-11). Although an interaction with Size 3 spills may occur, few deaths are assumed with primarily sublethal effects as a result of avoidance and natural dispersion/weathering of an oil spill in the offshore environment. It is estimated that a Size 3 oil spill will rarely contact and affect nonendangered cetaceans in the WPA.

Many types of plastic materials are used during drilling and production operations. Some of this material is accidentally lost overboard where it can be consumed, incidentally or accidentally, by cetaceans. The result of plastic ingestion could be lethal, although the probability of occurrence is low.

Activities resulting from the proposed action have a potential to affect nonendangered and nonthreatened cetaceans detrimentally. These cetaceans could be impacted by the degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service vessels and OCS structures. The majority of these activities are estimated to be sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or debris). Lethal effects are estimated from chance collisions with OCS service vessels, ingestion of plastic materials, and Size 3 oil spills. 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 on nonendangered and nonthreatened marine mammals is expected to result in primarily sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or debris) that are both chronic and sporadic. These impacts could cause acute or chronic physiological stress, alter normal behavior, and educe some degree of avoidance, either temporary or permanent, 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 only species seen with regularity in the Gulf of Mexico.

The major impact-producing factors related to the proposed action 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 degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service vessels and OCS structures.

An estimated 1.52 MMbbl of drilling fluids, 0.48 MMbbl of drill cuttings, and 93.4 MMbbl of produced waters are assumed to be generated offshore as a result of the proposed action (Table IV-4). These effluents are routinely discharged into offshore marine waters and are regulated by the USEPA'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; indirect effects via 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/or affect endangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis, averaging about 4,300 trips per year. The FAA (Advisory Circular 91-36C) and corporate helicopter policy state that helicopters maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. It is estimated that cetaceans will not be affected by routine OCS helicopter traffic at these altitudes. It is also expected that 10 percent of helicopter trips will occur at altitudes below the specified minimums listed above as a result of inclement weather. Such incidents are very short-term and may elicit a startle reaction from cetaceans closeby.

It is assumed that about 143 OCS-related oil/gas service-vessel trips will occur annually as a result of the proposed action and that 52 shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-4). Survey data have shown that most cetacean species found in the Gulf are distributed within deeper waters, on or beyond the continental shelf break. It is estimated that the number of service-vessel trips occurring within water depths greater than 100 m in the WPA by offshore subarea are as follows: 3 in Subarea W-1; 17 in Subarea W-2; and 100 in Subarea W-3. The probability of collisions are higher within these deeper waters. This is especially the case for encounters with endangered species that tend to prefer these waters exclusively. The shuttle tanker trips are expected to occur in coastal Subarea W-3, inshore of the predescribed offshore areas. Noise from service-vessel traffic may elicit a startle and/or avoidance reaction from cetaceans or mask their sound reception. This effect is sublethal and constitutes a short-term and temporary impact. It is estimated that service-vessel traffic will rarely contact and affect endangered cetaceans, although collisions could be fatal.

It is assumed that 120 exploration and delineation wells and 100 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 be relatively constant and 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, such as the sperm whale, echolocate and 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 and may elicit some degree of avoidance behavior in the open Gulf. It is estimated that drilling noise will rarely disturb and affect endangered cetaceans.

Explosive platform removals can temporarily interfere with communication, elicit a pronounced startle reaction with subsequent avoidance or flight behavior, temporarily or permanently reduce hearing sensitivity, or cause hemorrhaging and death in cetaceans. It is estimated that four 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 (Table IV-4). It is expected that structure removals will cause sublethal effects on cetaceans as a result of the implementation of the MMS guidelines for explosive removals (USDOL, MMS, 1990a, Appendix B). It is estimated that structure removals will rarely disturb and affect endangered cetaceans.

Seismic surveys use airguns to generate sound 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.a.(1)). It is expected that effects of noise on cetaceans from seismic surveys are entirely sublethal, constituting a short-term startle response and avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans, causing skin and soft tissue irritation, fouling of baleen plates, respiratory stress from inhalation of toxic fumes, food reduction or contamination, the direct ingestion of oil and/or tar, and temporary displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from sale-related Size 3 oil spills, the effects would primarily be sublethal; few mortalities are assumed. The effects of sale-related Size 1 and Size 2 offshore oil spills are assumed to be solely sublethal due to the small areas affected and their rapid dispersion.

Section IV.A.3.h. estimates the mean number of Size 1 and Size 2 spills occurring from the proposed action in the WPA. It is assumed that six Size 1 spills will occur during the 35-year life of the proposed action. It is estimated that the six spills will occur offshore. It is assumed that no Size 2 spills will occur during the 35-year life of the proposed action. Although an interaction with Size 1 and Size 2 offshore spills may occur, only sublethal effects are assumed as a result of avoidance and natural dispersion/weathering of a spill in the offshore environment. It is estimated that small spills will rarely contact and affect endangered cetaceans.

Section IV.A.3.h. estimates the mean number of Size 3 spills resulting from the proposed action in the WPA. It is assumed that no crude oil Size 3 spill 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 Size 3 oil spill will not contact or affect endangered cetaceans in the WPA.

Many types of plastic materials are used during drilling and production operations. Some of this material is accidentally lost overboard where it can be consumed, incidentally or accidentally, by cetaceans. The result of plastic ingestion could be lethal, despite the large size of endangered cetacean species in the Gulf. The probability of this occurrence is low.

Summary

Activities resulting from the proposed action have a potential to affect endangered and nonendangered cetaceans detrimentally. These cetaceans could be impacted by the degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service vessels and OCS structures. The effects of the majority of these activities are estimated to be sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or debris). Lethal effects are estimated from chance collisions with OCS service vessels and ingestion of plastic materials. 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 proposed action on endangered and threatened marine mammals within the potentially affected area is expected to result in primarily sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or debris) that are both chronic and sporadic. These impacts could cause acute or chronic physiological stress, alter normal behavior, and reduce some degree of avoidance, either temporary or permanent, of the impacted area(s). Lethal impacts are expected to be rare for all marine mammals, with the most likely impacts resulting from vessel collisions to lethargic surfaced individual animals. The unexpected and unintentional removal of individuals of any species is considered an incidental take. Such

removals have not been documented in the Gulf. Recovery times will vary with species size, gestation period, and rates of reproductive activity. These will vary from two to several (less than ten) years.

High Case Analysis

The major impact-producing factors analyzed below are related to the proposed action and include degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service vessels and OCS structures.

An estimated 3.9 MMbbl of drilling fluids, 1.2 MMbbl of drill cuttings, and 241.9 MMbbl of produced waters are assumed to be generated offshore as a result of the proposed action (Table IV-4). 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; indirect effects via 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/or affect endangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis, averaging about 13,000 trips per year. The FAA (Advisory Circular 91-36C) and corporate helicopter policy state that helicopters must maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. It is estimated that cetaceans will not be affected by routine OCS helicopter traffic at these altitudes. It is also expected that 10 percent of helicopter trips will occur at altitudes below the specified minimums listed above as a result of inclement weather. Such incidents are very short-term and may elicit a startle reaction from cetaceans closeby.

It is assumed that about 380 OCS-related oil/gas service-vessel trips will occur during the peak year of the proposed action, and that 153 total shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-4). Noise from service vessel traffic may elicit a startle and/or avoidance reaction from cetaceans or mask their sound reception. This effect is sublethal and constitutes a short-term and temporary impact. Survey data show that most cetacean species of the Gulf are distributed within deeper waters, on or beyond the continental shelf break. It is estimated that the number of service-vessel trips occurring within water depths greater than 100 m in the WPA by offshore subarea are as follows: 108 in Subarea W-1; 1,160 in Subarea W-2; and 10,900 in Subarea W-3. The probability of collisions are higher within these deeper waters. It is estimated that service-vessel traffic will rarely contact and affect endangered cetaceans, although collisions could be fatal.

It is assumed that 310 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 estimated that noise from drilling activities will be relatively constant and 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, such as the sperm whale, echolocate and 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 and may elicit some degree of avoidance behavior in the open Gulf. It is estimated that drilling noise will rarely disturb and affect endangered cetaceans.

Explosive platform removals can interfere with communication, elicit a pronounced startle reaction with subsequent avoidance or flight behavior, temporarily or permanently reduce hearing sensitivity, or cause hemorrhaging and death in cetaceans. It is estimated that eight 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 (Table IV-4). It is expected that structure removals will cause sublethal effects on cetaceans as a result of the implementation 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 sound 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.a.(1)). It is expected that effects of noise

on cetaceans from seismic surveys are entirely sublethal, constituting a short-term startle response and avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans, causing skin and soft tissue irritation, fouling of baleen plates, respiratory stress from inhalation of toxic fumes, food reduction or contamination, the direct ingestion of oil and/or tar, and temporary displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from sale-related Size 3 oil spills, the effects would primarily be sublethal, few deaths are assumed. The effects of sale-related Size 1 and Size 2 offshore oil spills are assumed to be solely sublethal due to the small areas affected and their rapid dispersion.

Section IV.C.1. estimates the mean number of Size 1 and Size 2 spills occurring from the proposed action in the WPA. It is assumed that 18 Size 1 spills will occur during the 35 year life of the proposed action. It is estimated that the 18 spills will occur offshore and that none will contact land. It is assumed that one Size 2 spill will occur during the 35-year life of the proposed action, and it is estimated that the spill will occur offshore. Although an interaction with Size 1 and Size 2 offshore spills may occur, only sublethal effects are assumed. It is estimated that Size 1 and Size 2 spills will rarely contact and affect endangered cetaceans.

Section IV.C.1. estimates the mean number of Size 3 spills resulting from the proposed action in the WPA. It is assumed that one crude oil Size 3 spill will occur from either a platform or pipeline in the Western Gulf during the 35-year life of the proposed action. Table IV-11 identifies the estimated risk of one or more Size 3 oil spills occurring and contacting areas within 10 days where many cetaceans have been sighted during surveys. There is a 5 percent probability that a Size 3 oil spill will occur and contact within 10 days cetacean habitats at or beyond the shelf break of the WPA (Table IV-11). Although an interaction with Size 3 spills may occur, few deaths are assumed with primarily sublethal effects as a result of avoidance and natural dispersion/weathering of an oil spill in the offshore environment. It is expected that a Size 3 oil spill will rarely contact and affect endangered cetaceans in the WPA.

Many types of plastic materials are used during drilling and production operations. Some of this material is accidentally lost overboard where it can be consumed, incidentally or accidentally, by cetaceans. The result of plastic ingestion could be lethal, despite the large size of endangered cetacean species in the Gulf. The probability of this occurrence is low.

Conclusion

The impact of the High Case on endangered and threatened marine mammals within the potentially affected area is assumed to result in primarily sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS related contaminants or debris) that are both chronic and sporadic. These impacts could cause acute or chronic physiological stress, alter normal behavior, and reduce some degree of avoidance, either temporary or permanent, of the impacted area(s). Lethal impacts are expected to be rare for all marine mammals, with the most likely impacts resulting from vessel collisions to lethargic surfaced individual animals. The unexpected and unintentional removal of individuals of any species is considered an incidental take. Such removals have not been documented in the Gulf. Recovery times will vary with species size, gestation period, and rates of reproductive activity. These will vary from two to several (less than ten) years.

(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. Major impact-producing factors that may occur as a result of the proposed action are reviewed in detail in *Decline of the Sea Turtles: Causes and Prevention* (NRC, 1990) and are also described in the Biological Opinions (Appendix B).

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

Structure installation and removal, pipeline placement, dredging, and water quality degradation may adversely affect marine turtle habitat through destruction of seagrass beds and live-bottom communities used

by marine turtles. Potential impacts on these habitats caused by the proposed actions are discussed in detail in Section IV.D.1.a.(1)-(3).

Noise from service-vessel traffic may elicit a startle reaction from marine turtles and produce a temporary, sublethal stress (NRC, 1990). Service vessels could collide with and harm marine turtles while they are at the sea surface, but this appears to be less than 4 percent of their total time (Byles, 1989; Lohoefer et al., 1990). Vessel-related injuries were noted in 9 percent of stranded marine turtles examined in the Gulf of Mexico during 1988, but this figure includes turtles that may have been struck by boats post mortem (USDOD, NMFS, 1989b).

Explosive platform removals can cause capillary damage, disorientation, and loss of motor control in marine turtles (Duronslet et al., 1986). Although sublethal effects such as carapace damage may be temporary, marine turtles near detonation sites would likely sustain fatal injuries. Deaths have been suspected but not documented in previous explosive platform removals. Although marine turtles occur near offshore oil and gas structures, aerial surveys in the Central Gulf have shown that the only statistical correlation between marine turtles and offshore structures occurs near the Chandeleur Islands, Louisiana (Lohoefer, personal communication, 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-limited detonation, 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 cause injury or death. Marine turtles, particularly leatherbacks, are known to be attracted to floating plastic debris because it resembles 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 (Carr, 1987; USDOD, NOAA, 1988d; Heneman and the Center for Environmental Education, 1988; USDOD, 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), prohibits the disposal of any plastics at sea or in coastal waters.

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. As mandated by the Oil Pollution Act of 1990, these areas are expected to receive individual consideration during oil spill cleanup. Required oil spill contingency plans include special notices to minimize adverse effects from vehicular traffic during cleanup activities and to maximize protection efforts to prevent contact of these areas with spilled oil (Section IX.E.).

Oil spills can adversely affect marine turtles by toxic external contact, toxic ingestion or blockage of the digestive tract, disruption of salt gland function, asphyxiation, and displacement from preferred habitats (Vargo et al., 1986; Lutz and Lutcavage, 1989). Turtles may become entrapped by tar and oil slicks and rendered immobile (Witham, 1978; Plotkin and Amos, 1988). Hatchling and small juvenile turtles are particularly vulnerable to contacting or ingesting oil because the currents that concentrate oil spills also form the debris mats in which these turtles are sometimes found (Carr, 1980; Collard and Ogren, 1990). Fritts and McGhee (1982) noted that sea turtle eggs were damaged by contact with weathered oil from the *Italc* spill.

When an oil spill occurs, the severity of effects and the extent of damage to marine turtles are affected by geographic location, oil type, oil dosage, impact area, oceanographic conditions, meteorological conditions, and season (NRC, 1985; USDOD, MMS, 1989b). Adult marine turtles may not detect and avoid an oil spill (Vargo et al., 1986), and eggs and hatchlings are particularly vulnerable to contact (Fritts and McGhee, 1982; Lutz and Lutcavage, 1989). Contact with oil may not cause direct or immediate death but cumulative sublethal effects could impair the marine turtle's ability to function effectively in the marine environment (Vargo et al., 1986; Lutz and Lutcavage, 1989).

Base Case Analysis

The major impact-producing factors related to the proposed action that may affect Gulf marine turtles include structure installation, pipeline placement, dredging, blowouts, operational discharges, OCS-related trash

and debris, vessel traffic, explosive platform removals, oil spill response activities, blowouts, oil spills, and habitat and water quality degradation.

The impact from structure installation, pipeline placement, dredging, and water quality and habitat degradation on seagrass bed and live bottom sea turtle habitats are analyzed in detail in Sections IV.D.1.a.(1)-(3). It is expected that 10-15 ha of wetlands loss will occur from contact with spilled oil for one growth season. Up to 5.5 ha of wetlands and estuaries could be eroded along navigation channels in Louisiana and along the north Texas coast as a result of vessel traffic within the channels. The physical integrity, species diversity, and biological productivity of topographic features and live bottoms where marine turtles occur are expected to suffer only temporary damage. Small areas of 5-10 m² could be disturbed by the proposed action for periods of a few weeks but recovery would be complete within one or two years.

Offshore operational discharges are not known to cause deaths of marine turtles and are diluted and dispersed rapidly within 1 km of the discharge point. Unfavorable effects on marine turtle food sources by water quality degradation have not been previously demonstrated (API, 1989; NRC, 1983). Impacts on marine turtles from bottom disturbance, structure installation, pipeline emplacement, blowouts, and dredging are expected to be indistinguishable from the long-term (25-50 years) natural variability within populations. Marine turtles are expected to avoid 5-10 m² of impoverished live-bottom foraging areas for up to one month, and this avoidance is not likely to have detectable effects on marine turtles.

Suspended particulate matter in offshore operational discharges and blowouts is expected to reduce visibility and may displace prey items in the vicinity. Marine turtles within 1 km of the discharge point are expected to be less able to locate prey for the short time period they would spend traversing the discharge plume.

Marine turtles can become entangled in or ingest trash and debris produced by the proposed action. Debris such as plastics, galley waste, and packaging accidentally lost in the Gulf may be consumed by marine turtles. Although leatherback turtles that mistake plastics for jellyfish may be singularly more vulnerable to lethal effects, the limited amount of marine debris resulting from the proposed action is not expected to substantially harm a detectable number of marine turtles in the Gulf of Mexico.

Explosive platform removals can cause capillary damage, disorientation, loss of motor control, and fatal injuries in marine turtles. It is estimated that four structures will be removed by explosives from the Western Gulf of Mexico as a result of the proposed action (Table IV-4). These removals are expected to occur during the last 12 years of the life of the proposed action, and some removals will occur beyond the continental shelf. While pelagic marine turtles occur in deep water habitats, there is no correlation between marine turtles and the presence of offshore structures beyond the shelf break. No deaths or serious impacts to marine turtles are expected to result from platform removals because of MMS guidelines for explosive removals (USDOL, MMS, 1990a, Appendix B). Marine turtles are also widely distributed in the WPA and their densities would not be expected to be high near the vicinity of platform removals.

It is assumed that about 5,000 OCS related oil and gas service vessel trips and 52 shuttle tanker trips will occur during the 35 year life of the proposed action (Table IV-4). Noise from service-vessel traffic may elicit a startle reaction from marine turtles, but this effect is a temporary disturbance. Collision between service vessels and surfaced marine turtles would likely cause fatal injuries. However, service vessel traffic and marine turtles will seldom be in proximity, and marine vessel operators can avoid marine turtles and reduce potential deaths. The OCS service vessel traffic's contribution to the total 9 percent estimated marine turtle deaths from this source is expected to vary according to location and trends in OCS waterway use.

Oil spills and oil spill response activities can negatively affect marine turtles as outlined above. Although oil-spill response activities such as vehicular and vessel traffic are assumed to contact marine turtle habitat, harm to marine turtles is expected to be minimized because of protection efforts to prevent contact of these areas with spilled oil as mandated by the Oil Pollution Act of 1990. Marine turtle nesting areas in coastal Texas would also be expected to receive special cleanup considerations under these regulations.

Six Size 1 offshore (Table IV-4) and two onshore (Table IV-15) oil spills are assumed to occur during the 35-year life of the proposed action; a few will contact land. No Size 2 offshore or onshore spills are assumed to occur offshore during the 35-year life of the proposed action (Tables IV-4 and IV-15). No Size 3 offshore or onshore spills (Tables IV-4 and IV-15) are expected to occur in the WPA during the proposed action period.

Since marine turtle habitat in the Gulf includes both inshore and offshore areas, marine turtles could

possibly be contacted by small sale-related spills. Few deaths would be expected because of the small area of contact involved, the rapid dispersion and loss of oil, and the low density of marine turtles in the area. However, sublethal biological and behavioral impacts, such as salt gland disruption or liver dysfunction, could temporarily disturb oiled marine turtles. The extent and severity of effects from any sale-related oil spill will be lessened by coastal oil-spill contingency planning and by possible avoidance of oil spills by marine turtles.

Summary

Structure installation, dredging, water quality and habitat degradation, operational discharges, blowouts, OCS-related trash and debris, vessel traffic, explosive platform removals, oil-spill response activities, and oil spills resulting from the proposed action may be expected to harm or debilitate marine turtles. Impacts from oil spills, oil-spill response activities, and explosive platform removals are expected to be reduced by spill contingency planning and the Oil Pollution Act of 1990 habitat protection stipulations.

Conclusion

The impact of the proposed action is expected to temporarily disturb some marine turtles and their habitats, but deaths are expected to be rare. All disturbances are expected to be temporary, and marine turtles are expected to recover within a period of weeks to months.

High Case Analysis

The major impact-producing factors related to the proposed action that may affect Gulf marine turtles include structure installation, pipeline placement, dredging, operational discharges, blowouts, OCS-related trash and debris, vessel traffic, explosive platform removals, oil-spill response activities, blowouts, oil spills, and habitat and water quality degradation. Impacts from structure installation, pipeline placement, dredging, blowouts, and habitat and water quality degradation on seagrass beds and live-bottom sea turtle habitat is analyzed in detail in Sections IV.D.1.a.(1) and (2).

The loss of up to 10-15 ha of wetlands will occur for less than one growing season from contact with spilled oil or sediment discharges as a result of all activities within the proposed action. Up to 11 ha of wetlands and estuaries could be eroded along navigation channels in Louisiana and along the north Texas coast. Little or no damage is expected to befall the physical integrity, species, diversity, or biological productivity of topographic features or live bottoms. Small areas would be disturbed or sediments displaced for periods of weeks to months.

Offshore operational discharges are diluted and dispersed rapidly within 1 km of the discharge point. Disturbance and degradation in water quality effects on marine turtle food sources are not expected to be detectable (API, 1989; NRC, 1983). Disturbances to marine turtle behavior and movements caused by the High Case are not expected to be distinguishable from those produced by long-term alteration of Gulf water quality and coastal habitat degradation. Marine turtles may avoid disturbed live-bottom areas for up to a month but this avoidance of impoverished foraging areas will have no observable effect on marine turtles. Suspended particulate matter in operational discharges and blowouts may reduce marine turtles' ability to visually locate their prey. Marine turtles may avoid this disturbance by shifting their foraging or resting areas.

The OCS-related trash and debris will be accidentally lost into the Gulf and pose a threat to marine turtles, but this risk is minimized by offshore dumping prohibitions (30 CFR 250.40).

In the High Case, eight structures will be removed using explosives from the WPA (Table IV-4). These removals are expected to occur during the last 12 years of the life of the proposed action, and some of the removals will occur in habitats beyond the continental shelf. No marine turtle deaths are expected because of the MMS guidelines for explosive removals that require prior survey and minimum explosives (USDOl, MMS, 1990a, Appendix B).

It is assumed that a maximum of about 13,300 OCS-related oil and gas service-vessel trips and 153 shuttle tanker trips (maximum of eight/year) will occur during the 35-year life of the proposed action (Table IV-4).

Disturbances will occur as described in the Base Case, and the impact of service-vessel traffic is expected to comprise a greater fraction of the estimated 9 percent total of all marine turtle vessel-related deaths in the Gulf of Mexico.

One Size 3 oil spill from either a platform or pipeline and one Size 2 oil spill are assumed to occur offshore during the 35-year life of the proposed action (Table IV-4). No onshore spills of these sizes are expected to occur (Table IV-15). Eighteen offshore Size 1 spills (Table IV-4) and 6 onshore Size 1 spills (Table IV-15) are expected to occur during the 35-year life of the proposed action; a few will contact land. The highest estimated probabilities of one or more Size 3 oil spills occurring and contacting marine turtle habitat within 10 days in the Central Gulf is 1 percent (East Texas coastal marshes, Table IV-11).

The largest offshore spills are seldom expected to contact and affect marine turtles because marine turtles are widely distributed offshore and because of oil spill contingency plans. If any marine turtle deaths occur, they are expected to be few in number.

Structure installation, dredging, water quality and habitat degradation, operational discharges, blowouts, OCS-related trash and debris, vessel traffic, explosive platform removals, oil-spill response activities, and oil spills resulting from the High Case may be expected to harm or debilitate some marine turtles. Impacts from oil spills, oil-spill response activities, and explosive platform removals are expected to be greatly reduced by oil spill contingency planning and by MMS and Biological Opinion stipulations. Marine turtles may avoid OCS disturbances by shifting their feeding and resting areas to an undisturbed area.

Conclusion

The impact of the High Case is expected to temporarily disturb some marine turtles and their habitats, but the number of deaths are expected to be low. All disturbances are expected to be temporary, and marine turtles are expected to recover within a period of weeks to months.

(7) Impacts on Coastal and Marine Birds

(a) Nonendangered and Nonthreatened Species

The Gulf of Mexico is populated by resident and migratory species of coastal and marine birds. This broad category consists of five main groups: seabirds, shorebirds, wading birds, marsh birds, and waterfowl. The major impact-producing factors analyzed below are related to the proposed action and include oil spills and spill response activities, degradation of water quality resulting from OCS discharges, OCS helicopter and service-vessel traffic and noise, habitat loss and modification resulting from pipeline landfalls and coastal facility construction, and discarded trash and debris from service-vessels and OCS structures.

Base Case Analysis

Section IV.A.3.h.(2) estimates the mean number of Size 1 and Size 2 spills occurring from the proposed action in the WPA. It is assumed that six Size 1 offshore spills and one Size 1 onshore spill 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 Size 2 spill will occur during the 35-year life of the proposed action. Most Size 1 onshore spills related to the proposed action are predicted to occur near or at OCS-related transfer facilities, and will not contact wetlands and other biologically sensitive coastal areas. For the purpose of this analysis, Size 1 and Size 2 onshore spills will rarely contact and affect feeding, resting, or nesting habitats within wetland or other inland areas. Effects from Size 1 onshore spills which occur away from transfer facilities are expected to result in some degradation of habitat, physical oiling of birds, and some degree of both acute and chronic physiological stress associated with direct and secondary uptake of oil. Onshore pipeline spills and spills resulting from accidents in navigational waterways can contact and affect many of the different groups of coastal and marine birds, most commonly marsh birds, waders, waterfowl, and certain shorebirds. Some bird deaths from these groups are to be expected, and recruitment through successful reproduction is expected to take several years, depending upon the species and existing conditions.

Section IV.A.3.h.(2) estimates that there will be no Size 3 oil spills resulting from the proposed action in the WPA.

Degradation of coastal and inshore water quality resulting from OCS-related discharges is expected to impact coastal and marine birds within these areas.

Helicopter and service-vessel traffic related to OCS activities could sporadically disturb feeding, resting, or nesting behavior of birds or cause abandonment of preferred habitat. This impact-producing factor could contribute to indirect population loss through reproductive failure resulting from nest abandonment. The FAA (Advisory Circular 91-36C) and corporate helicopter policy states that helicopters must maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. When flying over land, the specified minimum altitude is 1,000 ft over unpopulated areas or across coastlines, and 2,000 ft over populated areas and biologically sensitive areas such as wildlife refuges and national parks. Many undisturbed coastal areas and refuges provide preferred and/or critical habitat for feeding, resting (or staging), and nesting birds. The effects of low-flying aircraft within the vicinity of aggregations of birds on the ground or on the water typically results in mass disturbance and abandonment of the immediate area. Compliance to the specified minimum altitude requirements is expected to significantly reduce effects of aircraft disturbance on coastal and marine birds. It is expected, however, that approximately 10 percent of helicopter trips will occur at altitudes somewhat below the minimums listed above as a result of inclement weather. Although these incidents are very short term in duration and sporadic in frequency, they can disrupt coastal bird behavior and, at worst, possibly result in habitat or nest abandonment. Birds in flight over water typically avoid helicopters; temporary disruption of feeding or flight paths is expected when encountering low-flying helicopters. It is estimated that there will be about 2,900 helicopter flights across coastal areas annually, with about 290 flights at altitudes somewhat below specified minimums. For this analysis, helicopter traffic will periodically disturb coastal and marine birds, but will maintain general adherence to FAA and corporate helicopter protocol on service altitudes.

It is assumed that about 140 OCS-related oil and gas service-vessel trips, 8 barge trips, and no shuttle tanker trips will occur during the 35-year life of the proposed action (Tables IV-4, and IV-15). Service vessels will use selected nearshore and coastal (inland) navigational waterways, or corridors, and adhere to protocol set forth by the Coast Guard for reduced vessel speeds/wakes within these inland areas. Routine presence and low speeds of service vessels within these waterways diminishes the effects of disturbance from service-vessels on nearshore and inland populations of coastal and marine birds. For the purpose of this analysis, service-vessel traffic will seldom disturb populations of coastal and marine birds existing within these areas. The effects of service-vessel traffic on birds offshore are negligible.

The greatest negative impact to coastal and marine birds is the extent of preferred or critical habitat loss or degradation. Destruction of habitat from OCS pipeline landfalls and onshore construction displaces localized groups or populations of these species. As these birds move to undisturbed areas of similar habitat, their presence augments habitat utilization pressure on these selected areas as a result of intra- and interspecific competition for space and food. 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. For the purpose of this analysis, it is estimated that OCS pipeline landfalls and onshore construction will not interact with feeding, resting, or nesting habitats of coastal and marine birds within the western Gulf.

Coastal and marine birds are commonly entangled and snared in discarded trash and debris. In addition, many species will readily ingest small plastic debris, either intentionally or incidentally. Interaction with plastic materials is therefore very serious, and can lead to permanent injuries and death. It is expected that coastal and marine birds will seldom become entangled in or ingest OCS-related trash and debris as a result of MMS prohibitions on the disposal of equipment, containers, and other materials into offshore waters by lessees (30 CFR 250.40). In addition, MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. For the purpose of this analysis, OCS oil- and gas-related plastic debris will seldom interact with coastal and marine birds, and therefore, the effect will be negligible.

Summary

Activities resulting from the proposed action are expected to affect coastal and marine birds within the WPA. It is expected that the majority of effects from the major impact-producing factors on coastal and marine birds are sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or debris), causing temporary disturbances and displacement of localized groups onshore. Chronic sublethal stress, however, is often undetectable in birds. It can serve to weaken individuals (which is especially serious for migratory species), and expose them to infection and disease. Lethal effects result primarily from uncontained onshore oil spills and associated spill response activities. Spills occurring in biologically sensitive areas are expected to remove a number of individuals from any or all groups. The effects of OCS helicopter and service-vessel traffic estimated from the proposed action is expected to periodically disturb localized groups or individual birds. These events, though periodic, will not permanently displace coastal and marine birds within the WPA. The net effect will be the alteration of species composition and possibly the reduction of the overall carrying capacity of disturbed area(s) in general. Recovery of these areas is expected to take up to several years.

Conclusion

Nonendangered and nonthreatened coastal and marine birds may encounter periodic disturbance and temporary displacement of localized groups and individuals from proposed activities. Decreases in numbers of adults and/or nests could occur as a result of oil spills and spill-related coastal habitat loss or degradation. Groups experiencing the loss of individuals would require up to several years to recover to a pre-disturbance condition, depending on the species and existing conditions.

High Case Analysis

Nonendangered and nonthreatened coastal and marine birds may be affected by various sale-related activities. The major impact-producing factors analyzed include oil spills and spill-response activities, degradation of water quality resulting from OCS discharges, OCS helicopter and service-vessel traffic and noise, habitat loss or modification resulting from pipeline landfalls and coastal facility construction, and discarded trash and debris from service-vessels and OCS structures.

Section IV.A.3.h.(2) estimates the mean number of Size 1 and Size 2 spills occurring from the proposed action in the WPA. It is assumed that 18 Size 1 offshore spills and six Size 1 onshore spills 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 Size 2 offshore spill and no Size 2 onshore spills will occur during the 35-year life of the proposed action. None of the offshore spills will contact the coastline. For the purpose of this analysis, it is assumed that offshore spills will seldom contact and affect feeding, resting, or nesting habitats. Many of the Size 1 and Size 2 onshore spills are expected to occur in direct association with transfer facilities and will not, as a result, impact wetlands and other biologically sensitive coastal areas. The effect on coastal and marine birds is expected to be minor.

Section IV.A.3.h.(2) estimates the mean number of Size 3 offshore oil spills resulting from the proposed action in the WPA. It is assumed that one Size 3 crude oil spill will occur from either a platform or pipeline and none will originate from OCS tankering in the Western Gulf during the 35-year life of the proposed action (median size is 6,500 bbl). Table IV-11 identifies the estimated risk of one or more Size 3 oil spills occurring and contacting within 10 days feeding, resting, or nesting habitats within 10 days. The highest probability of one or more Size 3 oil spills occurring and contacting within 10 days a coastal bay or marsh in the Western Gulf is 1 percent (East Texas Coastal Marshes). For the purpose of this analysis, a Size 3 offshore oil spill will not contact and affect the feeding, resting, or nesting habitats in the WPA. The effect from Size 3 spills on Gulf coastal and marine birds is expected to be negligible.

Helicopter and service-vessel traffic related to OCS activities could sporadically disturb feeding, resting, or nesting behavior of birds or cause abandonment of preferred habitat. This could contribute to indirect population loss through reproductive failure resulting from nest abandonment. The FAA (Advisory Circular 91-36C) and corporate helicopter policy states that helicopters must maintain a minimum altitude of 700 ft

while in transit offshore, and 500 ft while working between platforms. When flying over land, the specified minimum altitude is 1,000 ft over unpopulated areas or across coastlines, and 2,000 ft over populated areas and biologically sensitive areas such as wildlife refuges and national parks. Many undisturbed coastal areas and refuges provide important and/or critical habitat for feeding, resting (or staging), and nesting birds. The effects of low-flying aircraft within the vicinity of aggregations of birds on the ground typically results in mass disturbance and abandonment of the immediate area. Compliance to the specified minimum altitude requirements is expected to significantly reduce effects of aircraft disturbance on coastal and marine birds. It is expected, however, that approximately 10 percent of helicopter trips will occur at altitudes somewhat below the minimums listed above as a result of inclement weather. Although these incidents are very short term in duration and sporadic in frequency, they can disrupt coastal bird behavior and, at worst, possibly result in habitat or nest abandonment. Birds in flight over water typically avoid helicopters; temporary disruption of feeding or flight paths is expected when encountering low-flying helicopters. It is estimated that there will be about 7,000 helicopter flights across coastal areas annually, with about 720 flights at altitudes somewhat below specified minimums. For this analysis, this extent of helicopter traffic will periodically disturb coastal and marine birds; general adherence to FAA and corporate helicopter protocol on service altitudes will serve to reduce the level of disturbance.

It is assumed that 380 OCS-related oil and gas service-vessel trips, 29 barge trips, and no shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-15). Service vessels will use selected nearshore and coastal (inland) navigational waterways, or corridors, and adhere to protocol set forth by the Coast Guard for reduced vessel speeds/wakes within inland areas. Routine presence and low speeds of service vessels within these waterways effectively diminishes the effects of disturbance from service vessels on nearshore and inland populations of coastal and marine birds. For the purpose of this analysis, service-vessel traffic will rarely disturb coastal and marine birds occurring within these areas. The effects on birds offshore are negligible.

The greatest negative impact to these species is the extent of preferred or critical habitat loss and degradation within coastal areas. The extent of bird displacement resulting from habitat loss is highly variable between species, based upon specific habitat requirements and availability of similar habitat in the area. Generally, destruction of habitat from OCS pipeline landfalls and onshore construction displaces localized groups or populations of these species. As these birds move to undisturbed areas of similar habitat, their presence augments habitat utilization pressure on these selected areas as a result of intra- and interspecific competition for space and food. 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. Under the High Case, it is thus estimated that OCS pipeline landfalls and onshore construction will not interact with feeding, resting, or nesting habitats of coastal and marine birds within the Western Gulf.

Coastal and marine birds are commonly entangled and snared in discarded trash and debris. In addition, many species will readily ingest small plastic debris, either intentionally or incidentally. Interaction with plastic materials is therefore very serious, and can lead to permanent injuries and death. It is expected that coastal and marine birds will seldom become entangled in or ingest OCS-related trash and debris as a result of MMS prohibitions on the disposal of equipment, containers, and other materials into offshore waters by lessees (30 CFR 250.40). In addition, MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. For the purpose of this analysis, OCS oil- and gas-related plastic debris will seldom interact with Gulf coastal and marine birds, and therefore, the effect will be negligible.

Conclusion

Nonendangered and nonthreatened coastal and marine birds may encounter periodic disturbances and displacement of localized groups and individuals from proposed activities. Decreases in numbers of adults and/or nests could occur as a result of OCS-related oil spills and spill-related coastal habitat loss. Groups experiencing the loss of individuals would require up to several years to recover to a pre-disturbance condition, depending on the species and existing conditions.

(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, piping plover, least tern, and whooping crane. It summarizes and incorporates the discussion of the effects on the coastal and marine birds in Section IV.D.1.a.(8)(a) (nonendangered and nonthreatened birds) and additional information as cited. Oil spills and spill response activities, degradation of water quality resulting from OCS discharges, OCS helicopter and service-vessel traffic and noise, habitat loss or modification resulting from pipeline landfalls and coastal facility construction, and discarded trash and debris from service-vessels and OCS structures 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.(8)(a)).

Base Case Analysis

Section IV.A.3.h.(2) estimates the mean number of Size 1 and Size 2 spills occurring from the proposed action in the WPA. It is assumed that six Size 1 offshore spills and one Size 1 onshore spill 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 Size 2 spills will occur during the 35-year life of the proposed action. Most Size 1 spills related to the proposed action are predicted to occur near or at OCS-related transfer facilities, and will not contact wetlands and other biologically sensitive coastal areas. For the purpose of this analysis, Size 1 and Size 2 onshore spills will rarely contact and affect feeding, resting, or nesting habitats for endangered species of birds within coastal areas. Size 1 onshore spills away from transfer facilities are expected to result in some degradation of habitat (such as spoil banks which provide nesting and feeding habitats for congregations of pelicans and plovers, respectively), physical oiling of individuals or local groups of birds, and some degree of both acute and chronic physiological stress associated with direct and secondary uptake of oil. Raptors, such as the bald eagle and peregrine falcon, feed upon weakened or dead birds (and fish, in the case of the eagle), and may as a result become physically oiled or affected by the ingestion of the oiled prey. Pelicans are active swimmers, and plunge dive for prey. They are, therefore, very susceptible to both physical oiling and secondary effects via ingestion of oiled prey, i.e., fish. Plovers congregate and feed along tidally exposed banks and shorelines. They can be physically oiled while foraging on oiled shores, or secondarily affected through ingestion of oiled intertidal sediments and prey. The least tern captures fish by means of shallow splash diving and surface dipping techniques. Some physical oiling could occur during these dives, as well as secondary toxic effects through the uptake of prey. The whooping crane traverses large expanses of coastal plain and wetland habitat, on or near the Aransas National Wildlife Refuge. Spills within nearby navigational waterways could contact the Refuge and possibly result in physically oiling cranes. It is possible that some mortality of endangered species could occur, especially if the onshore spill(s) occur during winter months when raptors, plovers, and whooping cranes are most common along the coastal Gulf, or if spills occur within preferred or critical habitat for all representatives.

Section IV.A.3.h.(2) estimates that there will be no Size 3 oil spills resulting from the proposed action in the WPA.

Degradation of coastal water quality through OCS discharges is expected to impact endangered bird species of the WPA.

Helicopter and service-vessel traffic related to OCS activities could sporadically disturb feeding, resting, or nesting behavior of birds or cause abandonment of preferred habitat. This impact-producing factor could contribute to indirect population loss through reproductive failure resulting from nest abandonment. The FAA (Advisory Circular 91-36C) and corporate helicopter policy states that helicopters must maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. When flying over land, the specified minimum altitude is 1,000 ft over unpopulated areas or across coastlines, and 2,000 ft over populated areas and biologically sensitive areas such as wildlife refuges and national parks. Many undisturbed coastal areas and refuges provide preferred and/or critical habitat for feeding, resting (or staging), and nesting birds. The effects of low-flying aircraft within the vicinity of aggregations of birds on the ground or on the water typically results in mass disturbance and abandonment of the immediate area. Compliance to the specified minimum altitude requirements is expected to significantly reduce effects of aircraft disturbance on

coastal and marine birds. It is expected, however, that approximately 10 percent of helicopter trips will occur at altitudes somewhat below the minimums listed above as a result of inclement weather. Although these incidents are very short-term in duration and sporadic in frequency, they can disrupt bird behavior within coastal areas and, at worst, possibly result in habitat or nest abandonment. Birds in flight over water typically avoid helicopters; temporary disruption of feeding or flight paths is expected when encountering low-flying helicopters. It is estimated that there will be about 2,900 helicopter flights across coastal areas annually, with 290 flying at altitudes somewhat below specified minimums. For this analysis, helicopter traffic will periodically disturb endangered birds, but will maintain general adherence to FAA and corporate helicopter protocol on service altitudes.

It is assumed that about 140 OCS-related oil and gas service-vessel trips will occur annually as a result of the proposed action. It is also assumed that eight barge trips and no shuttle tanker trips will occur during the 35-year life of the proposed action (Tables IV-4 and IV-15). Service vessels will use selected nearshore and coastal (inland) navigational waterways, or corridors, and adhere to protocol set forth by the Coast Guard for reduced vessel speeds within these inland areas. Routine presence and low speeds of service vessels within these waterways diminishes the effects of disturbance from service vessels on nearshore and inland populations of coastal and marine birds. For the purpose of this analysis, service-vessel traffic will seldom disturb populations of endangered birds existing within these areas. The effects of service-vessel traffic on birds offshore are negligible.

The greatest negative impact to endangered coastal and marine birds is the extent of preferred or critical habitat loss. Effects from habitat loss are highly variable between different species, based upon specific habitat requirements and availability of similar habitat in the area. Destruction of habitat from OCS pipeline landfalls and onshore construction displaces localized groups or populations of coastal and marine birds, including endangered species. As these birds move to undisturbed areas of similar habitat, their presence augments habitat utilization pressure on these selected areas as a result of intra- and interspecific competition for space and food. 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. For the purpose of this analysis, it is estimated that OCS pipeline landfalls and onshore construction will not interact with feeding, resting, or nesting habitats of endangered coastal and marine birds within the WPA.

Coastal and marine birds are commonly entangled and snared in discarded trash and debris. In addition, many species such as the brown pelican and least tern will readily ingest small plastic debris, either intentionally or incidentally. Interaction with plastic materials is therefore very serious, and can lead to permanent injuries and death. It is expected that endangered birds will seldom become entangled in or ingest OCS-related trash and debris as a result of MMS prohibitions on the disposal of equipment, containers, and other materials into offshore waters by lessees (30 CFR 250.40). In addition, MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. For the purpose of this analysis, it is assumed that OCS oil- and gas-related plastic debris will seldom interact with endangered birds within the Western Gulf, and therefore, the effect will be negligible.

Summary

Activities resulting from the proposed action are expected to affect endangered species of birds along coastal areas of the Western Gulf. It is expected that the majority of effects from the major impact-producing factors on these species are sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or debris), causing temporary disturbances and some displacement of individuals or localized groups onshore. Chronic sublethal stress, however, is often undetectable in birds, and can be masked for some period of time. It can serve to weaken individuals (which is especially serious for migratory species), and expose them to infection and disease. Lethal effects result primarily from uncontained onshore oil spills and associated spill response activities, and are especially serious for endangered species. Any reductions in population size represents a threat to their existence. The net effect will be the alteration of species composition and possibly the reduction of the overall carrying capacity of affected area(s) in general.

Conclusion

Endangered and threatened birds within the WPA may encounter periodic disturbances and displacement of individuals and/or localized groups from proposed activities. Decreases in numbers of adults and/or nests could occur as a result of OCS-related oil spills and spill-related loss of preferred or critical habitat. The loss of individuals represents a serious loss to the regional population(s) of endangered and threatened species; restoration of numbers to a pre-disturbance state would require up to several years, depending on the species and existing conditions.

High Case Analysis

Endangered and threatened coastal and marine birds may be affected by various sale-related activities. The major impact-producing factors analyzed below are related to the proposed action, and include oil spills and spill response activities, degradation of water quality resulting from OCS discharges, OCS helicopter and service-vessel traffic and noise, habitat loss or modification resulting from pipeline landfalls and coastal facility construction, and discarded trash and debris from service-vessels and OCS structures.

Section IV.A.3.h.(2) estimates the mean number of Size 1 and Size 2 spills occurring from the proposed action in the WPA. It is assumed that 18 Size 1 offshore spills and 6 Size 1 onshore spills will occur during the 35-year life of the proposed action. None of the offshore spills will contact the coastline. One Size 2 offshore spill and no Size 2 onshore spills will occur during the 35-year life of the proposed action. The offshore spills will not contact the coastline. Many of the onshore spills are expected to occur in direct association with OCS-related transfer facilities and will not, as a result, impact wetlands and other biologically sensitive coastal areas. Uncontained Size 1 onshore spills are expected to result in some degradation of habitat (such as spoil banks which provide resting or feeding habitat for congregations of pelicans and plovers, respectively), physical oiling of individuals or local groups of birds, and some degree of both acute and chronic physiological stress associated with direct and secondary uptake of oil. Raptors, such as the bald eagle and peregrine falcon, feed upon weakened or dead birds (and fish, in the case of the eagle), and may as a result become physically oiled or affected by the ingestion of the oiled prey. Pelicans are active swimmers, and plunge dive for prey. They are, therefore, very susceptible to both physical oiling and secondary effects via ingestion of oiled prey, i.e., fish. Plovers congregate and feed along tidally exposed banks and shorelines. They can be physically oiled while foraging on oiled shores, or secondarily affected through the ingestion of oiled intertidal sediments and prey. The least tern captures fish by means of shallow splash diving and surface dipping techniques. Some physical oiling could occur during these dives, as well as secondary toxic effects through the uptake of prey. The whooping crane traverses large expanses of coastal plain and wetland habitat, on or near the Aransas National Wildlife Refuge. Spills within nearby navigational waterways could contact the Refuge and possibly result in physically oiling cranes. It is possible that some mortality of endangered species could occur, especially if the onshore spill(s) occur during winter months when raptors, plovers, and whooping cranes are most common along the coastal Gulf, or if spills occur within preferred or critical habitat for all representatives.

Section IV.A.3.h.(2) estimates the mean number of Size 3 offshore oil spills resulting from the proposed action in the WPA. It is assumed that one Size 3 crude oil spill will occur from either a platform or pipeline and none will originate from OCS tankering in the Western Gulf during the 35-year life of the proposed action (median size is 6,500 bbl). Table IV-11 identifies the estimated risk of one or more Size 3 oil spills occurring and contacting feeding, resting, or nesting habitats within 10 days. The highest probability of one or more Size 3 oil spills occurring and contacting within 10 days a coastal bay or marsh in the Western Gulf is one percent (East Texas Coastal Marshes). For the purpose of this analysis, a Size 3 offshore oil spill will seldom contact and affect the feeding, resting, or nesting habitats of endangered species in the WPA. Therefore, the effect from Size 3 oil spills on endangered species is expected to be negligible.

Degradation of water quality resulting from OCS discharges is expected to affect endangered bird species of the WPA.

Helicopter and service-vessel traffic related to OCS activities could sporadically disturb feeding, resting, or nesting behavior of birds or cause abandonment of preferred habitat. This impact-producing factor could contribute to indirect population loss through reproductive failure resulting from nest abandonment. The FAA (Advisory Circular 91-36C) and corporate helicopter policy states that helicopters must maintain a minimum

altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. When flying over land, the specified minimum altitude is 1,000 ft over unpopulated areas or across coastlines, and 2,000 ft over populated areas and biologically sensitive areas such as wildlife refuges and national parks. Many undisturbed coastal areas and refuges provide important and/or critical habitat for feeding, resting (or staging), and nesting birds, including groups of endangered species. The effects of low-flying aircraft within the vicinity of aggregations of birds on the ground typically results in mass disturbance and abandonment of the immediate area. Compliance to the specified minimum altitude requirements is expected to significantly reduce effects of aircraft disturbance on endangered birds. It is expected, however, that approximately 10 percent of helicopter trips will occur at altitudes somewhat below the minimums listed above as a result of inclement weather. Although these incidents are very short term in duration and sporadic in frequency, they can disrupt coastal bird behavior and, at worst, possibly result in habitat or nest abandonment. Birds in flight over water typically avoid helicopters; temporary disruption of feeding or flight paths is expected when encountering low-flying helicopters. It is estimated that there will be about 7,000 helicopter flights across coastal areas annually, with about 720 flights at altitudes somewhat below specified minimums. For this analysis, this extent of helicopter traffic will periodically disturb endangered birds; general adherence to FAA and corporate helicopter protocol on service altitudes will serve to reduce the level of disturbance. The effect of OCS-related flights on endangered birds is expected to be minor.

It is assumed that 380 OCS-related oil and gas service-vessel trips, 29 barge trips, and no shuttle tanker trips will occur during the 35-year life of the proposed action (Table IV-15). Service vessels will use selected nearshore and coastal (inland) navigational waterways, or corridors, and adhere to protocol set forth by the Coast Guard for reduced vessel speeds within inland areas. Routine presence and low speeds of service vessels within these waterways effectively diminishes the effects of disturbance from service vessels on nearshore and inland populations of coastal and marine birds, including endangered species. For the purpose of this analysis, it is thus assumed that service-vessel traffic will seldom disturb endangered birds occurring within these areas. The effects on birds offshore are negligible.

The greatest negative impact to endangered coastal and marine birds is the extent of preferred or critical habitat loss within coastal areas. Effects of habitat loss are highly variable between species, based upon their specific habitat requirements and availability of similar habitat in the area. Destruction of habitat from OCS pipeline landfalls and onshore construction displaces individuals and localized groups or populations of coastal and marine birds, including endangered species. As these birds move to undisturbed areas of similar habitat, their presence augments habitat utilization pressure on these selected areas as a result of intra- and interspecific competition for space and food. This is especially critical for piping plovers and whooping cranes, whose feeding habitat requirements are fairly strict. 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. For the purpose of this analysis, pipeline landfalls and onshore construction will not interact with feeding, resting, or nesting habitats of endangered coastal and marine birds.

Endangered species of birds along the Western Gulf can easily become entangled and snared in discarded trash and debris. In addition, some species such as the brown pelican and least tern will readily ingest small plastic debris, either intentionally or incidentally. Interaction with plastic materials therefore very serious, and can lead to permanent injuries and death. It is expected that endangered birds will seldom become entangled in or ingest OCS-related trash and debris as a result of MMS prohibitions on the disposal of equipment, containers, and other materials into offshore waters by lessees (30 CFR 250.40). In addition, MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. For the purpose of this analysis, it is assumed that OCS oil- and gas-related plastic debris will seldom interact with endangered birds, and therefore, the effect will be negligible.

Conclusion

Endangered and threatened birds within the WPA may encounter periodic displacement of individuals and/or localized groups from proposed activities. Decreases in numbers of adults and/or nests could occur as a result of OCS-related oil spills and spill-related preferred or critical habitat loss. The loss of individuals

represents a serious loss to the regional population(s) of endangered and threatened species; restoration of numbers to a pre-disturbance state would require up to several years, depending on the species and existing conditions.

(8) Impacts on Commercial Fisheries

Effects on commercial fisheries from activities associated with the proposed action could come from coastal environmental degradation, emplacement of production platforms, underwater OCS obstructions, production platform removals, seismic surveys, oil spills, subsurface blowouts, pipeline trenching, and offshore discharges of drilling muds, produced waters, and naturally occurring radioactive material (NORM). Potential effects from these impact-producing factors are described below.

Sections providing supportive material for the commercial fisheries analysis include Sections III.B.7. (description of fish resources), III.C.3. (commercial fisheries), IV.D.2.a.(1) (impacts on sensitive coastal environments), IV.D.2.a.(3) (impacts on water quality), IV.A.3.b.(2) (space-use conflicts), IV.A.2.a.(4) (structure removals), IV.A.2.a.(1) (seismic surveying), IV.A.3.h.(2) (offshore oil spills), IV.B.2.d.(1) (onshore oil spills), IV.A.3.h.(1) (subsurface blowouts), IV.A.2.b.(1) (pipelines), IV.A.3.d. (offshore discharges), and IV.B.2.c. (onshore disposal).

Since approximately 92 percent of commercially harvested species are estuary dependent, coastal environmental degradation resulting from the proposed action, although indirect, has the potential to adversely affect commercial fisheries. The environmental deterioration and effects on commercial fisheries result from the loss of Gulf wetlands as nursery habitat and from the functional impairment of existing habitat through decreased water quality.

Wetlands and estuaries within the WPA may also be affected by OCS-related activities resulting from the proposed action. These include construction of new onshore facilities in wetland areas; pipeline placement in wetland areas; vessel usage of navigation channels and access canals; maintenance of navigation channels; onshore disposal of OCS-generated, oil-field wastes; and, oil and chemical spills from both onshore and offshore OCS support activities.

Water quality in coastal and estuarine areas adjacent to the WPA may be altered by OCS-related activities resulting from the proposed action. These activities include construction of new onshore support facilities; routine point and nonpoint source discharges from onshore facilities; discharges from associated support vessel traffic; canal maintenance dredging and pipeline emplacement actions; onshore disposal of OCS-generated, oil-field wastes; oil and chemical spills from both onshore and offshore OCS support activities; and OCS-related trash and debris.

The emplacement of a production platform, with a surrounding 100-m navigational safety zone, in water depths less than 152 m, results in the loss of approximately 6 ha of bottom trawling area to commercial fishermen and causes space-use conflicts. Underwater OCS obstructions, such as pipelines, cause gear conflicts that result in losses of trawls and shrimp catch, business downtime, and vessel damage. However, all pipelines in water depths less than 61 m will be buried, and their locations made public knowledge (Alpert, 1990). Nearly 97 percent of trawl fishing in the WPA occurs in water depths less than 61 m (Louisiana Dept. of Wildlife and Fisheries, 1992). Although Gulf fishermen are experiencing some economic loss from gear conflicts, the economic loss for a fiscal year has historically been less than 0.1 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. Approximately 100 and 125 structures were removed from the Gulf of Mexico in 1991 and 1992, respectively. Eighty percent of multi-leg platforms in water depths less than 156 m are removed by severing their pilings with 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 (Scarborough-Bull and Kendall, 1992; Young, 1991). Within the past decade, stocks of reef fish 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 entered into a formal Interagency Agreement with NOAA and NMFS and is investigating fish

deaths associated with structure removal. This study will attempt to relate the role of fish deaths from platform removals to the status of reef fish stocks in the Gulf of Mexico (USDOL, 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 (Chamberlain, 1991; 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).

Chronic low-level pollution is a persistent and recurring event resulting in frequent but nonfatal physiological irritation to those resources that lie within the range of impact and that are likely to be adversely affected by the pollution. The geographic range of the pollutant effect depends on the mobility of the resource, the characteristics of the pollutant, and the tolerance of the resource to the pollutant in question (in this case hydrocarbons). Adult fish must experience continual exposure to relatively high levels of hydrocarbons over several months before secondary toxicological compounds that represent biological harm are detected in the liver (Payne et al., 1988). Adult fish are likely to actively avoid an oil spill, thereby limiting the effects and lessening the extent of damage (Baker et al., 1991; Malins et al., 1982).

The primary objective of a recently awarded MMS contract is to document any fundamental detoxification responses, which have resulted from exposure to low-level contaminants associated with long-term OCS activities, in the resident fauna at OCS production sites. Documentation at this biochemical level will serve as an early warning signal of possibly more serious pathologies before any changes that are secondary in nature appear. An ancillary objective of the study is to identify any secondary changes in order to document the indirect impacts of any contaminant exposure at the population or community level. By examining differences in both time and space of the reproductive patterns of the resident biota, it should be possible to detect the effects of chronic exposure to low-level contaminants.

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). Upon exposure to spilled oil, liver enzymes of fish oxidize soluble hydrocarbons into compounds that are easily excreted in the urine (Spies et al., 1982). When contacted by spilled oil, floating eggs and larvae, with their limited mobility and physiology, 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 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 pelagic eggs and larvae are present have the greatest potential to affect commercial fishery resources. Migratory species, such as mackerel, cobia, and crevalle, could be impacted if oil spills contact nearshore open waters. An oil spill contacting a low-energy inshore area would affect localized populations of commercial fishery resources, such as menhaden, shrimp, and blue crabs. Chronic oiling in an inshore area would affect all life stages of a localized population of a sessile fishery resource such as oysters.

For OCS-related oil spills to have an effect on a commercial fishery resource, whether estuary dependent or not, eggs and larvae would have to be abnormally concentrated in the immediate spill area. Oil components also would have to be present in highly toxic concentrations when both eggs and larvae are in the pelagic stage (Longwell, 1977). There is no evidence at this time that commercial fisheries in the Gulf have been adversely affected on a regional population level by spills or chronic oiling.

Observations at oil spills around the world, including the *Exxon Valdez* spill in Prince William Sound, consistently indicate that free-swimming fish are rarely at risk from oil spills (Anon., 1991c; NRC, 1985). Fish swim away from spilled oil and this behavior explains why there has never been a commercially important fish-kill on record following an oil spill. The only adult fish-kill on record following an oil spill was on the French coast when several tons of small rock-clinging fish (not commercially harvested) were killed at the site of the *Amoco Cadiz* wreck. In addition, concerns about the possible impact of spilled oil, on the breeding cycle of commercial fishery resources have proved to be false (Anon., 1991c; Baker et al., 1991).

Large numbers of fish eggs and larvae have been killed by oil spills. However, fish over-produce eggs on an enormous scale and the overwhelming majority of them die at an early stage, generally as food for

predators. Even a heavy mortality from an oil spill has no detectable effect on the adult population, which is exploited by a commercial fishery. This has been confirmed during and after the *Torrey Canyon* spill off southwest England and the *Argo Merchant* spill off Nantucket. In both cases a 90 percent mortality of fish eggs and larvae, pilchard and pollack, respectively, was observed in the affected area, but this had no impact on the regional commercial fishery (Baker et al., 1991).

Development abnormalities in juveniles occur naturally in wild fish populations, and the frequency of these abnormalities is increased in populations chronically exposed to oil. These abnormal fish do not survive long in the struggle for existence. Such delayed death is likely to have an equally negligible impact on commercial fisheries as are the immediate deaths following an oil spill.

Benthic disturbance from subsurface blowouts of both oil and natural gas wells in water depths less than 152 m and trenching (burial) of pipelines in water depths less than 61 m may be detrimental to commercial fisheries. Trenching and blowouts can resuspend sediments, and the loss of oil-well control can release varying amounts of hydrocarbons into the water column (USDOL, MMS, 1987a). 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. However, sandy sediments are quickly redeposited within 400 m of the blowout site. Finer sediments are widely dispersed and redeposited over a period of 30 days or longer within a few thousand meters. Released hydrocarbons are diluted to background levels within a few thousand meters of the blowout site and degrade quickly without major biological effect. Gas well blowouts are even less of an environmental risk, resulting in little resuspended sediments and increased levels of natural gas for a few days very near the source of the blowout. Natural gas consists mainly of nontoxic methane, which rapidly disperses upward into the air (Van Buuren, 1984). Loss of well control and resultant subsurface blowouts seldom occur on the Gulf of Mexico OCS. Only 0.6 percent of all wells experience an uncontrolled loss of pressure and no more than 23 percent of those result in the release of some oil (Fleury, 1983).

Drilling muds contain materials toxic to commercial fishery resources; 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; Parrish and Duke, 1990). 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; Proni, 1984).

In addition to toxic trace elements and hydrocarbons in produced waters, there are additional components and properties, such as hypersalinity and organic acids, 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). Produced water will be disposed of onshore by reinjection or discharge into the Mississippi River (Section IV.B.2.c.).

The fate and effects of NORM from the discharge of produced water on seafood available for commercial harvest has become an issue of environmental concern. The NORM occurs in some produced waters because oil is extracted from reservoir rock where NORM is formed by the radioactive decay of naturally occurring uranium and thorium. Radium isotopes comprise over 90 percent of the total radioactivity in produced waters (Laul et al., 1985; Snively, 1989). Animals are able to reject radium in favor of calcium; marine fish and shellfish reject 70-90 percent; man rejects 98 percent (De Bartoli and Gaglione, 1972; Snively, 1989). When metabolized by animals, radium follows calcium in the body and thus will accumulate mostly in the skeleton or shell, which are inedible to man (Mulino and Rayle, 1992). In shellfish, 90 percent of the radium is in the shell; in fish, 80-90 percent is in the skeleton (Snively, 1989).

Fish and shellfish require at least a year for their body radium to equilibrate with the radium content of the surrounding water (Lyengar, 1984). During any continuous time period substantial variations in radium intake are caused by variations in the volume and radioactivity of discharged produced water, tidal and river flow, and rainfall (Snively, 1989).

Data collected from offshore platforms discharging NORM in produced waters show that epifaunal and associated organisms within 3 m of the discharge are not accumulating radium to high levels (Mulino and Rayle, 1992). The levels of radioactivity measured in soft tissue and hard parts of all biota tested (barnacles, molluscs, fish, and blue crabs) were near the lower limit of detection (LLD). Any radium concentrations above the LLD were in inedible hard parts (shell or bone).

An investigation concerning the health risk for radium in seafood harvested near onshore produced water outfalls in 1990 was performed by Hamilton et al. (1992). The study concluded that the health risks associated with the discharge of produced water are comparable to those expected to result from background concentrations of radium in Louisiana coastal waters. The authors state that they were purposely conservative and overestimated the concentration of radium in fish and shellfish and the amount of seafood harvested near outfalls. In addition, the authors admit to using USEPA risk factors that they believe overestimate the health risks associated with small amounts of radium.

The likelihood of consuming seafood available for commercial harvest containing higher than normal radium for a sufficient period of time to present a risk is minimal. The prospect that NORM discharged in offshore produced water will affect commercial fishery species and subsequently increase man's intake of radium is virtually zero.

Base Case Analysis

The major impact-producing factors analyzed below are related to the proposed action and include coastal environmental degradation, production platform emplacement, underwater OCS obstructions, production platform removal, seismic surveys, oil spills, subsurface blowouts, pipeline trenching, and OCS discharge of drilling muds, produced waters, and NORM.

The effect of the proposed action on wetlands and inshore water quality in the WPA is analyzed in detail in Sections IV.D.2.a.(1) and (3), respectively. The indirect effect on commercial fisheries is considered below.

To summarize the effects on wetlands and estuarine areas, it is expected that 3 ha of coastal areas will be affected by onshore oil spills as a result of the proposed action. The productivity of 1 ha will be suppressed for 4 years from barge spills; the productivity of 2 ha will be suppressed for 10 years from pipeline spills. Up to 3 ha of wetlands could be eroded as a result of vessel usage of navigation channels and access canals in coastal Louisiana and Texas. Up to 7 ha of wetlands could be eroded as a result of pipeline canal widening in coastal Texas. Overall, 5 ha of wetlands in the WPA will be converted to open water as a result of the proposed action.

To summarize the effects on coastal and estuarine water quality, it is expected that coastal waters in the Western Gulf of Mexico would be degraded from periodic point source discharges and bottom disturbances (elevated turbidity) from OCS support activities--occurring in an area within 1,000 m of the source and persisting for several days to weeks after the activity has concluded. Further decrease in water quality would occur from chronic low-level contamination (elevated levels of hydrocarbons, trace metals, salinity, temperature, organic compounds, and lower dissolved oxygen) resulting from OCS-associated site runoff and maritime traffic activities occurring over the life of the proposal. Significant increases in water concentrations of dissolved and particulate hydrocarbons and trace metals are not expected beyond 1,000 m of any discharge site.

It is expected that coastal environmental degradation from the proposed action will affect commercial fishery resources. The impact of coastal degradation in the WPA is expected to cause less than a 1 percent decrease in commercial fishery populations, in essential habitats, or in commercial fishing. Recovery of commercial fishery resources can occur from more than 90 percent, but not all, of the expected coastal environmental degradation. However, at the expected level of effect the resultant influence on Western Gulf fisheries is negligible and will be undistinguishable from natural population variations.

In Subarea W-2, an area of bottom trawl fishing, one platform emplacement in water depths less than 152 m (Table IV-4) is expected to result from the proposed action, eliminating 6 ha of the trawling area. For the purpose of this analysis, it is assumed that space-use conflicts rarely 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 W-2 or in the WPA.

Underwater OCS obstructions such as pipelines cause gear conflicts. Table IV-4 estimates the kilometers of offshore pipeline resulting from the proposed action in the WPA. It is expected that 220 km of pipeline will be installed in the WPA during the 35-year life of the proposed action. In Subarea W-1, the area of concentrated bottom trawl fishing, less than 20 percent, or 40 km, of pipeline will be installed during the 35-year life of the proposed action, with no more than 7 km installed during any one year. Gear conflicts are mitigated by the FCF. During FY 91, 128 claims were processed, with 91 percent being approved for a total

of \$512 thousand (Jackson, written communication, 1992). This economic loss from gear conflicts for F-Y 91 was less than 0.1 percent of the value (\$641 million) of Gulf commercial fisheries landings for 1991. For the purpose of this analysis, it is assumed that installed pipelines will seldom conflict with bottom trawl fishing, and it is expected to 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-4 estimates that four 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. For the purpose of this analysis, it is expected that structure removals will have a negligible effect on Western Gulf fisheries because of the inconsequential number of removals and the considerations that removals kill only those fish proximate to the removal site.

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

Oil spills that contact coastal bays, estuaries, and waters of the OCS when pelagic eggs and larvae are present have the greatest potential to affect commercial fishery resources. In the event that sale-related oil spills should occur in coastal bays, estuaries, or waters of the OCS proximate to mobile adult finfish or shellfish, the effects are expected to be nonfatal and the extent of damage are expected to be limited and lessened due to some capability of adult fish and shellfish to avoid an oil spill, to metabolize hydrocarbons, and to excrete both metabolites and parent compounds. For floating eggs and larvae contacted by spilled oil, the effect is expected to be lethal. Tables IV-4 (Section IV.A.3.h.(2)) and IV-15 (Section IV.B.2.d.(1)) project the number of offshore and onshore spills expected to occur in the WPA as a result of the proposed action.

It is estimated that 8 onshore spills of 1 bbl or less will occur at a frequency of about one every three years. It is assumed that spills of this volume will affect a very small area and dissipate rapidly. Six offshore and two onshore Size 1 spills (average size 3 bbl) are estimated to occur at a respective frequency of about one offshore spill every three years and 1 onshore every decade in the WPA. It is assumed that spills of these volumes will affect a very small area and dissipate rapidly and that none of the offshore Size 1 spills will contact the coast.

No Size 2 or Size 3 spills are estimated to occur in the WPA during the life of the proposed action. The effect of sale-related oil spills on commercial fisheries is expected to cause less than a 1 percent decrease in commercial populations or in commercial fishing. At the expected level of effect, the resultant influence on Western Gulf fisheries is negligible and will be undistinguishable from natural population variations.

Subsurface blowouts of both oil and natural gas wells and pipeline trenching have the potential to adversely affect commercial fishery resources. Loss of well control and resultant blowouts seldom occur on the Gulf OCS (6 blowouts per 1,000 well starts; 23% will result in some spilled oil). It is assumed that there will be one blowout in the WPA resulting from the proposed action during the 35 year life of the proposed action. Table IV-4 estimates the resuspension of some 0.113 million m^3 of sediment during the installation of 220 km of pipelines in water depths less than 61 m. Offshore Subarea W 2, an area of bottom trawl fishing and consolidated sediments, will support the greatest portion of sale-related pipeline burial activities (65 km) and associated sediment resuspension (0.092 million m^3) (Table IV-4). Sandy sediments will be quickly redeposited within 400 m of the trench and finer sediments will be widely dispersed and redeposited over a period of 30 days or longer within a few thousand meters of the trench. For the purpose of this analysis, it is expected that the infrequent subsurface blowout that may occur on the Gulf OCS will have a negligible effect on Gulf commercial fisheries. The effect on commercial fisheries from pipeline trenching in the WPA is expected to cause less than a 1 percent decrease in commercial fishery populations or in commercial fishing. Any affected population is expected to recover to predisturbance condition in one generation. At the expected level of effect, the resultant influence on Western Gulf fisheries is negligible and will be undistinguishable from natural population variations.

Drilling mud discharges (Table IV-4) 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 Western Gulf fisheries.

Produced-water discharges (Table IV-4) contain components and properties detrimental to commercial fishery resources; however, toxic compounds are undetectable beyond 1,000 m from the discharge point.

Offshore discharges of produced water will rapidly disperse and dilute to background levels and will have a negligible effect on Western Gulf fisheries.

The NORM discharged offshore in produced water has the potential to affect adversely commercial fishery species and subsequently increase man's intake of radium; however, this is only at concentrations 10-12 orders of magnitude higher than those found within 3 m from the discharge point. The NORM component of offshore discharges of produced water will rapidly dilute to background levels, will have no effect on commercial fishery resources, and will have no effect on commercial fishing in the WPA.

Summary

Activities resulting from the proposed action have the potential to cause detrimental effects to Western Gulf commercial fisheries. It is expected that the effects from the major impact-producing factors on commercial fisheries in the WPA will be inconsequential and rare. At the expected level of effect, the resultant influence on Western Gulf fisheries is negligible and will be undistinguishable from natural population variations. As a result, there will be little discernible disturbance to Gulf commercial fisheries.

Conclusion

The proposed action is expected to result in less than a 1 percent decrease in commercial fishery populations, in essential habitat, or in commercial fishing. It will require less than six months for fishing activity and one generation for fishery resources to recover from 99 percent of the impacts.

High Case Analysis

The major impact-producing factors analyzed in the High Case include coastal environmental degradation, production platform emplacement, underwater OCS obstructions, production platform removal, seismic surveys, oil spills, subsurface blowouts, pipeline trenching, and OCS discharge of drilling muds, produced waters, and NORM.

The effect of the proposed action on wetlands and inshore water quality in the WPA is analyzed in detail in Sections IV.D.2.a.(1) and (3), respectively. The indirect effect on commercial fisheries is considered below.

It is expected that 9 ha of coastal areas will be affected by onshore oil spills as a result of the proposed action. The productivity of 3 ha will be suppressed for 4 years from barge spills; the productivity of 5 ha will be suppressed for 10 years from pipeline spills. Up to 6 ha of wetlands could be eroded as a result of vessel usage of navigation channels and access canals in coastal Louisiana and Texas. Up to 14 ha of wetlands could be eroded as a result of pipeline canal widening in coastal Louisiana and Texas. Overall, 11 ha of wetlands in the WPA will be converted to open water as a result of the proposed action.

It is expected that coastal waters in the Western Gulf of Mexico would be degraded from periodic point source discharges and bottom disturbances (elevated turbidity) from OCS support activities--occurring in an area within 1,000 m of the source and persisting for several days to weeks after the activity has concluded. Further decrease in water quality would occur from chronic low-level contamination (elevated levels of hydrocarbons, trace metals, salinity, temperature, organic compounds, and lower dissolved oxygen) resulting from OCS associated site runoff and maritime traffic activities occurring over the life of the proposal. Significant increases in water concentrations of dissolved and particulate hydrocarbons and trace metals are not expected beyond 1,000 m of any discharge site.

It is expected that coastal environmental degradation from the proposed action will affect commercial fishery resources. The impact of coastal degradation in the WPA is expected to cause less than a 1 percent decrease in commercial fishery populations, in essential habitats, or in commercial fishing. Recovery of commercial fishery resources can occur from more than 90 percent, but not all, of the expected coastal environmental degradation. However, at the expected level of effect, the resultant influence on Western Gulf fisheries is negligible and will be undistinguishable from natural population variations.

In offshore Subarea W-2, an area of bottom trawl fishing, two platform emplacements in water depths less than 152 m (Table IV-4) are expected to result from the proposed action, eliminating 12 ha of the trawling area. 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 W-2 or in the WPA.

Underwater OCS obstructions such as pipelines cause gear conflicts. Table IV-4 estimates the kilometers of offshore pipeline resulting from the proposed action in the WPA. It is expected that 380 km of pipeline will be installed in the WPA during the 35-year life of the proposed action. In Subarea W-1, the area of concentrated bottom trawl fishing, less than 12 percent, or 40 km, of pipeline will be installed during the 35-year life of the proposed action, with no more than 7 km installed during any one year. Gear conflicts are mitigated by the FCF. During FY 91, 128 claims were processed, with 91 percent being approved for a total of \$512 thousand (Jackson, written communication, 1992). This economic loss from gear conflicts for FY 91 was less than 0.1 percent of the value (\$641 million) of Gulf commercial fisheries landings for 1991. For the purpose of this analysis, it is assumed that installed pipelines will seldom conflict with bottom trawl fishing, and it is expected to 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-4 estimates that eight 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. For the purpose of this analysis, it is expected that structure removals will have a negligible effect on Western Gulf fisheries because of the inconsequential number of removals and the considerations that removals kill only those fish proximate to the removal site.

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

Oil spills that contact coastal bays, estuaries, and waters of the OCS when pelagic eggs and larvae are present have the greatest potential to affect commercial fishery resources. In the event that sale-related oil spills should occur in coastal bays, estuaries, or waters of the OCS proximate to mobile adult finfish or shellfish, the effects are expected to be nonfatal and the extent of damage is expected to be limited and lessened due to some capability of adult fish and shellfish to avoid an oil spill, to metabolize hydrocarbons, and to excrete both metabolites and parent compounds. For floating eggs and larvae contacted by spilled oil, the effect is expected to be lethal. Tables IV-2 (Section IV.A.3.h.(2)) and IV-13 (Section IV.B.2.d.(1)) project the number of offshore and onshore spills expected to occur in the WPA as a result of the proposed action.

It is estimated that 24 onshore spills of 1 bbl or less will occur at a frequency of about two every 5 years. It is assumed that spills of this volume will affect a very small area and dissipate rapidly. Eighteen offshore and two onshore Size 1 spills (average size, 3 bbl) are estimated to occur at a respective frequency of about 1 offshore spill per year and one onshore spill per decade in the WPA. It is assumed that spills of these volumes will affect a very small area and dissipate rapidly and that none of the offshore Size 1 spills will contact the coast.

One onshore Size 2 spill (average size, 500 bbl) is estimated to occur in the WPA during the life of the proposed action. The onshore spill will originate near terminal locations in the coastal zone of Louisiana. For the purpose of this analysis, it is assumed that Size 2 spills will rarely contact and affect the coastal bays and marshes critical to the well-being of commercial fisheries in the WPA.

Tables IV-4 estimates that one Size 3 spill of about 6,500 bbl will occur in the WPA during the 35-year life of the proposed action. There is a 1 percent probability that an oil spill of this size would occur and contact within 10 days coastal Texas. All other coastal areas have less than 0.5 percent probability of an occurrence and contact. For the purpose of this analysis, it is estimated that a Size 3 spill 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 of migratory species in the WPA is comparatively small, these species are of high value. Migratory species could be affected by oil spills occurring in the coastal area. There is a 1 percent probability that a Size 3 spill would occur and contact within 10 days nearshore and coastal areas along the Western Gulf. For the purpose of this analysis, it is estimated that a Size 3 spill will seldom contact and affect nearshore and coastal areas of migratory Gulf fisheries.

The effect of sale-related oil spills on commercial fisheries is expected to cause less than a 1 percent decrease in commercial populations or in commercial fishing. At the expected level of effect the resultant

influence on Western Gulf fisheries is negligible and will be undistinguishable from natural population variations.

Subsurface blowouts of both oil and natural gas wells and pipeline trenching have the potential to adversely affect commercial fishery resources. Loss of well control and resultant blowouts seldom occur on the Gulf OCS (6 blowouts per 1,000 well starts; 23% will result in some spilled oil). It is assumed that there will be three blowouts in the WPA resulting from the proposed action during the 35-year life of the proposed action. Table IV-4 estimates the resuspension of some 0.168 million m³ of sediment during the installation of 380 km of pipelines in water depths less than 61 m. Offshore Subarea W-2, an area of bottom trawl fishing and consolidated sediments, will support the greatest portion of sale-related pipeline burial activities (90 km) and associated sediment resuspension (0.147 million m³) (Table IV-4). Sandy sediments will be quickly redeposited within 400 m of the trench and finer sediments will be widely dispersed and redeposited over a period of 30 days or longer within a few thousand meters of the trench. For the purpose of this analysis, it is expected that the infrequent subsurface blowout that may occur on the Gulf OCS will have a negligible effect on Gulf commercial fisheries. The effect on commercial fisheries from pipeline trenching in the WPA is expected to cause less than a 1 percent decrease in commercial fishery populations or in commercial fishing. Any affected population is expected to recover to predisturbance condition in one generation. At the expected level of effect the resultant influence on Western Gulf fisheries is negligible and will be undistinguishable from natural population variations.

Drilling mud discharges (Table IV-4) 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 will have a negligible effect on Western Gulf fisheries.

Produced water discharges (Table IV-4) contain components and properties detrimental to commercial fishery resources; however, toxic compounds are undetectable beyond 1,000 m from the discharge point. Offshore discharges of produced water will rapidly disperse and dilute to background levels and will have a negligible effect on Western Gulf fisheries.

The NORM discharged offshore in produced water has the potential to affect adversely commercial fishery species and subsequently increase man's intake of radium; however, this is only at concentrations 10-12 orders of magnitude higher than those found within 3 m from the discharge point. The NORM component of offshore discharges of produced water will rapidly dilute to background levels, will have no effect on commercial fishery resources, and will have no effect on commercial fishing in the WPA.

Conclusion

The High Case is expected to result in less than a 1 percent decrease in commercial fishery populations, in essential habitat, or in commercial fishing. It will require less than six months for fishing activity and one generation for fishery resources to recover from 99 percent of the impacts.

(9) Impacts on Recreational Resources and Beach Use

Section IV.D.1.a.(11) presents a general discussion regarding chronic trash and debris and Size 3 oil spills 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.

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 Padre Island National Seashore, State parks and recreational areas, county and local parks, urban beaches, private resort areas, and State and private environmental preservation and conservation areas. The primary impact-producing factors 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, and noise from aircraft can disturb

the ambience of a beach-related recreation experience. All these factors, either individually or collectively, may adversely affect the number and value of recreational beach visits. 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.

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.3.e.). 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.3.b.(3)), and noise associated with vessels and aircraft (Section IV.A.3.g.) 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 WPA.

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 Size 3 oil spills (5% probability) (Table IV-9) throughout the 35-year life of the proposed action (1994-2028). Wind, waves, and currents could cause spills to interact with major shorefront recreational beaches throughout the coastal areas of the WPA and CPA.

The OSRA estimates (Table IV-11) indicate the proposed action is not expected (less than a 0.05% probability) to result in the occurrence and contact of a Size 3 oil spill 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 a Size 3 oil spill will not impact recreational beaches in the operations resulting from proposed Sale 150.

As noted in Table IV-15, two onshore Size 1 spills are assumed to occur as a result of proposed Sale 150. Even if both assumed onshore spills directly affect recreational beaches, only a small portion of the beach would be temporarily closed to recreational use.

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 estimated 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

Small onshore oil spills and marine debris lost from OCS operations associated with drilling 240 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 of pollution on Texas beaches from proposed Sale 150 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, together with one or two small onshore spills, 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 would be derived from the same impacting factors identified under the Base Case, above. Included are oil spills and trash and debris.

The OSRA estimates (Table IV-11) indicate that, even with more optimistic oil and gas finds from the proposed action, the estimated probability of a Size 3 oil spill 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.A.3.h.(2), it is assumed that 1 offshore Size 3 spill will occur and that up to 30 Size 1 onshore spills are assumed (Table IV-15) and could result in a temporary closure of portions of a Texas recreational beach.

With 560 wells drilled and 30 platform complexes producing oil and gas throughout the life of the proposed action (Table IV-4), 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 High Case is expected to result in one oil pollution incident causing a temporary beach closure and 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.

(10) Impacts on Archaeological Resources

Lease blocks with a high probability for the occurrence of prehistoric, prehistoric and historic, or historic archaeological resources may be 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 were 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.2.a. (offshore infrastructure), IV.B.1.a. (onshore infrastructure), and IV.A.3.h. and IV.B.2.b. (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 in less than 457 m of water will directly disturb 1.5 ha of soft bottom; the average platform, under the same conditions, 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 must be buried. Burial depths of 1 m are required with the exception of shipping fairways and anchorage areas, where the requirements are 3.0 and 4.6 m, 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. Eight of these are located in the WPA.

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 the 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-4, under the Base Case, 220 exploration, delineation, and development wells will be drilled, and 10 production platforms and 220 km of pipelines will be installed in the Western Gulf. Of this number, 25 exploration, delineation, and development wells will be drilled, and 5 platforms and 105 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 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 historic period 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.

The loss or toss of ferromagnetic debris during exploration and production activities has the potential to mask the magnetic signatures of historic shipwrecks. Under the Base Case, it is expected that hundreds of tons of ferromagnetic debris will be lost or tossed as a result of OCS activities. It has been noted that such debris has the potential to be moved from the area of initial deposition as a result of trawling activities (Garrison et al., 1989). It is expected that most ferromagnetic debris associated with emplaced structures will be removed from the seafloor during site clearance activities. Site clearance, however, takes place after the useful life of the structure is complete. Also, no site clearance activities occur in association with pipeline emplacement. Therefore, there remains the potential for masking the signatures of historic shipwrecks as a result of ferromagnetic debris from OCS oil and gas activities.

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 150. 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-18 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 traffic use as a result of the proposed action is negligible. As this shipwreck is a unique historic archaeological resource, maintenance dredging, in general, is responsible for impacts to a historic shipwreck. That portion of the impact attributable to OCS activities resulting from the Base Case is extremely low. Table IV-18 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-11 the probability of a Size 3 spill occurring and contacting within 10 days the coast of the WPA is less than 0.5 percent under the Base Case. This impact is expected to be temporary and reversible. It is assumed that onshore spills will occur as a result of OCS oil being transported to shore. In the WPA it is assumed that an average of less than one Size 1 spill will occur every 2 years. Should such an oil spill contact a historic site, the effects would 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, 1987a).

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. An 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 not expected to impact historic archaeological resources. No new onshore infrastructure construction or pipeline landfalls are expected as a result of the proposed action. Ferromagnetic debris has the potential to mask the magnetic signatures of historic shipwrecks. Historic cultural resources, therefore, will not be affected by these activities. There is a small 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. Maintenance dredging of navigation channels may result in impacts to historic shipwrecks; however, the percentage of OCS use of these channels under the proposed action for the WPA is less than 0.1 percent.

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 low probability 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. 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. Archaeological surveys are the only means to determine whether objects of historical or archaeological interest would be impacted by geological exploration. These surveys should still be required by the OCSLA even without the stipulation in place. The effects of the impact-producing factors on historic archaeological resources without the Archaeological Resource Stipulation in place should, 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. An 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 a Size 3 oil spill occurring and contacting land is less than 0.5 percent. 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. The amount of dredging directly attributed to the proposed action is 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 be found in the Western Gulf. An LTL dated November 30, 1990, redefined the high probability areas for the presence of historic period shipwrecks. The NTL 91-02, changes survey methodology requirements for historic shipwreck survey. 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.2.a. (offshore infrastructure), IV.B.1.a. (onshore infrastructure), and IV.A.3.h. and IV.B.2.b. (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. 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.

The loss or toss of ferromagnetic debris during exploration and production activities has the potential to mask the magnetic signatures of historic shipwrecks. Under the High Case, it is expected that hundreds of tons of ferromagnetic debris will be lost or tossed as a result of OCS activities. It has been noted that such debris has the potential to be moved from the area of initial deposition as a result of trawling activities (Garrison et al., 1989). It is expected that most ferromagnetic debris associated with emplaced structures will be removed from the seafloor during site clearance activities. Site clearance, however, takes place after the useful life of the structure is complete. Also, no site clearance activities occur in association with pipeline emplacement. Therefore, there remains the potential for masking the signatures of historic shipwrecks as a result of ferromagnetic debris from OCS oil and gas activities.

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-4, under the High Case, 560 exploration, delineation, and development wells will be drilled, and 30 production platforms and 380 km of pipelines will be installed in the Western Gulf. Of this number, 45 exploration and production wells will be drilled, and 8 platforms and 130 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 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 historic period 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 would be damage to or loss of significant or unique historic archaeological information. The greater effectiveness of the survey in the eastern part of the WPA would further 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 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. The probability of a Size 3 oil spill occurring and contacting land under the High Case is 1 percent. This impact would most likely be temporary and reversible. It is assumed that onshore spills will occur as a result of OCS oil being transported to shore. In the WPA it is assumed that an average of less than one Size 1 spill will occur per year. Should such an oil spill contact a historic site, the effects would 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, 1987a).

Conclusion

There is a very low probability 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-4, under the Base Case, 220 exploration, delineation, and development wells will be drilled, and 10 production platforms and 220 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 25 exploration, delineation, and development wells; 5 production platforms; and 105 km of pipelines installed (Table IV-4). 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 150. 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 Size 3 spill occurring and contacting the WPA coast within 10 days is less than 0.5 percent (Table IV-11). Based on this low probability, the assumption is that no Size 3 spills will affect prehistoric archaeological resources.

It is assumed that onshore spills will occur as a result of OCS oil being transported to shore. In the WPA it is assumed that an average of less than one Size 1 spill will occur every year under the Base Case. It is further assumed that the majority of such spills would occur around terminals and be contained in the vicinity of the spill. There is a low probability of these spills contacting a prehistoric archaeological site. However, should such an oil spill contact a prehistoric site, the carbon-14 dating of organic matter would be affected along those portions of the site that was contacted by the oil.

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* (USDOL, MMS, 1987a).

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 would 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, pipelining, trenching, and navigation canal dredging. None of these activities is expected to occur under the proposed action.

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 Size 1 spill occurring and contacting a coastal prehistoric site within 10 days (Table IV-11) is less than 0.5 percent. It is assumed that no contact will occur. There is a small possibility of onshore oil spills contacting a prehistoric site; however, should such contact occur, C-14 dating of organic material would be affected in these portions of the site that was contacted.

Conclusion

There is a very low probability of an impact between OCS 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 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. 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. Archaeological surveys are the only means to determine whether objects of historical or archaeological interest would be impacted by geological exploration. These surveys should still be required by the OCSLA even without the stipulation in place. The effects of the impact-producing factors on prehistoric archaeological resources without the Archaeological Resource Stipulation in place should, 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 Size 3 spill contacting a coastal prehistoric site is very low, and it is assumed that no contact will occur. It is also assumed that no Size 1 or Size 2 oil spills between 1 and 1,000 bbl will occur and contact the coast. There is a small possibility of onshore oil spills contacting prehistoric sites; however, should such contact occur, C-14 dating of organic materials would be affected along those portions of the site that was contacted by the oil.

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-4, under the High Case, 560 exploration, delineation, and development wells will be drilled, and 30 production platforms and 380 km of pipelines will be installed in the Western Gulf. Removing Subarea W-3 from the projected impacts resulting from the High Case leaves 45 exploration, delineation, and development wells; 8 production platforms; and 130 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 Size 3 spill occurring and contacting the WPA coast within 10 days is 1 percent (Table IV-11). Based on this low probability, the assumption is that no Size 3 spills will affect prehistoric archaeological resources. Furthermore, it is assumed that no Size 1 or Size 2 spills will occur and contact land. It is assumed that onshore spills will occur as a result of OCS oil being transported to shore. In the WPA it is assumed that an average of less than one Size 1 spill will occur per year under the High Case. It is further assumed that the majority of such spills would occur around terminals and be contained in the vicinity of the spill. There is a low probability of these spills contacting a prehistoric archaeological site. However, should such an oil spill contact a prehistoric site, the carbon-14 dating of organic matter would be affected along those portions of the site that was contacted by the oil.

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* (USDOL, MMS, 1987a).

Conclusion

There is a very low probability of an impact between OCS 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 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 the counties and parishes within the coastal impact area of the Central and Western Gulf Region 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 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 seismic surveying, 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 eight wells per year with approximately 133 workers.
Development Activity -	One platform rig can drill an average of nine 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 computerized population and employment spreadsheet 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 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

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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 environment, 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 Sections IV.A.3.h., IV.B.2.d., and IV.C.5.

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 0.66.

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 resulting from 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-9. 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 18,828 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 64 percent of the total employment resulting from the proposed action in the Western Gulf is expected to be supported by the coastal communities of the CPA. Peak-year impacts occur in 2001, with a total of 976 workers involved in primary, secondary, and tertiary industries. Direct employment in the primary oil and gas extraction industry (SIC 13) accounts for 48 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 within the first 11 years of the life of the proposed action, are the largest contributor to peak-year direct impacts and total employment impacts. After their initial peak in 2001, 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 2010, as employment resulting from production activities offshore reaches a second peak of 340 workers. 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 58 percent of total employment impacts due to Western Gulf activity.

A. Western Planning Area

B. Central Planning Area

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

Figure IV-9. Base Case Employment Impacts from Western Gulf Sale 150 (USDOl, MMS, Gulf of Mexico OCS Region estimates, 1992).

Table IV-26 ¹² plays the model projections of total OCS-related employment impacts (direct, indirect, and induced) from proposed Sale 150 in the Western Gulf to the coastal subareas of the CPA and WPA throughout the life of the proposed action. Table IV-27 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 LA-1 and LA-2, with peak year impact estimates for 2001 of 0.09 percent and 0.10 percent, respectively. Coastal Subareas LA-1 and LA-2 collectively provide over 64 percent of the total employment required in support of the proposed action in the Western Gulf. Coastal Subareas TX-1 and TX-2 contribute the remaining 36 percent of the employment; however, the peak-year employment impacts in those areas are only 0.02 percent and 0.01 percent, respectively. 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.A.3.h. 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 Size 3 offshore spills will occur and contact land within 10 days of the accident is less than 1 percent (Table IV-11). 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.

No Size 2 spills are assumed to occur and contact the coastline. Six Size 1 spills are assumed to occur in the WPA over the life of the proposed action. None are estimated to contact land.

In addition to the offshore spills referenced above, a number of small onshore spills are expected to occur. The level of cleanup action associated with these spills will be minimal.

The greatest impact on population from activities associated with Sale 150 is expected in coastal Subareas LA-1 and LA-2 with peak-year estimates for 2001 of 0.09 and 0.10 percent, respectively (Table IV-27). 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 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 result in 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 in the Western Gulf. The coastal communities of the CPA are expected to support 64 percent of the total employment generated by the Western Gulf sale. The WPA contributes the remaining 36 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.

Table IV-26

Base Case OCS-Related Employment Projections (Direct+Indirect+Induced)
 Western Gulf Sale 150
 (Person-Years)

Year	TX-1	TX-2	LA-1	LA-2	LA-3	MA-1	WGOM*	CGOM**
====	=====	=====	=====	=====	=====	=====	=====	=====
1994	0	0	0	0	0	0	0	0
1995	6	41	36	100	0	0	48	136
1996	24	131	111	299	0	0	155	410
1997	37	190	158	420	0	0	227	579
1998	44	207	170	441	0	0	251	612
1999	51	224	182	463	0	0	274	645
2000	51	224	182	463	0	0	274	645
2001	58	241	194	484	0	0	298	678
2002	58	216	170	405	0	0	274	575
2003	58	216	170	405	0	0	274	575
2004	65	233	182	426	0	0	298	608
2005	60	167	123	247	0	0	227	369
2006	67	184	135	268	0	0	250	402
2007	67	184	135	268	0	0	250	402
2008	67	184	135	268	0	0	250	402
2009	67	184	135	268	0	0	250	402
2010	73	201	147	289	0	0	274	436
2011	73	201	147	289	0	0	274	436
2012	73	201	147	289	0	0	274	436
2013	73	201	147	289	0	0	274	436
2014	73	201	147	289	0	0	274	436
2015	73	201	147	289	0	0	274	436
2016	68	169	119	212	0	0	238	331
2017	61	153	107	190	0	0	214	298
2018	55	136	96	169	0	0	190	265
2019	48	119	84	148	0	0	166	232
2020	41	102	72	127	0	0	143	199
2021	41	102	72	127	0	0	143	199
2022	34	85	60	106	0	0	119	166
2023	27	68	48	85	0	0	95	132
2024	20	51	36	63	0	0	71	99
2025	14	34	24	42	0	0	48	66
2026	7	17	12	21	0	0	24	33
2027	7	17	12	21	0	0	24	33
2028	0	0	0	0	0	0	0	0
	=====	=====	=====	=====	=====	=====	=====	=====
	1,641	5,081	3,837	8,269	0	0	6,722	12,106

* Western Gulf of Mexico

** Central Gulf of Mexico

Source: USDOL, MMS, Gulf of Mexico OCS Region estimates, 1992.

Table IV-27

IV-356 Population and Employment Percentage Impact Levels for the Base Case (State 199)

Year 1994-2028	TX-1 1994-2028	TX-2 1994-2028	LA-1 1994-2028	LA-2 1994-2028	LA-3 1994-2028	MA-1 1994-2028
Employment Impacts						
1994	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1995	0.00%	0.00%	0.02%	0.02%	0.00%	0.00%
1996	0.01%	0.01%	0.05%	0.07%	0.00%	0.00%
1997	0.01%	0.01%	0.07%	0.09%	0.00%	0.00%
1998	0.01%	0.01%	0.08%	0.09%	0.00%	0.00%
1999	0.01%	0.01%	0.08%	0.10%	0.00%	0.00%
2000	0.01%	0.01%	0.08%	0.09%	0.00%	0.00%
2001	0.02%	0.01%	0.09%	0.10%	0.00%	0.00%
2002	0.02%	0.01%	0.08%	0.08%	0.00%	0.00%
2003	0.01%	0.01%	0.07%	0.08%	0.00%	0.00%
2004	0.02%	0.01%	0.08%	0.08%	0.00%	0.00%
2005	0.01%	0.01%	0.05%	0.05%	0.00%	0.00%
2006	0.02%	0.01%	0.06%	0.05%	0.00%	0.00%
2007	0.02%	0.01%	0.06%	0.05%	0.00%	0.00%
2008	0.02%	0.01%	0.06%	0.05%	0.00%	0.00%
2009	0.02%	0.01%	0.06%	0.05%	0.00%	0.00%
2010	0.02%	0.01%	0.06%	0.05%	0.00%	0.00%
2011	0.02%	0.01%	0.06%	0.05%	0.00%	0.00%
2012	0.02%	0.01%	0.06%	0.05%	0.00%	0.00%
2013	0.02%	0.01%	0.06%	0.05%	0.00%	0.00%
2014	0.02%	0.01%	0.06%	0.05%	0.00%	0.00%
2015	0.02%	0.01%	0.06%	0.05%	0.00%	0.00%
2016	0.02%	0.01%	0.05%	0.04%	0.00%	0.00%
2017	0.01%	0.00%	0.04%	0.03%	0.00%	0.00%
2018	0.01%	0.00%	0.04%	0.03%	0.00%	0.00%
2019	0.01%	0.00%	0.03%	0.03%	0.00%	0.00%
2020	0.01%	0.00%	0.03%	0.02%	0.00%	0.00%
2021	0.01%	0.00%	0.03%	0.02%	0.00%	0.00%
2022	0.01%	0.00%	0.02%	0.02%	0.00%	0.00%
2023	0.01%	0.00%	0.02%	0.01%	0.00%	0.00%
2024	0.00%	0.00%	0.01%	0.01%	0.00%	0.00%
2025	0.00%	0.00%	0.01%	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%
2028	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Population Impacts						
1994	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1995	0.00%	0.00%	0.02%	0.02%	0.00%	0.00%
1996	0.01%	0.01%	0.05%	0.07%	0.00%	0.00%
1997	0.01%	0.01%	0.08%	0.09%	0.00%	0.00%
1998	0.01%	0.01%	0.08%	0.10%	0.00%	0.00%
1999	0.01%	0.01%	0.09%	0.10%	0.00%	0.00%
2000	0.01%	0.01%	0.09%	0.10%	0.00%	0.00%
2001	0.02%	0.01%	0.09%	0.10%	0.00%	0.00%
2002	0.02%	0.01%	0.08%	0.09%	0.00%	0.00%
2003	0.02%	0.01%	0.08%	0.08%	0.00%	0.00%
2004	0.02%	0.01%	0.09%	0.09%	0.00%	0.00%
2005	0.02%	0.01%	0.06%	0.05%	0.00%	0.00%
2006	0.02%	0.01%	0.06%	0.05%	0.00%	0.00%
2007	0.02%	0.01%	0.06%	0.05%	0.00%	0.00%
2008	0.02%	0.01%	0.06%	0.05%	0.00%	0.00%
2009	0.02%	0.01%	0.06%	0.05%	0.00%	0.00%
2010	0.02%	0.01%	0.07%	0.06%	0.00%	0.00%
2011	0.02%	0.01%	0.07%	0.06%	0.00%	0.00%
2012	0.02%	0.01%	0.07%	0.06%	0.00%	0.00%
2013	0.02%	0.01%	0.07%	0.06%	0.00%	0.00%
2014	0.02%	0.01%	0.06%	0.06%	0.00%	0.00%
2015	0.02%	0.01%	0.06%	0.06%	0.00%	0.00%
2016	0.02%	0.01%	0.05%	0.04%	0.00%	0.00%
2017	0.02%	0.01%	0.05%	0.04%	0.00%	0.00%
2018	0.01%	0.00%	0.04%	0.03%	0.00%	0.00%
2019	0.01%	0.00%	0.04%	0.03%	0.00%	0.00%
2020	0.01%	0.00%	0.03%	0.02%	0.00%	0.00%
2021	0.01%	0.00%	0.03%	0.02%	0.00%	0.00%
2022	0.01%	0.00%	0.03%	0.02%	0.00%	0.00%
2023	0.01%	0.00%	0.02%	0.02%	0.00%	0.00%
2024	0.00%	0.00%	0.02%	0.01%	0.00%	0.00%
2025	0.00%	0.00%	0.01%	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%
2028	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Source: USDOl, MMS, Gulf of Mexico OCS Region estimates, 1992.

Conclusion

The impact of the proposed action 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 more than two-and-a-half times those expected in the Base Case. A total of 53,237 person-years of employment (direct, indirect, and induced) are required in the Central and Western Gulf coastal subareas in support of the proposed action. Peak-year impacts occur in 2000, with approximately 3,040 workers involved in primary, secondary, and tertiary industries. Direct employment in the primary oil and gas extraction industry (SIC 13) accounts for 48 percent of the total employment impact projected for the coastal subareas of the Central and Western Gulf over the life of the proposed action. Exploration activities are the main contributor to peak-year direct impacts and total employment impacts. A smaller yet noteworthy peak will occur in 2010 in association with production activities. The greatest contributor to overall employment impacts for the High Case is production operations. Employment related to oil and gas production activities accounts for 62 percent of total employment impacts resulting from Western Gulf activity.

Table IV-28 displays the model projections of total OCS-related employment impacts (direct, indirect, and induced) from Sale 150 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-29 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 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 LA-1 and LA-2, with peak-year impact estimates for 2000 of 0.35 percent and 0.26 percent, respectively. Coastal Subareas LA-1 and LA-2 collectively provide over 58 percent of the total employment required in support of the proposed action in the Western Gulf. Coastal Subareas TX-1 and TX-2 contribute the remaining 42 percent of the total employment associated with the proposed action.

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.A.3.h. presents estimates of the mean number of offshore spills assumed to result from the proposed action (High Case) in the WPA. The probability that one or more Size 3 offshore spills will occur and contact land within 10 days of the accident is 1 percent (Table IV-11). 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. One Size 2 spill is assumed to occur (Table IV-4); however, it will not contact the coastline. Eighteen Size 1 spills are assumed to occur in the WPA over the life of the proposed action. None are estimated to contact land.

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 these spills will be minimal.

The greatest impact on population from activities associated with Sale 150 in the High Case is expected in coastal Subareas LA-1 and LA-2 with peak-year impact estimates for 2000 of 0.28 and 0.37 percent,

Table IV-28

High Case OCS-Related Employment Projections (Direct+Indirect+Induced)
Western Gulf Sale 150
(Person-Years)

Year	TX-1	TX-2	LA-1	LA-2	LA-3	MA-1	WGOM*	CGOM*
====	=====	=====	=====	=====	=====	=====	=====	=====
1994	0	0	0	0	0	0	0	0
1995	10	115	105	321	0	0	125	425
1996	30	292	262	787	0	0	322	1,048
1997	42	396	354	1,058	0	0	439	1,412
1998	57	490	434	1,282	0	0	546	1,716
1999	71	583	514	1,505	0	0	654	2,019
2000	77	660	584	1,719	0	0	737	2,303
2001	67	520	456	1,321	0	0	587	1,776
2002	77	565	493	1,413	0	0	642	1,906
2003	71	488	423	1,199	0	0	559	1,622
2004	75	466	399	1,102	0	0	541	1,500
2005	71	403	340	917	0	0	474	1,257
2006	82	458	386	1,034	0	0	539	1,419
2007	79	428	359	951	0	0	507	1,310
2008	82	458	386	1,034	0	0	539	1,419
2009	79	428	359	951	0	0	507	1,310
2010	90	499	420	1,121	0	0	589	1,541
2011	87	469	393	1,038	0	0	557	1,432
2012	87	469	393	1,038	0	0	557	1,432
2013	87	469	393	1,038	0	0	557	1,432
2014	87	469	393	1,038	0	0	557	1,432
2015	87	469	393	1,038	0	0	557	1,432
2016	85	440	367	956	0	0	525	1,323
2017	79	413	344	898	0	0	492	1,242
2018	74	385	321	840	0	0	459	1,161
2019	63	315	261	670	0	0	378	930
2020	55	274	227	582	0	0	328	809
2021	46	233	193	495	0	0	279	688
2022	38	192	159	408	0	0	230	566
2023	30	151	125	320	0	0	181	445
2024	22	109	91	233	0	0	131	324
2025	14	68	57	146	0	0	82	202
2026	8	41	34	87	0	0	49	121
2027	3	14	11	29	0	0	16	40
2028	0	0	0	0	0	0	0	0
	=====	=====	=====	=====	=====	=====	=====	=====
	2,012	12,229	10,429	28,568	0	0	14,241	38,996

* Western Gulf of Mexico

** Central Gulf of Mexico

Source: USDOl, MMS, Gulf of Mexico OCS Region estimates, 1992.

Table IV-29

Population and Employment Percentage Impact Levels for the High Case (Sale 150)

IV-359

Year =====	TX-1 =====	TX-2 =====	LA-1 =====	LA-2 =====	LA-3 =====	MA-1 =====
Employment Impacts						
1994	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1995	0.00%	0.01%	0.05%	0.07%	0.00%	0.00%
1996	0.01%	0.01%	0.12%	0.17%	0.00%	0.00%
1997	0.01%	0.02%	0.17%	0.23%	0.00%	0.00%
1998	0.02%	0.02%	0.20%	0.27%	0.00%	0.00%
1999	0.02%	0.02%	0.23%	0.31%	0.00%	0.00%
2000	0.02%	0.03%	0.26%	0.35%	0.00%	0.00%
2001	0.02%	0.02%	0.20%	0.27%	0.00%	0.00%
2002	0.02%	0.02%	0.22%	0.28%	0.00%	0.00%
2003	0.02%	0.02%	0.18%	0.24%	0.00%	0.00%
2004	0.02%	0.02%	0.17%	0.22%	0.00%	0.00%
2005	0.02%	0.02%	0.15%	0.18%	0.00%	0.00%
2006	0.02%	0.02%	0.16%	0.20%	0.00%	0.00%
2007	0.02%	0.02%	0.15%	0.18%	0.00%	0.00%
2008	0.02%	0.02%	0.16%	0.20%	0.00%	0.00%
2009	0.02%	0.02%	0.15%	0.18%	0.00%	0.00%
2010	0.02%	0.02%	0.17%	0.21%	0.00%	0.00%
2011	0.02%	0.02%	0.16%	0.19%	0.00%	0.00%
2012	0.02%	0.02%	0.16%	0.19%	0.00%	0.00%
2013	0.02%	0.02%	0.16%	0.19%	0.00%	0.00%
2014	0.02%	0.02%	0.15%	0.19%	0.00%	0.00%
2015	0.02%	0.02%	0.15%	0.18%	0.00%	0.00%
2016	0.02%	0.01%	0.14%	0.17%	0.00%	0.00%
2017	0.02%	0.01%	0.13%	0.16%	0.00%	0.00%
2018	0.02%	0.01%	0.12%	0.14%	0.00%	0.00%
2019	0.01%	0.01%	0.10%	0.11%	0.00%	0.00%
2020	0.01%	0.01%	0.08%	0.10%	0.00%	0.00%
2021	0.01%	0.01%	0.07%	0.08%	0.00%	0.00%
2022	0.01%	0.01%	0.06%	0.07%	0.00%	0.00%
2023	0.01%	0.00%	0.04%	0.05%	0.00%	0.00%
2024	0.00%	0.00%	0.03%	0.04%	0.00%	0.00%
2025	0.00%	0.00%	0.02%	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%
2028	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Population Impacts						
1994	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1995	0.00%	0.01%	0.05%	0.07%	0.00%	0.00%
1996	0.01%	0.01%	0.13%	0.18%	0.00%	0.00%
1997	0.01%	0.02%	0.17%	0.23%	0.00%	0.00%
1998	0.02%	0.02%	0.21%	0.28%	0.00%	0.00%
1999	0.02%	0.02%	0.25%	0.33%	0.00%	0.00%
2000	0.02%	0.03%	0.28%	0.37%	0.00%	0.00%
2001	0.02%	0.02%	0.22%	0.28%	0.00%	0.00%
2002	0.02%	0.02%	0.23%	0.30%	0.00%	0.00%
2003	0.02%	0.02%	0.20%	0.25%	0.00%	0.00%
2004	0.02%	0.02%	0.19%	0.23%	0.00%	0.00%
2005	0.02%	0.02%	0.16%	0.19%	0.00%	0.00%
2006	0.02%	0.02%	0.18%	0.21%	0.00%	0.00%
2007	0.02%	0.02%	0.17%	0.19%	0.00%	0.00%
2008	0.02%	0.02%	0.18%	0.21%	0.00%	0.00%
2009	0.02%	0.02%	0.16%	0.19%	0.00%	0.00%
2010	0.02%	0.02%	0.19%	0.22%	0.00%	0.00%
2011	0.02%	0.02%	0.18%	0.21%	0.00%	0.00%
2012	0.02%	0.02%	0.18%	0.20%	0.00%	0.00%
2013	0.02%	0.02%	0.18%	0.20%	0.00%	0.00%
2014	0.02%	0.02%	0.17%	0.20%	0.00%	0.00%
2015	0.02%	0.02%	0.17%	0.20%	0.00%	0.00%
2016	0.02%	0.02%	0.16%	0.18%	0.00%	0.00%
2017	0.02%	0.01%	0.15%	0.17%	0.00%	0.00%
2018	0.02%	0.01%	0.14%	0.16%	0.00%	0.00%
2019	0.02%	0.01%	0.11%	0.12%	0.00%	0.00%
2020	0.01%	0.01%	0.10%	0.11%	0.00%	0.00%
2021	0.01%	0.01%	0.08%	0.09%	0.00%	0.00%
2022	0.01%	0.01%	0.07%	0.07%	0.00%	0.00%
2023	0.01%	0.00%	0.05%	0.06%	0.00%	0.00%
2024	0.01%	0.00%	0.04%	0.04%	0.00%	0.00%
2025	0.00%	0.00%	0.02%	0.03%	0.00%	0.00%
2026	0.00%	0.00%	0.01%	0.02%	0.00%	0.00%
2027	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%
2028	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Source: USDOL, MMS, Gulf of Mexico OCS Region estimates, 1992.

respectively (Table IV-29). The communities of the Western Gulf coastal Subareas TX-1 and TX-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 High Case is more than two-and-a-half times 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 result in positive net migration to any given area. None of the coastal subareas is projected to experience population impacts greater than 1 percent. 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.

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 for the High Case 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 58 percent of the total employment generated by the Western Gulf Sale. The remaining 42 percent will be supported by coastal communities in 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 impact of the High Case 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.a. (offshore infrastructure), IV.B.1.a. (onshore infrastructure), IV.A.3.h. and IV.B.2.b. (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 workforce 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 predicted and will not be considered in this analysis.

Approximately 18,828 person-years of employment (direct, indirect, and induced) are required in the Central and Western Gulf coastal areas to sustain the proposed action throughout its 35-year life (Table IV-26).

Over 64 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 9 percent for Subarea TX-1, 27 percent for Subarea TX-2, 20 percent for Subarea LA-1, and 44 percent for Subarea LA-2. In the peak year of 2001, approximately 976 person-years of total employment will be required to support the proposed action. The greatest amount of this employment is expected to occur within Subarea LA-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-28. The greatest impact to employment is expected to occur in coastal Subareas LA-1 and LA-2, with peak-year impact estimates in 2001 of 0.09 and 0.10 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 workforce 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 workforce 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. Table IV-27 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 LA-3 and LA-4. No coastal subarea is expected to experience population impacts greater than 0.10 percent (1997 to 2001-peak years) 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, with resulting 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 result in positive net migration into a given area. Table IV-27 indicates that population impacts are not expected to exceed this figure. 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 18,828 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 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 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. 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 in the WPA as a result of the proposed action. Specific impact-producing factors examined in this analysis include workforce 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 result in positive net migration into a given area. Population impacts are not expected to exceed peak-year impacts of 0.10 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 by the unemployed, 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.

Conclusion

Population and employment impacts that result from the proposed action 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 predicted and will not be considered in this analysis.

Approximately 53,237 person-years of employment (direct, indirect, and induced) are required to sustain the proposal throughout its 35-year life (Table IV-28). Almost 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 4 percent for Subarea TX-1, 23 percent for Subarea TX-2, 20 percent for Subarea LA-1, and 54 percent for Subarea LA-2. In the peak year of 2000, approximately 3,000 person-years of total employment are estimated. The greatest amount of this employment is expected to occur within Subarea LA-2. The expected population and employment impacts for the coastal subareas are shown in Table IV-29. The greatest impact to employment is expected to occur in coastal Subareas LA-1 and LA-2, with peak-year impact estimates in 2000 of 0.26 and 0.35 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 workforce 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 workforce 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. Table IV-29 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 LA-3 and MA-1. No coastal subarea is expected to experience population impacts greater than 0.37 percent (2000-peak year). It is expected that employment will not require importation of labor and that the existing labor pool will be adequate to supply labor needs. The proposal is expected to provide jobs for the unemployed, 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 result in positive net migration into a given area. Table IV-29 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 53,237 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. Employment needs 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. 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 workforce 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 result in positive net migration into a given area. Population impacts are not expected to exceed a peak-year (2000) impact of 0.37 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 by the unemployed, 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.

Conclusion

Population and employment impacts would not result in disruption to community infrastructure and public services beyond what is anticipated by in-place planning and development agencies.

(c) Sociocultural Issues

This impact analysis includes the coastal parishes and counties of the Central and Western Gulf of Mexico. Sociocultural issues, 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, sociocultural changes within the analysis area. However, the present analysis will consider only the effects of OCS-related oil and gas activity on the social and cultural patterns of the Central and Western Gulf coastal subareas.

Sections providing supportive material for this analysis include Sections III.C.2. (description of social issues), IV.A.2.a. (offshore infrastructure), IV.C.5. (oil spills), IV.D.2.a.(1) (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 sociocultural issues will include OCS-related employment and workforce fluctuations, population and demographic change, relative income, wetlands loss, oil spills, and work scheduling. Adverse effects to social and cultural patterns could arise if disruption of these patterns occurred and resulted in changes in traditional occupations, disruption in the viability of extant subcultures, social and community dysfunction, and detrimental effects on individual or family life.

The OCS-related employment and workforce fluctuations may result in positive and/or negative effects on social and cultural patterns. The obvious positive benefit lies in the availability of jobs (or continuity of existing jobs) for persons in the analysis area. This can allow for the economic stability of those persons who are already working in OCS-related positions, and for the incorporation of persons into OCS-related jobs who are unemployed or underemployed. Large numbers of short-term layoffs in OCS oil and gas industry personnel could result in large numbers of persons returning to more traditional ways of employment (i.e. fishing, trapping, farming, etc.). This could stress the carrying capacity of local ecosystems and diminish the various resources that would be exploited, which, in turn, would have economic impacts on resource exploiters as the ability to sustain the activity decreased. An additional effect could be increased economic stress placed on families and individuals with concomitant social problems. A large increase in the hiring of oil and gas industry personnel could result in increases in populations of small communities highly involved in the OCS oil and gas industry with attendant social and cultural effects.

In-migration and out-migration may be considered resultants of rapid increases and decreases in the rate of OCS activity. During periods of rapid increases in OCS activity, it is reasonable to assume that persons move into the coastal areas to take part in the increased opportunity for employment in the OCS oil and gas industry. The rapid influx of persons into coastal communities could effect community function and cohesion, quality of life, and cultural identity. During periods of rapid decreases in OCS activity, out-migration of persons from coastal communities could occur. This could result in fiscal and sociocultural effects. Adverse impacts could include effects on community cohesion and function following departure of long term residents, emotional stress in individuals and families as a result of the departure of family members, and the departure of persons who are engaged in traditional occupations.

Jobs associated with the OCS oil and gas industry in the Gulf of Mexico have generally been viewed as higher paying jobs. This is true at both the professional and blue collar levels. The impacts associated with

the higher paying jobs in the OCS oil and gas industry include possible destabilization of small businesses that can not compete with salaries and benefit packages of larger OCS-related companies, possible lack of incentives for increased business efficiency (particularly during "boom" times), and dependency on these relatively higher wages which can lead to individual and family economic stress (particularly if layoffs occur and the wage-earner cannot find work at comparable pay).

The loss of wetlands has the potential to impact many traditional occupations associated with the coastal parishes and counties of the analysis area. Wetlands loss could result in the loss of productivity of the estuarine marshes. This could diminish the availability of biological resources and have an adverse economic effect on individuals engaged in resource fishing, trapping, and other exploitative efforts. This could eventually result in a loss of or diminution of traditional occupations.

Oil spills have the potential to damage wetlands and adversely effect persons engaged in fishing, trapping, etc. Aesthetic enjoyment and recreational use of those areas impacted by an oil spill would be adversely effected. Cleanup of oil spills could result in short-term, adverse effects on communities. The problems would be similar to those associated with a large influx of strangers into small, coastal communities.

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 of time on duty (or at site) followed by a large block of time off duty. The scheduled may range from 7 days on followed by 7 days off to a 30 day-on/30 day-off schedule. This extended work schedule necessitates adjustment by the family and the working family member to changes in traditional roles (e.g. when the family member, usually the husband, is away other members must perform those duties which would ordinarily be done by the absent person). In those families which cannot adjust to this absence, adverse effects (such as divorce or family dysfunction) could occur.

Base Case Analysis

Baseline employment projections and information related 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 predicted and cannot be presumed for this analysis.

The proposed action will result in approximately 18,828 person-years of direct, indirect, and induced employment throughout its 35-year life (Table IV-26). Approximately 36 percent of employment is projected to take place in the Western Gulf coastal subareas (9% in TX-1 and 27% in TX-2). The remaining employment is expected to lie within coastal Subareas LA-1 (20%) and LA-2 (44%). In the peak year of 2001, approximately 976 person-years of total employment are required to support the proposed action. The greatest amount of this employment is expected to occur in subarea LA-2. The expected population and employment impacts for the coastal subareas as a result of the proposed action are shown in Table IV-27. The greatest impact to employment is expected to occur in coastal Subareas LA-1 and LA-2, with peak-year impact estimates in 2001 of 0.09 and 0.10 percent, respectively. The employment projected to occur in association with the proposed action is expected to be filled by persons already engaged in OCS oil and gas related employment, unemployed persons living in the area, and underemployed persons living in the area. Inasmuch as jobs will be provided for persons living in the coastal subareas, some positive impact is expected.

Given the present amount of OCS-related jobs in the coastal subareas, the proposed action is not expected to result in workforce fluctuations. The creation of jobs associated with the proposed action (i.e., 18,828 person-years of employment over the life of the proposed action) is expected to reduce the amount of workforce fluctuations which would occur without the proposal. It is therefore 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.

Projected population impacts in the Central and Western Gulf coastal subareas are presented in Table IV-27. Peak impacts are expected to occur in coastal Subareas LA-1 and LA-2 from 1997 to 2001 with impact levels of 0.07-0.10 percent. An analysis of historical trends indicates that only population impacts greater than 1 percent typically result in positive net migration into a given area. None of the coastal subareas are projected to experience population impacts greater than 0.10 percent as a result of the proposed action. 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. Social and cultural problems typically associated with in-migration and out-migration are not expected to occur as a result of the proposed action.

It is reasonable to expect that some persons engaged in lower-paying occupations will seek employment in OCS-related oil and gas activities. It is also reasonable to expect that some persons engaged in traditional occupations will seek employment in OCS-related activities. Employment projections for the life of the proposed action indicate that peak year employment will occur in 2001 and will total 976 person-years. The relatively small amount of employment associated with the proposed action, in comparison with the total employment in the affected Western and Central Gulf coastal subareas, is not expected to result in deleterious impacts to small businesses.

The proposed action is assumed to result in an impact to approximately 2.7 ha of wetlands from oil spills in the WPA over the 35-year life of the proposed action. Four and 10 years after each spill, 1 and 1.4 ha will, respectively, recover. Other sources of wetlands loss related to the proposed action include secondary impacts from OCS-related pipelines and erosion of wetlands from OCS vessel wakes. Total wetlands loss as a result of the proposed action is projected to be approximately 5 ha, with suppressed productivity of an additional 1 and 1.4 ha (for 4 and 10 years, respectively). The projected amount of wetlands loss is not sufficient to effect the practice of traditional occupations in the WPA, given the total amount of coastal marsh which is available for exploitation.

Section IV.A.3.h.(2) 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 Size 3 offshore spills will occur and contact land within 10 days of the accident is less than 1 percent (Table IV-11). 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.

No Size 2 spills are assumed to occur (Table IV-4). Six Size 1 spills are assumed to occur in the WPA over the 35-year life of the proposed action. None of these spills are assumed to contact land. A number of Size 1 onshore spills are expected to occur. The level of cleanup action associated with these spills will be minimal. As mentioned above, wetlands impacted by oil spills will recover in large part. Therefore, the practice of traditional occupations will not be impacted given the total amount of coastal marsh which is available for exploitation.

In the peak year of 2001, approximately 976 person-years of total employment are projected to be required to support the proposed action. A total of 460 person-years of direct, offshore employment in OCS activities will be required to support the proposed action. These persons will likely encounter the extended work schedule which is typically associated with OCS offshore activities. The extended work schedule will allow for part time participation in more traditional occupations (fishing, trapping, etc.). The relationship between OCS oil and gas activities and traditional culture in the coastal subareas of Louisiana has been mostly positive (Forsythe, written communication, 1992). The extended work schedule changes the practice of traditional familial roles, in an adaptive response to absence. In the majority of cases, it is expected that the familial adaptations to the extended work schedule will be successful. However, it is expected that in a small number of cases, successful adaptation of the family to the extended work schedule will not occur. In these cases, some deleterious impacts to family are expected.

Summary

The employment projected to occur in association with the proposed action is expected to be filled by persons already engaged in OCS oil and gas related employment, unemployed persons living in the area, and underemployed persons living in the area. Inasmuch as jobs will be provided for persons living in the coastal subareas, some positive impact is expected. Given the present amount of OCS-related jobs in the coastal subareas, the proposed action is not expected to result in workforce fluctuations. None of the coastal subareas are projected to experience population impacts greater than 0.10 percent as a result of the proposed action. 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. Social and cultural problems typically associated with in-migration and out-migration are not expected to occur as a result of the proposed action. The relatively small amount of employment associated with the proposed action, in comparison with the total employment in the affected Western and Central Gulf coastal subareas, is expected to result in no deleterious impacts to small

businesses. The projected amount of wetlands loss is not sufficient to effect the practice of traditional occupations in the WPA, given the total amount of coastal marsh available for exploitation. Based on the low probability of an offshore spill occurring and contacting land, the assumption is that no significant employment requirements will result from the clean-up of offshore spills. Employment requirements for cleanup of onshore spills is expected to be minimal. It is expected that in a small number of cases, successful adaptation of the family to the extended work schedule will not occur. In these cases, some deleterious impacts to family are expected.

Conclusion

Sociocultural impacts are expected to be minimal, with some deleterious impacts to family life in a small number of cases resulting from the extended work schedule.

High Case Analysis

The High Case will result in approximately 53,237 person-years of direct, indirect, and induced employment throughout its 35-year life (Table IV-28). Approximately 27 percent of total employment is projected to occur in the Western Gulf coastal subareas (4% in TX-1 and 23% in TX-2). The remaining employment is expected to lie within coastal subareas LA-1 (20%) and LA-2 (54%). In the peak exploration year of 2000, approximately 3,040 person-years of total employment will be required. The greatest amount of exploration and production employment is expected to occur in Subarea LA-2. The expected population and employment impacts for the coastal subareas as a result of the High Case are shown in Table IV-29. The greatest impact to employment is expected to occur in coastal Subareas LA-1 and LA-2, with a peak-year impact estimate in 2000 of 0.26 and 0.35 percent, respectively. The projected employment is expected to be filled by persons already engaged in OCS oil and gas related employment, unemployed persons living in the area, and underemployed persons living in the area. Inasmuch as jobs will be provided for persons living in the coastal subareas, some positive impact is expected.

Given the present amount of OCS-related jobs in the coastal subareas, the High Case is not expected to result in workforce fluctuations. The creation of jobs (i.e., 53,237 person-years of employment over the life of the proposed action) is expected to reduce the amount of workforce fluctuations which would occur without the proposed action. It is therefore expected that no large increases or decreases in OCS-related employment would occur within the Central and Western Gulf coastal subareas.

Projected population impacts in the Central and Western Gulf coastal subareas are presented in Table IV-29. Peak impacts are expected to occur in Subarea LA-2 in 2000 at 0.37 percent. An analysis of historical trends indicates that only population impacts greater than 1 percent typically result in positive net migration into a given area. None of the coastal subareas are projected to experience population impacts greater than 0.37 percent. 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. Social and cultural problems typically associated with in-migration and out-migration are not expected to occur.

It is assumed that some persons engaged in lower-paying occupations will seek employment in OCS-related oil and gas activities. It is also assumed that some persons engaged in traditional occupations will seek employment in OCS-related activities. In the peak exploration year of 2000, approximately 3,040 person-years of total employment are estimated. The greatest amount of exploration and production employment is expected to occur in Subarea LA-2. The relatively small amount of employment associated with the proposed action, in comparison with the total employment in the affected Western and Central Gulf coastal subareas, is not expected to result in deleterious impacts to small businesses.

Approximately 8.1 ha of wetlands are assumed to be impacted from oil spills in the WPA over the 35-year life of the proposal. Four and 10 years after each spill, 3 and 4.2 ha will, respectively, recover. Other sources of wetlands loss include secondary impacts from OCS-related pipelines and erosion of wetlands from OCS vessel wakes. Total wetlands loss as a result of the High Case is projected to be approximately 10.1 ha, with suppressed productivity of an additional 3 and 4.2 ha (for 4 and 10 years, respectively). The projected amount of wetlands loss is not sufficient to effect the practice of traditional occupations in the WPA, given the total amount of coastal marsh which is available for exploitation.

Section IV.A.3.h.(2) presents estimates of the mean number of offshore spills assumed to result from the High Case. The probability that one or more Size 3 offshore spills will occur and contact land within 10 days of the accident is 1 percent (Table IV-11). 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.

One Size 2 spill is assumed to occur (Table IV-4); however, it is not assumed to contact the coastline. Eighteen Size 1 spills are assumed to occur in the WPA over the 35-year life of the proposal. None of these spills are assumed to contact land. A number of Size 1 onshore spills are expected to occur. The level of cleanup action associated with these spills will be minimal. As mentioned above, wetlands impacted by oil spills will recover in large part. Therefore, the practice of traditional occupations will not be impacted given the total amount of coastal marsh which is available for exploitation.

In the peak exploration year of 2000, approximately 3,040 person-years of total employment are estimated. The greatest amount of exploration and production employment is expected to occur in Subarea LA-2. A total of 1,400 person years of direct, offshore employment in OCS activities is required to support peak exploration. These persons will likely encounter the extended work schedule typically associated with OCS offshore activities. The extended work schedule will allow for part time participation in more traditional occupations (fishing, trapping, etc.). The relationship between OCS oil and gas activities and traditional culture in the coastal subareas of Louisiana has been mostly positive (Forsythe, written communication, 1992). The extended work schedule changes the practice of traditional familial roles, in an adaptive response to absence. In the majority of cases, it is expected that the familial adaptations to the extended work schedule will be successful. However, it is expected that in a small number of cases, successful adaptation of the family to the extended work schedule will not occur. In these cases, some deleterious impacts to family are expected.

Conclusion

Sociocultural impacts are expected to be minimal, with some deleterious impacts to family life in a small number of cases resulting from the extended work schedule.

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

Description of the Alternative

Alternative B would offer for lease 4,573 unleased blocks in the WPA. It differs from Alternative A (the proposed action) by not offering the 109 unleased blocks of the 200 total blocks that are possibly affected by the Topographic Features Stipulation (Section II.B.1.c.(1)). All the assumptions (including three potential mitigating measures) and estimates are the same as in the Base Case of Alternative A. Details are presented in Sections I.A. and II.B.2.

Effects of the Alternative

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 IV.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 adjacent coastal region is divided into two coastal subareas (TX-1 and TX-2). These subareas are delineated on Figure IV-1.

(1) Impacts on Sensitive Coastal Environments

(a) Coastal Barrier Beaches and Associated Dunes

No oil spill is expected to contact a barrier beach. Should an unforeseen contact occur, it is expected that resulting oiling will be very light.

No onshore and nearshore construction of new infrastructure (pipeline landfalls, navigation channels, service bases, platform yards, etc.) as a result of Alternative B are expected to occur.

Some maintenance dredging is expected to occur, but has been shown to have little negative impact on barrier beaches. The need for dredging cannot be attributed to the small percentage of vessel traffic in these channels, traffic that is accounted for by Alternative B activities.

Deepening of the channel to Corpus Christi, Texas, is expected to maintain continuing impacts on nearby barrier features. Strategic placement of dredged material from this project and subsequent maintenance dredging is expected to benefit barrier beaches down drift of the channel jetties.

Conclusion

Alternative B is expected to result in the alteration of barrier beach configurations in localized areas downdrift from navigation channels that are jettied and maintained or deepened. Strategic placement of dredged material resulting from these actions can mitigate adverse impacts upon those localized areas.

(b) Wetlands

Only spills from pipeline and navigational accidents are expected to result in high-enough concentrations of oil contacting wetlands to result in impacts. Several onshore barge and pipeline accidents are anticipated to occur, impacting approximately 3 ha of wetlands over the course of 35 years. For 4 and 10 years after each spill, 1 and 2 ha will cumulatively recover, respectively. Cumulatively, 1 ha of wetlands will be converted to open water.

Seagrass beds are not expected to be contacted by oil from this spill. No impacts to seagrass beds are expected.

As a secondary impact of OCS-related pipeline canals attributable to Alternative B, 7 ha of wetlands are estimated to be lost over 35 years.

Deepening one channel to accommodate larger service vessels is expected to occur within a saline marsh environment and affords the opportunity for creation of 6 ha of wetlands.

Insignificant adverse impacts from maintenance dredging are expected. Alternative dredged material disposal methods can be used to enhance coastal wetlands.

Erosion of wetlands from OCS vessel wakes is expected to result in up to 3 ha of wetlands loss during the 35-year life of the proposed action.

Conclusion

Alternative B is expected to result in the loss of up to 11 ha, suppressed productivity of up to 1 ha for 4 years and 2 ha for 10 years, and a gain of up to 6 ha due to beneficial use of dredged material.

(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), 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 seafloor blowout accidents. 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), high-density chemosynthetic communities are found only in water depths greater than 400 m. 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-4. 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 damage as a result of physical disturbances 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 proposed action. As noted in Section IV.D.2.a.(2)(b), 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-4. It should be noted that 107 of the total of 200 blocks that would be subject to the stipulation are currently leased; 2 blocks at the Flower Garden Banks are excluded 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-4.

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 5 percent chance of a Size 3 oil spill 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-9), and it is assumed that six Size 1 spills will occur each year and that no Size 2 spills will occur during the 35-year life of the proposed action. In addition, it is assumed there will be three spills of diesel oil and other pollutants, the average size of which will be only 34 bbl (Table IV-4). No Size 3 oil spills are assumed to occur during the 35-year life of the proposed action. 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. Small areas would be impacted by operational discharges (i.e., muds and cuttings), and recovery 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

Expected future water quality degradation associated with discharges and spills from Sale 150 operations under Alternative B will not differ from Alternative A because there are no expected changes in onshore infrastructure usage, vessel traffic, and spill occurrences under Alternative B. Impacts from discharges occurring from the use of onshore infrastructure supporting Sale 150 operations is expected to be very minor but will be widespread and continuous, especially in the Galveston, Texas, area and the Chenier Plain area of Louisiana, where support facilities are concentrated. There will be minor, localized, long-term changes in water quality characteristics from current levels in the confined portions of 15 channels used by OCS vessels. These changes, resulting from vessel traffic operations, are from vessel bank erosion and chronic, bilge and sanitary wastes discharges. Thirty-one maintenance and deepening dredging operations will result in localized impacts (primarily elevated water column turbidities) during the duration (up to several months). Low-level petroleum hydrocarbon contamination of coastal waters will occur from onshore spills associated with Sale 150 operations and will affect localized, confined areas for up to 6 months in 11 locations along the Louisiana coast and 2 along the Texas coast; up to 6 weeks in 26 locations along the Louisiana coast and 8 in Texas; and will persist for up to 5 years in 2 locations in Louisiana, affecting 54 ha of marsh waters.

Conclusion

Alternative B will result in minor, long-term changes in water quality within, or in the vicinity of, navigation channels and support complexes. These changes will not preclude current uses of the waters affected. Alternative B will also result in localized, short-term changes in water quality during dredging operations or from spill occurrences, which will alter uses of the affected waters for up to 6 months or up to 5 years on two locations in Louisiana.

Marine Waters

Expected future regional water quality degradation associated with discharges and spills occurring as a result of Alternative B will not differ from Alternative A. It is assumed that if industry does not drill near offshore sensitive areas that they will invest in development of resources elsewhere in the Gulf; therefore, projections of operations for Alternative B do not differ from Alternative A. Sediment disturbance from the emplacement of 10 platforms and 220 km of pipeline and from the drilling of 220 wells over a 35-year period will result in minor, localized, temporary impacts on water quality. The drilling of the wells, construction of the platforms, and laying of the pipe will result in increased water-column turbidities in offshore waters. Such bottom disturbance of sediments will result in resuspension of any settled pollutants, such as trace metals, chlorinated hydrocarbons, and excess nutrients, that may have accumulated in the sediments. The resuspension of significant quantities of contaminants from bottom-disturbance operations is not expected to occur due to a lack of contaminants in deep-water sediments and the infrequency of the operations. Given the low frequency of platform removals (maximum is 3 in the peak year), minimum impacts on water quality due to resuspension of sediments, especially resulting from explosive removals, are expected from these operations.

Only six Size 1 spills are projected. Given the infrequent nature of these spills, especially the fact that no spills larger than 50 bbl are projected, impacts on offshore water quality from oil-spill events related to Alternative B are projected to be negligible, to be of short-duration (2-3 months), and to only affect a small area of offshore waters at any one time.

The area around each of the 10 projected platforms can be contaminated from the discharge of 36,000 bbl of drilling muds and cuttings at each site. These discharges may be released continuously for about a year and a half (assuming 3 exploratory wells and 9 development wells were drilled at one site) and then other quantities discharged intermittently when old wells become depleted and new wells are drilled. These discharges of drilling wastes will affect an area several thousand meters around a platform. Sediment contamination can be expected out to 3 km from the discharge point in the primary direction of the current and will last up to 1 year after drilling ceases. Benthic marine organisms will be affected out to 1,000 m. Water quality criteria are expected to be exceeded within 100 m from the discharge. Moderate petroleum and metal contamination of sediments and water column from the discharge of 115 MMbbl of produced water at 5 platforms will occur out to several hundred meters from the discharge point and will have small scale, localized effects on benthic organisms out to 200-500 m. If, for analytical purposes, an assumption is made that the regional, long-term contamination of Gulf waters and sediments by the OCS industry makes up 50 percent of the total water quality degradation that occurs, then discharges resulting from Alternative B operations would contribute a little more than 1 percent of the Gulf water quality cumulative contamination (Section IV.D.2.d.).

Conclusion

As a result of Alternative B, marine waters will be degraded from discharges, oil spills, and bottom disturbances. Bottom disturbances (platform and pipeline emplacements and removals) and oil spills are expected to result in minor, localized, temporary impacts to water quality. Changes in water quality parameters will return to background within months from the disturbance. Operational discharges are primarily muds and cuttings and produced waters. Drilling muds and cuttings, which are discharged intermittently throughout the life of a platform, are expected to contaminate a localized area around platforms out to 3,000 m for up to 1 year after drilling ceases. Production wastes, which are discharged continuously throughout the life of most of the platforms, will change some water quality and sediment parameters within several hundred meters downcurrent from the discharge point for an average of 20 years. These discharges will also contribute, to a very small extent, to the long-term, regional contamination of Gulf waters and sediments.

(4) Impacts on Air Quality

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 90 blocks would be withheld from proposed Sale 150 if this alternative were adopted, it is safe to assume that activities, infrastructure, and other factors described in that analysis will not change appreciably. Table IV-4 indicates the number of wells and platforms related to Alternative A. It is assumed that, given the level of activities produced by Alternative B is comparable to those of Alternative A, the analyses described in Alternative A will not be changed.

The proposed action projects that 120 exploration and delineation wells and 100 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)

<u>Pollutant</u>	<u>W-1</u>	<u>W-2</u>	<u>W-3</u>
NO _x	4,237.1	6,355.6	10,592.7
CO	633.4	950.1	1,583.5
SO _x	86.0	129.0	215.0
THC	1,445.3	2,167.9	3,613.1
TSP	54.7	82.1	136.8

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 18 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 their low concentrations generally will have little effect on the visibility of these areas. 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 $1 \mu\text{gm}^{-3}$ (box model steady concentrations). The impacts decrease during winter because onshore winds occur only about 34 percent of the time and maximum impacts increase in summer because onshore winds occur 85 percent of the time.

(5) *Impacts on Marine Mammals*

(a) *Nonendangered and Nonthreatened Species*

The level of activity associated with Alternative B is the same as the summary of infrastructure and activity described for the Base Case in Table IV-4. 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 sources of impact include degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service vessels and OCS structures. The effects of these activities are estimated to be primarily sublethal and the probability of an interaction is unlikely.

Conclusion

The impact of Alternative B on nonendangered and nonthreatened marine mammals is expected to result in primarily sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that are both chronic and sporadic. These impacts could cause acute or chronic physiological stress, alter normal behavior, and result in some degree of avoidance, either temporary or permanent, of the impacted area(s).

(b) *Endangered and Threatened Species*

The level of activity associated with Alternative B is the same as the summary of infrastructure and activity described for the Base Case in Table IV-4. The sources and severity of impacts for endangered and threatened marine mammals, including whales and dolphins, in Alternative B are the same as those discussed for the Base Case (Section IV.D.2.a.(5)). The sources of impact include degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service vessels and OCS structures. The effects of these activities are estimated to be primarily sublethal and the probability of an interaction is unlikely.

Conclusion

The impact of Alternative B on nonendangered and nonthreatened marine mammals is expected to result in primarily sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that are both chronic and sporadic. These impacts could cause acute or chronic physiological stress, alter normal behavior, and result in some degree of avoidance, either temporary or permanent, of the impacted area(s). Lethal impacts are expected to be rare for all marine mammals, with the most likely impacts resulting from vessel collisions to lethargic surfaced individual animals. The unexpected and unintentional removal of individuals of any species is considered an incidental take. Such removals have not been documented in the Gulf. Recovery times will vary with species size, gestation period, and rates of reproductive activity. These will vary from two to several (less than ten) years.

(6) Impacts on Marine Turtles

The level of activity associated with Alternative B is the same as the summary of infrastructure and activity described for the Base Case in Table IV-4. 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.2.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, blowouts, water quality and habitat degradation, and oil or oil-spill response activities. The effects of these activities are expected to produce only temporary disturbances in habitat use, or chronic physiological stress, and to result in few deaths; the probability of an interaction is low.

Conclusion

The impact of Alternative B is expected to temporarily disturb some marine turtles and their habitats, but deaths are expected to be rare. All disturbances are expected to be temporary, and marine turtles are expected to recover within a period of weeks to months.

(7) Impacts on Coastal and Marine Birds

(a) Nonendangered and Nonthreatened Species

The sources and severity of impacts to marine and coastal birds associated with Alternative B are identical to those discussed for the Base Case (Table IV-4). As noted in Section IV.D.2.a.(7) for the Base Case, effects that may result from this alternative include oil spills and oil-spill response activities, degradation of coastal water quality from OCS discharges, disturbance from OCS helicopters and service vessels near coastal areas, loss or modification of preferred or critical habitat, onshore pipeline landfalls and facility construction, and entanglement and ingestion of offshore oil- and gas-related plastic debris.

It is expected that the effects from most of the major impact-producing factors on coastal and marine birds within the WPA are negligible and of nominal occurrence. It is expected that uncontained oil spills and oil-spill response activities within coastal areas will occasionally contact and thus affect local groups and individuals.

Conclusion

Nonendangered and nonthreatened coastal and marine birds may encounter periodic disturbance and temporary displacement of localized groups and individuals from activities associated with Alternative B. Decreases in numbers of adults and/or nests could occur as a result of OCS-related oil spills and spill-related coastal habitat loss or degradation. Groups experiencing the loss of individuals would require up to several years to recover to a pre-disturbance condition, depending on the species and existing conditions.

(b) Endangered and Threatened Species

The sources and severity of impacts to these species associated with Alternative B are identical to those discussed for the Base Case. The endangered and threatened birds include the piping plover, brown pelican, bald eagle, Arctic peregrine falcon, least tern, and whooping crane. 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-4. The sources and severity of impacts in Alternative B for these species are the same as those discussed for the Base Case (Section IV.D.2.a.(7)). The impacts include oil spills and oil-spill response activities, degradation of coastal water quality from OCS discharges, disturbance from OCS helicopters and service vessels near coastal areas, loss or modification of preferred or critical habitat onshore pipeline landfalls and facility construction, and entanglement and ingestion of offshore oil- and gas-related plastic debris. The effects of these activities are expected to be primarily sublethal; lethal effects stem primarily from contact with uncontained oil spills in coastal areas. The probability of this interaction is unlikely, based upon scenario estimates for the proposed action.

Conclusion

Endangered and threatened birds may encounter periodic disturbance and temporary displacement of localized groups and individuals from activities associated with Alternative B. Decreases in numbers of adults and/or nests could occur as a result of OCS-related oil spills and spill-related coastal habitat loss or degradation. The loss of individuals represents a serious loss to the regional population(s); restoration of numbers to a pre-disturbance state could require up to several years, depending on the species and existing conditions.

(8) 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-4). As noted in Section IV.D.2.a.(8) for the Base Case, effects that may result from this alternative include coastal environmental degradation, emplacement of production platforms, underwater OCS obstructions, production platform removals, seismic surveys, oil spills, subsurface blowouts, pipeline trenching, and offshore discharges of drilling muds, produced waters, and naturally occurring radioactive material (NORM).

It is expected that the effects from the major impact-producing factors on commercial fisheries in the WPA are inconsequential and of nominal occurrence. At the expected level of effect, the resultant influence on Central Gulf fisheries is negligible and will be undistinguishable from natural population variations. 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 less than a 1 percent decrease in commercial fishery populations, in essential habitat, or in commercial fishing. It will require less than six months for fishing activity and one generation for fishery resources to recover from 99 percent of the impacts.

(9) Impacts on Recreational Resources and 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) for the Base Case, effects that may result on beach use from this alternative include oil spills and trash and debris.

No Size 3 oil spills are assumed to occur and contact a major recreational beach in the WPA. There will 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. One Size 2 spill is 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 and some oil pollution 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.

(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 (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 low probability 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 low probability of an impact between OCS 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. The sources and severity of impacts to population, labor, and employment are, therefore, the same as those assessed for Western Gulf Sale 150 in the Base Case. A total of approximately 53,237 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 Central Gulf are expected to support 58 percent of the total employment generated by proposed Sale 150 under this alternative. The remaining 42 percent will be supported by Western Gulf communities. 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 affected by leasing and development activities in the 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, 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.

Conclusion

Population and employment impacts that result from 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) Sociocultural Issues

Impacts on sociocultural issues would be related to dramatic changes in population, employment, and the disruption of environmental resources, as well as conditions inherent to OCS-related employment (i.e., work scheduling and rate of pay). 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 in the Base Case for the proposed action. The sources and severity of impact to sociocultural issues are, therefore, the same as those assessed for the Base Case. No positive net migration into coastal areas of the Central and Western Gulf is expected to occur as a result of the proposal. It is expected that employment will be filled 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. 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 minimal displacement from traditional occupations will occur as a result of Alternative B. The extended work schedule is expected to have some deleterious effects on family life in pertinent, individual cases.

Conclusion

Sociocultural impacts associated with the Alternative B in the WPA are expected to be minimal, with some deleterious impacts to family life in a small number of cases resulting from the extended work schedule.

c. Alternative C - No Action

Description of the Alternative

Alternative C is equivalent to cancellation of a sale projected for a specific timeframe on the approved 5-year Oil and Gas Leasing Schedule. Sales in the Western Gulf are scheduled on an annual basis. By canceling proposed Sale 150, the opportunity is postponed or foregone for development of the estimated 0.04 BBO and 0.65 tcf of gas.

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.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.

Strategies that could provide replacement resources for lost domestic OCS oil and gas production include a combination of energy conservation; onshore domestic oil and gas supplies; alternative energy sources; and imports of oil, natural gas, and LNG. These are discussed in some detail in Appendix D. 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.

Market forces are assumed to be the predominant factor in determining substitutes for OCS oil and gas. Based on this, increased imports of foreign oil are assumed to be the largest replacement source. Much of this imported oil would enter the United States through the Gulf of Mexico, thus increasing the risks due to tanker spills. This is thoroughly analyzed in the Final EIS for the OCS Comprehensive Program (1992-1997).

d. Cumulative Actions

This section analyzes "cumulative" impacts, defined as the impacts on the environment from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions, both Federal and nonfederal (40 CFR 1508.7). The time period that these future impacts are examined is limited to the time of the proposed actions (1994-2028), 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.C. 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 and Associated Dunes

This Cumulative Analysis for the WPA 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 reduced sedimentation, pipeline landfalls, navigation canal and onshore facility construction, oil spills, beach protection and stabilization projects, and recreational activities.

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). 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. Dam construction upstream on coastal rivers has trapped sand-size sediments. Shoreline stabilization using 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 by shore erosion. In addition, the eastern part of the affected area is influenced by the sediment discharge of the Mississippi River, which has decreased by more than 50 percent since the 1950's (Turner and Cahoon, 1987). Reductions in sediment supply along the Texas coast will continue to have a significant adverse impact on barrier landforms.

Oil spills can originate from petroleum production activities (OCS Program, coastal, and onshore) and from transportation activities of domestic and imported petroleum crude and resulting petroleum products.

Table IV-5 estimates that 187 offshore spills will occur as a result of the OCS Program in the WPA over 35 years. Of those spills, a few Size 1, one Size 2, and one Size 3 spills should be expected to contact land (Section IV.A.3.h. and Table IV-11). As described in Section IV.A.3.h., oil slick weathering and dissipation will significantly reduce slick volume and resulting concentration on beaches. From that information, it is assumed that the only significant land contact will result from a Size 3 (6,500 bbl) offshore oil spill, which will generally follow the dissipation and contact characteristics described in Table IV-12. The probabilities of offshore spills contacting various shoreline segments (Figure IV-2) are provided in Table IV-11. The coastal region with the highest probability of oil-slick landfall is Madagorda, Texas; in the CPA, the region with the greatest probability of land fall is Terrebonne to Plaquemines Parishes. The large majority of oil slicks that contact land will come ashore on barrier landforms, as discussed in Sections IV.D.1. and 2.

Table IV-16 anticipates that 354 onshore oil spills will occur as a result of the OCS Program in the WPA. 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 would contact the landward side of a barrier island, rather than the ocean side.

Non-OCS spills can occur as a result of import tankering, tidelands oil activities, and petroleum product spills. It is assumed that numerous Size 1 and 2 spills 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 Size 3 spills, averaging 6,500 bbl each, are assumed to occur over the 35-year life of the proposed action from both 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 Size 3 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 for Grand Isle, Louisiana. Due to the higher range of dune elevations in Texas, the probability of impact and degree of adverse impacts are expected to be lower, depending on the particular coastal setting and the elevation of the vegetation. Given the higher frequency of non-OCS spill occurrence and the heavier oilings from onshore Size 3 spills, it is assumed that the lower elevations of some sand dune vegetation will be contacted. Considering the results of an investigation on 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 elevation 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 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.

As a result of the OCS Program, construction of the three new pipelines is expected and is described in Sections IV.A.2.b. and IV.B.1. and 2. The new landfalls are to Matagorda Island, Matagorda Peninsula, and Mustang Island, Texas. Pipeline landfall sites on barrier islands have been identified as potential causes of accelerated beach erosion and island breaching. Subsequent to these perceptions, studies have shown that little to no impact to barrier beaches occurs as a result of modern techniques for pipeline crossings (Wicker et al., 1989; LeBlanc, 1985; Mendelsohn and Hester, 1988). Hence, adverse impacts of new pipeline landfalls upon coastal barrier beaches are not anticipated. Current environmental regulations and pipeline emplacement techniques are sufficient for minimizing impacts from future and unforeseen pipeline projects.

Stabilization of navigational 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 generally limited to the immediate area downdrift from channel jetties. Accelerated erosion immediately downdrift from the channel is coupled with accretion updrift from the channel jetty. Artificially deepened and maintained bar channels serve as sediment traps that interrupt longshore sediment drift, compounding problems caused by jetties. Sediments from maintenance dredging of bar channels and tidal inlets can be of considerable benefit to barrier beaches if used to mitigate adverse impacts caused by jetties and artificially deep channels. It is assumed in this EIS that materials dredged from bar channels will be placed strategically in the interrupted longshore sediment drift, downdrift of the interruption. No new navigation canals are expected to be installed for other purposes during the next 35 years. The basis for this assumption is that the large number of existing navigation canals can accommodate future navigation needs.

Section IV.B.1.b. states that a channel in onshore Subarea TX-1 (the Corpus Christi, Texas, area) will be deepened to provide access for larger service vessels that are expected to be used in deep-water operations. It is assumed that existing jetties will not be modified and 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.

No new terminals, which will impact barrier beaches or associated dunes, are projected to be constructed.

Efforts to stabilize the Gulf shoreline have adversely 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 structures. Morton (1982) identifies coastal structures as one of the major causes of coastal erosion along the Texas coast.

Barrier islands in Texas are accessible to the large population that inhabits the coastal counties in Texas for recreation because of their proximity to shore and their connection to the mainland, in many cases. The Texas Open Beaches Act (1959) guarantees the public's right to unimpeded use of the State's beaches. It also provides 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 landforms. Vehicle and pedestrian traffic on sand dunes can weaken the vegetation that binds and stabilizes the dune. Dunes that are affected in this way are more easily 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 facilities and activities adversely impact barrier beaches and associated dunes under the Cumulative Scenario. The amount of sediment delivered to the Texas coast has decreased because of dams on coastal rivers, coastal groins and jetties, and a natural decrease in sediment supply as a result of climatic changes during the past several thousand years.

Studies have documented little to no impacts from pipeline landfalls to barrier beaches and dunes.

Oil spills from several sources could contact barrier landforms. It is assumed that several Size 3 spills from both coastal and offshore sources and that several onshore Sizes 1 and 2 spills will contact coastal barrier beaches. 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 significant impacts to coastal habitats will be used to install pipelines.

Maintenance of navigation channels through barrier passes can interfere with littoral dynamics and cause localized, accelerated erosion. Localized accelerated erosion also occurs downdrift of jetties installed to stabilize navigation channels. Localized erosion in these settings is expected to continue, although strategic placement of maintenance-dredged material is expected to be used to mitigate such impacts.

Beach stabilization projects, such as groins, jetties, and seawalls, 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.

The incremental contribution of the proposed action associated with the Cumulative Scenario to coastal barrier beach impacts is expected to be negligible 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

Coastal barrier beaches have received severe cumulative adverse impacts from both natural processes and human activities. Although natural processes are considered to be the major contributor to these impacts, human activities significantly accelerate coastal barrier deterioration. Deterioration of barrier beaches is expected to continue in the future.

(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. 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 both 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. Two offshore Size 3 spills are assumed to occur as a result of OCS Program activities. According to Table IV-11, OCS Program spills occurring and contacting land within 10 days would most probably contact along the Chenier Plain coast in Louisiana to the Galveston, Texas, area. 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-11, this analysis assumes no contacts will occur along the Texas coast.

Onshore spills impacting wetlands could also occur from OCS operations. These spills could occur as a result of pipeline accidents or barge and shuttle tanker accidents during transit or offloading. According to Table IV-16, about 70 percent of pipeline landfalls are in TX-2, 10 percent are in TX-1, and 20 percent are in LA-1. The most likely area for pipeline accidents would, therefore, be in Subarea TX-2. Table IV-16 predicts that 354 onshore oil spills will occur as a result of the OCS Program in the WPA. Seventy-nine percent of these spills will be less than 1 bbl and are assumed to occur at transfer facilities where they will be contained without significant impacts on wetlands. Seventy spills (20%) are listed as Size 1 spills (the smallest), 50 percent of which are assumed to occur in direct association with transfer facilities where effective spill recovery plans are in place. The remaining 50 percent of Size 1 spills and all Sizes 2 and 3 spills are assumed to result from pipeline or navigation accidents away from transfer facilities. For the purpose of analyses in this EIS, typical Sizes 1, 2, and 3 spills will be considered as 50, 500, and 6,500 bbl, respectively. Hence it is estimated that over 35 years, a total of 16,750 bbl of oil will be spilled by 39 events, thereby impacting approximately 905 ha of wetlands. After 4 and 10 years, 335 and 469 ha will recover, respectively. Converted to open water will be 100 ha of wetlands.

Non-OCS spills can occur as a result of import tankers, tidelands oil activities, and petroleum product spills. In Section IV.C.5, it was estimated that 17,146 non-OCS-related oil spills may occur over the same 35-year period. As described in Section IV.D.1.d., approximately 1,720 spills averaging 50 bbl each, 8 spills averaging 7,665 bbl, 18 spills averaging 5,000 bbl, and 44 averaging 10,000 bbl will contact wetlands. Hence, it is estimated that over 35 years a total of 677,320 bbl will be spilled by 1,790 events, impacting approximately 36,575 ha of wetlands. After 4 and 10 years, approximately 13,546 and 18,965 ha will recover, respectively. Converted to open water will be 4,064 ha of wetlands.

Under the WPA Cumulative Scenario, spills that occur on and 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.2.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. 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 near Corpus Christi, it is assumed that several contacts to seagrass beds will occur and will result in 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 by 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-16). 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.

Pipeline maintenance activities that disturb wetlands are very infrequent and are considered to be insignificant. Structures constructed for the purpose of mitigating adverse impacts of pipeline construction fail very frequently (Gosselink, 1984). Decisions to not maintain mitigative structures allow deterioration and eventual failure. Those significant, indirect, and adverse impacts on wetlands that the structures were designed to prevent or mitigate then proceed. These adverse impacts include saltwater intrusion, reduction of freshwater head, sediment erosion and export, expansion of tidal influence, and habitat conversion. The length of OCS-related pipeline canals and the number of related mitigative structures in the WPA are unknown. Although the extent of impacts caused by failure to maintain mitigation structures is unknown, such impacts are believed to be significant (Gosselink, 1984; Tabberer et al., 1985; Turner and Cahoon, 1987).

No new navigation channels are projected under the Cumulative Scenario (Table IV-16). 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-19, 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.2.c., OCS activities in deep water are requiring larger service vessels for efficient operations. Currently, service bases in Corpus Christi and Galveston, Texas, and Berwick, Louisiana, are accessible to the larger vessels; bases in Empire and Cameron, Louisiana, are considered marginally usable. This document assumes that one channel in Subarea TX-1 (the Corpus Christi area) will be deepened to 6.7 m. An adequate analysis of the project's impacts cannot be performed until a project description is developed by the U.S. Army Corps of Engineers. Deepening the Corpus Christi Ship Channel from -13.7 to -15.2 m NGVD (National Geodetic Variable Datum) is expected to displace approximately 353 million m³. For the purposes of this EIS, it is assumed that the dredged material will be used to create and refurbish wetlands in the immediate vicinity of the channel. No significant impacts of saltwater intrusion were caused by deepening this channel since it was recently dredged to -13.7 m NGVD. It is assumed that channel deepening will occur in waterways leading to support facility locations. As discussed in the analysis of impacts to wetlands in the CPA (Section IV.D.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 significant 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-16 and IV-19, 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 940 barge trips and 161,900 service-vessel trips (Table IV-16) 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 TX-1 and TX-2) and western Louisiana coastal zone, where the impacts will be assessed.

According to Johnson and Gosselink (1982), canals that have high navigation usage in coastal Louisiana widen about 2.58 m/yr compared to 0.95 m/yr for canals that are seldom used. For the purpose of this EIS, it is assumed that OCS-related navigational canals will widen at an average rate of 1.5 m/yr in Texas also. As established in Section IV.B.2., approximately 139 km of navigational canals are found in the coastal regions of the WPA (derived from Wicker et al., 1989). Hence, it is estimated that 20.8 ha/yr or 728 ha over 35 years of wetlands are lost. Twelve percent of this rate is attributed to the OCS Program, thereby accounting for 2.5 ha/yr, or 87.6 ha over 35 years.

According to Table IV-16, 585,000 bbl of produced sands and 7.846 MMbbl of drilling fluids will be transported to shore for disposal. 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, 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).

Summary

The OCS related coastal oil spills may adversely impact up to 905 ha of wetlands over the 35-year life of the proposed action, of which 100 ha may be converted to open water. Non-OCS-related coastal oil spills may adversely impact up to 36,575 ha of wetlands, of which 4,064 ha may be converted to open water. 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 faunal and floral communities.

Onshore construction of oil and gas infrastructure, other than pipelines, is expected to avoid conversion of wetlands to commercial land. Material from maintenance dredging and channel deepening of the Corpus Christi Channel is expected to be used in a manner that will enhance or create approximately 192 ha of wetland habitats. About 640 ha of wetlands along navigation channel margins are expected to be eroded as a result of vessel traffic; 88 ha of which is attributed to the OCS Program.

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

The incremental contribution of the proposed action (as analyzed in Section IV.D.2.a.(1)(b)) to the cumulative adverse impact upon wetlands is small in comparison to natural and other man-made impacts.

Cumulative impacts to wetlands are primarily due to subsidence, channelization, and levees. Cumulative impacts are expected to result in the loss of up to 5,600 ha, suppressed productivity for 2-10 years of up to 32,400 ha, and a gain of up to 192 ha due to beneficial use of dredged material.

(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, anchoring, and accidental seafloor blowouts, 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, associated anchoring activities, and accidental seafloor blowouts. The impacts to deep-water benthic communities from these activities are discussed in detail in Section IV.D.1.a.(2)(b). Because of the great water depths at which chemosynthetic communities are found, routine discharges from oil and gas operations, such as muds and cuttings, sanitary wastes, and produced waters, are not expected to have adverse impacts to chemosynthetic communities. These effluents would have to undergo a great deal of dilution and dispersion before contacting these benthic communities. In addition, oil spills would not impact chemosynthetic communities because the communities are often seen growing among oil-saturated sediments and natural gas bubbles, using these hydrocarbons as an energy source.

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-5 indicates that in the WPA an estimated 3,420 exploration and delineation wells and 1,940 development wells will be drilled, and 140 platforms will be installed. Approximately 33 accidental blowout events are estimated. However, as noted in Section IV.D.2.a.(2)(a), 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. This disturbance is considered to be a threat only to the high-density (Bush Hill-type) communities; the widely distributed low-density communities would not be at risk. The provisions of NTL 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 incremental contribution of the proposed action (as analyzed in Section IV.D.2.a.(2)(a)) to the cumulative impact is expected to be slight due to effects of the possible impacts caused by physical disturbance of the seafloor. Negative impacts will be limited but not completely eliminated by adherence to NTL 88-11 (currently in effect).

Cumulative impacts are expected to be due entirely to OCS Program (past and future sales, as well as the activities of the proposed action 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 impact chemosynthetic communities.

Conclusion

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 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 impact analysis below is presented for the proposed action and includes the Topographic Features Stipulation. Oil and gas operations covered by the stipulation are not expected to have an adverse impact on the biota of the topographic features. Thus, impact(s) 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 effects resulting from the proposed action (as explained in Section IV.D.2.a.(2)(b)). These include anchoring and structure emplacement, effluent discharge, blowouts, oil spills, and structure removal. Other effects include those from 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. The Flower Garden Banks are designated as a National Marine Sanctuary, where no anchoring is permitted. No data are available on the extent to which such anchoring on other banks 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. 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 some localized and occasionally severe 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 operators of a lease to perform certain measures, such as shunting, that would keep discharge materials at depths below sensitive biota. 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 on the order of 2-4 weeks.

There is an estimated 78-percent chance of a Size 3 oil spill occurring in the Western Gulf as a result of the OCS Program Table IV-9. It is also assumed that five Size 1 spills will occur each year and that seven Size 2 spills will occur during the 35-year life of the proposed action (Section IV.A.3.h.). It is assumed that two Size 3 oil spills will occur on the OCS from OCS oil and gas operations. Because of the water depths in which topographic features are found, no oil will reach the biota of concern. A total of 33 blowouts are expected to occur within the WPA under the OCS Program scenario; it is assumed that subsurface oil spilled into the water column from a blowout could reach the biota of a topographic feature.

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.(4) 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, discharges are not expected to reach topographic features.

Impacts from natural occurrences such as hurricanes occasionally result in damage to the biota of the banks. Massive corals are toppled, and resuspended sand can scour coral tissue. 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 Flower Garden Banks are protected under Marine Sanctuary status, which prohibits both collecting activities and anchoring on the living reef areas.

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 and treasure hunting activities, described in detail above). These activities include hurricanes, activities of scuba divers (including treasure hunting), 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, may have local and short term (i.e., 2-4 weeks) effects on the biota of the topographic features.

The cumulative impacts to topographic features are not expected to be great. The incremental contribution of the proposed action (as analyzed in Section IV.D.2.a.(2)(b)) to the cumulative impact level is minor 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 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. It is anticipated that any damage inflicted on these areas would be small, 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

This Cumulative Analysis addresses the changes in water quality from contamination of coastal waters of the northern Gulf of Mexico resulting from point- and nonpoint-source discharges, from both chronic low-level and large petroleum and other chemical spills, and from trash and debris.

Point sources of discharges are numerous along the Gulf of Mexico, and include both municipal and industrial inputs, as well as vessel operations. Major industrial sources operating in the coastal area of the Western Gulf include petroleum refineries, chemical manufacturing industries, dredge and fill activities, hard mineral mining, fish processing facilities, oil and gas production (both OCS and State) and onshore support facilities that service all OCS Program operations. In addition to land sources, discharges into coastal waters occur from vessels associated with an extensive maritime shipping industry--in particular the tanker transport of crude oil, petroleum products, and hazardous wastes; and commercial and recreational fishing. Of the 460 municipalities and major industrial facilities identified that discharge pollutants through pipelines directly into coastal waters of the Gulf in a comprehensive report by USEPA on the environmental quality of the Gulf, 113 were municipalities, which discharge primarily sewage wastes (USEPA, 1990). The remaining 347 dischargers were major industrial facilities, most of which (192) were in Texas. Most were petroleum refineries and petrochemical plants, although some were fish processing and forest product industries.

The existing OCS onshore infrastructure base in Texas and Louisiana used for future OCS operations in the WPA is expected to be sufficient to support future OCS oil and gas operations (Table IV-16), with the exception of the construction of 3 new pipelines and the 3 associated terminals. Table IV-16 lists 96 facilities in Texas and 274 facilities in Louisiana expected to support all future OCS operations. Not included in these numbers are the 4 onshore transfer stations and 1 waste processing facility that handle offshore wastes brought onshore in Texas (Section IV.B.1.a.(3)(c)). Routine point-source discharges, non-quantified but characterized in Section IV.B.2.b.(1), occurring from these existing onshore support facilities will continue to impact coastal and nearshore water quality as long as the facilities are in operation. Because the number and types of existing onshore support facilities is expected to remain the same or decline over time in Texas (discussed in Section IV.B.1.a.), historical trends in surrounding water quality conditions are assumed to be indicative of future conditions. Of these support facility types, only refineries were identified by USEPA in their summary report (USEPA, 1990) as major sources of point-source discharges in the coastal zone. Utilization capacities of these refineries are projected to only provide 21 percent support to the offshore oil industry. This being the case, the contribution to water quality problems from onshore OCS onshore support facilities is expected to be minor and impacts from discharges associated with the 20 refineries in Texas are only partially attributable to OCS oil production.

Vessels traversing the coastal zone act as point sources, dumping galley wastes, sewage, and bilge and ballast waters into waterways. 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. Impacts will occur along the Gulf's coastal waterways, the Gulf Intracoastal Waterway (GIWW), and within bays and coastal rivers from discharges from vessel traffic associated with maritime commerce, and commercial and recreational fishing activities.

Vessel traffic associated with OCS oil and gas industry activities in the WPA is expected to be extensive in Texas and west Louisiana. About 162,000 service-vessel trips and 940 barge trips carrying crews and supplies between offshore facilities and shorebases are estimated to occur in support of future OCS operations in the WPA (Table IV-19). Eight ship channels in Texas and seven navigation channels in Louisiana will be used to various degrees. The average usage of these channels by the OCS oil industry has been estimated to be about 12 percent (Turner and Cahoon, 1987, Appendix B), but can be as high as 69 percent for Bayou Teche, Louisiana, or 42 percent for Bayou Lafourche, Louisiana (both channels are used to some degree by WPA operations). The Calcasieu Ship Channel to Cameron (LA-1), Freshwater Bayou to Intracoastal City (LA-1), Aransas Pass to Ingleside (TX-1), Freeport Harbor Channel to Freeport (TX-2), Houston Ship Channel to Galveston (TX-2), and Sabine Pass (TX-2) are expected to receive the bulk of OCS support vessel trips from the WPA in the future (Table IV-19). Less than 10 percent of all areas in Texas will be used for OCS operations. Besides barge trips to and from platforms, about 18 percent of the barge traffic carrying oil from

terminals to other terminals or refineries is expected to be OCS-related (Section IV.B.1.b.(2)). Also shuttle tankers transporting OCS crude oil from floating production systems in the WPA will make 22 trips to Mississippi River terminals, 133 trips to Port Arthur/Lake Charles, 125 trips to Freeport, and 244 trips to the Galveston/Houston area (Table IV-19).

Over the 35-year analysis period, about 236 million liters of bilge water (Table IV-17) are estimated to be discharged into the waters of the 23 navigation channels by the projected OCS Program service vessel traffic in the WPA, especially into the Calcasieu, Houston, and Sabine Pass ship channels in Texas. If one assumes that 50 percent of these discharges (118 million liters) will occur in all the 950 km of confined channels (Section IV.B.1.b.(4)), there will be about 3,500 liters discharged per km of channel per year on an average, or about 10 liters/km/day. Bilge waters can contain petroleum and metallic compounds leaked from machinery. New MARPOL regulations severely restricting the levels of oil and grease in bilge water discharges in coastal areas (40 CFR 110) should diminish the types of impacts noted historically from such discharges. If one compares total daily estimates of the discharges of bilge from all OCS service traffic (about 5,000 gal/day) to estimates of sewage effluents discharged into Gulf waters (estimated at 1 billion gal/day) (USEPA, 1990), the contribution from bilge water discharges are negligible. MARPOL regulations now require that large vessels discharge their operational wastes into onshore receptacle facilities. It is assumed that all large vessels inclusive of OCS-related shuttle tankers and barges will comply. Smaller vessels, such as recreational fishing vessels, will still discharge their bilge water into coastal waters. No estimates of these quantities are available. Certainly this will be significantly larger than quantities discharged from OCS service vessels.

The discharge of sewage and wastes from boats and vessels in coastal waters may also impact water quality by increasing the biological oxygen demand (BOD) locally and introducing pathogens into the water column. The FWPCA (Section I.B.3.d.(3)(e)) requires recreational boats to be equipped with approved marine sanitation devices; however, boats still legally discharge treated waste, and illegally discharge untreated waste, into coastal water bodies. Although the wastewater generated by such boats is small, the organic compounds 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 dissolved oxygen concentrations of the water may decrease. 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 shellfish taken from such waters. Bacteria, viruses, and other water-borne diseases can be attributed to vessel sewage pollution. Although no total estimates are available, for each person working or traveling in Gulf waters on a vessel, about 0.227 m³ of sanitary wastes are discharged into coastal waters per day.

Another major type of point-source pollution in Gulf coastal waters is the dumping of dredged materials. Over 75 million tons of dredged materials are disposed of in Gulf estuarine waters every year (USEPA, 1990). Dredged disposal can result in changes in the natural flow or circulation of surface waters, which will result in secondary water quality affects; and in the addition of pollutants to the water in excess quantities resulting in water quality degradation of surrounding waters. Dredged materials are often contaminated with toxic heavy metals, organic chemicals, pesticides, oil and grease, and other pollutants originating from municipal and industrial discharges and nonpoint sources, and thus result in contamination of areas formerly isolated from major anthropogenic sources (USEPA, 1979).

Section IV.C.1. documents the impacts that have resulted historically from the discharge of oil-field wastes into coastal waters. The State of Texas has restricted, to a large extent, the direct discharge of waste drilling mud and produced water into its estuaries. Furthermore, the USEPA is proposing more restrictive discharge of such wastes through their coastal NPDES permitting program (Section I.B.3.d.(3)(e)) and is expected to prohibit completely the discharge of drilling muds and cuttings, produced waters, and produced sands into surface waters. These contaminants will no longer be a source of pollution in Texas coastal waters.

Before a characterization of Gulf contamination from chronic pollution can be provided, the contribution from nonpoint-source pollution must be considered. Sources of nonpoint-source pollution examined include runoff from municipal, industrial, and agricultural operations; vessel traffic alterations; and waste disposal practices. The major cause of nonpoint-source contamination in Texas is related to population growth and the growth of petrochemical industries in the coastal zone. Urban runoff, especially, puts substantial quantities of oil and grease, lead, and chromium into the Gulf coastal zone, although decreases in lead inputs have been

documented since the 1970's (USEPA, 1990). Agricultural runoff along the Gulf Coast contributes large quantities of nutrients, herbicides, pesticides, and fecal coliform bacteria.

Dredging operations can cause increased turbidity and resuspension of contaminants from sediments. This type of water-quality degradation can also result from bank erosion and runoff caused by extensive vessel channel usage. It is estimated that 10 ha will erode from canals, bayous, and river banks in Texas and 61 ha in Louisiana due to OCS Program service-vessel and barge trip use in of these channels. This erosion averages 2 ha per year for the 950 km of confined channels. If we assume that OCS Program channel usage is 12 percent of the total vessel usage of these channels, then about 17 ha per year will erode from the major channels of the Gulf due to vessel traffic.

A substantial percentage of the Texas coastal area is significantly affected by both point- and nonpoint-source pollution so that identified areas do not support fully designated uses of surrounding water. The oyster industry is a good indicator of impacts from septic tank runoff pollution. During northerly winds in winter, about half of the harvestable shellfish beds in Louisiana are closed because of E-coli bacteria contamination (Dugas, 1988). Another consequence of nonpoint-source pollution may be hypoxia, or recurring areas of oxygen-depleted waters. Hypoxia in the Gulf of Mexico has been most noticeable in shallow (less than 20 m) Louisiana waters.

It is expected that the current level of contamination of coastal waters will continue over the 35-year analysis period, but will not increase. This assumption is based on the fact that although urban and industrial growth is expected to increase in the coastal area and thereby result in increased discharge levels, improved environmental regulatory programs adopted by the Gulf Coast States (such as tougher water quality standards) and USEPA should result in discharge contaminant levels decreasing (USEPA, 1988)--and on balance--result in steady state conditions. Given the above, chronic discharges into Texas coastal waters, caused primarily by urban growth and growth of the petrochemical industry, will result in continued low-level, regionally distributed degradation of coastal waters. The contribution of discharges from OCS onshore support facilities and vessel traffic is considered to be very small.

The oil and gas industry's coastal and onshore operations have contributed to the hydrocarbon contamination of Gulf waters to a small degree, according to the results of NOAA's Status and Trends Program, a program that measures national trends in chemical contamination in space and time (USDOC, NOAA, NOS, 1990). 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 large point sources, such as large cities and industrial areas. The following conclusions about hydrocarbon contamination were made by the study scientists: 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 water quality degradation from oil and gas operations 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.

The Gulf Coast is particularly susceptible to crude oil, petroleum product, and hazardous wastes spills. In 1986, almost 20 percent of all hazardous, and other substances spills occurred in the Gulf area (USDOT, Coast Guard, 1989). An even larger portion of crude oil and petroleum product spills occur each year. Approximately 44 percent of all spills causing a sheen occur in the Gulf area according to USCG statistics (Oil Spill Intelligence Report, 1992). This is primarily due to the extensive petroleum industry that exists in the Gulf. About 60 percent of the nation's imported crude comes into the Gulf for refining, and the Gulf also produces most of the nation's crude oil. Projections of the numbers of spills occurring in the coastal zone over the 35-year analysis period are 8 Size 3 crude oil spills from import tanker operations near Texas ports; 18 Size 3 spills from coastwise movement of crude oil in the WPA coastal zone, most of these spills occurring in the GIWW; 44 Size 3 petroleum product spills (average size, 10,000 bbl) in restricted waters of Texas; and 500 spills less than 1,000 bbl (many less than 1 bbl) each year in Texas waters (based on an analysis of 6 years of USCG data). The portion of these spills attributable to the OCS program is minor. Only 10 Size 1 and Size 2 spills per year are expected to be OCS-related (about 2% of all onshore spills). Most of these are expected to occur near terminal areas where they can be confined within protection levees.

In addition to onshore spills, both small and large spills occurring offshore may reach restricted waters and affect coastal water quality. One large spill from import operations and one spill greater than 1,000 bbl from OCS operations in the WPA are expected to occur offshore and reach land, most likely in the Galveston area

(Table IV-11). No small spills (Sizes 1 and 2) occurring offshore are projected to reach land (Section IV.A.3.h.(2)).

Combining the number of onshore and offshore spills that will contact coastal resources, about 17,500 Size 1 and Size 2 spills and 72 Size 3 spills are expected to occur in the 35-year analysis period in the WPA coastal zone and, depending on the factors affecting spill impact, to alter coastal water quality in some way. For purposes of analysis, it is assumed that 90 percent of these spills will remain in open bay areas, nearshore, or leveed waterways, such as the Mississippi River, and these spills will be 50 bbl (a conservative size estimate). If one applies the open water area of potential contact for a 50-bbl spill described in Section IV.B.2.d.(1) of 8,000 m² per Size 1 and Size 2 spill and 1 million m² per Size 3 spill, projected spills would contact about 200 million m² of open water during the next 35 years. Acknowledging that contaminant levels are expected to reach background levels in 6 months (Section IV.B.2.d.(1)), the frequency, number, and areal extent of the projected spills is such that these spills will represent a chronic petroleum contamination source for open coastal water.

Applying the assumptions regarding area of potential contact and contaminant residence times described in Section IV.B.2.d.(1) to spills occurring in marsh areas, about 1,750 spills assumed to average 50 bbl each will get into marsh areas, affecting a total of 4,700 ha of marsh waters, each spill remaining a maximum of 6 months; and about 7 Size 3 spills will reach marsh waters, affecting a total of about 2,500 ha for as long as 10 years for each event. Again this level of interaction with coastal waters will add a low-level, chronic, regional input of petroleum hydrocarbons to coastal waters. This chronic input will be in addition to inputs of routine point- and nonpoint-source discharges and will result in increased water quality degradation of WPA coastal waters.

Summary

Routine point- and nonpoint-source discharges from non-OCS activities, such as agriculture, general construction projects, water resource developments, forestry, septic tank leakage, urban runoff, and, to a small extent, oil and gas activities, are degrading 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. All existing onshore infrastructure and associated coastal activities occurring in support of OCS Program operations will contribute to the degradation of regional coastal 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 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 domestic and sanitary discharges.

The incremental contribution of the proposed action to the cumulative changes in regional water quality is expected to be less than 3 percent because the proposed action contributes 3 percent of the OCS Program's contribution.

Chronic discharges into Texas coastal waters, caused primarily by urban growth and growth of petrochemical industries, will result in continued low-level, regionally distributed degradation of coastal waters throughout the Gulf region. Some uses of the waters will be partially lost, such as recreational uses and some fishing. The contribution of discharges from OCS onshore support facilities in Louisiana is considered to be very small.

Accidental spills will introduce oil usually into open bays and waterways, and sometimes (10% of the time) into marshes creating elevated hydrocarbon levels within affected waters for as long as 6 months for Size 1 and Size 2 spills and for as long as 10 years for Size 3 spills. Much of the oil will be dispersed throughout the water column during the next several days to weeks. The number of spills is increasing primarily due to the increased levels of transport of crude oil and petroleum products in the coastal zone between refineries and importers and consumers. Oil spills, expected at about 670 per year, will continue to add to coastal water-quality degradation as a result of increased petroleum contamination.

Conclusion

Chronic discharges and runoff into Louisiana, Mississippi, and Alabama coastal waters, resulting primarily from urban growth, will maintain the current water quality status facing these States. There will continue to be low-level, regionally distributed degradation of a substantial percentage of coastal waters. The extensive oil and gas industry operating in the Gulf area will continue to add to low-level, chronic, petroleum contamination of coastal waters. In Mississippi and Alabama, there will be an increase in the onshore support infrastructure, which will cause increased contamination, localized around the new sites.

Marine Waters

This Cumulative Analysis considers the effects of the OCS oil and gas leasing program, OCS sulfur mining program, oil tankering and other vessel traffic, ocean dumping, and shoreline development on offshore water quality. Specific impact-producing factors considered in the analysis include the discharge of oil and gas drilling and production wastes, bottom disturbances from platform and pipeline emplacement and removal, offshore dredging and dredged material dumping, accidental oil and hazardous substance spills, operational and human-waste discharges from vessels, ocean disposal of hazardous material and industrial waste, and municipal and industrial effluents and runoff.

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. 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. Bilge waters must now be discharged at onshore receptacles. 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 two 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.

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+ ft from the source. Accidental spills of molten sulphur would have a minimal impact on offshore water quality. Impacts to water quality within the Gulf are expected to be negligible.

Historically, most oil spills have impacted water quality during the life of the spill and for a short time afterwards (Neff, 1990a). Most of the components of oil are insoluble in water, and most of the spilled oil floats. A number of weathering processes act on an oil spill to remove oil from the water column and surface of the water within several months. Section IV.C.2. of the Final EIS for Sales 142 and 143 (USDOL, MMS,

1992b) provides more detail on weathering processes. The frequency of occurrence and the area of contact of spilled oil is the major factors determining water quality degradation. Sections IV.A.3.h.(2) and IV.C.5. provide projections on spill occurrence, the average size of each spill, and the areal coverage of projected spills. Any one spill is not expected to result in significant long-term changes in offshore water quality; impacts will be of short duration (2-3 months), and only affect a small area of offshore waters at any one time. However, occurrence of future spills are expected to be quite numerous. Approximately 60 percent of all crude oil imported into this nation comes through Gulf waters (Rainey, 1992). Spills may occur from vessels that are importing crude oil and petroleum products from other countries, from vessels that are transporting oil and its products through Gulf waters between States, from vessels carrying other commodities when accidents result in the loss of fuel oil from their tanks, and from OCS oil and gas production operations. It is estimated that 37 Size 3 crude oil spills will occur from import tankering (median size, 7,665 bbl); 60 crude oil spills from coastwise movement (average size, 5,000 bbl); and 104 spills (60 in the CPA) from import or coastwise movement of petroleum products (average size, 10,000 bbl) in the Gulf of Mexico during the 35-year life of the proposal. Nine Size 3 crude oil spills are expected to occur from offshore pipelines and platforms. Although no estimates are available, there may also be oil spills from State oil and gas operations, from non-oil carrying vessels, and many more smaller sized spills occurring in the next 35 years. Given the frequency of these spills, they are expected to add to the regional petroleum contamination of Gulf waters, besides resulting in localized changes to water quality conditions in the area affected by the spill.

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 hazardous materials enter the marine environment as a result of accidental spills. 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.

Besides the contribution from spills and oil and gas operational discharges, petroleum hydrocarbon contamination of the Gulf of Mexico is occurring from natural seeps, atmospheric inputs, discharges from coastal municipalities and industries, and urban and river runoff. Onshore sources of hydrocarbons to Gulf waters far outweigh the contribution from offshore sources. The Mississippi River is the major source of petroleum contamination into the Gulf (Southwest Research Institute, 1981; Brooks and Giammona, 1988).

Contaminants and high levels of nutrients found in land-based effluents and runoff have been identified as potential causes of hypoxia in Gulf waters. Hypoxia occurs in some areas of the Gulf bottom waters because of high summer temperatures combined with freshwater runoff from the Mississippi River and/or phytoplankton blooms in surface waters caused by excess nutrients. A zone about 30 mi wide has been found to occur in August in the central Louisiana shelf, and mass mortalities of the bottom organisms have been documented. Some researchers have identified nutrient inputs from river runoff and sewerage as responsible for this condition; others believe it is a natural condition that occurs during hot summers. Most believe that the cause is a combination of these factors.

Of particular concern are impacts from all future OCS Program operations in the Gulf. Impacts from spills are discussed above. Table IV-5 indicates that, under the OCS Program, 3,420 exploration and delineation wells, 1,940 development wells, 140 platforms, and 3,000 km of pipelines supporting future operations in the Western Gulf will be installed in the next 35 years. Over 259 platforms will be removed explosively during the 35-year analysis period. No projections are available for pipeline removal.

The drilling of the wells, construction of the platforms, and laying of the pipe will result in increased water column turbidities in overlying offshore waters. Using average rig and platform sizes, the total bottom area disturbed by the pile-driving, anchoring, or dredging needed for the temporary presence of rigs during drilling and by all pipeline and platform installation operations is estimated at 2,138 ha. For those pipelines laid in water depths shallower than 61 m, burial below the seafloor is required. Pipeline burial activities will result in the resuspension of some 3 million m³ of sediment during the installation of pipelines in water depths of 61 m and less. Such bottom disturbance of sediments will result in resuspension of any settled pollutants, such as trace metals, chlorinated hydrocarbons, and excess nutrients, that may have accumulated in the sediments. Major sources of these contaminants are coastal or land-based, and sediment contamination is a function of

distance from shore. Examining the extent of these operations in each subarea (Table IV-5), a majority of operations in the future will occur at a substantial distance from shore; therefore, any sediments disturbed are not as likely to be contaminated. The resuspension of significant quantities of contaminants from bottom disturbance operations will only occur when the operation is very close to shore. Looking at peak-year estimates for Subarea W-1, the subarea nearest to the shore, about 19 wells will be drilled, 1 platform installed, and 40 km of pipeline laid. Such level of activity is somewhat greater than the level of operations examined in a study researching water quality effects from platform installation discussed above (Arthur D. Little, Inc., 1985). The conclusion of the study can therefore be applied to each installation operation. Sediment disturbance and suspension resulting from pile-driving, anchoring, and associated dredging will result in minor, localized, and temporary impacts on water quality lasting up to several months after the operation ceases.

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. Explosive removal operations are projected to occur often in the future, as production at existing platforms ends. The peak-year estimate is 11 platforms (Table IV-5). The consensus of research on explosive removals is that such resuspension will have a short-term local effect of a very limited nature. Given the low frequency of occurrence, very minor impacts on water quality are expected from this operation.

About 27 MMbbl of drilling fluids and 12 MMbbl of drilling cuttings will be discharged from the drilling of 5,360 exploratory and development wells (Table IV-5). The discharge from each exploratory well will last for approximately 40 days, and about three exploratory wells will be drilled per block. On an average, about 14 development wells are typically drilled from each platform (12 of these wells will go into production) (Section IV.A.2.). The discharge from each development well will last for approximately 35 days. If development wells are all drilled immediately, a maximum number of wells in any one year from any one platform will be nine. Applying the above scenario to information on discharge quantities, it is possible that the area around each of the 140 new platforms can be contaminated from the discharge of 36,000 bbl of drilling discharges continuously for about a year and a half (if 3 exploratory wells and 9 development wells were drilled at one site) and then intermittently afterwards when old wells become depleted and new wells are drilled. These quantities are consistent with the level and frequency of discharges studied. Therefore, the impacts that were based on both modelling and historical data and that were summarized in the general discussion are expected to result from these future discharges. In general, discharges of drilling wastes will affect an area several thousand meters around a platform. Sediment contamination can be expected out to 3 km from the discharge point in the direction of the primary flow and will last up to 1 year after drilling ceases. Benthic marine organisms will be affected out to 1,000 m. Water quality criteria may be exceeded within 100 m from the discharge twice; sediment-pore water quality criteria will be exceeded 3-9 times. Regional contamination from these discharges are discussed below.

About 2 Bbbl of produced water will be discharged from about 50 percent of the projected and existing platforms equipped with three-phase separators; the other 50 percent will pipe their water to these platforms. These quantities are consistent with historical operations, for the most part, and it is expected that the documented impacts summarized above will be applicable to future conditions. Moderate petroleum and metal contamination of sediments and water column will occur around OCS platforms out to several hundred meters and will have small-scale, localized effects on benthic organisms out to 200-500 m.

In open water conditions, the factors that enhance local dispersion also contribute to regional, low-level contamination. Historically, it has been shown that discharges from operations in the Gulf associated with the OCS oil and gas industry have contributed to some cumulative, regional contamination of waters and sediments in the Central Gulf of Mexico shelf, primarily from barium, low-boiling aromatic hydrocarbons, and radium. This contamination is expected to continue but decrease somewhat over time because of two factors: new limitations on oil and grease in produced waters and barium in drilling muds by the USEPA, and a general decline in offshore operations.

Summary

Major activities degrading marine waters include the discharge of oil and gas drilling and production wastes, bottom disturbances from platform and pipeline emplacement and removal, offshore dredging and dredged

material dumping, accidental oil and hazardous substance spills, operational and human-waste discharges from vessels, ocean disposal of hazardous material and industrial waste, and municipal and industrial effluents and runoff. The OCS sulphur mining operations off Louisiana have been ongoing since 1954 and have not been identified as causing any measurable water quality degradation. Data from years of testing at the Grand Isle Mine indicate that bleedwater, the major discharge from this operation, is not measurable at 300+ ft from the source. Perhaps the most publicized source of oil pollution is the operational discharge of bilge and ballast waters by tankers and other vessels. New regulations limit oil content in the bilge waters, require tanker designs for minimizing contamination of ballast water, and require that most bilge waters be disposed of at onshore receptacles.

Sediment disturbance from the emplacement of 140 platforms, the explosive removal of 259 platforms, the installation of 3,000 km of pipeline, and the drilling of 5,360 wells in the western Gulf over a 35-year period will result in minor, localized, temporary impacts on water quality. The drilling of the wells, construction of the platforms, and laying of the pipe will result in increased water-column turbidities and possible resuspension of pollutants when the activities occur close to shore.

The area around each of the 140 projected platforms can be contaminated from the discharge of 36,000 bbl of drilling muds and cuttings at each site. These discharges may be released continuously for about a year and a half (assuming 3 exploratory wells and 9 development wells were drilled at one site) and then other quantities discharged intermittently when old wells become depleted and new wells are drilled. These discharges of drilling wastes will affect an area several thousand meters around a platform. Sediment contamination can be expected out to 3 km from the discharge point in the primary direction of the current and will last up to 1 year after drilling ceases. Benthic marine organisms will be affected out to 1,000 m. Water quality criteria are expected to be exceeded within 100 m from the discharge. Moderate petroleum and metal contamination of sediments and water column from the discharge of 2 Bbbl of produced waters at production platforms will occur out to several hundred meters from the discharge point and will have small-scale, localized effects on benthic organisms out to 200-500 m. These discharges are contributing slightly to the long-term, regional degradation of the Gulf's water quality, particularly related to petroleum and barium contamination.

Approximately 200 Size 3 spills are projected to occur over the next 35 years in the Gulf from a variety of oil-related operations. Given the frequency of these spills, they are expected to add to the regional petroleum contamination of Gulf waters, in addition to resulting in localized, short-term (2-3 months) changes to water quality conditions in the area affected by the spill. Other offshore sources adding to the petroleum hydrocarbon contamination of the Gulf include natural seepage and atmospheric inputs. Besides petroleum contamination, substantial amounts of hazardous materials enter the marine environment as a result of accidental spills.

Adding to the contribution from offshore sources, contamination of the Gulf of Mexico is occurring from discharges from coastal municipalities and industries, and urban and river runoff. Onshore sources of pollutants to Gulf waters far outweigh the contribution from offshore sources. The Mississippi River is the major source of petroleum contamination into the Gulf (Southwest Research Institute, 1981; Brooks and Giammona, 1988). Contaminants and high levels of nutrients found in land-based effluents and runoff have been identified as the probable cause of hypoxia in Gulf waters. The incremental contribution to water quality by the proposal added to all onshore and offshore sources is considered very minor and less than 1 percent.

Conclusion

Land-based municipal and industrial low-level discharges and runoff will contribute to the greatest extent to the long-term degradation of marine waters in the Gulf. The Mississippi River, draining two-thirds of the United States, is the major source of pollution in the northern Gulf. Bottom disturbances resulting from platform and pipeline emplacements, dredging, and dredged material disposal operations are expected to result in minor, localized, temporary impacts to water quality. Operational discharges are primarily muds and cuttings and produced waters. Drilling muds and cuttings, which are discharged intermittently throughout the life of a platform, are expected to contaminate a localized area around platforms, out to 3,000 m for 1 year after drilling ceases. Production wastes, which are discharged continuously throughout the life of most of the platforms, will change some water quality and sediment parameters within several hundred meters downcurrent

from the discharge point for an average of 20 years. Operational discharges and spills from future oil and gas development and transportation offshore will also contribute, to a minor extent, to the regional petroleum contamination of Gulf 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 Cumulative Scenario discussed in Section IV.A. (Table IV-5) establishes that 3,420 exploration and delineation wells and 1,940 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-5 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. 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-5.

Total OCS Emissions in the WPA
(tons over the 35-year life of the Cumulative Scenario)

<u>Activity</u>	<u>NO_x</u>	<u>CO</u>	<u>SO_x</u>	<u>THC</u>	<u>TSP</u>
Service Vessels	54,566.3	6,392.5	862.1	2,776.7	3,849.6
LTO Helicopters	495.1	399.9	76.2	20.7	19.0
Cruise Helicopters	1,599.5	4,570.0	342.8	372.6	457.0
Blowouts without Fire	0.0	0.0	0.0	900.0	0.0
Spills without Fire	0.0	0.0	0.0	510.0	0.0
Barge Loading	0.0	0.0	0.0	463.9	0.0
Tanker Loading	0.0	0.0	0.0	3,148.6	0.0
Transit Loss	0.0	0.0	0.0	3,045.8	0.0
Tanker Exhaust	21,830.2	2,387.1	27,117.5	35.7	7,845.4
Tug Exhaust	1,699.1	32.1	21.9	76.6	102.0
Exploratory Wells	33,071.4	8,823.6	3,864.6	3,317.4	957.6
Development Wells	12,888.0	3,438.0	1,512.0	1,296.0	378.0
Platforms	147,971.6	19,275.1	258.8	56,082.5	362.4
Totals	274,121.2	45,318.3	34,055.9	72,046.5	13,971.0

Total emissions for each subarea in the WPA during the Cumulative Scenario are presented below. Observe that activities in Subareas W-1 and W-2, which are closest to land, generate the largest emissions, while activities in Subarea W-3 generates the smallest amounts of all pollutant emissions.

Total Emissions in WPA Subareas
(tons over the 35-year life of the Cumulative Scenario)

<u>Pollutant</u>	<u>W-1</u>	<u>W-2</u>	<u>W-3</u>
NO _x	27,412.1	84,194.4	162,514.7
CO	4,531.8	13,919.2	26,867.3
SO _x	3,405.6	10,460.0	20,190.3
THC	7,204.7	22,128.6	42,713.3
TSP	1,397.1	4,291.1	8,282.8

The total pollutant emissions per year are not uniform. During the early years of the OCS Program activities, emissions would be large but would decrease over time as reserves, production, and associated drilling and service-vessel activity decrease.

The following table presents peak emissions of primary pollutants from OCS Program activities in tons per year. It is 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)

<u>Pollutant</u>	<u>Wells</u>	<u>Platforms</u>	<u>Vessels</u>	<u>Others</u>	<u>Mean</u>	<u>Aggregate</u>
NO _x	3,837.4	18,950.8	2,291.2	0.00	7,832.04	11,498.06
CO	1,023.8	2,468.6	393.8	0.00	1,294.81	2,097.46
SO _x	448.7	33.2	812.0	0.00	973.03	1,253.51
THC	111.3	7,182.5	93.8	230.5	2,058.47	2,784.34
TSP	385.1	46.4	350.7	0.0	399.17	471.26

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 Scenario are those related to infrastructures and resources. These changes are reflected in an increase of emissions for all analyzed pollutants. A comparison of Cumulative Scenario 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 2.61 and 0.34 μgm^{-3} for speeds from 1 to 7 m/s⁻¹ and a mixing height of 900 m; for a 300-m mixing height, concentrations varied from 7.82 to 1.01 μgm^{-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_2 , 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 $3,400\text{-D}^{2/3}$ and 33.3-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 emission level of VOC in Subarea W-1 is estimated at 278.4 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 OGD Model (USDOL, 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 μgm^{-3} , which is below the national standard of 100 μgm^{-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 (USDOL, MMS, 1991d). Annual average concentrations peaked around 0.08 μgm^{-3} and the highest 1-hour concentration never exceeded 2.31 μgm^{-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 (2.6 μgm^{-3}) and spread over 145.3 billion m³ would have a moderate effect.

Oil-spill effects on air quality are examined below. It is assumed that Size 1 and Size 2 oil spills would cause low pollutant concentrations because their input of pollutants (it is assumed that 50% of the spill evaporates in 3 days) would be very small. Information from OCS accidents indicates emissions of fewer than 100 tons/hr by the second hour. For Size 3 spills, 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 13 percent of OCS crude-oil production is offloaded from surface vessels at ports. The unintentional emissions from these offloading operations are estimated to be 3,612 tons, which represent less than 5 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 μm and a third peak with a diameter larger than 2 μm . Particles with diameters of 2 μm or larger settle very close to the source (residence time of approximately 1/2 day, Lyons and Scott, 1990), so their impact on these areas would be low. For particles smaller than 2 μm , which do not settle fast, wind transport determines their

impacts. Results from the box model indicate that the largest concentration for TSP will be $0.32 \mu\text{gm}^{-3}$, which is less than the allowable annual increase level of $5 \mu\text{gm}^{-3}$. Besides, Section III.A.3. indicates that in the coastal areas the suspended particulate matter is around $50 \mu\text{gm}^{-3}$ and the national standard is $150 \mu\text{gm}^{-3}$, 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.

Results from two ongoing studies concerning the OCS contributions to onshore ozone episodes have become available. These studies are the *Preliminary Scope for a Gulf Coast Ozone Study* conducted by Sonoma Technology Inc. for the American Petroleum Institute and the *Preliminary Assessment of Gulf of Mexico OCS Contributions to Ozone Formation in Onshore Areas using the Regional Oxidant Model* sponsored by MMS as an Interagency Agreement with USEPA. The results in the following paragraph regarding historical ozone episodes are from a working draft by Sonoma Technology (Blumenthal et al., 1992).

In the WPA the number of ozone exceedance days at the Houston region varies from 30 to about 66 days with most years having about 45 days between 1982 and 1990. The number of ozone exceedance days per year and site-hours per year in the same region show that most ozone episodes peak in August with a smaller peak in May and a minimum in June. The number of exceedances declines rapidly after October and before April. The site-hours peak show two peaks, one in August-September and a second in May. Results for Beaumont (not presented because too few exceedances occurred at the long-term monitoring stations) indicate that exceedances occurred mostly from May through October. To study the influence of OCS emissions, they analyzed the pollutant emissions and meteorological data at Sabine Pass, Texas, which is only 5 km inland. Days were classified as onshore and offshore based on the meteorological data. The analyses show that days of onshore flow had lower average and median ozone concentrations over land than offshore flow (by 5-8 parts per billion (ppb); the National Ozone Standard is 120 ppb) and maximum over land ozone concentrations were higher during offshore flow than during onshore flows (128 versus 108 ppb). Less than 1 percent of the onshore flow hours had ozone concentrations above 80 ppb. Of five days with ozone concentrations above 95 ppb, two days were associated with northerly flow at Sabine Pass and three days were associated with sea-land breezes. Land breeze (offshore flow) may be transporting ozone and precursors offshore; when the flow is onshore (sea breeze), ozone is transported back onshore. However, additional studies are needed to understand the dynamics of ozone formation and transport in this area. These results are subject to change when the study is completed.

The preliminary ozone assessment using the Regional Oxidant Model was performed to establish, to an order of magnitude, OCS contributions to onshore ozone. This is the first study to analyze OCS contributions to onshore problems. The ROM model (ROM 2.2) includes the following physical and chemical processes: boundary layer photochemistry, carbon bond mechanism IV, dry deposition, cloud and terrain effects, and anthropogenic and natural emissions. Inputs to the model are air quality data, pollutant emissions, meteorological data, land-use information, and topography. The domain used by the USEPA is extensive (26° to 38°N and 81° to 99°W); however, results for the MMS study were calculated for five areas (125 by 125 mi^2 polygons extending to or beyond the coastline) between Texas and Louisiana. The areas were located around Corpus Christi, Houston, Beaumont-Lake Charles, Baton Rouge, and Baton Rouge-New Orleans. The two ozone episodes analyzed in the study occurred during July 25 to August 6, 1988, and July 6-31, 1990. Observed ozone concentrations during the first episode varied between 40 and 150 ppb in Houston and between 51 and 167 ppb in Baton Rouge. Observed ozone concentrations during the second episode varied between 90 and 190 ppb around Houston and between 63 and 202 ppb around Baton Rouge. The results (Figure IV-5) show that most OCS ozone contributions occur over water with contributions of about 25 ppb, while over land contributions are about 8 ppb. It is worth noting that ozone reached as far as Georgia under southwest winds, although the concentrations are only about 5 ppb. During southeast winds the plume turned west, but the impact levels remained unchanged (Figure IV-6). During the second episode, concentrations were about 29

ppb over water and about 5 ppb over land (Figure IV-7). The OCS ozone impacts can be summarized as contributions between 5 and 8 ppb to onshore ozone concentrations and between 11 and 29 ppb over water. However, several cautions need to be mentioned for these results. First, the OCS emissions inventory employed was from 1985, while the episodes are from 1988 and 1990 and contain large uncertainties. Second, these results are based on only two episodes; thus, variance tends to be large. Third, the model tends to underpredict high ozone concentrations and overpredict low concentrations. Because of these uncertainties, the day-to-day ozone concentrations contributed by OCS could be larger than the average results presented above. The above results show that the OCS contributions to onshore areas are small (8 ppb or less); however, this is just an order of magnitude assessment. The three-year study, mandated by Congress, will undoubtedly produce results that have higher resolution over a greater span of meteorological conditions and these results may change.

The amount of power generation that occurs during the period 1994-2028 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_2 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_2 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 and State oil and gas activities and are defined as an uncontrolled flow of fluids from a wellhead or wellbore. Thirty-three blowouts are assumed to occur 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. Further, most blowouts occurred without fire (MMS Database), and the amount of oil released during these accidents has been small. The total emission of THC is 900 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 Cumulative Scenario discussed in Section IV.A. (Table IV-5) establishes that 3,420 exploration and delineation wells and 1,940 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 minimal 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 between 1 and 8 μgm^{-3} (box model steady concentrations). The impacts decrease during winter, because onshore winds occur only about 34 percent of the time and impacts increase in summer, because 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, and pathogens that may occur and adversely affect nonendangered and nonthreatened marine mammals 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 marine mammals analysis include III.B.3. (description of marine mammals), IV.A.2.a.(1) (seismic operations), IV.A.2.a.(4) (structure removal), IV.A.2.c. (support activities), IV.A.3.d. (offshore discharges), IV.A.3.h. and IV.B.2.d. (oil spills), and IX.E. (oil-spill response activities).

An estimated 2.7 Bbbl of drilling fluids, 1.2 Bbbl of drill cuttings, and 3.1 MMbbl of produced waters are assumed to be generated offshore as a result of the proposed action plus prior and future OCS sales (Table IV-5). These effluents are routinely discharged into offshore marine waters and are regulated by the USEPA'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; indirect effects via 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/or affect nonendangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis, averaging about 131,000 trips per year. The FAA (Advisory Circular 91-36C) and corporate helicopter policy state that helicopters must maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. It is expected that cetaceans will not be affected by routine OCS helicopter traffic at these altitudes. It is also expected that 10 percent of helicopter trips will occur at altitudes below the specified minimums listed above as a result of inclement weather. Such incidents are very short-term and may elicit a startle reaction from cetaceans closely.

It is assumed that, during the peak year, 9,100 OCS-related oil/gas service-vessel trips, 31 shuttle tanker trips, and 30 barge traffic trips will occur as a result of the proposed action, plus prior and future OCS sales in the WPA (Table IV-5). Noise from service-vessel traffic may elicit a startle and/or avoidance reaction from cetaceans or mask their sound reception. This effect is sublethal and constitutes a short-term and temporary impact. Survey data show that most cetacean species of the Gulf are distributed within deeper waters, on or beyond the continental shelf break. It is estimated that annual service-vessel trips occurring (by offshore subareas) within water depths greater than 100 m are as follows: W-1--9,477; W-2--33,640; and W-3--68,800. The probability of collisions is higher within these waters. It is expected that the extent of service-vessel traffic predicted in the Cumulative Scenario will result in the incidental take of cetaceans either through active avoidance behavior or displacement of individuals or groups. Collisions, though expected to be rare events, could be fatal.

It is assumed that, during the peak year, 200 exploration and delineation wells and 75 development wells will be drilled as a result of the proposed action, plus prior and future OCS sales in the WPA (Table IV-5), and will produce sounds at intensities and frequencies that could be heard by cetaceans. It is estimated that noise from drilling activities will be relatively constant and 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 echolocate and 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 and may elicit some degree of avoidance behavior and/or temporary displacement in the open Gulf. It is expected that drilling noise will periodically disturb and affect nonendangered cetaceans.

Explosive platform removals can temporarily interfere with communication, elicit a pronounced startle reaction with subsequent avoidance or flight behavior, temporarily or permanently reduce hearing sensitivity, or cause hemorrhaging and death in cetaceans. It is estimated that 259 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. It is expected that structure removals will cause only sublethal effects on cetaceans as a result of the implementation of the MMS guidelines for explosive removals (USDOL, MMS, 1990a, Appendix B). It is expected that structure removals will seldom disturb and affect nonendangered cetaceans.

Seismic surveys use airguns to generate sound 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 of noise on cetaceans from seismic surveys are entirely sublethal, constituting a short-term startle response and avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans, causing skin and soft tissue irritation, fouling of baleen plates, respiratory stress from inhalation of toxic fumes, food reduction or contamination, the direct ingestion of oil and/or tar, and temporary displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from Size 3 oil spills, the effects would primarily be sublethal; few deaths are assumed. The effects of offshore Size 1 and Size 2 oil spills are assumed to be solely sublethal due to the small areas affected and their rapid dispersion.

Section IV.A.3.h. estimates the mean number of Size 1 and Size 2 spills occurring as a result of the proposed action, plus prior and future OCS sales in the WPA. It is assumed that 5 Size 1 offshore spills will occur each year and that a few will contact nearshore areas and resident dolphin populations. It is assumed that 1 Size 2 spill will occur every 5 years and that one will contact nearshore areas. Although an interaction with Size 1 and Size 2 spills is assumed, only sublethal effects are assumed as a result of avoidance and natural dispersion/weathering of a spill in the offshore environment. It is estimated that Size 1 and Size 2 spills will periodically contact and affect nonendangered cetaceans, in both offshore and nearshore areas.

It is assumed that 39 Size 3 crude oil spills 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-5). Section IV.A.3.h. identifies the assumed risk of one or more Size 3 oil spills occurring and contacting areas within 10 days where many cetaceans have been sighted during surveys. There is a 71 percent probability from import tankering and a 84 percent probability from the OCS program that an oil spill will occur and contact cetacean habitat at or beyond the shelf break of the WPA. There is up to a 33 percent probability that a Size 3 oil spill will occur and contact coastal areas of Texas with high densities of dolphins. An interaction with Size 3 spills is expected,

although primarily sublethal effects are assumed with infrequent deaths as a result of avoidance and natural dispersion/weathering of a spill in the offshore environment. It is assumed that a Size 3 oil spill will periodically contact and affect nonendangered cetaceans in the WPA.

Many types of plastic materials are used during drilling and production operations. Some of this material is accidentally lost overboard where it can be consumed, incidentally or accidentally, by cetaceans. The result of plastic ingestion could be lethal, especially to smaller species. The probability of this occurrence is low.

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 deaths of cetaceans. It is expected that commercial fishing equipment will periodically 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 deaths in the Gulf in 1989-1990 and along the Atlantic Seaboard in 1988 (USDOD, NMFS, 1990). Naturally occurring and anthropogenic toxins have been the hypothesized cause. Toxicological data from tissues sampled from stranded individuals is forthcoming. Suspected sources include algal blooms, oil spills, ocean dumping, industrial and municipal effluents, and agricultural runoff. These concentrations are not widespread, and deaths 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 will periodically affect nonendangered and nonthreatened cetaceans detrimentally. These cetaceans could be impacted by the degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, discarded trash and debris from service vessels and OCS structures, commercial fishing, capture and removal, and pathogens. The effects of the majority of these activities are estimated to be sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris). Lethal effects are expected from Size 3 oil spills, chance collisions with OCS service vessels, ingestion of plastic materials, 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 expected to be negligible. Effects of sale specific operational discharges, helicopter and service-vessel noise, and seismic activity are estimated to be sublethal though some displacement of local individuals or groups is expected. No deaths are expected from explosive platform removal because of MMS guidelines. Lethal effects are probable from the increased chance of collisions with service vessels, the ingestion of plastic materials, and Size 3 oil spills. Collisions are more apt to occur offshore with large cetaceans and those species that frequently rest on the surface for extended periods of time (e.g., *Kogia* spp.). It is assumed that there will be some interaction between sale-related oil spills and nonendangered and nonthreatened cetaceans.

Conclusion

The impact of the Cumulative Scenario on nonendangered and nonthreatened cetaceans within the potentially affected area is assumed to result in a number of chronic and sporadic sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that may serve to weaken individuals of a local group or population and make them more susceptible to infection from natural or anthropogenic sources. Some displacement of individuals or groups, either temporary or permanent, is expected. Projected lethal effects will remove individuals from local populations, restoration of which may take several years, depending upon both species and location.

(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 only species seen with regularity in the Gulf of Mexico.

The major impact-producing factors are described in the preceding section (Section IV.D.2.a.(5)(a), nonendangered and nonthreatened species). Sections providing supportive material for the endangered marine mammal analysis include III.B.3. (description of marine mammals), IV.A.2.a.(1) (seismic operations), IV.A.2.a.(4) (structure removal), IV.A.2.c. (support activities), IV.A.3.d. and IV.A.3.g. (offshore discharges and noise emissions), IV.A.3.h. and IV.B.2.d. (oil spills), and IX.E. (oil-spill response activities).

An estimated 2.7 Bbbl of drilling fluids, 1.2 Bbbl of drill cuttings, and 3.1 MMbbl of produced waters are assumed to be discharged annually as a result of the proposed action plus prior and future OCS sales (Table IV-5). 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; indirect effects via 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/or affect endangered cetaceans.

It is assumed that helicopter traffic will occur on a regular basis, averaging about 131,000 trips per year. The FAA (Advisory Circular 91-36C) and corporate helicopter policy state that helicopters must maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. It is estimated that cetaceans will not be affected by routine OCS helicopter traffic at these altitudes. It is also expected that 10 percent of helicopter trips will occur at altitudes below the specified minimums listed above as a result of inclement weather. Such incidents are very short term and may elicit a startle reaction from cetaceans closeby.

It is assumed that, during the peak year, 9,100 OCS-related oil/gas service-vessel trips, 31 shuttle tanker trips, and 30 barge traffic trips will occur as a result of the proposed action, plus prior and future OCS sales in the WPA (Table IV-5). Noise from service vessel traffic may elicit a startle and/or avoidance reaction from cetaceans or mask their sound reception. This effect is sublethal and constitutes a short-term and temporary impact. Survey data show that most cetacean species of the Gulf are distributed within deeper waters, on or beyond the continental shelf break. It is estimated that annual service-vessel trips occurring (by offshore subareas) within water depths greater than 100 m are as follows: W-1--9,477; W-2--33,640; and W-3--68,808. All of the endangered species of cetaceans found in the Gulf are large and commonly spend lengthy periods of time on the surface. The probability of vessel collisions is higher within these waters. It is expected that the extent of service-vessel traffic predicted in the Cumulative Scenario will result in the incidental take of cetaceans either through active avoidance behavior or displacement of individuals or groups. Collisions, though expected to be rare events, could be fatal.

It is assumed that, during the peak year, 200 exploration and delineation wells and 75 development wells will be drilled as a result of the proposed action, plus prior and future OCS sales in the WPA (Table IV-5), and will produce sounds at intensities and frequencies that could be heard by cetaceans. It is estimated that noise from drilling activities will be relatively constant and 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, such as the sperm whale, echolocate and 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 and may elicit some degree of avoidance behavior in the open Gulf and possibly cause displacement from the affected area. It is expected that drilling noise will periodically disturb and affect endangered cetaceans.

Explosive platform removals can temporarily interfere with communication, elicit a pronounced startle reaction with subsequent avoidance or flight behavior, temporarily or permanently reduce hearing sensitivity, or cause hemorrhaging and death in cetaceans. It is assumed that 259 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. It is expected that structure removals will cause only sublethal effects on cetaceans as a result of the implementation of the MMS guidelines for explosive removals (USDOJ, MMS, 1990a, Appendix B). It is expected that structure removals will seldom disturb and affect endangered cetaceans.

Seismic surveys use airguns to generate sound 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.a.(1)). It is expected that effects of noise on cetaceans from seismic surveys are entirely sublethal, constituting a short-term startle response and avoidance behavior.

Oil spills and oil-spill response activities can adversely affect cetaceans, causing skin and soft tissue irritation, respiratory stress from inhalation of toxic fumes, food reduction or contamination, the direct ingestion of oil and/or tar, and temporary displacement from preferred habitats or migration routes. In the event that oiling of cetaceans should occur from Size 3 oil spills, the effects would primarily be sublethal; few deaths are assumed. The effects of Size 1 and Size 2 offshore oil spills are assumed to be solely sublethal due to the small areas affected and their rapid dispersion.

Section IV.A.3.h. estimates the mean number of Size 1 and Size 2 spills occurring as a result of the proposed action, plus prior and future OCS sales in the WPA. It is assumed that five Size 1 offshore spills will occur each year. It is assumed that one Size 2 spill will occur every 5 years. Although an interaction with Size 1 and Size 2 spills less than 1,000 bbl is assumed, only sublethal effects are assumed as a result of avoidance and natural dispersion/weathering of a spill in the offshore environment. It is expected that Size 1 and Size 2 spills will periodically contact and affect endangered cetaceans.

It is assumed that two Size 3 crude oil spills 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-5). Section IV.A.3.h. identifies the assumed risk of one or more Size 3 oil spills occurring and contacting areas within 10 days where many cetaceans have been sighted during surveys. There is a 71 percent probability from import tankering and a 84 percent probability from the OCS program that a Size 3 oil spill will occur and contact cetacean habitats at or beyond the shelf break of the WPA. Although an interaction with Size 3 spills is assumed, primarily sublethal effects are expected, with infrequent deaths as a result of avoidance and natural dispersion/weathering of a spill in the offshore environment. It is expected that a Size 3 oil spill will periodically contact and affect endangered cetaceans in the WPA.

Many types of plastic materials are used during drilling and production operations. Some of this material is accidentally lost overboard where it can be consumed, incidentally or accidentally, by cetaceans. The result of plastic ingestion could be lethal, despite the large size of the endangered cetaceans of the Gulf. The probability of this occurrence is low.

It is assumed that the generalized migratory behavior of endangered cetaceans found in the Gulf 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, disturb, or collide with whales, no incidents of the latter have been reported. These activities are not common place 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 will periodically affect endangered and threatened cetaceans detrimentally. These cetaceans could be impacted by the degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response operations, discarded trash and debris from service vessels and OCS structures, natural and anthropogenic activities contacted during migration, and recreational whale-watching. The effects of the majority of these activities are estimated to be sublethal (behavioral effects and

nonfatal exposure to or intake of OCS-related contaminants or discarded debris). Lethal effects are expected from Size 3 oil spills, chance collisions with OCS service vessels, ingestion of plastic materials, and several factors encountered during migrations outside the Gulf OCS. 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 expected to be negligible because the effects of the most probable impacts, such as sale-specific operational discharges, helicopter and service-vessel noise, and seismic activity, are estimated to be sublethal though some displacement of local individuals or groups is expected. No deaths are assumed from explosive platform removal because of MMS guidelines. It is assumed that there will be some interaction between sale-related oil spills and endangered and threatened cetaceans.

Conclusion

The impact of the Cumulative Scenario on endangered and threatened cetaceans within the potentially affected area is assumed to result in a number of chronic and sporadic sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that may serve to weaken individuals of a local group (e.g., sperm whales) or solitary individuals and make them more susceptible to infection from natural or anthropogenic sources. Activities may displace individuals or groups from specific preferred habitat or disrupt mating behavior. Lethal impacts are expected to be rare for all marine mammals, with the most likely impacts resulting from vessel collisions to lethargic surfaced individual animals. The unexpected and unintentional removal of individuals of any species is considered an incidental take. Such removals have not been documented in the Gulf. Recovery times will vary with species size, gestation period, and rates of reproductive activity. These will vary from two to several (less than ten) years.

(6) Impacts on Marine Turtles

This Cumulative Analysis considers the effects of impact-producing factors related to Western Gulf prior and future OCS sales, State oil and gas activity, dredge-and-fill operations, water quality degradation, natural catastrophes, agricultural pollution, commercial fishing, hopper dredge operation, recreational boat traffic, migration, and human consumption on the loggerhead, Kemp's ridley, hawksbill, green, and leatherback marine turtles of the Gulf of Mexico.

Major impact-producing factors that may occur are reviewed in detail in Section IV.D.2.a.(6) and are described below. Further discussion of cumulative actions are found in *Decline of the Sea Turtles: Causes and Prevention* (NRC, 1990) and are also described in the Biological Opinions (Appendix B). Sections providing supportive material for the marine turtle analysis include Sections III.A.2. (meteorological conditions), III.C.5. (description of marine turtles), IV.A.2.a.(4) (structure removal), IV.A.3.(d) (offshore discharges), IV.B. (other major coastal/onshore activities), IV.A.3.h. (oil spills), and IX.E. (oil-spill response activities).

The major impact-producing factors related to the OCS Program that may affect Gulf marine turtles include structure installation, dredging, operational discharges, vessel traffic, explosive platform removals, OCS-related trash and debris, oil-spill response activities, oil spills, blowouts, and water quality and coastal environmental degradation.

Structure installation and removal, pipeline placement, dredging, and water quality degradation may adversely affect marine turtle habitat through destruction of seagrass beds and live-bottom communities used by marine turtles. Potential impacts on these habitats caused by the OCS Program are discussed in detail in Sections IV.D.1.a.(1)-(3). Wetlands and estuaries could be eroded along navigation channels in Louisiana and along the north Texas coast as a result of vessel traffic within the channels. The physical integrity, species diversity, and biological productivity of topographic features and live bottoms where marine turtles occur are expected to suffer temporary damage or disturbance.

Noise from service-vessel traffic may elicit a startle reaction from marine turtles and produce a temporary, sublethal stress (NRC, 1990). It is assumed that about 161,900 OCS-related oil and gas service-vessel trips, 940 barge trips, and 955 shuttle tanker trips will occur during the 35-year life of the OCS Program (Table IV-5).

Collision between service vessels or barges and surfaced marine turtles would likely cause fatal injuries,

but marine vessel operators can avoid marine turtles and reduce potential deaths. Vessel traffic, in general, is estimated to cause about 9 percent of all marine turtle deaths in the southeastern United States, and this mortality may grow if fishing, recreational, and OCS Program vessel traffic continues to increase.

Offshore operational discharges are not known to be lethal to marine turtles and are diluted and dispersed rapidly within 1 km of the discharge point. Unfavorable effects on marine turtle food sources by water quality degradation have not been previously demonstrated (API, 1989; NRC, 1983). Impacts on marine turtles from bottom disturbance, structure installation, pipeline emplacement, blowouts, and dredging are expected to be indistinguishable from the long-term (25-50 years) natural variability within populations. Suspended particulate matter in offshore operational discharges and blowouts is expected to reduce visibility and may displace prey items in the vicinity. Marine turtles within 1 km of discharge points are expected to be less able to locate prey for the short time period they would spend traversing discharge plumes.

Explosive platform removals can cause capillary damage, disorientation, and loss of motor control in marine turtles (Duronslet et al., 1986). Although marine turtles far from the site may suffer only disorientation, those near detonation sites would likely sustain fatal injuries. 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-limited detonation, staggered charges, placement of charges 5 m below the seafloor, and pre- and post-detonation surveys of surrounding waters. It is estimated that 259 structures will be removed by explosives from the Western Gulf of Mexico as a result of the proposed action, plus prior and future OCS sales (Table IV-5). As many as 105 structures may be removed in the WPA in one year, and some removals will occur beyond the continental shelf. Although a few marine turtle deaths may occur as a result of oversights during the large number of projected removals, MMS guidelines for explosive platform removals may reduce this likelihood (USDOL, MMS, 1990a, Appendix B). Also, marine turtles are widely distributed in the WPA, and their densities would not be expected to be high near the vicinity of platform removals.

Marine debris is a well-documented source of deaths and debilitation for marine turtles (NRC, 1990). In addition to the incremental amount of trash and debris generated by the OCS Program, marine debris is carried into the Gulf and Atlantic via oceanic currents from South and Central America, Europe, and North Africa (Plotkin and Amos, 1988; Hutchinson and Simmonds, 1992). The volume of nonbiodegradable materials contributed by these sources is unknown. Turtles that consume or become entangled in debris may die or become debilitated (O'Hara, 1989; USDOC, NMFS, 1989a; Heneman and the Center for Environmental Education, 1988). Marine turtles, particularly leatherbacks, are known to be attracted to floating plastic debris because it resembles their preferred food, the jellyfish. Plastics and other materials may remain in the gut for at least six months and interfere with digestion, growth, and other physiological processes (Lutz and Alfaro-Shulman, 1992). Ingestion of plastic and styrofoam materials could result in drowning, lacerations, and reduced mobility resulting in starvation (Carr, 1987; USDOC, NOAA, 1988d; Heneman and the Center for Environmental Education, 1988; USDOL, 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), prohibits the disposal of any plastics at sea or in coastal waters. Despite these safeguards, marine turtles can become entangled in or ingest trash and debris produced by human activity in the Gulf and elsewhere.

Some marine turtles may be expected to consume debris and die following ingestion or immobilization, and leatherback turtles that mistake plastics for jellyfish may be singularly more vulnerable to lethal effects. Estimates of these deaths cannot be made at this time.

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. As mandated by the Oil Pollution Act of 1990, these areas are expected to receive individual consideration during oil-spill cleanup. Required oil spill contingency plans include special notices to minimize adverse effects from vehicular traffic during cleanup activities and to maximize protection efforts to prevent contact of these areas with spilled oil.

Oil spills can adversely affect marine turtles by toxic external contact, toxic ingestion or blockage of the digestive tract, disruption of salt gland function, asphyxiation, and displacement from preferred habitats (Witham, 1978; Vargo et al., 1986; Lutz and Lutcavage, 1989). Marine turtles may become entrapped by tar and oil slicks and rendered immobile (Witham, 1978; Plotkin and Amos, 1988). In the past, tanker washings

have been the main source of this oil (Van Vleet and Pauly, 1987). Hatchling and small juvenile turtles are particularly vulnerable to contacting or ingesting oil because the currents that concentrate oil spills also form the debris mats in which these turtles are sometimes found (Carr, 1980; Collard and Ogren, 1990). Fritts and McGehee (1982) noted that sea turtle eggs were damaged by contact with weathered oil released from the IXTOC spill.

When an oil spill occurs, the severity of effects and the extent of damage to marine turtles are affected by geographic location, oil type, oil dosage, impact area, oceanographic conditions, and meteorological conditions (NRC, 1985; USDO, MMS, 1987b). Adult marine turtles may not detect and avoid an oil spill (Vargo et al., 1986), and eggs, hatchlings, and small juveniles are particularly vulnerable to contact (Fritts and McGehee, 1982; Lutz and Lutcavage, 1989). Contact with oil may not cause direct or immediate mortality, but cumulative sublethal effects could impair the marine turtle's ability to function effectively in the marine environment (Vargo et al., 1986; Lutz and Lutcavage, 1989).

Oil spills and oil-spill response activities can negatively affect marine turtles as outlined above. A total of 178 offshore (Table IV-5) and 70 onshore (Table IV-16) Size 1 oil spills are assumed to occur during the 35-year life of the OCS Program. Seven offshore (Table IV-5) and two onshore (Table IV-16) Size 2 spills are assumed to occur during the 35-year OCS Program. Although marine turtles may encounter these spills in their inshore and offshore habitats, primarily sublethal and minor effects are expected in addition to some deaths that may occur.

Two offshore (Table IV-5) and two onshore (Table IV-16) Size 3 oil spills are expected to occur and contact marine turtle habitat within 10 days from either a platform or pipeline in the Western Gulf during the OCS Program. Since marine turtle habitat in the Gulf includes both inshore and offshore areas, marine turtles are likely to encounter a few OCS or import tanker spills. Few mortalities are expected because of the small area of contact involved, the rapid dispersion and loss of oil, and the low density of marine turtles in the area. However, sublethal biological and behavioral impacts could temporarily disturb oiled marine turtles.

Although oil-spill response activities such as vehicular and vessel traffic stemming from OCS Program or import tankering are assumed to contact marine turtle habitat, harm is expected to be minimized because of contingency plans and response mandated by the Oil Pollution Act of 1990.

It is important to note that during nesting season the Kemp's ridley marine turtle would be particularly vulnerable to harm from a large oil spill occurring in the immediate vicinity of its only known nesting beach--Tamaulipas province, Mexico (Lutz and Lutcavage, 1989). The estimated probability for any Size 3 oil spill, of any origin, at the Tamaulipas site is less than 5 percent for the 35-year OCS Program (Table IV-11).

Marine turtles are vulnerable to harm from human activities throughout their migratory ranges, particularly because of their wide-ranging movements in coastal waters. Major activities that affect marine turtles in the WPA include commercial fishing, hopper dredging, pollutant discharge, ingestion of or entanglement in debris, nearshore boat traffic, human consumption, and contact with foreign, inshore, or processed oil (reviewed in NRC, 1990).

Capture and drowning in commercial fishing gear, particularly shrimp trawls, is the largest cause of death for sea turtles in the United States and the Gulf of Mexico (NRC, 1990). Turtle Excluder Devices (TED's) on shrimp trawls and seasonal restrictions for other fisheries are legislatively mandated to decrease turtle deaths. However, deaths are believed to occur in association with some inshore shrimping operations that do not presently require TED use (Crouse, 1992). Turtles also drown in driftnet, longline, and set-net fisheries, but these deaths are neither fully documented nor regulated (NRC, 1990). Collisions with boats may also disable or kill sea turtles, and is typically associated with about 8 percent of sea strandings identified by the U.S. sea turtle stranding network (Teas and Martinez, 1992).

Dredge-and-fill activities occur in many of the nearshore seasonal habitats of marine turtles in the southeastern U.S. and in other areas. Operations range in scope from propeller dredging by recreational boats to large-scale navigation dredging and fill for land reclamation. Hopper dredging has caused turtle deaths in coastal areas, including Cape Canaveral Ship Channel in Florida and the King's Bay Submarine Channel in Georgia (Slay and Richardson, 1988), but deaths in the Gulf of Mexico have not been estimated.

Sea turtles frequent coastal areas such as algae and seagrass beds to seek food and shelter (Carr and Caldwell, 1956; Hendrickson, 1980), and these nearshore areas are used by juvenile Kemp's ridleys in Louisiana (Ogren, 1989) and Texas (Manzella and Williams, 1992). Juvenile hawksbill, loggerhead, and green turtles are typically found in nearshore Texas waters (Shaver, 1991). Submerged vegetated areas may be lost or damaged

by activities that alter salinity, increase turbidity, or disturb natural tidal and sediment exchange. Natural catastrophes, including storms, floods, droughts, and hurricanes, can also substantially damage sea turtle habitats and nesting beaches (Agardy, 1990).

Construction, vehicle traffic, beachfront erosion, and artificial lighting are activities that disturb marine turtles or their nesting beaches (Raymond, 1984; Garber, 1985) and that would be of particular concern for marine turtles nesting in the Padre Island areas. Sand mining, beach renourishment, and oil spill cleanup operations may remove sand from the littoral zone and temporarily disturb onshore sand transport, potentially disturbing marine turtle nesting activities. The main causes of permanent nesting beach loss within the Gulf of Mexico are the reduction in sediment transport, rapid rate of relative sea-level rise, coastal construction and development, and recreational use of accessible beaches near large population centers.

Human consumption of turtle eggs, meat, or byproducts occurs worldwide and depletes turtle stocks (Mack and Duplaix, 1979; Cato et al., 1978). Human take is estimated to be substantial worldwide, but it is not considered to be a serious concern in the Gulf of Mexico.

Chronic pollution, including industrial and agricultural wastes and urban runoff, threatens sea turtles worldwide (Frazier, 1980; Hutchinson and Simmonds, 1991) and may be a particular concern in the coastal areas of Texas, Louisiana, and other Gulf States. Some turtle species have lifespans greater than 50 years (Congdon, 1989; Frazer et al., 1989), creating the potential for bioaccumulation of heavy metals (Hillestad et al., 1974; Stoneburner et al., 1980; Davenport et al., 1990), pesticides (Thompson et al., 1974; Clark and Krynsky, 1980; Davenport et al., 1990), and other toxins (Lutz and Lutcavage, 1989). Chronic pollution from industrial or agricultural sources is linked with immune suppression in some marine mammals and would similarly be a source of concern for marine turtles in the Gulf of Mexico.

Fibropapillomas, debilitating tumors occurring primarily in green turtles, also threaten sea turtles in populated coastal areas (Teas, 1991). Fibropapillomas may be accompanied by trematode and leech infestations and severe anemia (Norton et al., 1990). The disease was documented in the 1930's (Smith and Coates, 1938), but its incidence has increased in the last century, especially from 1985-1990, in Florida, Hawaii, and Puerto Rico turtles. The disease also appears to be increasing in other heavily populated coastal areas (Teas, 1991). The origin of marine turtle fibropapilloma disease is unknown, but viral and toxicological causes and immune suppression are among those under investigation (Jacobson, 1991). At present, the link between water quality degradation and health impacts on migratory marine vertebrates such as marine turtles is poorly understood, and no mortality estimates are available (NRC, 1990).

Summary

Activities resulting from the Cumulative Scenario have a potential to harm marine turtles. Those activities include structure installation, dredging, water quality and habitat degradation, operational discharges, blowouts, OCS-related trash and debris, vessel traffic, explosive platform removals, oil-spill response activities, oil spills, dredge-and-fill operations, natural catastrophes, pollution, hopper dredge operation, recreational boat traffic, commercial fishing, human consumption, and potentially harmful activities contacted during migration. Deaths resulting from OCS-related spills and import tankering, debris ingestion, or explosive platform removals are assumed to occur but are expected to be few in number. The incremental contribution of the proposed action to the cumulative impact is expected to be negligible because most of the probable impacts, disturbances to feeding, disturbances to feeding habitat, and prey availability are expected to be temporary. Marine turtles may avoid OCS Program and other disturbances by shifting their feeding and resting areas to undisturbed areas. Oil spills, oil-spill response activities, and explosive platform removals are potential threats that may be expected to cause marine turtle deaths, but the risks are greatly reduced by spill contingency planning and by the Oil Pollution Act of 1990 habitat protection stipulations.

Conclusion

The impact of the Cumulative Scenario on marine turtles within the WPA is expected to remove some animals from marine turtle populations and to displace temporarily marine turtles from feeding, reproduction, and resting habitats.

(7) Impacts on Coastal and Marine Birds

(a) Nonendangered and Nonthreatened Species

The Gulf of Mexico is populated by resident and migratory species of coastal and marine birds. This broad category consists of five main groups: seabirds, shorebirds, wading birds, marsh birds, and waterfowl.

This Cumulative Analysis considers the status of populations and migratory habits of coastal and marine birds within the WPA, 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, and recreational offshore and coastal activities that may occur and adversely affect those populations. Specific types of impact-producing factors considered in the analysis include oil spills and spill response activities, degradation of water quality, aircraft and vessel traffic and noise, habitat loss and modification resulting from coastal construction and development, OCS pipeline landfalls and coastal facility construction, and discarded and beached trash and debris.

Section IV.A.3.h.(2) estimates the mean number of Size 1 and Size 2 offshore spills occurring as a result of the proposed action and prior and future OCS sales in the WPA. Fifty-nine offshore spills and two Size 1 onshore spills are assumed to occur each year; it is predicted that a few offshore spills will contact the coastline. Two Size 2 spills will occur offshore and two onshore during the predicted 35-year life of the OCS Program. One of the offshore spills will contact land in the WPA. Most Size 1 spills related to the proposed action are predicted to occur near or at OCS-related transfer facilities, and will not contact wetland and other biologically sensitive coastal areas, and thus will not detrimentally affect coastal and marine birds. Effects from Size 1 onshore spills away from transfer facilities and Size 2 onshore spills are expected to result in some degradation of habitat, physical oiling of birds, acute and chronic physiological stress, and mortalities of individuals or localized groups associated with direct and secondary intake of oil. Onshore spills in wetland and other coastal areas can affect most groups of coastal birds, including marsh birds, waders, waterfowl, and certain shorebirds.

Two Size 3 crude oil spills will occur offshore and two onshore in the WPA for the Cumulative Scenario (Tables IV-5 and IV-16). In the WPA, the probability of Size 3 OCS spills contacting sensitive coastal habitat within ten days is less than 10 percent (Table IV-11). Imported oil in the WPA has the highest probability of contacting coastal marsh in East Texas (33%), an area noted for high densities of coastal and marine birds. Thus, contact probabilities suggest that Size 3 oil spills will contact and affect the Western Gulf coastline and inshore habitats with some deleterious effects, including the deaths of individuals from any or all of the five groups of resident coastal and marine birds. Coastal and onshore spills not related to the OCS Program constitute the vast majority of the total spills which occur in the WPA. These include inshore crude and petroleum product spills, spills from import tankering, and spills from coastwise movement of petroleum products in restricted waters. It is estimated that the effects of non-OCS spills in coastal areas will far exceed the negative impacts to local populations of coastal and marine birds estimated from the OCS Program, causing the deaths of adults and nestlings, degradation of coastal habitats, and displacement of local populations in proximity to the affected areas.

Degradation of water quality resulting from OCS discharges is expected to affect coastal and marine birds within nearshore and inland areas of the WPA.

Helicopter and service-vessel traffic related to OCS activities could sporadically disturb feeding, resting, or nesting behavior of birds or cause abandonment of preferred habitat. This impact-producing factor could contribute to indirect population loss through reproductive failure resulting from nest abandonment. The FAA (Advisory Circular 91-36C) and corporate helicopter policy states that helicopters must maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. When flying over land, the specified minimum altitude is 1000 ft over unpopulated areas or across coastlines, and 2000 ft over populated areas and biologically sensitive areas such as wildlife refuges and national parks. Many undisturbed coastal areas and refuges provide preferred and/or critical habitat for feeding, resting (or staging), and nesting birds. The effects of low-flying aircraft within the vicinity of aggregations of birds on the ground or on the water typically results in mass disturbance and abandonment of the immediate area. Compliance to the specified minimum altitude requirements is expected to significantly reduce effects of aircraft disturbance on coastal and marine birds. It is expected, however, that approximately 10 percent of helicopter trips will occur

at altitudes somewhat below the minimums listed above as a result of inclement weather. Although these incidents are very short term in duration and sporadic in frequency, they can disrupt coastal bird behavior and, at worst, possibly result in habitat or nest abandonment. Birds in flight over water are expected to avoid helicopters; temporary disruption of feeding or flight paths is expected when encountering low-flying helicopters. It is estimated that there will be over 73,000 helicopter flights across coastal areas annually, with 7,000 flights at altitudes somewhat below specified minimums. For this analysis, helicopter traffic will periodically disturb coastal and marine birds; general adherence to FAA and corporate helicopter protocol on service altitudes will serve to reduce the level of disturbance. The net effect of OCS-related flights on coastal and marine birds is expected to result in sporadic disturbances which may result in displacement of localized groups. During nesting periods, this could ultimately result in some reproductive failure from nest abandonment, predation, etc.

It is assumed that about 4,600 OCS-related oil and gas service-vessel trips, 27 barge trips, and 27 shuttle tanker trips will occur annually for the Cumulative Scenario (Tables IV-5 and IV-16). Service vessels will use selected nearshore and coastal (inland) navigational waterways, or corridors, and adhere to protocol set forth by the Coast Guard for reduced vessel speeds/wake within these inland areas. Routine presence and low speeds of service vessels within these waterways diminishes the effects of disturbance from service vessels on nearshore and inland populations of coastal and marine birds. For the purpose of this analysis, it thus is assumed that service-vessel traffic will seldom disturb populations of coastal and marine birds existing within these areas. The effects of service-vessel traffic on birds offshore are negligible. Recreational vessel traffic is a much greater source of impact to birds in coastal habitats. These vessels are, in most cases, not required to comply with strict speed/wake restrictions; small recreational fishing boats, ski boats, etc. often flush coastal and marine birds from feeding, resting, and nesting areas. Such disturbances displace local groups from these preferred habitats and could lead to abandonment of the areas in general or reproductive failure. It is estimated that the effects of non-OCS vessel traffic on birds within coastal areas of the WPA are substantial.

The greatest impact to coastal and marine birds is the extent of preferred or critical habitat loss resulting from oil spill and spill response activities, urban and industrial development within coastal areas, erosion of areas bordering navigational channels from vessel usage, and OCS-related activities such as pipeline landfalls and onshore construction. Historic census data shows that many of these species are declining in numbers and are being displaced from areas along the coast (and elsewhere) as a result of the encroachment of their preferred habitat(s) by the aforementioned sources. As these birds move to undisturbed areas of similar habitat, their presence augments habitat utilization pressure on these selected areas as a result of intra- and interspecific competition for space and food. The OCS Program contribution to coastal land loss or modification includes construction of three pipeline landfalls, 120 km of onshore pipeline, three marine terminals, and one separation facility (Table IV-16). The contribution of development from urban and other industrial growth will be substantial, causing both the permanent loss of lands and increased levels of disturbance associated with and in proximity to new construction and facilities.

Coastal and marine birds are commonly entangled and snared in discarded trash and debris. Many species will readily ingest small plastic debris, either intentionally or incidentally. Interaction with plastic materials is therefore very serious, and often leads to permanent injuries and death. Much of the floating material discarded from vessels and structures offshore drifts ashore or remains within coastal waters. These materials include lost or discarded fishing gear such as gill nets and monofilament lines, which cause the greatest damage to birds. It is expected that coastal and marine birds will seldom become entangled in or ingest OCS-related trash and debris as a result of MMS prohibitions on the disposal of equipment, containers, and other materials into offshore waters by lessees (30 CFR 250.40). In addition, MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. For the purpose of this analysis, OCS oil- and gas-related plastic debris will seldom interact with Gulf coastal and marine birds, and therefore, the effect will be negligible. Despite these regulations, quantities of plastic materials are still discarded and lost into the marine environment, and so remain a threat to individual birds within these areas.

Effects outside OCS activities include storms and floods; pollution of coastal waters resulting from municipal, industrial, and agricultural runoff and discharge; and collisions with structures such as power line towers, etc. Coastal storms and hurricanes can often cause death to coastal birds through high winds; associated flooding destroys active nests and nesting areas. Elevated levels of municipal, industrial, and

agricultural pollutants into coastal wetlands and waters expose resident birds to chronic physiological stress. Collisions with power lines and supporting towers are not atypical during inclement weather and during periods of migration, often causing death or permanent injury to birds (Avery et al., 1980).

Summary

Activities resulting from the Cumulative Scenario will detrimentally affect coastal and marine birds. It is expected that the majority of effects from the major impact-producing factors on coastal and marine birds are sublethal (behavioral effects or nonfatal exposure to or intake of OCS-related contaminants or discarded debris), and will cause temporary disturbances and displacement, some permanent, of localized groups onshore. Chronic sublethal stress, however, is often undetectable in birds. It can serve to weaken individuals (which is especially serious for migratory species), and expose them to infection and disease. Lethal effects, resulting primarily from uncontained onshore oil spills and associated spill response activities in wetland and other biologically sensitive coastal habitats, are expected to remove a number of individuals from any or all groups through primary effects from physical oiling and the ingestion of oil, and secondary effects resulting from the ingestion of oiled prey; recruitment of birds through successful reproduction is expected to take up to many years, depending upon the species and existing conditions. The net effect of habitat loss from oil spills, new construction, and maintenance and use of pipeline corridors and navigational waterways will alter species composition and reduce the overall carrying capacity of disturbed area(s) in general.

The incremental contribution of the proposed to the cumulative impact is expected to be negligible because the effects of the most probable impacts, such as sale-specific operational discharges and helicopters and service-vessel noise and traffic, are estimated to be sublethal though some displacement of local individuals or groups is expected. It is assumed that there will be some interaction between sale-related oil spills and coastal and marine birds.

Conclusion

The cumulative effect on coastal and marine birds is expected to result in a discernible decline in the numbers of birds which form localized groups or populations, with associated change in species composition and distribution. Some of these changes are expected to be permanent, as exemplified in historic census data, and to stem from a net decrease in preferred and/or critical habitat.

(b) Endangered and Threatened Species

This Cumulative Analysis considers the effects of the OCS Program for the WPA on endangered and threatened birds, including the brown pelican, Arctic peregrine falcon, bald eagle, piping plover, least tern, and whooping crane. It summarizes and incorporates the discussion of the effects on the coastal and marine birds in Section IV.D.1.a.(8)(a) (nonendangered and nonthreatened birds) and additional information as cited. Oil spills and spill response activities, degradation of water quality, aircraft and vessel traffic and noise, habitat loss or modification, and discarded trash and 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.(8)(a)).

Section IV.A.3.h.(2) estimates the mean number of Size 1 and Size 2 offshore spills occurring as a result of the proposed action, and prior and future OCS sales in the WPA. Fifty-nine offshore spills and two Size 1 onshore spills are assumed to occur each year; it is predicted that a few offshore spills will contact the coastline. Two Size 2 spills will occur offshore and two onshore during the 35-year life of the OCS Program. One of the offshore Size 2 spills will contact land in the WPA. Most Size 1 onshore spills related to the proposed action are predicted to occur near or at OCS-related transfer facilities and will not contact wetland and other biologically sensitive coastal areas. Effects from Size 1 onshore spills away from transfer facilities and Size 2 spills are expected to result in some degradation of habitat, physical oiling of individuals or local groups of birds, and some degree of both acute and chronic physiological stress associated with direct and secondary uptake of oil. Raptors, such as the bald eagle and peregrine falcon, feed upon weakened or dead

birds (and fish, in the case of the eagle), and may as a result become physically oiled or affected by the ingestion of the oiled prey. Pelicans are active swimmers, and plunge dive for prey. They are, therefore, very susceptible to physical oiling and secondary effects through the ingestion of oiled prey, i.e., fish. Plovers congregate and feed along exposed banks and shorelines. They can be physically oiled while foraging on oiled shores, or secondarily affected through oiled intertidal sediments and prey. The least tern captures fish via shallow splash diving and surface dipping techniques. Some physical oiling could occur during dives, as well as secondary toxic effects through the uptake of prey. The whooping crane traverses large expanses of coastal plain and wetland habitat, on or near the Aransas National Wildlife Refuge. Spills within nearby navigational waterways could contact the Refuge and possibly result in physically oiling cranes. It is possible that some deaths of endangered species could occur, especially if the onshore spill(s) occur during winter months when raptors, plovers, and cranes are most common along the coastal Gulf, or if spills occur within preferred or critical habitat for all representatives. Brown pelicans and piping plovers are most susceptible to oiling, as a result of their preferred habitats and, in the case of the pelican, highly aquatic nature. For the purpose of this analysis, it is estimated that Size 1 and Size 2 spills will occasionally contact and thus affect endangered species of birds inhabiting coastal areas of the WPA.

Two Size 3 crude oil spills will occur offshore and two onshore in the WPA for the Cumulative Scenario (Tables IV-5 and IV-16). In the WPA, the probability of Size 3 OCS spills contacting sensitive coastal habitat within 10 days is less than 10 percent (Table IV-11). Imported oil in the WPA has the highest probability of contacting coastal marsh in East Texas (33%), an area which supports all endangered species of concern, save the whooping crane. Thus, contact probabilities suggest that such spills will therefore contact and affect some endangered species within the WPA. Some mortalities are possible. Coastal and onshore spills not related to the OCS Program constitute the vast majority of the total spills which occur in the WPA. These include inshore crude and petroleum product spills, spills from import tankering, and spills from coastwise movement of petroleum products in restricted waters. It is estimated that the effects of non-OCS spills in coastal areas will far exceed the negative impacts to local populations of coastal and marine birds estimated from the OCS Program, creating a much higher risk for deaths of both adults and young, degradation of preferred and critical habitat for these species, and displacement of individuals or local groups in proximity to affected areas.

Degradation of water quality is expected to affect endangered species of coastal and marine birds within nearshore and inland areas of the WPA.

Helicopter and service-vessel traffic related to OCS activities could sporadically disturb feeding, resting, or nesting behavior of birds or cause abandonment of preferred habitat. This impact-producing factor could contribute to population loss through reproductive failure via nest abandonment. The FAA (Advisory Circular 91-36C) and corporate helicopter policy states that helicopters must maintain a minimum altitude of 700 ft while in transit offshore, and 500 ft while working between platforms. When flying over land, the specified minimum altitude is 1,000 ft over unpopulated areas or across coastlines, and 2,000 ft over populated areas and biologically sensitive areas such as wildlife refuges and national parks. Many undisturbed coastal areas and refuges provide preferred and/or critical habitat for feeding, resting (or staging), and nesting birds. The effects of low-flying aircraft within the vicinity of aggregations of birds on the ground, in trees or structures, or on the water typically results in mass disturbance and abandonment of the area in proximity to the source. Compliance to the specified minimum altitude requirements is expected to significantly reduce effects of aircraft disturbance on endangered birds. It is expected, however, that approximately 10 percent of helicopter trips will occur at altitudes somewhat below the minimums listed above as a result of inclement weather. Although these incidents are very short term in duration and sporadic in frequency, they can disrupt bird behavior and, at worst, possibly result in habitat or nest abandonment. Birds in flight over water are expected to avoid helicopters; temporary disruption of feeding or flight paths is expected when encountering low-flying helicopters. It is estimated that there will be over 73,000 helicopter flights across coastal areas annually, with 7,000 flights at altitudes somewhat below specified minimums. For this analysis, it is assumed that helicopter traffic will periodically disturb endangered birds, but will maintain general adherence to FAA and corporate helicopter protocol on service altitudes. The effect of OCS-related flights on endangered birds is expected to result in sporadic disturbances which may result in displacement of localized groups or individuals. During nesting periods, this could ultimately result in some reproductive failure from nest abandonment, predation, etc.

Approximately 4,600 OCS-related oil and gas service-vessel trips, 27 barge trips and 27 shuttle tanker trips will occur annually for the Cumulative Scenario (Tables IV-5 and IV-16). Service vessels will use selected nearshore and coastal (inland) navigational waterways, or corridors, and adhere to protocol set forth by the Coast Guard for reduced vessel speeds within these inland areas. Routine presence and low speeds of service vessels within these waterways diminishes the effects of disturbance from service vessels on nearshore and inland populations of coastal and marine birds, including endangered species. For the purpose of this analysis, service-vessel traffic will seldom disturb populations of endangered birds existing in nearshore and coastal areas. Recreational vessel traffic is a much greater source of impact to birds in coastal habitats. These vessels are, in most cases, not required to comply with strict speed/wake restrictions; small recreational fishing boats, ski boats, etc. often flush coastal and marine birds from feeding, resting, and nesting areas. Such disturbances displace local groups or individuals from these preferred habitats and could lead to abandonment of the areas in general or reproductive failure. It is estimated that the effects of non-OCS vessel traffic on endangered birds within coastal areas of the WPA are substantial.

The greatest impact to endangered birds within the WPA is the extent of preferred or critical habitat loss resulting from oil spill and spill response activities, urban and industrial development within coastal areas, erosion of areas bordering navigational channels from vessel usage, and OCS-related activities such as pipeline landfalls and onshore construction. Destruction or modification of habitat from these sources displaces localized groups or populations of coastal and marine birds. As these birds move to undisturbed areas of similar habitat, their presence augments habitat utilization pressure on these selected areas as a result of intra- and interspecific competition for space and food. The OCS Program contribution to coastal land loss or modification includes construction of three pipeline landfalls, 72 km (45 mi) of onshore pipeline, one marine terminal, one separation facility, and one gas processing plant (Table IV-17). The contribution of development from urban and other industrial growth will be substantial, causing both the permanent loss of lands and increased levels of disturbance associated with and in proximity to new construction and facilities.

Coastal and marine birds are commonly entangled and snared in discarded trash and debris. In addition, many species such as the brown pelican and least tern will readily ingest small plastic debris, either intentionally or incidentally. Interaction with plastic materials is therefore very serious, and can lead to permanent injuries and death. Much of the floating material discarded from vessels and structures offshore drifts ashore or remains within coastal waters. These materials include lost or discarded fishing gear such as gill nets and monofilament lines, which cause the greatest damage to birds. It is expected that endangered birds will seldom become entangled in or ingest OCS-related trash and debris as a result of MMS prohibitions on the disposal of equipment, containers, and other materials into offshore waters by lessees (30 CFR 250.40). In addition, MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. For the purpose of this analysis, OCS oil- and gas-related plastic debris will seldom interact with endangered birds within the Western Gull, and therefore, the effect will be negligible. Despite these regulations, quantities of plastic materials are still discarded and lost into the marine environment, and so remain a threat to individual birds within these areas.

Effects outside OCS activities include storms and floods; pollution of coastal waters resulting from municipal, industrial, and agricultural runoff and discharge; collisions with structures such as power line towers, etc.; and accidental or deliberate shooting. Coastal storms and hurricanes can often cause deaths to coastal birds through high winds; associated flooding often destroys active nests and nesting areas, and preferred feeding habitat, such as barrier islands, spoil banks, etc. Elevated levels of municipal, industrial, and agricultural pollutants into coastal wetlands and waters exposes resident birds to chronic physiological stress. Collisions with power lines and supporting towers are not atypical during inclement weather and during periods of migration, often causing death or permanent injury to birds (Avery et al., 1980).

Summary

Activities resulting from the Cumulative Scenario will detrimentally affect endangered birds. It is expected that the majority of effects from the major impact-producing factors on these species are sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) and will cause temporary disturbances and displacement, some permanent, of individuals or localized groups onshore. Chronic sublethal stress, however, is often undetectable in birds, and can be masked for some period of time. It can

serve to weaken individuals (which is especially serious for migratory species), and expose them to infection and disease. Lethal effects, resulting primarily from uncontained onshore oil spills and associated spill response activities, are especially serious for endangered species, as any reductions in population size represents a threat to their existence. Non-OCS spills and OCS onshore spills in wetland or other uncontained areas, plus Size 3 offshore spills, which are predicted to reach the coast in the Cumulative Scenario, could contact one or more species of endangered birds, causing deaths of individuals or isolated groups through primary effects from physical oiling and the ingestion of oil, and secondary effects resulting from the ingestion of oiled prey. Recruitment of these birds via successful reproduction is expected to take up to many years, depending upon the species and existing conditions. The net effect of habitat loss from oil spills, new construction, and maintenance and use of pipeline corridors and navigational waterways will alter species composition and reduce the overall carrying capacity of the disturbed area(s) in general.

The incremental contribution of the proposed action to the cumulative impact is expected to be negligible because the effects of the most probable impacts, such as sale-specific operational discharges and helicopter and service-vessel noise and traffic, are estimated to be sublethal though some displacement of local individuals or groups is expected. It is assumed that there will be some interaction between sale-related oil spills and endangered and threatened birds.

Conclusion

The cumulative effect on endangered and threatened birds is expected to result in a discernible decline in the number of individuals, or localized groups or populations of these species, with associated change in species composition and distribution. The decline will represent displacement of these species from their natural habitats, as well as some expected mortalities. Some of these changes are expected to be permanent, as exemplified in historic census data, and to stem from a net decrease in preferred and/or critical habitat loss.

(8) Impacts on Commercial Fisheries

This Cumulative Analysis considers commercial fishing activity, the status of commercial fishery stocks, the effects of impact-producing factors related to the Western Gulf OCS Program (proposed action and 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, coastal environmental degradation, emplacement of production platforms, underwater OCS obstructions, production platform removals, seismic surveys, oil spills, subsurface blowouts, pipeline trenching, and offshore discharges of drilling muds, produced waters, and naturally occurring radioactive material (NORM).

Sections providing supportive material for the commercial fisheries analysis include Sections III.B.7. (description of fish resources), III.C.3. (commercial fisheries), IV.D.1.d.(1) (impacts on sensitive coastal environments), IV.D.1.d.(3) (impacts on water quality), IV.A.3.b.(2) (space-use conflicts), IV.A.2.a.(4) (structure removals), IV.A.2.a.(1) (seismic operations), IV.A.3.h.(2) (offshore oil spills), IV.B.2.d.(1) (onshore oil spills), IV.A.3.h.(1) (subsurface blowouts), IV.A.2.b.(1) (pipelines), and IV.B.2.c. (onshore disposal).

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.

Many of the commercially important species harvested from the Gulf of Mexico are believed to be in decline from overfishing (USDOC, NOAA, 1991b). 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 communication, 1989; USDOC, NMFS, 1991b). It is expected that overfishing of targeted species and trawl fishery bycatch will adversely affect commercial fishery resources. The impact of overfishing on the commercial fisheries resources is expected to cause less than a 10 percent decrease in commercial fishery populations or in commercial fishing. At the estimated level of effect, the resultant influence on Western Gulf fisheries is expected to be substantial and easily distinguished from effects due to natural population variations.

Because approximately 92 percent of commercially important species are estuary dependent, coastal environmental degradation has the potential to affect adversely commercial fisheries. The environmental deterioration and effects on commercial fisheries result from the loss of Gulf wetlands as nursery habitat and from the functional impairment of existing habitat through decreased water quality.

The effect of the OCS Program and non-OCS Program activities on wetlands and inshore water quality in the WPA is analyzed in detail in Sections IV.D.2.d.(1) and (3), respectively. The indirect effect on commercial fisheries is considered below.

To summarize the effects on wetlands and estuarine areas, it is expected that 905 ha of coastal areas will be affected by onshore oil spills as a result of the OCS Program. Approximately 36,575 ha of coastal areas will be affected by onshore oil spills as a result of non-OCS Program activities. The productivity of up to 100 ha could be permanently lost. Up to 88 ha of wetlands could be eroded as a result of OCS-related vessel usage of navigation channels and access canals in coastal Louisiana and Texas. Up to 552 ha of wetlands could be eroded as a result of non-OCS-related vessel traffic.

To summarize the effects on coastal and estuarine water quality, it is expected that coastal waters in the Western Gulf of Mexico would be degraded from periodic point source discharges and bottom disturbances (elevated turbidity) from OCS Program activities occurring in an area within 1,000 m of the source and persisting for several days to weeks after the activity has concluded. Further decrease in water quality would occur from chronic low-level contamination (elevated levels of hydrocarbons, trace metals, salinity, temperature, organic compounds, and lower dissolved oxygen) resulting from OCS-associated site runoff and maritime traffic activities occurring over the life of the proposal. Significant increases in water concentrations of dissolved and particulate hydrocarbons and trace metals are not expected beyond 1,000 m of any discharge site. Non-OCS Program factors will degrade water quality primarily in the northwestern Gulf's 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 (nutrient, organic matter, trace metals, hydrocarbons, etc.) may be severe, lasting for months or longer. Chronic low-level pollution will persist in coastal waters.

It is expected that coastal environmental degradation from the OCS Program and non-OCS activities will affect commercial fishery resources. The impact of coastal degradation in the WPA is expected to cause less than a 10 percent decrease in commercial fishery populations, in essential habitats, or in commercial fishing. Recovery of commercial fishery resources can occur from more than 90 percent, but not all, of the expected coastal environmental degradation. At the estimated level of effect, the resultant influence on Western Gulf fisheries is expected to be substantial and easily distinguished from effects due to natural population variations.

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 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 the OCS Program 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-5 estimates that 259 structure removals by explosives will occur in the WPA as a result of the OCS Program during the 35-year life of the proposed action. It is assumed that no more than 11 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 will have a major effect on Western 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 140 additional platforms resulting from the proposed action, plus prior and future OCS sales in the WPA (Table IV-5), are estimated to reduce the trawling area by about 1,932 ha, which represents an inconsequential amount of the total trawling area in the WPA. It is expected that platform emplacement will infrequently affect trawling activity.

Oil spills that contact coastal bays, estuaries, and waters of the OCS when pelagic eggs and larvae are present have the greatest potential to affect commercial fishery resources. In the event that sale-related oil spills should occur in coastal bays, estuaries, or waters of the OCS proximate to mobile adult finfish or shellfish, the effects are expected to be nonfatal and the extent of damage is expected to be limited and lessened due to some capability of adult fish and shellfish to avoid an oil spill, to metabolize hydrocarbons, and to excrete both metabolites and parent compounds. For floating eggs and larvae contacted by spilled oil, the effect is expected to be lethal. Tables IV-5 (Section IV.A.3.h.(2)) and IV-16 (Section IV.B.2.d.(1)) project the number of offshore and onshore spills expected to occur in the WPA as a result of the OCS Program.

It is estimated that 280 onshore spills of 1 bbl or less will occur at a frequency of about 8 per year. It is assumed that spills of this volume will affect a very small area and dissipate rapidly. A total of 178 offshore and 70 onshore Size 1 spills (average size, 3 bbl) are estimated to occur at a respective frequency of about 5 offshore and 2 onshore per year in the WPA. The offshore spills will originate from areas with the greatest density of platforms and largest volume of pipeline flow, and it is assumed that a few will contact the coast. The onshore spills will originate near terminal locations in the coastal zone of Louisiana. It is assumed that spills of these volumes will affect a very small area and dissipate rapidly. It is expected that oil spills less than 50 bbl will rarely affect coastal bays and marshes essential to the well-being of the commercial fishery resources in the WPA.

A total of nine Size 2 spills (7 offshore and 2 onshore) (average size, 500 bbl) are estimated to occur at a respective frequency of about one offshore spill every 5 years and one onshore spill every 18 years in the WPA. It is assumed that none of the offshore spills will contact the coast. The offshore and onshore spills will originate from and make contact with areas as described above. For the purpose of this analysis, it is assumed that Size 2 spills will rarely contact and affect the coastal bays and marshes critical to the well-being of commercial fisheries in the WPA.

A total of 39 Size 3 spills (37 import tankering and 2 OCS Program) will occur offshore in the WPA at a respective frequency of about 1 per year from imports and 1 every decade from the OCS Program during the 35-year life of the proposed action. It is estimated that two offshore spills of this volume will occur and contact within 10 days the coastline in the WPA. A total of two Size 3 spills are estimated to occur onshore at a respective frequency of about one every 18 years from the OCS Program during the 35-year life of the proposed action.

Galveston County, Texas, is the land segment with the highest probability (8% from OCS activities and 28% from imports) of occurrence and contact within 10 days by a Size 3 spill. Galveston Bay is the coastal inshore bay with the highest probability (8% from OCS activities and 28% from imports) of occurrence and contact within 10 days by a Size 3 spill.

It is expected 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 a Size 3 spill occurring and contacting within 10 days Gulf menhaden during their winter spawning in coastal waters of the WPA is 32 percent over the next 35 years. The impact of oil spills in the WPA is expected to cause less than a 5 percent decrease in commercial fishery populations or in commercial fishing. At the estimated level of effect, the resultant influence on Western Gulf fisheries is expected to be considerable but not easily distinguished from effects due to natural population variations.

Subsurface blowouts of both oil and natural gas wells and pipeline trenching have the potential to affect adversely commercial fishery resources. Loss of well control and resultant blowouts seldom occur on the Gulf OCS (6 blowouts per 1,000 well starts; 23% will result in some spilled oil). It is assumed that there will be 33 blowouts at a frequency of about 1 every other year in the WPA resulting from the OCS Program during the 35-year life of the proposed action. Table IV-5 estimates the resuspension of some 2.8 million m³ of sediment during the installation of 3,000 km of pipelines in water depths less than 61 m. Offshore Subarea W-2, an area

of bottom trawl fishing and consolidated sediments, will support the greatest portion of pipeline burial activities (855 km) and associated sediment resuspension (1.2 million m³) (Table IV-5). Sandy sediments will be quickly redeposited within 400 m of the trench, and finer sediments will be widely dispersed and redeposited over a period of 30 days or longer within a few thousand meters of the trench. For the purpose of this analysis, it is expected that the infrequent subsurface blowout that may occur on the Gulf OCS will have a negligible effect on Gulf commercial fisheries. The effect on commercial fisheries from pipeline trenching in the WPA is expected to cause less than a 5 percent decrease in commercial fishery populations or in commercial fishing. At the estimated level of effect, the resultant influence on Western Gulf fisheries is expected to be considerable but not easily distinguished from effects due to natural population variations.

Drilling mud discharges (Table IV-5) 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 Western Gulf fisheries.

Produced-water discharges (Table IV-5) contain components and properties detrimental to commercial fishery resources; however, toxic compounds are undetectable beyond 1,000 m from the discharge point. Offshore discharges of produced water will rapidly disperse and dilute to background levels and will have a negligible effect on Western Gulf fisheries.

The NORM discharged offshore in produced water has the potential to adversely affect commercial fishery species and subsequently increase man's intake of radium; however, this is only at concentrations 10-12 orders of magnitude higher than those found within 3 m from the discharge point. The NORM component of offshore discharges of produced water will rapidly dilute to background levels, will have no effect on commercial fishery resources, and will have no effect on commercial fishing in the WPA.

Summary

Activities resulting from the OCS Program and non-OCS Program events have the potential to cause detrimental effects to Western Gulf commercial fisheries. Impact-producing factors of the Cumulative Scenario that are expected to substantially affect commercial fisheries in the WPA include coastal environmental degradation, overfishing, oil spills, and pipeline trenching. At the estimated level of effect the resultant influence on Western Gulf fisheries is expected to be substantial and easily distinguished from effects due to natural population variations.

The incremental contribution of the proposed action (as analyzed in Section IV.D.2.a.(8)) to the cumulative impact is inconsequential. The effects of impact-producing factors (coastal environmental degradation, emplacement of production platforms, underwater OCS obstructions, production platform removals, seismic surveys, oil spills, subsurface blowouts, pipeline trenching, and offshore discharges of drilling muds, produced waters, and NORM) related to the proposed action are expected to be negligible.

Conclusion

The impact of the Cumulative Scenario on commercial fisheries within the potentially affected area is expected to result in less than a 10 percent decrease in commercial fishery populations, in essential habitat, or in commercial fishing. It will require 3-5 years for fishing activity and 2-3 generations for fishery resources to recover from 99 percent of the impacts.

(9) Impacts on Recreational Resources and Beach Use

This Cumulative Analysis considers the effects of impact-producing factors related to the proposed action (Section IV.D.2.a.(9)), 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 Size 3 oil spills (Table IV-11) and a few Size 2 spills each year are assumed to occur and contact land as a result of Federal OCS activity and crude-oil import tankering (Section IV.A.3.h.(2)). Estimates of one or more Size 3 spills occurring and contacting within 10 days major recreational beaches in Texas (Galveston/Bolivar Peninsula) and Louisiana (Cameron beaches) are also presented in Table IV-11. Offshore and onshore spills of 1,000 bbl (Section IV.A.3.h.(2)) or less 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. It is important to realize, especially in the cumulative impact context, that of all chronic hydrocarbon pollution existing in the Gulf, only a small percentage is directly related to Gulf of Mexico oil and gas leasing and production (Section IV.C.5.). 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 communication, 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 and 55-gallon drums, 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 Size 3 offshore oil spills and several onshore spills 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 large oil spills is assumed during cleanup operations.

(10) Impacts on Archaeological Resources

The following Cumulative 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.(12).

(a) Historic

Future OCS exploration and development activities in the WPA are expected to result in the drilling of 3,420 exploration and delineation wells and 1,940 development wells, the installation of 140 platforms, and the laying of 3,000 km of offshore pipelines (Table IV-5). 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 would result in the loss of or damage to significant or unique historic information.

The placement of 3,000 km of pipelines in the WPA is projected. 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 161,900 service-vessel trips are projected for the WPA (Table IV-16). 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 or damage to 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-11, there is an estimated 84 percent probability of one or more Size 3 oil spills occurring and contacting the coastal area within 10 days. There is up to a 74 percent probability that an imported Size 3 oil spill will occur and contact the coastal area within 10 days. However, the impacts caused by oil spills to coastal historic archaeological resources are generally short term and reversible. It is assumed that onshore oil spills will occur as a result of OCS oil being transported to shore. In the WPA, under the Cumulative Scenario, it is assumed that eight spills less than or equal to 1 bbl will occur each year, two Size 1 spills will occur each year, no Size 2 spills will occur each year, and two Size 3 spills will

occur over the life of the lease sale. It is further assumed that the majority of such spills would occur around terminals and be contained in the vicinity of the spill. There is a small possibility for these onshore spills to contact a historic site. Should such oil spills contact a historic site, the effects would be temporary 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. According to Table IV-5, there are currently 4,844 km of pipelines on the Western Planning Area OCS. 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-16, three terminals (each requiring 7-24 ha of land), one separation facility requiring 6 ha per 100,000 bbl of oil equivalents processed, three 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 in 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 3,420 exploration and delineation wells and 1,940 development wells, the installation of 140 platforms, and the laying of 3,000 km of offshore pipelines (Table IV-5). The archaeological surveys are assumed 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 prehistoric 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 3,000 km of pipelines in the WPA is projected. According to Table IV-5, there are currently 4,844 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 161,900 service-vessel trips are projected for the WPA (Table IV-5). 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 or damage to 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-11, there is an estimated 89 percent probability of a Size 3 oil spill occurring and contacting the coastal area within 10 days. There is an estimated 74 percent probability that a Size 3 oil spill will occur and contact the coastal area within 10 days. It is assumed that

onshore oil spills will occur as a result of OCS oil being transported to shore. In the WPA, under the Cumulative Scenario, it is assumed that eight spills less than or equal to 1 bbl will occur each year, two Size 1 spills will occur each year, no Size 2 spills will occur each year, and two Size 3 spills will occur over the life of the lease sale. It is further assumed that the majority of such spills would occur around terminals and be contained in the vicinity of the spill. There is a small possibility for these onshore spills to contact a prehistoric archaeological site. However, 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. Therefore, no effect of trawling on prehistoric sites is assumed.

According to Table IV-16, three terminals (each requiring 7-24 ha of land), one separation facility requiring 6 ha per 100,000 bbl of oil equivalents processed, three 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 prehistoric archaeological resources exist at the sites.

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.

Dredging and tropical storms are assumed to have caused loss of significant 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 and parishes 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 of Mexico can be found in Figure IV-10. 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 and Eastern 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.

Figure IV-10. Employment Impacts from the OCS Program (Western Planning Area) (USDOI, MMS, Gulf of Mexico OCS Region estimates, 1992).

A total of approximately 178,192 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 5,859 workers involved in primary, secondary, and tertiary industries. After this initial peak-year employment, impacts generally decline and then rise again to a second peak of 5,248 workers in 2012. Direct employment in the primary oil and gas extraction industry (SIC 13) accounts for 45 percent of the total employment impacts projected for the Western Gulf coastal subareas over the life of the proposed action. Exploratory activities peak in the year 1999. Both exploratory and development activities account for approximately 38 percent of the offshore employment resulting from the OCS Program in the Western Gulf during the 35-year life of the proposed action. Employment in oil and gas production activities and workover operations accounts for about 62 percent of total offshore employment due to activities in the Western Gulf.

Table IV-24 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-25 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. Impact to employment in the Western Gulf occurs equally in coastal Subareas TX-1 and TX-2, with peak-year impact estimates for 1994 of approximately 0.2 percent in each area. Likewise, all coastal communities in the Western Gulf 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 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.A.3.h. presents estimates of the mean number of offshore spills assumed as a result of the Cumulative Scenario in the Gulf of Mexico. The probability that one or more Size 3 offshore spills will occur as the result of the OCS Program or import tankering and contact land segments of the Western Gulf within 10 days of the accident can be found in Table IV-11. 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 TX-2. Calhoun County (Land Segment 7) in coastal Subarea TX-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 a Size 3 offshore spill will occur from accidents involving import tankering and contact a WPA land segment within 10 days is 28 percent for Galveston and Chambers Counties (Land Segment 10) in coastal Subarea TX-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 TX-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 22,278 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 (USDOl, MMS, 1985). 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 5,000 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 Western Gulf Coast. This estimate is equivalent to a total of 580 person-years of employment over the 35-year life of the proposed action.

One Size 2 spill is assumed to occur in the WPA and contact the Western Gulf coastline. A total of 178 Size 1 spills are assumed to occur in the WPA over the life of the proposed action. 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, a number of crude oil and petroleum product spills (Table IV-11) are assumed to occur, primarily in the coastal zone. 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 68 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 Texas. The service industry is projected to exhibit the highest growth.

By the year 2020, mining employment in Louisiana is projected to decrease by about 16 percent from 1988 levels (USDOC, Bureau of Economic Analysis, 1990). The growth projected for the service industry is expected to be about 40 percent between 1988 and 2020. Retail trade, finance, insurance and real estate, and transportation and public utilities are also projected to exhibit considerable growth over this time period.

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 two 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 LA-1 and LA-2). It appears that growth in employment to levels expected in 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 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.

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 significant (approximately 178,192 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

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 of the Western Gulf coastal impact area is significant, amounting to approximately 178,192 person-years of employment over the life of the proposed action, plus at

least an additional 580 person-years of oil spill clean-up employment. 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 workforce 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 predicted 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-24, approximately 178,192 person-years of employment (direct, indirect, and induced) are required in the Western Gulf coastal subareas potentially affected by activities to support OCS-related activities during the 35-year life of the proposed action. Peak-year impacts occur in 2000, with 5,859 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 TX-1 and 84 percent in Subarea TX-2. Examination of Table IV-25 reveals that impacts to employment in the WPA are within the 0.1-0.2 range throughout the 35-year analysis period. 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 workforce 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. Projected changes in the industrial composition of the regional economy during the 35-year analysis period reveal a decrease in mining employment and an increase in retail trade, finance, insurance, real estate, and transportation and public utilities (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 problematic for new infrastructure needed in response to normal growth. However, the more diversified economy is expected to buffer the effects of the decline in OCS-related employment.

Expected growth in the service industry will most likely provide employment for some of the workforce; 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 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 those in 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 over the 35-year analysis period.

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 expected to result in short-term (less 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 demographics.

(c) Sociocultural Issues

The Cumulative Analysis considers the effects of OCS-related impact producing factors on the Western Gulf of Mexico coastal subareas. The effects of prior, current, and future OCS sales on sociocultural issues will be examined. The analysis also considers the effects of certain non-OCS-related impact-producing factors.

For the purpose of this analysis, OCS-related impact-producing factors to sociocultural issues will include OCS-related employment and workforce fluctuations, population and demographic change, relative income, wetlands loss, oil spills, and work scheduling. Non-OCS-related impact-producing factors included in this analysis are oil and gas activities in State waters and tropical storms. Adverse effects could arise if disruption of social and cultural patterns occurred and resulted in changes in traditional occupations, disruption in the viability of extant subcultures, social and community dysfunction, and detrimental effects on individual or family life. 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 predicted and will not be considered in this analysis. It should be noted that, should such an event occur, the projections on which the current analysis is based could change markedly.

As stated in Section IV.D.2.d.(11)(a), a total of approximately 178,192 person-years of employment (direct, indirect, and induced) are required in the coastal subareas of the Western Gulf to support OCS-related activities in the Gulf during the 35 year life of the proposed action. Peak year impacts occur during 2000, with 5,859 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 by coastal subareas reveals total employment of 16 percent in Subarea TX-1 and 84 percent in Subarea TX-2. Examination of Table IV-25 reveals that impacts to employment in the WPA are within the 0.1-0.2 percent range throughout the 35-year analysis period. 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. Projected changes in the industrial competition of the regional economy for the 35-year analysis period reveal a decrease in mining employment and an increase in retail trade, finance, insurance, real estate, and transportation and public utilities. The diversifying economy of the WPA is expected to help ameliorate the impact of overall decline in OCS-related employment. The OCS-related employment is expected to provide jobs which would not exist without the OCS Program, and therefore provide some positive impacts.

Under the Cumulative Scenario, peak-year employment is projected to occur in 2000. 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 immigration. Employment is projected to decline after the peak year. Out-migration resulting from the overall decline is expected to be ameliorated by the diverse economy of the WPA. There could be, however, a loss of population, particularly in OCS-related staging centers and administrative centers. The quality of family life, in some individual cases, could be adversely effected by layoffs in the OCS oil and gas industry as a result of stress resulting from decreased family income and loss of security.

Dependence on the relatively high wages paid to persons in the oil and gas industry (both OCS and non-OCS) may have deleterious impact on family life, if layoffs occur, particularly in view of the projected decline in OCS-related oil and gas activity over the life of the proposed action. Impacts associated with the higher OCS-related salaries also include possible destabilization of small businesses that cannot compete with the high wages and larger benefit packages offered by OCS-related companies and a possible lack of incentive for increased business efficiency. The exodus of relatively high paying OCS-related jobs will allow small businesses to draw from a larger pool of potential employees; however, it is expected that these jobs will generally be lower paying than those associated with OCS activities. As OCS-related employment declines, impacts to small business related to the higher wages associated with OCS employment will decline as well.

In the peak exploration year of 2000, approximately 5,859 person-years of total employment are required to support OCS activities. The number of persons involved in direct offshore employment is projected to decline following the peak years. These persons will likely encounter the extended work schedule typically associated with OCS offshore activities. The extended work schedule will allow for part time participation in more traditional occupations (fishing, trapping, etc.). The extended work schedule changes the practice of traditional familial roles, in an adaptive response to absence. In the majority of cases, it is expected that the familial adaptations to the extended work schedule will be successful. However, it is expected that in a small number of cases, successful adaptation of the family to the extended work schedule will not occur. In these cases, some deleterious impacts to family are expected.

Oil and gas activities within State waters are assumed to result in similar impacts as those found from 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 occupations. This could result in overutilization of resources and threaten the continuation of traditional occupations. Family life could also be impacted by the suite of impact-producing factors associated with activities in State waters.

Under the Cumulative Scenario, approximately 993 ha of wetlands may be adversely impacted by OCS-related activities. Of this total, 100 ha may be converted to open water. Approximately 37,227 ha of wetlands may be adversely effected by non-OCS activities, including subsidence, vessel erosion, oil spills, and navigation channel dredging and maintenance. Of this total, 4,704 ha may be converted to open water. The projected amount of wetlands loss may result in impact to the practice of traditional occupations, such as trapping, as coastal marsh is converted to open water.

Section IV.A.3.h.(2) presents estimates of the mean number of offshore spills assumed under the Cumulative Scenario. The probability that one or more Size 3 offshore spills will occur as a result of the OCS Program or import tankering and contact land segments of the Western Gulf within 10 days can be found in Table IV-11. 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 TX-2. Calhoun County (Land Segment 7) in coastal Subarea TX-1 carries the second highest probability of occurrence and contact, with a probability of 3 percent. Based on these low probabilities, it is assumed that no offshore oil 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 a Size 3 offshore spill will occur from accidents involving import tankering and contact a WPA land segment within 10 days is 28 percent for Galveston and Chambers Counties (Land Segment 10) in coastal Subarea TX-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 Subarea TX-1 has a probability of occurrence and contact of 9 percent. Based on these probabilities, it is assumed that one spill of approximately 22,278 bbl will occur from import tankering operations and contact a land segment somewhere in the WPA. A spill of this size is expected to affect approximately 50 km of coastline and require an estimated 5,000 workers in support of clean-up efforts for approximately 6 weeks. The direct impact of oil on wetlands could result in relocation of traplines or recreational fishing activity for the period of time necessary for the marsh to regenerate. It is expected that social and cultural impacts related to clean-up activities for a spill of this size would be temporary; however, impacts such as housing shortages, social dysfunction, heightened sense of threat, and other impacts typically associated with a large influx of workers into small communities could occur for the period of the clean up activities.

One Size 2 spill is assumed to occur and contact the coastline in the WPA. A total of 178 Size 1 spills are assumed to occur in the WPA over the life of the proposed action. Only a few of these are expected to contact land. Social and cultural impacts resulting from spills of this size are expected to be negligible.

A number of onshore spills, from both OCS and non-OCS sources, are assumed to occur primarily in the coastal zone. The level of clean-up activities associated with these spills will vary with the size, timing, and location of the spill. Social and cultural impacts associated with clean-up of these spills will vary as well.

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 of the coast, from Atchafalaya Bay, Louisiana, to Texas, had a slightly lower incidence of cyclones (11-15). It is assumed that several major storms will impact the Central Gulf coastal subareas over the next 35 years. Experience with major historical hurricanes (cf. Vujanovich, 1974), as well as with Hurricanes Betsy (1965), Camille (1971), and most recently Hurricane Andrew, has demonstrated that major hurricanes can have a devastating effect on both the natural and human environment. Temporary disruption of traditional occupations and severe impairment of community and family life can result from the effects of tropical storms.

Summary

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. While the overall decline in OCS-related employment is expected to impact communities, families, and individuals during the 35-year life of the proposed action, the diverse economy of the WPA is expected to ameliorate this impact. The OCS-related employment is expected to provide jobs which would not exist without the OCS Program, and therefore provide some positive impacts. The quality of family life, in some individual cases, could be adversely effected by layoffs in the OCS oil and gas industry, resulting in stress from decreased family income and loss of security. As the level of employment in OCS-related industry decreases, it is likely that more persons will engage in traditional occupations (such as trapping and shrimping) to supplement their income. Given the level of projected employment, overfishing the resources is not expected. Little to no in-migration is expected to occur in support of the proposed action. Out-migration resulting from the overall decline could result in a loss of population, particularly in OCS-related staging centers and administrative centers. As OCS-related employment declines, impacts to small business related to the higher wages associated with OCS employment will decline as well. The projected amount of wetlands loss may result in impact to the practice of traditional occupations, such as trapping, as coastal marsh is converted to open water. It is expected that social and cultural impacts related to oil spill clean-up activities assumed in this analysis would be temporary; however, impacts such as housing shortages, social dysfunction, heightened sense of threat, and other impacts associated with a large influx of workers into small communities could occur for the period of the clean-up activities. The direct impact of oil on wetlands could result in relocation of traplines or recreational fishing activity for the period of time necessary for the marsh to regenerate. It is expected that in a small number of cases, successful adaptation of the family to the extended work schedule will not occur. In these cases, some deleterious impacts to family are expected. Community and family life, and the practice of traditional occupations could be impacted by the suite of impact producing factors associated with activities in State waters. Temporary disruption of traditional occupations and severe impairment of community and family life can result from the effects of tropical storms. The incremental contribution of the proposed action on sociocultural issues is expected to be minimal, with some deleterious impacts to family life in a small number of cases resulting from the extended work schedule.

Conclusion

The cumulative impact of the analyzed impact-producing factors on sociocultural issues is expected to be significant in the coastal subareas of the WPA, particularly as a result of an expected decline in OCS activity over the life of the proposed action.

E. ANALYSIS OF A LARGE OIL SPILL

The following analysis describes the potential effects of a hypothetical large oil spill that occurs in association with activities resulting from proposed Sales 147 and 150.

Scenario: The proposed scenario assumes a 100,000-bbl Louisiana crude oil spill occurs during the winter in 10 m (33 ft) of water, 6.5 km (4 mi) from the coastline at Port Arthur, Texas. The spill is the result of a shuttle tanker grounding and all of the crude is released within a 24-hour period. The prevailing climatological conditions at the time of the spill are winds from the east at 5.6 ms^{-1} , surface drift currents of 0.4 ms^{-1} west to northwest, and surface water temperature of 16°C (61°F). Offshore containment is ineffective, and the use of dispersants is not approved. Weathering is assumed to remove 33 percent of the oil during the first 4 hours; half of that amount due to evaporation. By the end of three days, 35,000 bbl remain. The leading edge of the spill is assumed to wash ashore in four hours and contact a 120-km (80-mi) stretch of shoreline. About 10 percent of the oil remains offshore and 60 percent of this is lost within 24 hours as a result of weathering.

Since oil slicks do not remain intact, it is assumed that the oil will be streaked over the primary area of contact. Beach removal is assumed to be effective, and the majority of the oil will be cleaned after six weeks.

Effects: The impacts of the hypothetical oil spill on environmental resources is summarized below. The greatest impacts will be on coastal waters and endangered species. The spill would also result in some transient changes in the use of recreational beaches. A more detailed discussion and analysis of this hypothetical large oil spill may be found in Section IV.E. of the Final EIS for Sales 142 and 143 and is hereby incorporated by reference.

Impacts to coastal barriers resulting from contact with the spill would be short-term changes in beach profile where sand is scraped away during clean-up operations and not replaced. The effects of the spill on coastal wetlands are expected to persist for 1-3 years, except in areas of marsh shoreline erosion. Some areas will receive heavier concentrations of oil causing reduced plant vigor and dieback. Where the marsh grass roots die, the shoreline will be more susceptible to wave attack, resulting in accelerated erosion. In these cases, the loss of wetland areas will be permanent. The majority of oil covering wetlands would weather, and the concentration of hydrocarbons would likely return to background levels within several months. Only a small percentage of the total contacted acreage will be destroyed or altered as a result of the spill.

Hydrocarbon concentrations would increase in offshore waters in the primary area of contact by several orders of magnitude. Degradation of water quality would persist up to several weeks. Effects on regional water quality will not be significant because of the relatively small area extent of the impact. The spill would significantly alter the nearshore coastal water quality adjacent to the contact zone, but hydrocarbon concentrations will dilute to background levels within several weeks after the removal of the oil on the beaches.

Evaporation of total hydrocarbons from the spill could result in high short-term (24-hr) impacts to air quality in localized areas. Long-term impacts will be lower.

Impacts on endangered or threatened species could include death or displacement of food, displacement from critical habitats, death or dysfunction 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. The bottlenose dolphin is the only marine mammal that would be contacted by the spill. Impacts on the bottlenose dolphin include dysfunction as a result of skin irritation, displacement from preferred habitats, ingestion, and loss of food sources.

The majority of waterfowl population in the impacted area are overwintering migrants. Within the area affected, it is expected that no more than 1,000 wetland birds will be contacted by the spill. Both migrant and resident coastal bird populations would decline and change their distribution and/or abundance for one to two generations or for 1-3 years.

Contact between the spilled oil and important commercial fish and shellfish species would result in both lethal and sublethal impacts on the contacted species. Important commercial fisheries species that could be contacted by the oil spill include brown shrimp, blue crab, American oyster, flounder, and several species of sciaenids. Within the affected area, commercial fisheries would be depressed, with local fishermen out of work and secondary employment affected for 1-2 years.

The hypothetical spill would have short-term adverse impacts on several designated park areas and general-use beaches. The spill could preclude or detract from public use and enjoyment of directly impacted beaches for up to six weeks, but use would return to normal after evidence of the spill is gone. In general, the socioeconomic impact on beach communities is unlikely to be severe since the spill occurs during the off season.

SECTION V

CONSULTATION AND COORDINATION

V. CONSULTATION AND COORDINATION

A. DEVELOPMENT OF THE PROPOSED ACTIONS

The Comprehensive Program for Outer Continental Shelf Natural Gas and Oil Resource Management (1992 to 1997) schedules proposed lease Sale 147 covering the Central Gulf of Mexico for March 1994 and proposed lease Sale 150 covering the Western Gulf of Mexico for August 1994.

The Information Base Review, or IBR, for proposed Sales 147 and 150 was completed in March 1992. The review process for this IBR was designed to incorporate both public and internal assessments of the information base available for decisionmaking on the OCS. Public involvement in the process was solicited during the Gulf of Mexico Region's Information Transfer Meeting (ITM) held in November 1991. Pertinent comments and study suggestions submitted by outside parties in response to recently published Environmental Impact Statements and Consistency Determinations were also considered. In addition, an MMS interdisciplinary and comprehensive assessment of the status of the information base was conducted.

The Call for Information and Nominations (Call), issued on April 30, 1992, formally initiated the scoping process for these lease sales. The required 45-day comment period closed on June 15, 1992. The Sale 147 Call area consisted of 5,213 unleased blocks (as of March 1992) covering approximately 28.2 million ac offshore Louisiana, Mississippi, and Alabama. The unleased blocks in the Call area are located from 3 to 220 mi (4.8 km to 354 km) offshore in water depths ranging from 4 to 3,425 m (13 to over 11,000 ft). As of March 1992 this area contained 130 unleased blocks (approximately 350,350 ac) within 3 mi of the Federal/State boundary that would be subject to provisions of Section 8(g) of the OCS Lands Act (OCSLA), as amended. Included in the Sale 147 Call area were 11 blocks offshore the State of Alabama that are the subject of discussions between the State and Federal governments regarding the Federal/State boundary in the vicinity of Sand Island Lighthouse. The blocks involved in these discussions are Mobile Blocks 820 through 830. However, only one block, Mobile Block 825, is unleased at this time.

The area included in the Sale 150 Call consisted of 4,739 blocks (as of May 1992) covering 26.0 million ac offshore Texas and in deeper waters offshore Louisiana. Excluded from this area are the two Flower Garden Banks blocks (High Island Area, East Addition, South Extension, Blocks A-375 and A-398, East and West Flower Garden Banks, respectively). These blocks were established as a deferral from the Comprehensive Program to afford maximum protection to the coral reef and biota in that location. The Call area is from 14 to 357 km (9 to 220 mi) offshore in water depths ranging from 8 to over 3,000 m (26 to over 9,000 ft). Included in the Call area (as of May 1992) were 142 unleased blocks (435,000 ac) within 3 mi of the Federal/State boundary that would be subject to Section 8(g) of the OCSLA, as amended.

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, respectively. The deferral area, containing 337 lease blocks and approximately 1.8 million ac, 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. On August 7, 1991, a meeting was held between MMS, DOD, and industry representatives at the Gulf of Mexico OCS 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. Since that meeting the MMS and DOD have entered into an agreement deferring the Corpus Christi carrier operations for Western Gulf of Mexico Sales 143 and 150.

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 used in determining the issues and concerns for the proposed 1994 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 NOTICE OF INTENT TO PREPARE AN EIS

The Call for Information and Nominations, issued on April 30, 1992, formally initiated the scoping process for these lease sales. The required 45-day comment period closed on June 15, 1992. A total of three responses were received--all from industry (Shell Offshore, Inc.; UNOCAL-Louisiana Region; and UNOCAL-Texas Southeastern Region). No comments were received from Federal agencies, State governments, or environmental organizations. The lack of response from various groups on the Call/Notice of Intent to Prepare an EIS (NOI) for individual sales and sale-specific EIS's is traditionally seen following preparation and response to Programmatic EIS's.

Industry interest and comments as submitted by companies indicate a general support for the continuation of areawide leasing for the 1994 sales in the Central and Western Gulf of Mexico. Two companies opposed the deferral of acreage for Naval operations in the Western Gulf and recommended that lease stipulations and drilling windows be used in its place. One company expressed concern over possible future periodic deep-water tract deferrals.

The NOI for Sales 147 and 150 was published in the *Federal Register* on April 30, 1992, concurrently with the Call. Although the NOI formally initiates the scoping process for the EIS, scoping efforts and other coordination meetings were also conducted prior to publication of the Call and NOI in the *Federal Register*. The comments and concerns summarized below were submitted in response to various agency requests for public, government, and industry input:

- The Call/NOI for proposed Sales 147 and 150
- The Information Base Review for proposed Sales 147 and 150
- The EIS review process for Sales 139 and 141
- Public Hearing Comments on Sales 142 and 143
- Comments on the Draft EIS for Sales 142 and 143
- Comments on the Draft EIS for the Comprehensive Program (1992-1997)

Air Quality

U.S. Environmental Protection Agency

- MMS should undertake a comprehensive ozone study.
- MMS should provide an interim ozone air quality analysis in the next Draft EIS.

Sierra Club (Delta Chapter)

- concerns regarding ozone--toxic emissions from oil and gas activities should be curtailed.

Sierra Club (Houston Regional Group)

- MMS should take into account emissions from State, Federal, and private actions when assessing cumulative air quality impacts.
- emissions from ships and other activities associated with OCS activities should be considered in the cumulative analysis.
- air emissions also come from barges, refineries, and petrochemical plants that use OCS oil.
- MMS should focus its attention on ozone.
- MMS should quantify emissions from offloading activities.
- MMS should assess impacts of air emissions from spills, leaks, and bilge water.

*Archaeology**Alabama Historical Commission*

- concerned about very high level of cumulative impacts on both historic and prehistoric resources.
- cultural resource preservation can be maximized through review of individual project plans.

Sierra Club (Delta Chapter)

- supports the Archaeological Resource Stipulation.

*Coastal Barrier Beaches**Mobile Bay Audubon Society*

- concerns regarding trash and debris on beach.
- concerned about "very high" cumulative impacts on coastal barrier beaches.

Sierra Club (Delta Chapter)

- concerned about impacts of oil spills on barrier beaches.

Sierra Club (Houston Regional Group)

- concerned about impacts of oil spills on barrier beaches.
- MMS needs to document that materials found on beaches are lost by accident and not purposely thrown overboard.

U.S. Environmental Protection Agency

- concerned about beach litter problem in Gulf of Mexico.
- industry should be more diligent in securing operational debris to reduce the problem of marine debris.

U.S. National Park Service

- concerned about impacts from oil spills and trash and debris on barrier beaches at Padre Island National Seashore and Gulf Island National Seashore.
- concerned about changes in erosion and sedimentation patterns associated with pipeline rights-of-way across barrier beaches.

Coastal and Marine Birds

Sierra Club (Delta Chapter)

- concerned about "very high" cumulative impacts on endangered and threatened coastal and marine birds.

Sierra Club (Houston Regional Group)

- MMS needs to verify that helicopter pilots adhere to the mandated ceilings when flying over Matagorda and Galveston Islands.

Commercial Fisheries

National Oceanic and Atmospheric Administration

- potential impacts to commercial and recreational important species need further addressing.
- include a discussion on habitat restoration mitigation measures.
- discuss the long-term impact of produced waters on local fish populations.
- address the potential impacts to fishery resources caused by lease-generated wetland loss.

Mobile Bay Audubon Society

- effects of oil and gas activities on fish should be determined.
- concerned about water quality effects on fish populations.

Office of the Attorney General (Texas)

- concerned about the effects of explosive structure removals on fish populations.

Sierra Club (Delta Chapter)

- concerned about "high" cumulative impacts on commercial fisheries.

Sierra Club (Houston Regional Group)

- concerned about declines in populations of red snapper, red fish, mackerels, etc.

Sierra Club Legal Defense Fund

- indicates a need to analyze the loss of fish nursery habitat due to coastal erosion.

State of Alabama

- believe that the live-bottom (Pinnacle Trend) area provides important recruitment area for inshore fisheries.

*Deep-Water Benthic Communities**National Oceanic and Atmospheric Administration*

- deep-water benthic community stipulation should be mandatory.
- requests that additional information be provided to determine the effectiveness of provisions of NTL 88-11 on reducing impacts to chemosynthetic communities or effectiveness of lease stipulations for protecting sensitive offshore habitats.

Sierra Club (Houston Regional Group)

- concerned that MMS does not know enough about deep-water benthic communities.
- need to know more about the ecology of deep-water benthic communities and how disturbance will affect them.
- concerned about the impacts of drilling muds, cuttings, and produced waters on these communities.
- need a complete mapping effort for chemosynthetic communities in the Gulf, along with research on impacts of pollutants on these unique animals.

Sierra Club Legal Defense Fund

- need to discuss the effect of drilling mud discharges on deep-water depositional environments.

*Endangered and Threatened Fish (Gulf Sturgeon)**Sierra Club (Delta Chapter)*

- concerned with the "very high" cumulative impacts on the Gulf sturgeon.

U.S. Fish and Wildlife Service

- Gulf of Mexico sturgeon was proposed for listing as a federally threatened species on May 2, 1990.

Live Bottoms (Pinnacle Trend)

Mobile Bay Audubon Society

- pinnacles should be mapped.

National Oceanic and Atmospheric Administration

- Pinnacle Trend stipulation should be mandatory.
- topographic features in Pinnacle Trend warrant protection--recommend that all blocks that may contain these features be constrained by a lease stipulation or deleted from lease offering.

Project ReefKeeper

- the Pinnacle Trend and other shelf-edge coral banks should be safeguarded by deleting them from lease sales.

U.S. Environmental Protection Agency

- Pinnacle Trend should be protected by stipulation.

U.S. Fish and Wildlife Service

- Pinnacle Trend stipulation should be considered part of the lease sale proposal.

State of Alabama

- The State supports the existing Live Bottom Stipulation as applied to the pinnacle trend area and is encouraged by recent efforts of MMS to determine the extent and significance of the area.

Marine Mammals

Marine Mammal Commission

- conclusions regarding expected impacts to marine mammals in the Draft EIS are not supported by data, analyses, or references.
- recommends that MMS conduct monitoring programs to detect possible adverse effects to marine mammals so that activities can be stopped or modified before effects reach significant levels.
- EIS should be expanded to provide a more complete description of the demography, habitat requirements, and status of bottlenose dolphins and other cetaceans.

- EIS should be expanded to describe uncertainties regarding when, where, why, and how many sperm whales and other nonendangered cetaceans occur in the northern Gulf.
- concerned that even though the probability of contact of an oil spill along the west coast of Florida is very low, the loss of even a small number of manatees could be catastrophic.
- EIS should assess the indirect, as well as direct, impacts on marine mammals (e.g., sublethal effects and second order food chain effects).
- assumptions upon which conclusions are based should be stated clearly.
- concerned about impacts of seismic exploration on marine mammals.
- concerned regarding impacts of explosive structure removals on bottlenose dolphins and other marine mammals.
- concerned about impacts of drilling muds and cuttings on marine mammals, including possible bioaccumulation of toxics from drilling muds and produced waters.
- concerned about effects of noise on marine mammals.
- concerned about effects of oil spills on marine mammals.

Mobile Bay Audubon Society

- concerned about water quality effects on porpoise populations.

Sierra Club (Delta Chapter)

- study needs to be done on marine mammals including population numbers and locations, behavioral aspects, general impacts, and impacts of contaminants.
- concerned with the "very high" cumulative impacts of nonendangered and nonthreatened and endangered and threatened marine mammals.

Sierra Club (Lone Star Chapter)

- concern was expressed over increased exploration activities in the deeper region's of the Gulf and increased opportunities for interactions between these activities and endangered and threatened marine mammals.
- concerned about impacts of explosives on cetaceans.

Marine Turtles

Sierra Club (Houston Regional Group)

- study needs to be done on marine turtles regarding population numbers, locations, behavioral aspects, general impacts, and impacts of contaminants.
- concerned with "very high" cumulative impacts on marine turtles.

Sierra Club (Lone Star Chapter)

- concerned about impacts of explosives on turtles.

Population, Labor, and Employment/Social Issues

Chevron U.S.A., Inc.

- restricted sale areas and slower-paced leasing would be detrimental to the already fragile economics of this area.

Louisiana Department of Natural Resources

- further analysis is needed concerning impacts on coastal social and economic systems.

Mobil Exploration & Producing U.S., Inc.

- concerned that uncertainty of both leasing and permitting on the OCS is so great that capital, jobs, and revenues are flowing to more predictable projects overseas.
- importance to Nation of energy resources produced from the Gulf of Mexico cannot be overstated.

National Ocean Industries Association

- need to reverse the current trends of ever-increasing imports of petroleum and ever-declining domestic production.
- demands of a growing population and economy will need to be met with additional supplies of petroleum products.

Sierra Club Legal Defense Fund

- provide further analyses on socioeconomic impacts resulting from the proposed sales. Included discussions on long-term employment trends as affected by OCS development, infrastructure, social welfare and other public sector demands, impacts on traditional cultures, impacts on subsistence hunting and fishing, and impacts on community structure.

State of Alabama

- coastal states and communities affected by OCS activities should receive a fair share of the financial benefits of development and production.
- support centralization of gas cleansing and processing facilities in southern Alabama but maintain that affected communities should share in the financial benefits from OCS production.

State of Louisiana

- concerned about socioeconomic impacts associated with OCS development and production activities.

- additional information is needed regarding public costs for supporting OCS infrastructure, e.g., highways, roads, ports, waterways, airports, waste facilities, etc.
- concerned about projected modifications to onshore infrastructure for the accommodation of deep-water (continental slope) development.
- potential effects of changes in industry on social structure and institutions.
- potential effects of changes in industry on community services and infrastructure.

Recreational Resources and Activities (Beach Use/Fishing)

Mobile Bay Audubon Society

- concerned about the offshore oil and gas industry's contribution to trash and debris on beaches.
- concerned about trash and debris on beaches.

U.S. Environmental Protection Agency

- concerned about beach litter problem in Gulf of Mexico.
- industry should be more diligent in securing operational debris to reduce the problem of marine debris.

U.S. National Park Service

- concerned about impacts from trash and debris on barrier beaches at Padre Island National Seashore and Gulf Island National Seashore.

Sierra Club (Houston Regional Group)

- MMS needs to document that materials found on beaches are accidentally lost and not purposely thrown overboard.

Topographic Features

National Oceanic and Atmospheric Administration

- Topographic Features Stipulation should be made mandatory on blocks containing sensitive features.
- Sebree, Big Adam, Little Adam, and Phleger Banks should be placed under the Topographic Features Stipulation.

Office of the Attorney General (State of Texas)

- concerned about impacts to reefs and banks due to nonroutine events such as slipped anchors, oil spills, and blowouts.

- supports Alternative B, which deletes sensitive blocks, and recommends that the pipeline exception be amended.

Project ReefKeeper

- request deletion of all Gulf coral habitat areas.
- concerned about impacts to the Flower Garden Banks and 19 other shelf-edge banks off Texas and Louisiana.
- concerned about impacts of anchoring, discharge of drilling muds and cuttings, and explosive structure removals on shelf-edge banks.
- concerned about impacts of oil from a pipeline break or subsurface blowout.
- concerned about the long recovery period for damaged coral ecosystems.

Shell Offshore Inc.

- supports continuing the deferral and protection of High Island Area, East Addition, South Extension Blocks A-375 and A-398, officially designated as the Flower Garden Marine Sanctuary.
- does not support Alternative B and believes that the existing MMS biological stipulations and NPDES limitations provide adequate protection for all other biologically sensitive habitats.

Sierra Club (Delta and Lone Star Chapters and the Houston Regional Group)

- support Alternative B, which excludes blocks near biologically sensitive topographic features.

Texas General Land Office

- MMS should implement Alternative B, which calls for deletion of a total of 200 blocks potentially affected by the Topographic Features Stipulation.

U.S. Environmental Protection Agency

- objects to leasing without inclusion of the Topographic Features Stipulation.

U.S. Fish and Wildlife Service

- recommends that topographic features stipulation be included as part of the proposed action.

UNOCAL

- believes that the existing MMS regulations provide the necessary safeguards and protection for the biologically sensitive topographic feature areas.

Water Quality

Marine Mammal Commission

- concerned about impacts of drilling muds and cuttings to water quality and potential impacts to marine mammals.

National Ocean and Atmospheric Administration

- expressed a need to address the dynamics of the Mississippi River plume front in the northern Gulf of Mexico (major sedimentary zone and an area of elevated larval abundance)

Mobile Bay Audubon Society

- concerned about impacts of water quality on fish and porpoise populations.
- water quality studies should be done in Mobile Bay to determine effects of contaminants and fate and effects of drilling discharges.

Sierra Club (Delta Chapter)

- concerned with the "high" cumulative impacts on coastal, nearshore, and offshore water quality.
- advocate "Zero Discharge" for oil- and gas-related activities.

Sierra Club (Houston Regional Group)

- concerned about open-water contamination from discharge of bilge waters.
- concerned about water quality impacts as a result of discharges from OCS activities.

Sierra Club Legal Defense Fund

- need to discuss the effect of drilling mud discharges on deep-water depositional environments.

U.S. Environmental Protection Agency

- concerned about discharge of produced waters into coastal water bodies and impacts to estuarine animals.

Wetlands

Louisiana Department of Natural Resources

- document needs to discuss the loss of biological productivity and, in particular, fisheries productivity from wetlands loss resulting from OCS development.
- further analysis/discussion is needed concerning impacts of physical activities on coastal wetlands.

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- further analysis is needed concerning indirect impacts to wetland areas resulting from OCS development activities.

Sierra Club (Delta Chapter)

- concerned about "very high" cumulative impacts to wetlands.
- concerned that activities that contribute to wetland loss conflict with Presidents Bush's "no net loss" policy.

Sierra Club (Lone Star Chapter)

- concerned about impact of produced water discharges on wetlands.
- concerned about the impacts of saltwater intrusion on wetlands.

Sierra Club (Houston Regional Group)

- concerned about the impacts of oil spills on wetlands.

Sierra Club Legal Defense Fund

- need to analyze other factors that directly and indirectly contribute to wetland loss, such as pipeline maintenance, saltwater intrusion from dredging, interference with hydrology caused by spoil banks, etc.

State of Louisiana

- need accurate geographic and cartographic information for coastal natural resources, including wetlands.
- concerned about disposal of OCS solid wastes in wetlands.
- concerned about consequences of coastal infrastructure in support of OCS activities.
- concerned about current erosion resulting from OCS vessel traffic, as well as increased erosion that may occur due to a shift to deeper draft vessels.

State of Texas

- need accurate geographic and cartographic information for coastal natural resources, including wetlands.

U.S. National Park Service

- concerned about impacts of oil spills, dredging, channelization, pipeline emplacement, and saltwater intrusion on wetlands.

Other Topics

Coalition to Restore Coastal Louisiana

- better address modes (pipelines, etc.) for transporting produced oil, gas, and brine to shore.
- analyze those issues associated with workovers and abandonment.

Shell Offshore Inc.

- concerned with the potential deferral of the large carrier operations area in the Western Gulf. Shell believes that the Military Areas Stipulation, coupled with a strong commitment of cooperation and communication, will provide for a successful co-existence of petroleum and Naval operations in this area.

Sierra Club (Lone Star Chapter)

- additional information needs to be provided concerning human health issues associated with the handling and disposal of NORM- contaminated materials.

Texaco Exploration and Production, Inc.

- believes the MMS stipulations are sufficient to negate the selection of the other Alternatives.

U.S. Environmental Protection Agency

- objects to proposed unrestricted leasing without inclusion of protective environmental stipulations. The USEPA encourages MMS to include potential mitigating measures as part of the proposed action--i.e., those stipulations that have been applied to previous sales should be applied to proposed Sales 147 and 150.
- wishes MMS to provide additional information concerning the size and environmental consequences associated with the use of tanker-based floating production, storage, and offloading systems.

D. DISTRIBUTION OF THE DRAFT EIS FOR REVIEW AND COMMENT

The following public and private agencies and groups were provided the opportunity to review and comment on the 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

- Technical Information Center

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

- Office of Environmental Protection

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 Public Service Commission
- Alabama State Oil and Gas Board
- Dauphin Island Marine Laboratory
- State Docks Department
- State Legislature Natural Resources Committee, Chair
- State Legislature Oil and Gas Committee, Chair

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 Legislature Natural Resources Committee, Chair
 State Legislature Oil, Gas, and Other Minerals Committee, Chair
 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
 State Legislature Natural Resources Committee, Chair
 Louisiana Geological Survey
 Louisiana State Archaeologist
 Office of Coastal Management

Florida

Governor's Office
 Environmental Policy Office
 Florida Coastal Zone Management Office
 Florida Department of Community Affairs
 Florida Department of Environmental Regulation
 Florida Department of Labor, Employment, and Security
 Florida Department of Natural Resources
 Florida Department of State, Archives, History and Records
 Florida Game and Freshwater Fish Commission
 Florida State Clearinghouse
 Florida State Historic Preservation Officer
 State Legislature Natural Resources and Conservation
 Committee, Chair
 State Legislature Natural Resources Committee, Chair

Texas

Governor's Office
 Budget and Planning Office
 Bureau of Economic Geology
 State Legislature Energy Committee, Chair
 State Legislature Natural Resources Committee, Chair
 Texas A&M University
 Texas Air Control Board
 Texas Department of Highways and Public Transportation
 Texas Department of Water Resources
 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 Conservation Association
Texas Water Development Board
The Attorney General of Texas

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 Montgomery
University of South Alabama

Florida

Charlotte Glades Regional Library
Collier County Public Library
Florida A&M University, Coleman Memorial Library
Florida Atlantic University Library
Florida State University Library
Key Largo Public Library
Lee County Library
Leon County Public Library
Marathon Public Library
Monroe County Public Library
Northwest Regional Library System
St. Petersburg Public Library
Selby 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
Lafayette Public Library
Louisiana State University Library
Louisiana Tech University Library
New Orleans Public Library
Nicholls State University Library
McNeese State University Library
Tulane University, Howard Tilton Memorial Library
University of New Orleans Library
University of Southwest Louisiana Library

Mississippi

Gulf Coast Research Laboratory, 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
 Rosenberg 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

Florida Institute of Oceanography
 Florida Sea Grant
 Gulf Coast Research Lab
 Louisiana State University
 Louisiana State University Sea Grant
 Louisiana Universities Marine Consortium Council
 Mississippi/Alabama Sea Grant
 Swarthmore College
 State University System of Florida
 Texas A&M University
 Texas Sea Grant
 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

Alabama Conservancy
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
Center for Marine Conservation
Coastal Conservation Association
Concerned Shrimpers of America
Environmental Coalition
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
Izaak Walton League of America
League of Women Voters
Louisiana Environmental Professionals Association
Louisiana Nature Center
Louisiana Wildlife Biologist Association
Louisiana Wildlife Federation
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
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
Wilderness Society

E. PUBLIC HEARINGS

In accordance with 30 CFR 256.26, the Minerals Management Service held public hearings soliciting comments on the Draft Environmental Impact Statement (EIS) for proposed 1994 Gulf of Mexico Lease Sales 147 and 150. In addition, the hearings were held to provide the Secretary of the Interior with information from interested parties; this information will help in the evaluation of the potential effects of the proposed lease sales. The hearing panels were comprised of members from the Minerals Management Service, the U.S. Fish and Wildlife Service, and the U.S. National Park Service. Public participation at these hearings was sparse.

The hearings were held on the following dates and at the times and locations indicated:

June 1, 1993

Austin Marriott at the Capitol
701 East 11th Street
Austin, Texas
1:00 p.m. to 4:00 p.m.

June 3, 1993

Marriot Hotel
900 N. Shoreline Blvd.
Corpus Christi, Texas
7:00 p.m. to 10:00 p.m.

June 7, 1993

Holiday Inn
9940 Airline Highway
Baton Rouge, Louisiana
Noon to 3:00 p.m.

June 9, 1993

Minerals Management Service
1201 Elmwood Park Boulevard
New Orleans, Louisiana
Noon to 3:00 p.m.

June 10, 1993

Ramada Resort
600 S. Beltline Highway
Mobile, Alabama
7:00 p.m. to 10:00 p.m.

The following summarizes the testimony presented by those in attendance:

Austin, Texas/June 1, 1993

Carver Richards, Phillips Petroleum Co.

- Supported a steady and predictable occurrence of annual areawide sales. Central and Western Gulf of Mexico must remain open for oil and gas activities.
- Indicated that technological advances have opened up the deep-water areas (400+m) of the Gulf.
- Stressed four decades of environmentally safe operations in Federal offshore areas.

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- Concerned with Congressional and other Federal actions limiting access to OCS areas--discouraging domestic energy development and forcing oil companies to invest in overseas markets.

Charles Scholz, Nippon Oil Exploration U.S.A./National Ocean Industries Association (NOIA)

- Supported a steady and predictable occurrence of annual areawide sales in the Central and Western Gulf of Mexico.
- Emphasized drilling in order to arrest the decline in reserves.
- Stressed the offshore industry's demonstrated ability to work offshore safely.

James M. Fitzpatrick, Hardy Oil and Gas, U.S.A., Inc.

- Supported continued availability of tracts for lease sales to support domestic oil and gas activities.

Barto Arnold, Texas Historical Commission

- Complimented the MMS on its performance in protecting cultural resources (historic shipwrecks and drowned prehistoric sites) on the OCS and for the agency's work on the *USS Hatteras*.

Corpus Christi, Texas/June 3, 1993

J.C. Walter III, Walter Oil and Gas Corp. & Independent Petroleum Association of America

- Emphasized the need to produce domestic resources in an environmentally sound manner. Through increased domestic production, the Nation will increase jobs and decrease our dependence on foreign imports, thus reducing the risk of large tanker spills.

Timothy A. Wallace, Phillips Petroleum Co.

- See testimony provided by Carver Richards with Phillips Petroleum Co. (Austin Hearing).

Bob Tabone, Aker Gulf Marine and the National Ocean Industries Association

- See testimony provides by Charles Scholz with NIPPON and NOIA (Austin Hearing).

Paul Watson, Mobil Exploration and Producing U.S. Inc.

- Endorsed Alternative A for both lease sales.
- Does not support Alternative B because the stipulations and NPDES limitations adequately protect these biological resources.
- Expressed concern over further modification of the Corpus Christi Naval Operations Area. (Mobil holds leases to the north of this area.)

- Concerned over areas of promise being placed under exploration moratoria and increased tanker trafficking due to decreased domestic energy production.

Ralph Watson, ARCO Oil and Gas Co.

- Believed it crucial to our Nation's economy and security to maintain a domestic petroleum infrastructure in the U.S.
- Supported annual sales in the Central and Western Gulf of Mexico to ensure consistent and orderly lease offerings.
- Supported the current 5-Year Leasing Program and the Department's efforts in the Gulf of Mexico.
- Believed it important in difficult economic times to offer broad offerings on a regular basis.
- Opposed wholesale tract withdrawals, particularly through legislative and administrative moratoria.
- Concerned with the domestic oil and gas industry's loss of 400,000 jobs.
- Regarding "buy-backs," ARCO opposed compensating leaseholders with credits for future lease sales.

Baton Rouge, Louisiana/June 7, 1993

Richard Metcalf, Louisiana Mid-Continent Oil and Gas Association

- Supported Alternative A for both sales.
- Opposed the deferral or elimination of acreage from these sales.
- Indicated that lease concerns could be handled through lease stipulations and forms of mitigation other than bans on leasing.
- Stressed some 40 years of environmentally safe oil and gas operations in the Gulf of Mexico OCS and the Nation's need to develop the Gulf's resource potential, thus reducing our dependence on imported oil.
- Concerned with the large loss of jobs associated with the oil and gas industry.

Jack A. Newton, Independent Land Consultant

- Supported the proposed 1994 lease sales.
- Emphasized increases in revenues, jobs, domestic production, and protection for the environment (reducing the numbers of import tanker spills).

Peter Velez, Shell Offshore Inc. and the Offshore Operators Committee

- Supported Alternative A for both proposed sales.

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- Stressed the need to keep tract deferrals at a minimum in the Central and Western Gulf of Mexico.
- Supported the use of biological stipulations in conjunction with the U.S. Environmental Protection Agency's NPDES permits to mitigate potential impacts on biota. Because these forms of mitigation have been proven successful in the past, Shell and the OOC did not support Alternative B.
- Opposed the deferral of the 337-block Naval Operations Area off Corpus Christi, Texas, but supported the use of multiple-use alternatives and the military areas stipulations.

New Orleans, Louisiana/June 9, 1993

Jim Carlton, Phillips Petroleum Co.

- See testimony provided by Carver Richards with Phillips Petroleum Co. (Austin hearing).

Aston Hinds, Baroid Drilling Services

- Supported a steady and predictable occurrence of annual areawide sales in the Central and Western Gulf of Mexico.
- Expressed concern over our increased reliance on energy imports.
- Stressed the offshore industry's demonstrated ability to work offshore safely in an environmentally sound manner.

Robert J. Alario, Offshore Marine Services Association

- Expressed support for the proposed 1994 lease sales and concern that without these sales and a successful OCS Program the marine transportation and service industry would deteriorate and become ineffective.

Harold Cargol, American Petroleum Institute

- Strongly supported Alternative A with the exception of the 337-block Naval Operations Area deferral.
- Supported the use of the military areas stipulations over tract deferrals to allow for multiple use of these areas.
- Expressed support for the 5-Year Program and annual lease sales in the Central and Western Gulf of Mexico.
- Emphasized increases in Federal revenues, jobs, domestic production, and protection for the environment (reducing the number of import tanker spills).

Mobile, Alabama/June 10, 1993

John McKnight, Seneca Resources and the National Ocean Industries Association

- See testimony provided by Charles Scholz with NIPPON and NOIA (Austin Hearing).

F. DRAFT EIS LETTERS OF COMMENTS AND RESPONSES

The Draft EIS for proposed Gulf of Mexico Sales 147 and 150 was filed with USEPA on April 16, 1993. The comment period on the document was for 90 days, ending on July 20, 1993. Letters of comment on the Draft EIS for proposed Sales 147 and 150 were received by MMS's Gulf of Mexico OCS Regional Office from the following groups:

Federal Agencies

Marine Mammal Commission
 U.S. Department of Commerce
 National Oceanic and Atmospheric Administration (Washington, D.C.)
 U.S. Department of the Interior
 Bureau of Mines (Denver)
 Fish and Wildlife Service (Washington, D.C.)
 Fish and Wildlife Service (Mountain-Prairie Region/Denver)
 National Park Service (Southwest Region, Santa Fe)
 U.S. Department of Transportation
 Coast Guard (Washington, D.C.)
 U.S. Environmental Protection Agency (Dallas)

State Agencies

Representative Taylor F. Harper, Alabama House of Representatives
 State of Alabama, Governor's Office (Montgomery)
 Texas Historical Commission (Austin)

Industry

Mid-Continent Oil and Gas Association (Jackson)
 Shell Offshore Inc. (New Orleans)

G. MAJOR DIFFERENCES BETWEEN THE DRAFT AND FINAL EIS'S

Federal and State agencies, and the oil and gas industry presented their comments on the Draft EIS by letter and during public hearings held in Texas, Louisiana, and Alabama. As a result of those comments received, changes were made between the Draft and Final EIS's. Corrections to the text ranged from minor editorial changes to insertion of new or updated information. Several of these changes are as follows:

- updated acreage and block estimates for planning areas available for lease under the various alternatives presented;

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- updated acreage and block estimates for areas available for lease that contain biologically sensitive features;
- expanded discussion on the Marine Mammal Protection Act;
- clarification of various writeups pertaining to marine mammals; and
- revision of the alternative energy appendix (Appendix D).

Letters from Federal Agencies

MARINE MAMMAL COMMISSION

1201 Elmwood Park Boulevard

New Orleans, LA 70123-2394

20 July 1993

J. Rogers Pearcy
Regional Director
Minerals Management Service
Gulf of Mexico Region
1201 Elmwood Park Boulevard
New Orleans, LA 70123-2394

Dear Mr. Pearcy:

The Marine Mammal Commission, in consultation with its Committee of Scientific Advisors, has reviewed the Draft Environmental Impact Statement, Gulf of Mexico Sales 147 and 150: Central and Western Planning Areas. We offer the following comments and recommendations regarding the assessment of the possible impacts of the proposed lease sales on marine mammals.

General Comments

The Draft Environmental Impact Statement (DEIS) provides an assessment of the resource potential and the possible environmental consequences of proposals to lease up to 29.3 and 25.7 million acres of submerged lands in the Central and Western Gulf of Mexico Planning Areas, respectively, for oil and gas exploration and development. It also provides an assessment of the resource potential and possible environmental consequences of three alternative actions, including a "no action" alternative.

The DEIS (Table III-5) indicates that 29 species of cetaceans, West Indian manatees, and California sea lions occur in the northern Gulf of Mexico. It notes that: six of the cetacean species (right, blue, sei, fin, humpback, and sperm whales), as well as the West Indian manatee, are listed as endangered under the Endangered Species Act; that six cetacean species and the West Indian manatee are common in the Gulf; and that the bottlenose dolphin is the most common delphinid species in the continental shelf and nearshore waters.

The DEIS states (page IV-136 and elsewhere) that marine mammals "could be impacted by the degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service vessels and OCS structures". It concludes (page IV-132 and

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elsewhere), with respect to Alternatives A and B, that the impact on marine mammals

"is expected to result in primarily sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that are both chronic and sporadic. These impacts could cause acute or chronic physiological stress, alter normal behavioral patterns, and result in some degree of avoidance, either temporary or permanent, of the impacted area(s)."

With respect to endangered and threatened marine mammals, the DEIS concludes on page IV-136 and elsewhere that

"[l]ethal impacts are not expected, though constitute a serious decrease in the population, even if only one individual is removed. Recovery times vary among species and their rarity; several years is a reasonable estimate for successful reproduction and recruitment."

MMC-1

The meaning of some of these statements is not clear. Also, while the statements may be correct, the DEIS does not provide data, analyses, or references to support all of them. Similarly, the DEIS concludes that production waters, drilling noises, etc. will not affect marine mammal food supplies, but provides no information on the diet, feeding areas, or food requirements of the various marine mammal species that occur in and near the proposed lease sale areas.

MMC-2

The Marine Mammal Commission has noted in previous comments on proposed OCS lease sales in the Gulf of Mexico that bottlenose dolphins are not distributed uniformly throughout the Gulf and may constitute a number of more or less discrete coastal and/or inshore-offshore populations or sub-populations. The Commission has also noted that the possible effects of live captures and removals for public display and scientific research, incidental take in commercial fisheries, and habitat degradation and destruction associated with other activities must be considered when assessing the possible effects of offshore oil and gas exploration and development on both the coastal and offshore bottlenose dolphin stocks. The DEIS does not, but should, consider how the proposed action, by itself and in combination with live captures and removals, incidental take in fisheries, and habitat degradation might affect discrete inshore/offshore, and resident local populations. As a related matter, the DEIS does not, but should, note and take into account the unusually high mortality of bottlenose dolphins that has occurred in several Gulf coastal areas in the last three years.

MMC-3

The DEIS indicates that the West Indian manatee is common to the Gulf of Mexico, but provides little information with regard

to the distribution, abundance, and productivity of the species. The DEIS states (page III-42), that the West Indian manatee "...is common throughout coastal and inshore waters of Florida. Manatees rarely venture as far west as the Central and Western Gulf Planning Areas, and thus, has [sic] been excluded from the analyses of this document."

Given the distribution of manatees in the U.S. and Mexico, it is unlikely that manatees will be affected adversely by the activities in the proposed lease sale area, however, the probability is not zero.

Both the Florida and Mexico manatee populations are severely endangered and loss of even a very small number of individuals could be significant. Small numbers of manatees occasionally migrate or disperse northward from Mexico and westward from Florida into the sale areas. The greatest risk to manatees, however, may be from the direct and indirect effects of a large oil spill occurring in the proposed lease sale areas and being transported to major manatee concentrations and habitats. The Exxon Valdez oil spill demonstrated that oil can be transported great distances and suggests that oil from a major spill within the proposed lease areas could be transported by wind and currents into areas inhabited by manatees along the coast of Mexico, Cuba, or Florida.

The Service should consider such a possibility and how manatees and their habitat throughout the Gulf could be affected if a large spill occurred. Therefore, the Marine Mammal Commission recommends that, if it has not already done so, the Minerals Management Service consult with the Fish and Wildlife Service pursuant to section 7 of the Endangered Species Act to obtain the best available information on all manatee populations and habitats that potentially could be affected by the proposed action and any reasonable and prudent alternatives that might be taken to avoid or minimize possible adverse effects. Based on the results of those consultations, the Marine Mammal Commission also recommends that the Environmental Impact Statement (EIS) for the proposed lease sale be revised to indicate the distribution, relative abundance, and status of manatees along the rim of the Gulf of Mexico (particularly the coasts of Cuba, Mexico, and Florida), and provide an assessment of the possible direct and indirect effects of a major oil spill on manatee distribution and abundance in known habitat areas.

With regard to cetaceans, opportunistic surveys conducted in the late 1980's suggested that substantial numbers of sperm whales and several non-endangered cetacean species occur offshore in the northern Gulf of Mexico. The Service has provided support for further studies to better determine when, where, and what cetacean species may be affected, directly and indirectly, by oil and gas exploration and development activities in the Gulf. The

MMC-3

MMC-4

EIS should be expanded to describe the critical uncertainties and what is being done or planned to resolve them.

The EIS should provide a more complete description of what is known about the demography, habitat requirements, and status of bottlenose dolphins, manatees, sperm whales, and other marine mammals in the Gulf and how they could be affected indirectly, as well as directly, by oil and gas activities in and near the proposed sale areas.

In this regard, it is our understanding that the Service is funding studies to better understand the distribution and abundance of marine mammals in the north-central and western Gulf of Mexico (page I-37), and that the National Marine Fisheries Service is conducting various marine mammal monitoring programs in the Gulf. Data from these ongoing studies are not described in, and apparently were not considered during preparation of, the DEIS. The Marine Mammal Commission recommends that the Service, if it has not already done so, consult its contractor(s) and the National Marine Fisheries Service to obtain the best possible information on populations of bottlenose dolphins and other marine mammals that could be affected, directly and indirectly, by oil and gas exploration and development in the Gulf of Mexico. These data should be examined and appropriate sections of the EIS should be revised to (1) ensure that they reflect the best available data and (2) describe remaining uncertainties and what is being done or planned to resolve them.

The Marine Mammal Commission recognizes that it may be prohibitively costly, if not impossible, to obtain all of the information necessary to accurately predict the possible impacts on each species and population that could be affected by activities in the proposed lease sale areas. Consequently, some requirements of the Marine Mammal Protection Act and other relevant legislation, such as the Endangered Species Act, might best be met by designing and conducting post-lease sale monitoring programs to detect possible adverse effects before they reach significant levels. In this regard, we note that section 20 of the Outer Continental Lands Act, as amended, requires that the Service conduct post-lease monitoring to detect and determine the cause of environmental change possibly resulting from oil and gas exploration and development. Also, section 101(a)(5) of the Marine Mammal Protection Act, as amended, provides that U.S. citizens engaged in offshore oil and gas activities can be exempted from the taking prohibitions in the Act when the taking is unintentional and involves small numbers of animals, has negligible effects on the affected marine mammal populations, and satisfactory provisions have been made to monitor and report the taking.

The Marine Mammal Commission recommends that the EIS be expanded to more fully describe what is being done to meet the

MMC-4

MMC-5

MMC-5

monitoring requirements of section 20 and to ensure that lessees are aware of the Marine Mammal Protection Act's prohibition on taking marine mammals and requirements for obtaining a "small take" exemption as provided by section 101(a)(5); if marine mammals may be taken incidental to exploration or development activities.

Specific Comments

MMC-6

Pages I-16 and I-37 (Marine Mammal Protection Act of 1972): As presently written, this section does not provide an accurate description of the intents or relevant provisions of the Marine Mammal Protection Act. Also, parts of this section -- e.g., paragraphs 3, 4, 5, and part of paragraph 6 -- relate to implementation of certain provisions of the Act, and might be included more appropriately elsewhere in the DEIS (e.g., in the section concerning post-sale site clearance, in the section concerning mitigation measures, in the section concerning consultation and coordination, or in a separate annex).

A more accurate description of the intents and relevant provisions of the Marine Mammal Protection Act is enclosed. Also enclosed is a paper describing the intents and provisions of section 101(a)(5) of the Marine Mammal Protection Act.

MMC-7

Page II-9 through II-10 (Marine Mammals): The rationale for some of the conclusions provided in this section is not self-evident and should be provided. For example, here and elsewhere (e.g., Tables II-2 and II-3), the DEIS indicates that if threatened or endangered marine mammals were to be killed, recovery time would "vary among species and their rarity; several years is a reasonable estimate for successful reproduction and recruitment". It is self-evident that the biological significance of this mortality would depend, in part, upon the natural history and rarity of the species. However, it is not self-evident what is meant by "several years" and "several years is a reasonable estimate for successful reproduction and recruitment." In addition, it is not self-evident what is meant by the phrase "alter normal behavioral changes" (page II-9, paragraph four, sentence two; and page I-10, paragraph one, sentence two). The meaning and/or rationale for these determinations and conclusions should be clarified.

MMC-8

Pages II-37 and II-69 (Tables II-2 and II-3): The sections in these tables concerning cumulative impact to endangered and threatened species includes the following statements:

"[t]he impact...may serve to weaken individuals of a local group (e.g., sperm whales) or solitary individuals and make them more susceptible to infection from natural or

anthropogenic sources. Activities may displace individuals from specific preferred habitat or disrupt mating behavior".

MMC-8

According to the DEIS (pages II-11 and II-64), these tables provide a summary of the discussion in the text. However, the referenced statements appear only in the table and are not supported by data, analyses, or literature cited in the text. In addition, although the statements are supposed to summarize "the cumulative analyses" (page II-60 and II-64) for activities in the lease sale areas, they identify and consider potential effects independently, not cumulatively. The tables or the text should be revised to more fully describe the possible cumulative effects.

MMC-9

Page III-41 through III-46 (Marine Mammals): This section does not provide a thorough summary or discussion of available information concerning non-endangered and non-threatened or endangered and threatened marine mammals that occur in the northern Gulf of Mexico. It provides only limited information on the habitat use patterns and habitat requirements of the marine mammals known to occur in the northern Gulf and on how these species and their habitat have been affected by previous oil and gas development or other activities (e.g., live captures and removals and incidental take in commercial fisheries). Further, it does not identify critical uncertainties concerning possible direct and indirect effects. At a minimum, this section should be expanded to describe the results of recent studies and the critical uncertainties and research needs identified by the participants in the 1989 Sea Turtles and Marine Mammals workshop.

This section also contains a list (Table III-5) of the marine mammals that occur in the Gulf of Mexico and includes notations about their relative abundance. There are several inaccuracies or inconsistencies in the table and text. For example, Sowerby's, Gervais', and Cuvier's beaked whales referenced in the text, appear to be identified as North Sea, Antillian, and gooseneaked beaked whales, respectively, in Table III-5. Also, the short-snouted spinner dolphin and the saddleback dolphin are listed in the table, but appear to be referenced as the clymene dolphin and common dolphin, respectively, in the text.

Tucker and Associates, Inc. 1990. Sea turtles and marine mammals of the Gulf of Mexico, proceedings of a workshop held in New Orleans, August 1-3, 1989. OCS Study MMS 90-0069. U.S. Dept of Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, LA 70119 pp.

MMC-9

The minke whale is incorrectly identified as an endangered species in the text of this section and elsewhere (see, for example, page IV-76). Therefore, there are only five endangered baleen whale species that could be affected by the proposed action, not six, as indicated in the last full paragraph on page III-48.

Page IV-10 (Structure Removal): This section indicates that lessees are required to remove all structures and underwater obstructions from their Federal OCS leases within one year of lease relinquishment or termination of production, and that 80% of the structures will be removed using explosives. It is our understanding that the Minerals Management Service has issued strict guidelines regarding platform removal to minimize potential harm to endangered marine turtles and mammals.

The impact of structure removal on marine mammals, turtles, and other biota will depend upon the nature of, and compliance with, the guidelines. Therefore, this section usefully could be expanded to include a discussion of the guidelines and steps that have been taken to implement them, including but not limited to the types and amount of training to be given to personnel conducting the pre-detonation monitoring surveys, the platform(s) to be used in conducting the surveys, and the identification of steps to be taken to avoid possible adverse effects (e.g., the authority and process by which detonations will be halted if marine mammals are seen in the vicinity of platforms being removed).

As a related matter, by letter of 20 March 1990 (Enclosure 3), the Marine Mammal Commission provided comments and recommendations to the National Marine Fisheries Service concerning the American Petroleum Industry Member Companies' "Petition for Promulgation of Regulations Pursuant to Section 101(a)(5) of the Marine Mammal Protection Act for the Removal of Offshore Structure and Related Facilities in the Gulf of Mexico". In the letter, the Commission noted a number of uncertainties concerning the possible effects of structure removal on bottlenose dolphins and other marine mammals and recommended that the petition be granted provided: (a) the applicants present information indicating that only small numbers of marine mammals will be taken; and (b) a monitoring program is undertaken to verify the predicted effects and to detect any unforeseen effects of the proposed removals on bottlenose dolphins and other marine mammals.

To the best of our knowledge, uncertainties concerning the possible effects of structure removal on bottlenose dolphins and other marine mammals have not been resolved. Therefore, the Marine Mammal Commission recommends that the monitoring requirements outlined in the 20 March 1990 letter to the National Marine Fisheries Service be included as an additional leasing

MMC-10

MMC-10

stipulation or, alternatively, that the necessary monitoring be done as part of the Region's Environmental Studies Program.

MMC-11

Pages IV-22 through IV-23 (Offshore Disturbances - Operational Waste Discharged Offshore): This section does not, but should, indicate the potentially toxic substances in drilling muds, production water, sanitary waste, etc. that could be bioaccumulated in the marine food web. Subsequent assessments of possible impacts of the proposed action should be expanded, as necessary, to indicate how bioaccumulation of toxic substances might affect the marine food web in the Gulf, particularly top-level carnivores, such as toothed cetaceans.

In this context, we note that one recommendation from the 1989 Workshop on Sea Turtles and Marine Mammals of the Gulf of Mexico was that a general survey or pilot study be conducted to determine the types and levels of potentially harmful contaminants present in representative species and age/sex groups of marine mammals from different parts of the northern Gulf of Mexico. The EIS should describe what has been done or is being planned to implement this recommendation.

MMC-12

On a related point, this and other sections of the DEIS cite studies by Geraci, St. Aubin, and others which suggest that contact with oil, and consumption of oil or oil-contaminated prey, are unlikely to have more than temporary, non-lethal effects on cetaceans. We understand that the results of studies to assess the effects of the Exxon Valdez oil spill on killer whales and other marine mammals suggest that oil spills may have substantially greater effects on marine mammals, including cetaceans, than indicated by the studies cited. Therefore, the Marine Mammal Commission recommends that the Minerals Management Service, if it has not already done so, consult with the National Marine Fisheries Service, the Fish and Wildlife Service, the Environmental Protection Agency, the Alaska Department of Fish and Game, and other organizations as may be appropriate to obtain the best available information concerning both the direct and indirect effects of the Exxon Valdez oil spill on cetaceans and other marine mammals.

MMC-13

Page IV-76 (Cetaceans): The proposed whale-watching regulations discussed in the last sentence in this section were withdrawn recently by the National Marine Fisheries Service.

MMC-14

Pages IV-128 through IV-129 (Impacts to Marine Mammals): This section provides an assessment of the possible effects of the proposed action on endangered, non-endangered, and non-threatened marine mammals. It concludes, in each case, that the proposed action

"is expected to result in primarily sublethal effects (behavioral effects and nonfatal exposure to or intake of

OCS-related contaminants or discarded debris that are both chronic and sporadic. These impacts could cause acute or chronic physiological stress, alter normal behavioral patterns, and result in some degree of avoidance, either temporary or permanent, of the impacted areas."

As noted earlier, the rationale for these conclusions is not self-evident. Also, the likely or potential biological significance of the expected impact is not discussed. That is, there is no discussion of the possibility or likelihood that chronic sub-lethal effects (e.g., stress) resulting in persistent physiological or behavioral changes and/or avoidance of impacted areas could cause declines in survival or productivity, and result in either acute or gradual, long-term population declines. In addition, there is no discussion of the food habits or food requirements, or how the key prey species of the various marine mammal species might be affected by spilled oil, drilling muds, production water, noise, or other contaminants that could be introduced into the marine environment in the proposed lease sale area.

Although it provides references to data and information to support a number of its conclusions, many are not supported and may be misleading or incorrect. For example, the second full paragraph on page IV-129 states that "[o]dontocete (toothed) cetaceans use sounds for acoustic echo-location and communication at frequencies that are generally higher than the dominant sounds generated by offshore drilling and production activities (Gales 1982)". This statement does not recognize that bottlenose dolphins, and probably many other odontocete species, have well-developed hearing sensitivity in low frequency ranges as well as the frequencies indicated, and many cetacean species, including those occurring in the Gulf, communicate using sounds that are within the frequency ranges of sounds produced by offshore drilling operations.

The fourth full paragraph on page IV-129 (and elsewhere in the text) states that the sound levels from seismic surveys "dissipates to levels below 200 dB at distances beyond 30 m from the acoustic source (Gales 1982)". This statement does not recognize that effects and the distances at which effects occur may vary depending upon such things as frequency composition, water depth, and bottom type, as well as source level. In addition, although information on the reactions of toothed whales to seismic noise is limited, studies on baleen whales (including those sponsored by the Minerals Management Service) indicate that some species show strong avoidance responses when received levels reach 160-170 dB and respond in detectable ways to sound levels

at and below 119 dB. Therefore, although the effects may not be lethal, it is likely that noise will affect the behavior and possibly the distribution, survival, and productivity of dolphins and other toothed cetaceans as well as baleen whales.

With respect to oil spills, this section provides a detailed assessment of the probability that various sized oil spills will occur and contact areas where cetaceans have been observed. It does not provide an assessment of what the possible indirect effects might be if a large spill occurred and contacted an area that is essential to marine mammal feeding or breeding. This and the corresponding sections of the EIS concerning proposed Lease Sale 150 should be expanded to provide a clearer and more complete assessment of the possible direct and indirect effects of the proposed action on endangered and non-endangered marine mammals in the northern Gulf. As noted earlier, data concerning the effects of the Exxon Valdez oil spill on Alaskan marine mammals should be factored into the assessment. If there are uncertainties concerning the distribution, abundance, seasonal movement patterns, food habits, food requirements, etc. of the various species, or how prey species or other components of the food web on which the marine mammals are a part might be affected by oil and gas development in the Gulf, the uncertainties should be identified clearly. Likewise, the assumptions upon which the various determinations are based should be indicated clearly.

Pages IV-205 through IV-243 and IV-376 through IV-406 (Cumulative Actions): The DEIS (page 205) states:

"[t]his section analyzes 'cumulative' impacts, defined as the impacts on the environment from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions, both Federal and nonfederal... Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

Although a number of potential impacts are considered individually, the DEIS does not assess the potential additive effects including possible food chain effects. If there are uncertainties regarding possible cumulative effects, they should be clearly identified.

Pages IV-432 through IV-433 (Analysis of a Large Oil Spill): This section assesses the possible impacts of a hypothetical

"LGL Ecological Research Associates, Inc. 1991. Effects of Noise on Marine Mammals. U.S. Dept. of Interior, Minerals Management Service, Atlantic Region, Contract No. 14-12-0001-30362.

100,000 barrel oil spill occurring during the winter from a shuttle tanker grounding accident four miles from the coastline near Port Arthur, Texas. It makes no mention of possible impacts on endangered marine mammals and indicates that the bottlenose dolphin would be the only marine mammal species that would be effected by the spill. A number of other marine mammal species occur, at least seasonally, in nearshore waters. As indicated previously, additional data on marine mammals that inhabit nearshore areas should be available from the National Marine Fisheries Service and from other Minerals Management Service contractors conducting research in the Gulf and should be utilized in the EIS. For the reasons noted earlier, data concerning the effects of the Exxon Valdez oil spill on marine mammals and other organisms should be considered when assessing the possible effects of oil spills.

Summary Comments and Recommendations

In summary, the DEIS does not provide a thorough or fully objective assessment of the possible effects of oil and gas activities in the proposed lease sale areas on marine mammals. The Commission believes that the Minerals Management Service can and should expand the EIS to provide a more thorough assessment of both the possible indirect food chain effects and the direct effects of the proposed actions on marine mammals, particularly the endangered sperm whale and West Indian manatee, and possible discrete populations of bottlenose dolphins that may occur in large embayments along the Gulf coast and in offshore areas.

If available information is insufficient to accurately predict the effects of the proposed action, the EIS should identify the uncertainties and describe the additional studies being conducted or planned to resolve the uncertainties and the monitoring programs that will be conducted to ensure that unforeseen effects are detected so that operations can be stopped or be modified before the effects reach significant levels. The Marine Mammal Commission recommends that the critical uncertainties, research needs, and recommendations identified by the August 1989 Minerals Management Service-sponsored workshop on Sea Turtles and Marine Mammals of the Gulf of Mexico be considered and incorporated, as appropriate, into the EIS. In addition the Commission recommends that, if it has not already done so, the Minerals Management Service consult the National Marine Fisheries Service and, where appropriate, the Fish and Wildlife Service to (a) obtain the most current information on the distribution, abundance, relative population discreteness, diet, and important calving/breeding/feeding areas (and uncertainties related thereto) of sperm whales, West Indian manatees, bottlenose dolphins, and other marine mammals known or thought to occur commonly in the northern Gulf of Mexico, and (b) ascertain the types of site-specific and population monitoring programs needed to verify that marine mammals and their habitat

are not adversely affected by offshore oil and gas activities in the northern Gulf of Mexico.

* * * * *

I hope that these comments and recommendations are helpful. If you or your staff have questions about them, please let me know.

Sincerely,

Robert J. Hoffman, Ph.D.
Scientific Program Director

Enclosures

cc: Nancy Foster, Ph.D.
The Honorable Tom Fry
Richard N. Smith, Ph.D.

D. Marine Mammal Protection Act of 1972

The Marine Mammal Protection Act (MMPA) of 1972 (16 U.S.C. § 1361 et seq.) established a moratorium on the taking of marine mammals in waters under U.S. jurisdiction. The Act defines "take" to mean "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal."

Under the MMFA, the Secretary of Commerce is responsible for all cetaceans and pinnipeds, except walruses. The Secretary of the Interior is responsible for walruses, polar bears, sea otters, manatees, and dugongs. The Secretary of Commerce has delegated authority for implementing the Act to the National Marine Fisheries Service; the Secretary of the Interior has delegated authority to the Fish and Wildlife Service.

The Act established the Marine Mammal Commission and its Committee of Scientific Advisors on Marine Mammals. The Commission, in consultation with its Committee of Scientific Advisors, is responsible for overseeing and providing advice to the responsible regulatory agencies, including the Minerals Management Service, on all Federal actions bearing upon the conservation and protection of marine mammals.

The Marine Mammal Protection Act provides that the moratorium on taking may be waived when the affected species or population stock is within its optimum sustainable population range, and will not be disadvantaged by the authorized taking -- e.g., be reduced below its maximum net productivity level, the lower limit of the optimum sustainable population range. Section 101(a)(5) of the Act, as amended, directs that the Secretary, upon request by citizens of the United States, authorize the unintentional taking of small numbers of marine mammals incidental to activities (other than commercial fishing) -- e.g., offshore oil and gas exploration and development -- when, after notice and opportunity for public comment, the Secretary finds that the total of such taking during the five-year (or less) period will have a negligible impact on the affected species or stock, and prescribes regulations setting forth (1) permissible methods of taking; and (2) requirements pertaining to the monitoring and reporting of such taking.

Section 101(a)(5) also specifies that the Secretary shall withdraw, or suspend for a time certain, permission to take marine mammals incidental to oil and gas and other activities if, after notice and opportunity for public comment, the Secretary finds (1) that the applicable regulations regarding methods of taking, monitoring, or reporting are not being complied with, or

(2) the taking is, or may be, having more than a negligible impact on the affected species or stock.

The persons (organizations) conducting the activities are responsible for obtaining the "small take" authorization. Actions taken in this regard by the American Petroleum Institute, representing all operators in the Gulf of Mexico, are described in section....

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MARINE MAMMAL AND HABITAT MONITORING:
REQUIREMENTS; PRINCIPLES; NEEDS; AND
APPROACHES

Steven L. Swartz and Robert J. Hofman

August 1991

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This paper discusses the intents and provisions of section 101(a) of the Marine Mammal Protection Act which allows the Secretaries of the Interior and Commerce to authorize the unintentional taking of small numbers of marine mammals incidental to offshore oil and gas development and other such activities. It explains the rationale for and describes the types of site-specific and population monitoring programs required to document the manner and level of take and to verify that the take has negligible effects on the distribution, size, and productivity of the affected species and populations.

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MARINE MAMMAL AND HABITAT MONITORING REQUIREMENTS, PRINCIPLES, NEEDS, AND APPROACHES

Questions have been raised as to what the oil and gas industry must do to meet the monitoring and reporting requirements of the National Marine Fisheries Service's and Fish and Wildlife Service's final rules authorizing the take of marine mammals incidental to pre- and post-lease oil and gas exploratory activities in the Beaufort and Chukchi Seas. To answer these questions, it is necessary to examine (1) the intent and relevant provisions of section 101(a)(5) of the Marine Mammal Protection Act, (2) the relevant provisions of the rules authorizing the take of marine mammals incidental to oil and gas exploration activities in the Beaufort and Chukchi Seas, and (3) the purposes and primary components of monitoring programs.

Marine Mammal Protection Act

The Marine Mammal Protection Act established a moratorium on the taking of marine mammals by persons and vessels subject to U.S. jurisdiction and the importation of marine mammals and marine mammal products into the United States except in certain cases. The Secretary of Commerce or the Secretary of the Interior, as appropriate, may authorize:

- taking or importation to enhance the survival or recovery of an individual marine mammal or a marine mammal species or stock;
- taking or importation for purposes of scientific research;
- taking or importation from non-depleted species and populations for purposes of public display;
- taking from non-depleted species and populations incidental to commercial fishing operations (Note: this provision was superseded in 1988 for a period of five years);
- unintentional taking of small numbers from both depleted and non-depleted species and populations incidental to activities other than commercial fishing (e.g., offshore oil and gas development); and
- other incidental takes and waivers consistent with the purposes and policies of the Act.

The Small Take Exemption

In 1981, section 101(a)(5) was added to the Act to allow the Secretary of the Interior and the Secretary of Commerce to authorize the incidental but unintentional taking of small numbers of non-depleted marine mammals by U.S. citizens engaged in specified activities (e.g., offshore oil and gas development) within specified geographic regions for periods of 5 years or less when, after notice and opportunity for public comment, the Secretary --

- (i) finds that the total of such taking would have a negligible impact on the affected species or stock, and (ii) prescribes regulations setting forth (a) permissible methods of taking, and (b) requirements for monitoring and reporting such taking.

This provision was amended in 1986 to allow the Secretaries to authorize the take of marine mammals from depleted, as well as non-depleted, species and stocks incidental to activities other than commercial fisheries when the take would have a negligible impact on the affected species or stock and would not have an unmitigable adverse effect on subsistence taking (see explanatory note No. 1).

The purpose of the section 101(a)(5) exemption process is to allow applicants for incidental taking authorization to avoid the more complex procedures for obtaining a waiver of the moratorium on taking, and to allow the incidental taking of marine mammals from endangered, threatened, and depleted species and populations, as well as taking from other species and populations, when the level and the effects of the take would be so small as to be inconsequential and to warrant little or no attention (see explanatory note No. 2). It follows, therefore, that the basic purposes of the monitoring and reporting requirements to be prescribed by the Secretaries of Commerce and Interior should be (1) to verify that the level, manner, and the effects of the take are inconsequential, and (2) to detect any unforeseen level, manner, or effects of take (see explanatory note No. 3).

Although not stated explicitly, these purposes are reflected in the National Marine Fisheries Service's rule authorizing the take of bowhead, gray and beluga whales and ringed, spotted, and bearded seals incidental to pre- and post-lease oil and gas exploratory activities in the Beaufort and Chukchi Seas, (50 C.F.R. § 228.37) and in the Fish and Wildlife Service's rule authorizing the take of walrus and polar bear incidental to oil and gas exploratory activities in the Chukchi Sea (50 C.F.R. § 18.117).

Definition of Take

The Marine Mammal Protection Act defines the term "take" to mean "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." The term "harass" has been interpreted through practice to include any action that results in an observable change in the behavior of a marine mammal -- e.g., abrupt termination of

Implementing Regulations

National Marine Fisheries Service. On 18 July 1990, the National Marine Fisheries Service published in the *Federal Register* (55 Fed. Reg. 29707-29716), a final rule authorizing the incidental, non-lethal take of six species of marine mammals (bowhead, gray and beluga whales, and bearded, ringed, and spotted seals) with no specified limit on the numbers of animals that can be taken in the Beaufort and Chukchi Seas from 1990-1995. To safeguard the spring subsistence hunt of bowhead whales by Alaskan Natives, the rule states that "no taking is to be allowed when bowhead whales are using the spring lead system to migrate through the Chukchi Sea and Beaufort Sea past Pt. Barrow."

With regard to monitoring the effects of pre- and post-lease oil and gas exploration activities, section 228.37 of the rule states that:

"(a) Holders of Letters of Authorization and their employees, agents, and designees must cooperate with the National Marine Fisheries Service and other designated Federal, State or local agencies to monitor the impacts of oil and gas exploration on marine mammals. The holder must notify the National Marine Fisheries Service Alaska Region, of any activities specified in Section 228.33 [of the rule] or any other activity that may involve a potential take at least 30 days prior to the activity in order to satisfy Section 228.37(d) [of the rule]."

"(b) Holders of Letters of Authorization must designate a qualified biologist or another appropriately experienced individual to observe and record the effects of exploration activities on marine mammals. The observer must be approved by the National Marine Fisheries Service."

"(c) When applying for a Letter of Authorization, the applicant must include a site-specific plan to monitor the effects on populations of marine mammals that are present during exploration activities. This plan, which must be approved by the National Marine Fisheries Service, should identify what survey techniques will be used to determine the movements and activity of marine mammals near the exploratory sites including migration and other habitat uses, such as feeding. A qualified biologist or another appropriately experienced individual must observe the behavior of the marine mammals present to determine if they are being affected. The monitoring program should document the acoustical effects on marine mammals and

The final rule requires estimation and reporting of the actual, level, and type of take, the numbers and direction of movement of each species observed, and any observed changes or modifications in behavior.

50 C.F.R. § 218.32 does not specify which species may not be taken during the spring bowhead migration. Thus, the rule conceivably prohibits the taking of any marine mammal "when bowhead whales are using the spring lead system to migrate through the Chukchi and Beaufort Sea past Pt. Barrow."

breeding or feeding, avoidance behavior, and changes in swimming speed, dive frequency, dive duration, or direction of movement.

The Endangered Species Act defines the term "take" to mean "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." The term "harm" in the Endangered Species Act's definition of "take" has been interpreted to include harm through degradation or destruction of habitat (see *Pallua v. Hawaii Department of Land and Natural Resources*, 639 F.2d 495 (9th Cir. 1981)).

Possible Types of Takes

Offshore oil and gas exploration may "take" marine mammals in a variety of ways. As examples, disturbance and noise from ship and aircraft operations, seismic profiling, and exploratory drilling may: (a) interfere with or disrupt communications, feeding, breeding, or other vital functions; (b) cause animals to avoid or abandon important feeding areas, breeding areas, resting areas, or migratory routes; (c) cause animals to use marginal habitat or to concentrate in undisturbed areas which in turn may result in crowding, over-exploited food resources, increased mortality, and decreased reproduction; (d) stress animals and make them more vulnerable to parasites, disease, and/or predation; (e) attract animals making them more vulnerable to oil spills, hunting, or harassment; and (f) affect marine mammals by altering the distribution, density, movements, or behavior -- i.e., the availability -- of important prey species.

If drilling is undertaken, there is an added risk of oil spills and discharges of other contaminants which may: (a) kill or debilitate marine mammals by matting and reducing the insulating quality of fur, by acute or chronic poisoning due to inhalation or ingestion of toxic compounds or ingestion of contaminated food, by irritation of skin, eyes, or mucous membranes, or by fouling of the feeding apparatus of baleen whales; (b) kill, debilitate or otherwise reduce the abundance or productivity (availability) of important marine mammals, prey species and/or species lower in the marine food web, and cause acute or chronic nutritional deficiencies including starvation; (c) stress animals making them more vulnerable to disease, parasitism, and/or predation; (d) interfere with formation of mother young bonds and cause mothers to abandon their young; (e) cause animals to abandon or avoid contaminated breeding areas, feeding areas, etc. and/or to concentrate in unaffected areas; and (f) attract animals to debilitated prey making them more vulnerable to contact with harmful compounds and oil and ingestion of contaminated prey. Also, increased ship traffic may alter physical and acoustic characteristics of certain habitats and increase the probability of collisions between ships and marine mammals, as well as disturb or otherwise take marine mammals.

document or estimate the actual level of take (Emphasis added). The requirements for monitoring plans may vary depending on the activity, the location, and the time.

"(d) At its discretion, the National Marine Fisheries Service may place an observer on board drillships, aircraft, etc. to monitor the impact of exploration activities on marine mammals.

"(e) The holder of a Letter of Authorization must submit a report to the Assistant Administrator for Fisheries within 90 days of the completion of any exploratory activities. This report must include the following information:

- (1) Dates and types of activities;
- (2) Dates and locations of any activities related to monitoring the effects of exploration on marine mammals; and,
- (3) Results of the monitoring activities including an estimate of the actual level and type of take, species name and numbers of each species observed, direction of movement of species, and any observed changes or modifications in behavior. [Emphasis added]

"(f) Results of behavior, feeding, or population studies must be made available to the National Marine Fisheries Service before applying for a Letter of Authorization for the following year."

Fish and Wildlife Service: On 14 June 1991, the Fish and Wildlife Service published in the Federal Register (56 Fed. Reg. 27443-2764) a final rule authorizing the incidental and unintentional take of small numbers of walrus and polar bears "during open water exploration for oil and gas in the Chukchi Sea adjacent to the coast of Alaska" during the next five years. The rule prohibits the incidental take of both walrus and polar bears "during the period in which walrus are migrating through the spring lead at a given location." It specifies that "[w]hen applying for a Letter of Authorization, the applicant must submit a plan of cooperation that identifies what measures have been, and will be, taken to minimize any adverse effects on the availability of walrus and polar bears for subsistence uses if the activity takes place in or near a traditional subsistence hunting area." The requirements for monitoring and reporting are similar to the requirements set forth in the National Marine Fisheries Service's rule as described above.

Monitoring and Reporting Requirements

Site Specific Monitoring

Purposes and Goals As noted earlier, section 101(a)(5) of the Marine Mammal Protection Act allows the Secretaries to authorize the taking of small numbers of depleted and non-depleted marine mammals if he or she finds that the total of the taking "will have a negligible impact on the species or stock and will not have an unmitigable adverse impact on the availability of the species for subsistence uses" and prescribes permissible methods of takes and requirements pertaining to monitoring and reporting of such takes. From the preceding it follows that the basic purposes of the monitoring reporting programs are to determine and report when, where, how, and how many marine mammals, by species, age, size and sex, are taken in the course of authorized pre- and post-lease exploration activities.

Design Requirements The first task in designing a monitoring reporting program to meet the requirements of section 101(a)(5) of the Marine Mammal Protection Act is to formulate hypotheses based on the best available information as to when, where, how, and how many marine mammals, by species, age, size, and sex, may be "taken" in various ways incidental to the planned pre- and post-lease exploratory activities. The formulation of testable hypotheses provides a conceptual framework for the monitoring program and a basis for determining the most appropriate sampling design (see for example Abbott and Benninghoff 1990). In this case, it might be hypothesized, for example, that bowhead, gray, and beluga whales will detect and change swimming direction to avoid noise from exploratory drill rigs at distances up to ten or more miles and that bearded, ringed, and spotted seals, walrus and polar bear will be unable to detect or will not respond to such noise.

The second task is to design programs to cost effectively verify the hypothesized manner and level of taking. In this context, it must be kept in mind that some forms of take may occur beyond the field of view of an observer at a particular site (e.g., a drill rig or seismic exploration ship) and that the monitoring program must be designed accordingly. In this regard, a "site" would be defined as an area or zone of influence around a particular activity in which a take might occur. Such an area might be defined as the distance from the source (e.g., the ship or platform) at which some proportion (e.g., 50%, 75%, 95%, or 100%) of the animals respond or fail to respond to water-borne noise.

Confirming that the Effects of the Observed Take are in Fact Negligible

The site-specific monitoring programs, if designed and carried out appropriately, should identify the numbers of animals by species, and in some cases age, size, and sex, taken in various ways incidental to the authorized pre- and post-lease exploratory activities. The resulting data may be insufficient, however, to verify that the effects of the take are

negligible (i.e., inconsequential). This determination requires that programs be in place to provide information on the status of the affected populations during the pre- and post-lease exploration period. The parameters of concern in this regard are, with respect to effects on population status -- abundance and productivity -- and with respect to availability for subsistence uses -- distribution and abundance. In this context, the goal of monitoring is to assure that offshore oil and gas exploration, by itself and in combination with other human activities and natural events, does not cause any species or population to be reduced or maintained below its optimum sustainable level (see explanatory note No. 4).

This goal was recognized by Congress when it passed the Outer Continental Shelf Lands Act Amendments of 1978 to provide for, among other things, controlled exploitation of oil and gas resources. Section 20 of the 1978 Amendments¹ requires the Secretary of the Interior to conduct environmental monitoring studies, including post-lease studies. "In order to establish information needed for assessment and management of environmental impacts on the human, marine, and coastal environments of the Outer Continental Shelf and the coastal areas which may be affected..." and "in a manner designed to provide time-series and data trend information which can be used for comparison with any previously collected data for the purpose of identifying any significant changes in the quality and productivity of such environments, for establishing trends in the areas studied and monitored, and for designing experiments to identify the causes of such changes."

To meet these goals, monitoring/reporting programs must be adequate to detect changes in population parameters that indicate the overall status of potentially affected species and populations. Programs must be sufficiently broad in their scope to discriminate between natural variation and human caused changes in the parameters being monitored. Baseline information must be of sufficient duration to establish the natural range of parameter values or, at a minimum, to document vital population parameters at the onset of the authorized oil and gas exploration activities.

As noted earlier, some forms of take (e.g., noise disturbance from seismic exploration) may occur beyond the field of view of an observer or may be inconspicuous rather than overt and yet have significant effects on individual survival or productivity, which in turn may affect population size and vital rates. It would be prohibitively costly, if not impossible, to assess and monitor all species and population parameters that may be affected by pre- and post-lease oil and gas exploration activities. It may be possible, however, to select and monitor a set of key species and parameters (i.e., indicator species and variables) that are likely to be sensitive to and to change in overt and measurable ways in response to the planned exploratory activities.

In this regard, the possible indicators might include indices of relative abundance (e.g., pup or calf counts, number of sightings per kilometer of survey, etc.), and indices of

¹ 43 U.S.C. § 1346, Public Law 95-372 (1978), 30 C.F.R. § 250.0 et seq. and 251.0 et seq.).

population status related to habitat carrying capacity (e.g., reproductive rates, survival rates, weight, behavior, etc.) (see for example Gerrodette and DeMaster 1990).

If changes are detected, judgments must be made as to the cause or causes of the change. To do this will require corollary information on possible changes in key environmental variables (e.g., changes in the extent, duration and thickness of seasonal ice cover, changes in prey availability, etc.) and on the nature, location, duration, and scale of human activities that may have caused or contributed to the observed changes. Thus, a second aspect of the site-specific monitoring/reporting requirement is to maintain a careful record of activities that may, by themselves or in conjunction with other activities, have direct effects or indirect effects (e.g., food chain effects) on the distribution, abundance or productivity of the affected species and populations.

When designing the site-specific programs, judgments must be made as to what activities might have direct, indirect, and cumulative effects, and what information must be collected and archived to permit retrospective assessment of possible cause-effect relationships. Similarly, when designing the long-term population monitoring programs, consideration must be given to environmental variables that must be monitored to be able to determine, retrospectively, whether observed changes are a product of natural environmental change or anthropogenic factors. In addition, marine mammal responses to exploration activities observed in the course of site-specific monitoring programs may provide information symptomatic of adverse effects. Once a particular response is linked to a particular activity, actions to mitigate, avoid, or reduce the effects may be considered.

In summary, the following, in addition to site-specific monitoring, must be done to verify that authorized pre- and post-lease oil and gas exploration activities have negligible effects:

1. determine and select species and population parameters most likely to change in detectable ways as a result of oil and gas exploration (and development) and that indicate the status of the affected populations (e.g., abundance, distribution, reproduction, survival, etc.);
2. ensure that there is adequate baseline information to define the current state of, and, as possible, the expected range of natural variation in, the indicator parameters selected for monitoring;
3. design and carry out monitoring programs of sufficient scale and duration to detect changes and identify trends in the selected indicator parameters, and
4. identify, and ensure compilation of accurate records on the nature and scale of environmental and anthropogenic factors that may cause or contribute to changes in the variables being monitored (e.g., ice extent

and thickness, drilling construction and operation, supply boat and helicopter operations, oil discharges, etc.) for retrospective assessment of possible cause-effect relationships should changes in the selected indicator parameters be detected.

Responsibility for Monitoring Programs

The monitoring requirements of section 101(a)(5) of the Marine Mammal Protection Act would be satisfied, in part, by site-specific monitoring and reporting programs. Additional monitoring to detect possible changes and trends in the size, distribution, and productivity of the affected species and populations is necessary to verify the required determinations of "negligible impact" and "unmitigable adverse impact on the availability of the species or population for subsistence use."

It could be argued that the oil and gas industry, as a condition of doing business, is or should be responsible for (a) population monitoring necessary to verify that authorized activities have negligible effects as well as site-specific monitoring to determine when, where, how, and how many animals are taken incidentally in the course of authorized activities, and (b) maintenance of records on activities and environmental variables that could cause or contribute to changes in the indicator variables being monitored. Conversely, it might be argued that, because the public is the beneficiary of the oil and gas resources and that Federal and state agencies have statutory responsibility for managing resource development and maintaining "optimum" marine mammal populations and habitats, government and industry share responsibility, at least for long term monitoring. It also might be argued that offshore oil and gas exploration is but one of a variety of activities that may be affecting the species and populations in question and that, to the extent that they may be having effects, subsistence users, fishermen, coastal developers, etc. should be contributing to the monitoring programs.

The National Marine Fisheries Service and the Fish and Wildlife Service have lead-agency responsibility under the Marine Mammal Protection Act and the Endangered Species Act, for ensuring that human activities do not cause marine mammal populations to be reduced or maintained below their optimal sustainable level. As noted earlier, under the Outer Continental Shelf Lands Act, the Department of the Interior's Minerals Management Service is responsible for establishing baselines and post-lease monitoring programs necessary to identify any significant changes in the "human, marine, and coastal environments" affected by offshore oil and gas activities. State agencies also have related responsibilities.

A compelling argument might be made that responsibility for carrying out various parts of the required monitoring programs should be shared by interested and responsible agencies and special interest groups that are the beneficiaries of the proposed activities. That is, the oil and gas industry should be responsible for site-specific monitoring and related

record keeping and various state and Federal government agencies should be responsible for long-term environmental and population monitoring. Funding for all or parts of the population and environmental monitoring programs might be provided by various user groups whose activities could be affecting the species and populations in question. Since both site-specific and long-term population monitoring programs are necessary to meet the intents and provisions of 101(a)(5), both the monitoring requirements and the funding issue should be resolved before any Letters of Authorization are issued.

Peer Review

As with basic research, monitoring programs should be subject to peer review at both the planning and the data analysis and reporting stages. Such independent external review provides a means for program managers and decision-makers to ensure that the program design and the analysis and interpretation of program results are unbiased and properly justified (see, for example, Arctic Research Commission 1989).

Review boards or panels should be comprised of impartial experts from relevant scientific disciplines. They should be asked to review and comment on or make recommendations concerning such things as: the appropriateness of methods proposed to be used to determine when, where, what, how and how many marine mammals are taken incidentally to authorized exploration and related support activities; the adequacy of planned survey effort; the reliability of survey and behavioral observation data; the appropriateness of statistical and other procedures used to analyze and compare data sets; and the validity of the program results and conclusions drawn therefrom. Representatives of the responsible regulatory agencies, affected industry and Native groups, and interested environmental organizations should be invited to participate in panel meetings as observers. The findings, conclusions and recommendations of the independent peer reviews should be made available to interested organizations and individuals, as well as the responsible regulatory agencies.

Geographic Information Systems

Many of the data necessary to determine and monitor the effects of oil and gas exploration and development have geographic attributes -- e.g., the locations and movements of whales relative to drill sites, bottom topography, etc. Organization, archiving, recovery and analyses of such data can be enhanced through the use of Geographic Information Systems (see, for example, Reynolds and Haddad 1990).

The utility of Geographic Information Systems should be considered and, as appropriate, be factored into the development of both site-specific and population monitoring programs.

* * * * *

References

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- Reynolds, J.E. III and K.D. Haddad (editors). 1990. Report of the workshop on Geographic Information Systems as an aid to managing habitat for West Indian manatees in Florida and Georgia. Florida Dept. of Nat. Resources Marine Research Publication No. 49. 57 pp.

Explanatory Notes

Explanatory Note No. 1, Sections 101(a)(5)(A) and (B) of the Marine Mammal Protection Act

As amended, this section of the Act states that:

"(A) Upon request therefore by citizens of the United States who engage in a specified activity (other than commercial fishing), within a specified geographical region, the Secretary shall allow, during periods of not more than five consecutive years each, the incidental, but not intentional, taking by citizens while engaging in that activity within that region of small numbers of marine mammals of a species or population stock if the Secretary, after notice (in the Federal Register and in newspapers of general circulation, and through appropriate electronic media, in the coastal areas that may be affected by such activity) and opportunity for public comment--

(i) finds that the total of such taking during each five-year (or less) period concerned will have a negligible impact on such species or stock and will not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses pursuant to subsection (b) or section 104(f), or, in the case of a cooperative agreement under both this Act and the Whaling Convention Act of 1949, pursuant to section 112(c), and

(ii) prescribes regulations setting forth--

(I) permissible methods of taking pursuant to such activity, and other means of effecting the least practicable adverse impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for subsistence uses, and

(II) requirements pertaining to the monitoring and reporting of such taking

"(B) The Secretary shall withdraw, or suspend for a time certain (either on an individual or class basis, as appropriate) the permission to take marine mammals under subparagraph (A) pursuant to a specified activity within a specified geographical region if the Secretary finds, after notice and opportunity for public comment (as required under subparagraph (A) unless subparagraph (C)(i) applies), that--

(i) the regulations prescribed under subparagraph (A) regarding methods of

taking, monitoring, or reporting are not being substantially complied with by a person engaging in such activity, or

(iii) the taking allowed under subparagraph (A) pursuant to one or more activities within one or more regions is having, or may have, more than a negligible impact on the species or stock concerned.

Explanatory Note No. 2, Negligible Effect The U.S. House of Representatives' Report on the 1981 amendments to the Marine Mammal Protection Act (Report No. 97-228) indicates (p. 19) that the term "negligible" is intended to mean an impact which is able to be disregarded and notes that Webster's Dictionary defines "negligible" as "so small or unimportant or of so little consequence as to warrant little or no attention." In general, an impact which, by itself and in combination with other impacts, would have no negative effect on population distribution or size lasting more than twelve months (one year) or cause less than a 5-10% increase in the time it would take a depleted stock to recover to its maximum net productivity level could be considered negligible (i.e., "so small or unimportant or of so little consequence as to warrant little or no attention"). Any impact that would increase the rate of decline of a declining species or population, decrease the rate of recovery of a depleted species or population, or affect a stable species or population, such that its distribution or size would be reduced for a period greater than one year, generally could not be considered negligible.

Explanatory Note No. 3, Verification of Small Numbers On 29 September 1989, the Secretary of the Interior and the Secretary of Commerce jointly published general regulations implementing the 1986 amendments to the Marine Mammal Protection Act. Among other things, the regulations defined "small numbers" to mean "a portion of a marine mammal species or stock whose taking would have a negligible impact..." and defined "negligible impact" as "an impact resulting from the specified activity that cannot be reasonably expected to, and is not likely to, adversely affect the species through effects on annual rates of recruitment or survival" (50 C.F.R. § 228.3).

The Marine Mammal Commission commented, by letter of 9 February 1990 to the National Marine Fisheries Service, that this definition effectively eliminated the distinction between the independent requirements of the Marine Mammal Protection Act section 101(a)(5) that only takings of small numbers may be authorized, and then, only if such taking would have a negligible impact on the species or stock. In this context, the Commission noted that Congress, in passing section 101(a)(5), recognized the "imprecision of the term 'small take', but was unable to offer a more precise formulation because the concept is not capable of being expressed in absolute numerical limits" (H.R. Rep. No. 228, 97th Cong., 1st Sess., 1981). However, the statute clearly states that the taking of only small numbers of marine mammals may be authorized and the legislative history explicitly states the requirement that the take have a negligible impact is an "additional and separate safeguard."

Id. To give full weight to the statutory provision limiting takes of marine mammals incidental to activities other than commercial fishing to small numbers, the Secretaries must verify that in fact "small numbers" are being taken and that the take would have no more than a "negligible impact" on the affected species population. Such determinations would, at minimum, require: (1) estimation of the numbers of animals potentially affected by the proposed development activities, and (2) estimation of the size and status of the affected populations.

Explanatory Note No. 4, Optimum Sustainable Population The Marine Mammal Protection Act, as amended, defines the term "optimum sustainable population" to mean: "with respect to any population stock, the number of animals which will result in the maximum productivity of the population or the species, keeping in mind the carrying capacity of the habitat and the health of the ecosystem of which they form a constituent element." For operational purposes, the National Marine Fisheries Service and the Fish and Wildlife Service have interpreted this definition to mean "a population size which falls within a range from the population level of a given species or stock which is the largest supportable within the ecosystem to the population level that results in maximum net productivity (MNP)." Maximum net productivity is defined as "the greatest net annual increment in population numbers or biomass resulting from additions to the population due to reproduction and or growth less losses due to natural mortality" (50 C.F.R. § 216.3).

The House of Representatives' Committee on Merchant Marine and Fisheries considered this regulatory definition of Optimum Sustainable Population in 1981 "and determined that, given the present state of scientific knowledge, [the] definition accurately reflects the intent of Congress in passing the original Act [in 1972]" (H.R. Rep. No. 97-228, 97th Cong., 1st Sess. (6 (1981))).

* * * * *

MARINE MAMMAL MONITORING REPORTING PROGRAMS

I. Basic purpose of monitoring and reporting requirements

To verify the predicted effects and detect any unforeseen effects of authorized pre and post-lease oil and gas exploration activities

II. Site-Specific Monitoring

A. Basic Purposes

1. Determine when, where, how, and how many marine mammals, by species, age/size, and sex, are taken, and.
2. Document, for retrospective analysis, the nature, location, duration, and scale of pre- and post-leasing oil and gas exploration activities that might affect marine mammals.

B. Key Tasks

1. Formulate hypotheses as to when, where, how, and how many marine mammals, by species, age/size, and sex, may be taken.
2. Design and carry out programs to test these hypotheses -- i.e., to document when, where, how, and how many marine mammals, by species, age/size, and sex, are taken, and.
3. Compile and maintain records on the location, timing, and scale of exploratory activities and environmental factors that may affect marine mammals.

III. Long-Term Monitoring

A. Basic Purposes

1. Verify that the effects of pre- and post-lease oil and gas exploration activities, by itself and in combination with other activities, are negligible (i.e., inconsequential).
2. Detect and measure changes in the status of affected species and populations, and.

3. Judge whether observed changes are the result of anthropogenic or natural factors, or both.

B. Key Tasks

1. Formulate hypotheses as to how the distribution, size, or productivity of the affected populations might be affected by the authorized activities.
2. Determine which species and population parameters are most likely to change in detectable ways if impacted by the authorized activities.
3. Determine whether there is adequate baseline information to define the current state of, and range of natural variation in, the indicator parameters selected for monitoring.
4. Design and carry out monitoring programs of sufficient scale and duration to detect changes and identify trends in the selected indicator parameters.
5. Compile and maintain records on environmental variables that may affect population variables monitored; and.
6. Conduct retrospective analyses of industrial and environmental records to determine the probable cause or causes of observed changes in the population variables being monitored.

MARINE MAMMAL COMMISSION
1625 EYE STREET N.W.
WASHINGTON, DC 20006

30 March 1990

Nancy Foster, Ph.D.
Director
Office of Protected Resources and
Habitat Programs
1335 East-West Highway
Silver Spring, MD 20910

Dear Dr. Foster:

The Marine Mammal Commission, in consultation with its Committee of Scientific Advisors on Marine Mammals, has reviewed the American Petroleum Industry Member Companies' "Petition for Promulgation of Regulations Pursuant to Section 101(a)(5) of the Marine Mammal Protection Act for the Removal of Offshore Structures and Related Facilities in the Gulf of Mexico," as described in the National Marine Fisheries Service's January 30, 1990 Federal Register Notice (55 Fed. Reg. 3074). We offer the following comments and recommendations concerning the assessment of the possible effects of the proposed removal of offshore oil and gas structures on Gulf of Mexico populations of bottlenose dolphins (*Tursiops truncatus*) and other marine mammals.

GENERAL COMMENTS

Section 101(a)(5) of the Marine Mammal Protection Act permits the Secretary of Commerce to allow the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) provided, among other things, that the total taking will have a "negligible impact" on the species or stock.

The petitioners propose to remove an estimated 600 oil and gas structures from the Gulf of Mexico with explosives during the next five years, and estimate that some 5,500 such structures will need to be removed over the next 25 years. To date, over 125 oil and gas structures have been removed from the Gulf of Mexico using the proposed methods. To avoid adverse impacts on endangered and threatened marine turtles, the National Marine Fisheries Service has required, pursuant to Section 7 of the Endangered Species Act, that the Minerals Management Service and the petitioners adhere to recommendations made by the National Marine Fisheries Service. As an interim measure, the Minerals Management Service and the platform removal operators have followed these recommendations to also avoid taking dolphins. These measures included: (1) conducting 30-minute aerial surveys

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within one hour before and after each blasting episode to look for dolphins in the vicinity of the rig to be removed; (2) using qualified observers to conduct the surveys; (3) delaying blasting until animals are at least 1000 yards from the site; (4) detonating explosives no earlier than 1 hour after sunrise and no later than 1 hour before sunset; and (5) staggering charges 0.9 seconds to minimize the cumulative effects of multiple blasts.

The petitioners state that impacts on dolphins will come from exposure to sound and pressure waves associated with detonating charges of 50 pounds or less of explosive material and that the radius of injury to dolphins is estimated at around 200 yards. The petitioners state that the most likely form of incidental take will be harassment from low level sound pressure waves, however, animals close to a detonation could be killed as a result of tissue destruction. The petitioners do not provide or reference the data or calculations used to conclude that animals beyond 200 yards are not likely to be injured by blasts or that the most likely form of take will be harassment. Further, they provide no evidence that blasts will not temporarily or permanently affect the hearing of dolphins that either are within or beyond 200 yards of the blast sites.

The petitioners also do not indicate the numbers of dolphins and other marine mammals that possibly could be affected, or how the effects might be compounded by such things as incidental take during commercial fishing operations, live captures, and the unusual dolphin mortality that is occurring in the Gulf at the present time. Without reliable information on the number of dolphins that might be affected, and how the populations are being affected by other human activities or natural events, it is not possible to make the findings necessary to obtain a "small take" exemption.

The Commission recognizes that the Service has defined "small numbers" to mean "a portion of a marine mammal species or stock whose taking would have a negligible impact..." (50 C.F.R. § 228.3), but notes that this definition effectively eliminates the distinction between the two independent requirements of Marine Mammal Protection Act section 101(a)(5), that only takings of small numbers may be authorized, and then, only if such taking would have a negligible impact on the species or stock. In this context, it should be noted that Congress, in passing section 101(a)(5), recognized the "imprecision of the term 'small take', but was unable to offer a more precise formulation because the concept is not capable of being expressed in absolute numerical limits." H.R. Rep. No. 228, 97th Cong., 1st Sess. (1981). However, the statute is clear that only the taking of small numbers of marine mammals may be authorized and the legislative history explicitly states that the requirement that the taking have a negligible impact is an "additional and separate safeguard." *Id.* To give full weight to the statutory provision

limiting takes of marine mammals incidental to activities other than commercial fishing to small numbers. The Commission recommends that the Service estimate the numbers of each species of marine mammal that may be taken and fully explain its determination as to whether those numbers are appropriately characterized as "small".

Specific Comments

Page 2. Standards for consideration of the request: NOAA has been authorized to permit the incidental taking of small numbers of non-depleted marine mammals since 1981, not 1971.

Pages 22-23. Question 1. The species and numbers of marine mammals likely to be taken: The petitioners do not identify the numbers, age, sex, and reproductive condition of animals that potentially could be taken by removal activities. We suggest that the results of surveys conducted before and following removals conducted to date be analyzed to estimate the number of animals that potentially could be taken.

On page 23 the petitioners note that "National Marine Fisheries Service observers were present at each...removal operation and reported no dolphin fatalities." It is likely that monitoring following the removals would detect only those animals floating at the surface. Dolphins and many other marine mammals tend to sink after death and float to the surface as decomposition progresses, sometimes days later. Also, injured dolphins may die sometime later far from the blast site. Therefore, to evaluate the numbers of dolphins killed but not detected floating at the surface following a blast, the petitioners should undertake surveys to locate floating and beached carcasses at appropriate periods (e.g., 1,3,5-10 days) following the removal of oil and gas structures.

On a related point, it should also be noted that a recent study (Klima, et al., 1988) reports a possible association between the removal of offshore oil structures and the occurrence of stranded dead turtles and dolphins in the Gulf of Mexico.

Pages 24-25. Question 4. A description of the status, distribution and seasonal distribution of the affected species or stock: The petitioners state that the variation in dolphin abundance from area to area is possibly related to "food abundance", "geographic structure of habitats and relative amount and kind of human activity..." (page 25). The data in the petition on the status, distribution and seasonal movements of bottlenose dolphin populations provided in the petition are more than 10 years old and not appropriate for evaluating the current status of potentially affected populations. Also the information fails to note that there may be more or less discrete populations or stocks in different areas along the coast and that near-shore

and off-shore populations may be discrete. The assessments should consider more recent data on dolphin populations in the Gulf of Mexico (e.g., Scott et al. 1989, Wells 1987, Loehleffner et al. 1987, and Schmidly and Scarbrough 1989).

Pages 29-32. Question 4. Continued. Status of spotted dolphin populations: The petitioners do not provide up-to-date information on the abundance and distribution of spotted dolphins. In addition, they state that the spotted dolphin population does appear to be stable, but no data or references to support the statement are provided (page 29). The statements regarding distribution of the species are also inconsistent. For example, on page 29 they state "spotted dolphins occur primarily near coastal areas," while the next sentence states "they are an offshore species throughout their range." It is not possible to assess the potential effects of the proposed activities on spotted dolphins with the information provided in the petition.

As a related matter, papers presented at the August 1989 Minerals Management Service sponsored Workshop on "Sea Turtles and Marine Mammals of the Gulf of Mexico" (Hain, in prep) suggest that several other marine mammal species are more likely to be present in the area than spotted dolphins. Schmidly and Scarbrough (1989) indicate that 27 cetacean species occur in the Gulf of Mexico, 12 of which are cosmopolitan in their distribution. Recent information on all marine mammal species likely to be found in the area should be reviewed and present estimates of the possible take of each species should be developed.

Pages 33-40. Question 5. Anticipated impact of the activity upon the species or stocks: The petitioners state that the "...sizes of the explosive charges used in offshore structure removal operations are relatively small, generally fifty pounds or less," and that "...the radius of slight injury to dolphins is estimated to be around 200 yards." Information is not, but should, be provided on the kind and characteristics of explosives that will be used as well as the data and calculations used to arrive at this conclusion. The results of research by Goertner, (1982), Aubrey and Thomas (1987), Klima et al. (1988), Myrick et al. (1990), Majors and Myrick (1990) and others which suggest that hearing damage as well as physical injury can occur from explosions, should be considered.

In this regard, recent studies by scientists at the Southwest Fisheries Center suggest that dolphins may be seriously injured by the detonation of Class C explosives containing approximately 40 grains (2.59 grams) of explosive material (e.g. potassium perchlorate or potassium chlorate, if they are within 0.6 meters of the explosion (Myrick et al., 1990). In addition, research on dolphin hearing and acoustic sensitivity suggests these animals may sustain hearing loss and impairment of their

Pages 15-19. Question 2. The availability and feasibility of the various methods and manner of conducting such activity are not the same. The least practicable adverse impact means of effecting the least practicable adverse impact is recommended below. It would be useful and appropriate for the participants to conduct monitoring programs during and following a representative subset of the platform removals to resolve uncertainties concerning the possible effects of this removal on the marine mammals and other components of the ecosystem to verify that the proposed activities constitute the "least practicable adverse impact" upon the affected species or stocks.

PAGES 1-17 Question 10 Suggested means of accomplishing the necessary monitoring and reporting which have been used at increased frequency of the species level or family or genus level. It is not clear in the petitioners' response whether the monitoring and reporting program will be undertaken as described. For example, in point (c) they state that "the proposed monitoring system... does not require that the petitioners do more than report the results of the monitoring." The petitioners are asked to evaluate the "adequacy" of the monitoring system as it is currently being conducted by the petitioners. In addition, the breadth and scope of the monitoring system must be stated.

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sonar capability from exposure to these same Class C devices at much greater distances.

The petitioners should more fully review the literature on the effect of exposure to underwater explosions and, using the data and models from the above mentioned studies, provide a better documented estimate of the injury (e.g., tissue damage, hearing loss, impairment of acoustic sensitivity, etc.) that could result from exposure to underwater explosions of the magnitudes proposed. In addition, it would be useful to provide actual measurements of sound pressure levels recorded at various distances from explosions during removal operations or, if these data are not available, conduct measurements of sound transmission and attenuation during future removals.

The petitioners should not be expected to pay for the cost of the National Marine Fisheries Study, and the Government should not be expected to pay for the cost of the National Marine Fisheries Study. The petitioners should not be expected to pay for the cost of the National Marine Fisheries Study, and the Government should not be expected to pay for the cost of the National Marine Fisheries Study.

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modification of these [detonation] time restrictions... "blasting may be allowed to proceed outside of this time frame" (emphasis added). It should made be clear what "special circumstances" would justify such a modification.

On point (7) the use of scare charges should be prohibited, not just "avoided."

Page 52. Question 11. Suggested means of learning of, encouraging, and coordinating research opportunities, plans, and activities. Information provided on the effects of the proposed removal activities is insufficient to evaluate their potential impact on marine mammals due to: (1) uncertainties concerning the direct physical effects of the underwater use of explosives on potentially affected species and the environment; and (2) uncertainties concerning the species, population structure, numbers, ages, sexes, and reproductive states of the potentially affected animals. It would be useful and appropriate, therefore, to undertake monitoring concurrent with the removal activities to verify the predicted effects and detect any unforeseen effects of the proposed activities.

Summary

In summary, the petitioners do not provide a complete assessment of the possible impacts of the proposed action on bottlenose dolphin or other marine mammal populations in the region. Among other things, they do not provide an assessment of the numbers of bottlenose dolphins or other species of marine mammals that possibly could be affected, or how the effects might be compounded by other sources of mortality or injury. Without estimates of the numbers of animals that could be affected, it is not possible to make the findings necessary to obtain a "small take" exemption. In addition, the petitioners do not provide a clear indication of whether the interim measures recommended by the National Marine Fisheries Service will adequately address the uncertainties noted above.

The Marine Mammal Commission believes that the proposed activities likely would have negligible impacts on the affected populations of marine mammals. The Commission also believes that the requested exemption should be granted provided that: (a) the applicants present information indicating that only small numbers of the various marine mammal species will be taken; and (b) a monitoring program is undertaken to verify the predicted effects and to detect possible unforeseen effects of the proposed removals on bottlenose dolphins and other marine mammals. In this regard the Commission recommends that the monitoring program include:

1. continuous aerial and ship surveys in the vicinity of blast sites from one hour before to one hour after a representative sample of removals to verify that no

animals move to within 1000 yards of platforms being removed before detonation of charges or during the period of sequential blasts, to observe possible change in the behavior of animals near the perimeters of the 1000 yard blast buffer zone, and to detect and recover dead, floating dolphins:

2. daily surveys for 2-10 days after blasts to locate and recover "floaters" (floating dolphin carcasses), and carcasses that wash up on beaches in the area;
3. recovery and necropsy of all "floaters" and beached carcasses to look for blast related injury and damage and, where possible, to determine the cause of death;
4. behavior studies before, during, and after the blasts to look for aberrant behavior potentially caused by hearing impairment;
5. examination of the ear bulla (tympanoperiotic bones) of "floaters" and beached carcasses for evidence of hearing damage; and,
6. if they have not already been done, measurements of sound pressure levels generated during a representative sample of rig removals to verify estimated sound levels at various distances taking into account differences in water depth, bottom type, construction of the platforms being removed, etc. and other variables that may influence the characteristics or transmission of the sound produced by the explosion.

If you or your staff have questions about our comments or recommendations, please let me know.

Sincerely,

Robert J. Hofman, Ph.D.
Scientific Program Director

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MARINE MAMMAL COMMISSION

MMC-1

The terminology of statements and conclusions contained in MMC-1 has been reviewed and enhanced and endangered and threatened marine mammals has been clarified through the following: to clarify their meaning. Consequently it is easier to document the direct support provided by the data analyses and references that provide these statements and conclusions. Current references (e.g., Mullin personal communication 1993, Mullin personal communication 1993, Herwood personal communication 1993) have been added to the text where appropriate to further support the MMS position on specific areas of concern in the MMC-1.

While the diet of some species is poorly documented, several generalities can be made. The hansen whales are known now to be quite uncommon in the Gulf and is believed that their food (zooplankton and small fishes) might be the most easily contaminated by oil and effluents. The odontocetes are primarily fish and squid eaters, with the notable exception of the killer whale which is capable of devouring other cetaceans and sea turtles. The uncommon ziphoid whales (the three phocaenids) and some of the offshore delphinids are predominantly squid eaters. The offshore delphinids are believed to feed on fish and squid. The degree to which the various food resources could be contaminated or reduced is small. The predatory nature of cetaceans and their ability to travel great distances over great distances suggest that the effects of toxic and other contaminants would be minimal and temporary.

Descriptions of the diet, feeding areas, and food requirements of the various marine mammal species in the Gulf can be found in Section III B 1a. A summation of the seasonal abundance information in Section III for marine mammal species that occur in and near the proposed lease area has been inserted into appropriate areas of Section IV D 1a to address MMC-1 concerns.

The ongoing MMS study of the distributions of cetaceans of the continental shelf off the Central and Western Gulf of Mexico has been designed to gather valuable information on the seasonal abundance of the various species in the area and will attempt to correlate their presence and densities with oceanographic features and events. The available seasonal abundance information was unavailable for incorporation into this writing but will be included in future marine mammal analyses.

MMC-2

Reports of the investigations on *Tursiops* mortalities and genetic relatedness will be available in 1994, but at present there is no evidence that *Tursiops* estimate genetically distinct onshore/offshore populations or that any coastal population in the Central Planning Area (CPA) or Western Planning Area (WPA) is seriously depleted. (Mullin personal communication 1993).

The types of fisheries performed in the Gulf of Mexico that might endanger any marine mammals are restricted to water depths less than 400 m. The NMFS indicates that *Tursiops* is the only species that might come in contact with such fisheries but that incidental take of marine mammals in Gulf fisheries is rare as is competition for food with commercial fisheries in the Gulf do not target the species that constitute the apparently principal food of marine mammals. Although they are discussed within Section IV D 1a and Section IV D 1b of the EIS, neither incidental take nor food competition from commercial fisheries are considered issues of concern for nonendangered and endangered species of marine mammals in the Gulf by NMFS at this time (Mullin personal communication 1993). The NMFS further indicates that for several years no marine mammal specimens have been removed in the Gulf for public display. Although there is no moratorium on the removal of marine mammal specimens for display, those institutions involved in such activities had improved management remains in effect due to the unusual number of *Tursiops* deaths in the early 1990s.

The first sentence of the cumulative analyses, Section IV D 1a of the CPA and Section IV D 1b of the WPA, states that the analyses consider the effects of impact from the various PFFs related to the proposed action on both present and future effects on the various operations, migratory, commercial, fishing, recreational, whale watching, and pathways of nonendangered marine mammals as well as endangered and threatened marine mammals in the Gulf. Specific inference is expected effects from the proposed action on the various cumulative impacts with the aforementioned PFFs are discussed in the summary of the cumulative effects.

Specific mention of the unusually high numbers of bottlenose dolphin mortalities in the Gulf during 1990, 1991, and 1992 and along the Atlantic seaboard in 1990 can be found in Section IV B 1a and in the cumulative analyses located in Section IV D 1a of the CPA and Section IV D 1b of the WPA. The issue of *Tursiops* deaths within the Gulf of Mexico still remain unresolved according to NMFS representatives, information on the completed battery of chemical analyses performed on tissue samples removed from the beached *Tursiops* is forthcoming and will be included in future EIS's when available.

MMC-3

The probability that manatees will be affected by the proposed action is indeed high, but very close to 0. The transport of oil into shallow water off west Florida from the WPA and CPA would require very unusual circumstances. Available data suggest that oil and oil spills must be transported to the Western Gulf or entrained into the circulation of the eastern Florida. Even with a forcing westerly wind, the wide continental shelf off west Florida provides a buffer to manatee habitat. Given the shallow coastal circulation and the distribution of manatees, the long time of transport and weathering and the low probability distribution of the remaining oil through mouse and tar, the chances of adverse effects on manatees is the risk of manatees is believed to be vanishingly small.

The endangered West Indian manatee is common in the Gulf of Mexico, but occurs only regularly with along the western coast and contiguous waters of Florida. It frequently uses the waters of Alabama, Mississippi, Louisiana, and Texas, is rare enough to consider that they are accidental occurrences within these areas. For every proposed lease area, MMS must formally consult with and receive and publish a biological opinion for that area from FWS under Section 7 of the Endangered Species Act concerning FWS's judgement on the potential impacts under their jurisdiction. As part of this formal consultation, MMS provides FWS a detailed description of the proposed action in addition to the best available information concerning the species in question, potential interactions between the proposed action and the species, and the expected effects of such interactions. The FWS biologists publish concerning manatees for all past OCS activities in the CPA and WPA and in previous cases, Series 147 and 151, find that the activities and operations involved will not be harmful to the continued existence of the manatee.

MMC-4

The ongoing MMS study of the distributions of cetaceans of the continental shelf off the Central and Western Gulf of Mexico has been designed to gather valuable information on the seasonal abundance of the various species in the area and will attempt to correlate their presence and densities with oceanographic features and events. Current data comprising the best available information from this ongoing MMS contract and from NMFS monitoring programs of both nonendangered and endangered marine mammals in the Gulf are specifically described in Section III B 1a. This information is referenced and was considered during the preparation of this EIS. Sections II B 1a, IV D 1a, and IV D 1b of the EIS. In addition, MMS consults with numerous sources as well as its own contractors and NMFS to obtain the best available information concerning marine mammals in the Gulf. These potential impacts of the proposed action. This is accomplished through the use of information and through written correspondence and direct conversations with the NMFS, NOAA's Southeast Fisheries Center, Miami, and Northwest Fisheries Center, Seattle, the

Basic ideas for the on-going MMS COLLEET study conducted in Tahiti and described in Section III B are resulted from the New Workshop on Sea Turtles and Marine Mammals Regional Studies Program

[illegible]

The MMS has consulted with WFFS and with professors at Oregon State University and Texas A&M University at Galveston to obtain the best available information on the direct and indirect effects of the Exxon Valdez oil spill on marine mammals and the effects would compare contrast to effects on species in the Gulf of Mexico. The information was incorporated into the various marine mammal workshops and analyses conducted at the EIS. Please see the response to comment WMS4.

MMCI-13 The NMFS withdrawal of regulations has been noted in Section IV.C.4.

[illegible]

The existing text in Section IV A.3 and in Section IV D.1.a is for the EPA and Section IV D.1.b is for the WPA regarding the possible effects of noise on cetaceans and the terminology of both agencies and frequencies as per the referenced research. The WMS recognizes that MMS-supplied studies have been done since that of Gates (1982) in which Gates' study refers to species that are known to be present in the Gulf of Mexico and that are not spatially confined to open marsh/wetland corridors. The WMS supplied a CD of 120 dBA and believed that noise effects on spatially confined marine mammals, specifically humpback whales, would be reduced by the land and corridors of the Atlantic. Marine mammals do not occur in the

WMC 10 Please see the responses to comments WMC 12 and WMC 14

The first sentence of the Cumulative Analysis (Section A.D. 1.3.5.1) of the EPA and Section A.D. 1.3.5.2 of the WPA states that the Agency considers the effects of proposed action on and proposed action, prior and future OCS sales on and gas operations, migration, commercial fishing, recreational waste washing, and pathogens, as noncumulative effects. Mammals as well as categorized threatened marine mammals in the Gulf of Mexico, all birds, taken commercially, whether related to the proposed action or not, are not considered as cumulative effects. "Other effects to the impact of any particular action is determined by the cumulative effects from the proposed action on the listed and noncumulative. Specific reference to expected effects from the proposed action on listed and noncumulative with the aforementioned IFFs is discussed in the summary of both sections as above.

[illegible][illegible]

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Office of the Chief Scientist

August 2, 1993

Mr. J. Rogers Pearcy
Regional Director
Minerals Management Service
Gulf of Mexico
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Dear Mr. Pearcy:

Enclosed are comments, from the National Marine Fisheries Service, Southeast Region, to the Draft Environmental Impact Statements for the proposed 1994 Outer Continental Shelf Oil and Gas Lease Sales 147 and 150 in the Central and Western Gulf of Mexico. We hope our comments will assist you. Thank you for giving us an opportunity to review the document.

Sincerely,

David Cottingham

David Cottingham
Director
Ecology and Conservation Office

Enclosure

cc: Thomas Fry, Director, MMS
Richard Miller, MMS
Andreas Mager, Jr., NOAA

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

COMMENTS ON

DRAFT ENVIRONMENTAL IMPACT STATEMENT
PROPOSED 1994 OUTER CONTINENTAL SHELF OIL AND GAS LEASE SALES
147 AND 150 IN THE CENTRAL AND WESTERN
GULF OF MEXICO

The National Oceanic and Atmospheric Administration (NOAA) is pleased to provide the Department of the Interior, Minerals Management Service (MMS) with our comments on the Draft Environmental Impact Statement (DEIS) on the Proposed 1994 Outer Continental Shelf Oil and Gas Lease Sales 147 and 150 in the Central and Western Gulf of Mexico. The National Marine Fisheries Service (NMFS) and the National Ocean Service (NOS) provided input for these comments.

General Comments

The (DEIS) adequately identifies impacts to estuarine and marine fishery organisms and habitat. The effectiveness of mitigation for certain impacts is questionable, especially with regard to Notice to Lessees 88-11, which is intended to reduce or eliminate impacts to deepwater benthic communities. To address this, a summary of past exploration and production activities discussing and quantifying stipulation effectiveness is needed. If stipulation effectiveness cannot be demonstrated, MMS should consider deleting the sale of blocks or sections of blocks known to contain these communities.

The NMFS recommends against Alternative A (the proposed action) which would allow the Secretary of the Interior to use discretionary authority concerning implementation or modification of sensitive area protection stipulations described in the FEIS. Instead, we recommend implementation of Alternative B since it would exclude leasing those blocks that contain, or are near sensitive features. We also propose some exclusions on the Live Bottoms (Pinnacle Trend) in the Central Gulf.

Four topographic highs in the Western Gulf of Mexico are addressed, but not placed under the Topographic High Stipulation protection in the FEIS for 1991 Gulf Lease Sales 111, 135 and 137; 1992 Gulf Lease Sales 139 and 141; and 1993 Gulf Lease Sales 142 and 143. These features should continue to be addressed in 1994 Lease Sales 147 and 150 and Seabee Bank should be afforded appropriate protective stipulations.

We are also concerned that the DEIS does not accurately estimate emergent wetland losses associated with lease-related navigation activities. Total net wetland losses were calculated by

NOAA-4

crediting losses with wetland acreage anticipated to be created by the beneficial use of dredged material. Although beneficial disposal options exist, such options are uncommon due to increased costs. The Corps of Engineers (COE), in its Mississippi River Delta maintenance dredging plan for 1993, proposes to utilize less than one percent, by volume, of the dredged material to create wetlands. The DEIS, in reviewing petroleum-related dredging activities conducted in Louisiana in 1988, notes that beneficial disposal occurred infrequently (less than two percent). The DEIS cites the new "mission" statement, which advocates beneficial use, as an indication of future COE activities. The current level of funding for beneficial use options in COE navigation projects and the constraints of the Federal Standard do not support the MMS's projections. Therefore, credit for beneficially disposing of dredged material should be adjusted to reflect a realistic occurrence of beneficial use, or the DEIS should document the validity of the beneficial use projections.

NOAA-5

The DEIS does not adequately discuss cumulative impacts related to proposed and past lease sales. Sale impacts are listed in the DEIS, but the document does not include a substantive discussion of additive or synergistic effects of these impacts on the Gulf of Mexico ecosystem. The cumulative impacts section should quantify total OCS impacts to provide a comparison of predevelopment conditions in the Gulf of Mexico.

Specific Comments

I. THE PROPOSED ACTION

B. BACKGROUND

2. Scoping Activities and Findings

a. Alternatives

(1) Alternatives for Proposed Central Gulf Sale 147

Page I-8. The Topographic Features Stipulation, as described in "Mitigating Measures" on Page I-9, may not be included in the leases. It also may be modified without benefit of further EIS preparation and review at the option of the Secretary of the Interior. Accordingly, the level of protection provided by the stipulation in Alternative A (the proposed action) is uncertain and the Topographic Features Stipulation should either be made mandatory for all lease sales affecting a reef or bank, or Alternative B (the proposed action excluding the blocks near biologically sensitive topographic features) should be implemented.

NOAA-6

The 18 biologically sensitive topographic features identified by the MMS in the Central Gulf of Mexico (Section III.B.2.c., of the 1990 FEIS) are critical to successful management of Gulf of Mexico marine resources within the United States Exclusive Economic Zone (EEZ) by the Department of Commerce (DOC), as

NOAA-6

mandated by the Magnuson Fishery Conservation and Management Act of 1976 (MFCMA). Adoption of Alternative B, deferring the 167 lease blocks where these 18 highly sensitive topographic features are located, would reduce the available lease blocks by only about three percent in Gulf Sales 147 and 150.

(2) Alternatives for Proposed Western Gulf Sale 150

NOAA-7

Page I-8. Because the Topographic Features Stipulation, as stated under Paragraph b. on Page I-9, may not be made a part of the leases, or may be modified at the option of the Secretary, without further EIS preparation and review, the protection offered by the stipulation in Alternative A (the proposed action) is uncertain. Therefore, the Topographic Features Stipulation should either be made mandatory for all lease sales affecting a reef or bank, or Alternative B should be implemented.

The 27 biologically sensitive topographic features identified by MMS in the Western Gulf of Mexico (Section III.B.2.c. of the 1990 FEIS) are critical to successful management of Gulf of Mexico marine resources within the United States EEZ. Adoption of Alternative B, deferring the 200 lease blocks where these 27 highly sensitive topographic features are located, would reduce the available lease blocks by less than five percent in Gulf Sale 150.

(3) Alternatives Considered But Not Offered.

NOAA-8

Page I-8, Paragraph 7. We disagree with the statement that removal of the alternative to delete live-bottom areas offshore Mississippi/Alabama is warranted because the Live Bottom (Pinnacle Trend) Stipulation would protect these areas. The DEIS indicates that these areas contain features of ecological importance and until a decision has been made regarding implementation of a protective stipulation these sites remain unprotected. We also believe the value of mitigative activities designed to eliminate or reduce impacts to these features should be documented.

b. Mitigating Measures

(1) Potential Mitigating Measures Analyzed Live Bottom (Pinnacle Trend) Stipulation

NOAA-9

Page I-9, Paragraph 5. Documentation that proposed mitigative regulations would protect pinnacles from nearby production discharges is needed. The DEIS identifies the pinnacles as structural habitat for a variety of pelagic fish but fails to provide scientific documentation demonstrating that contaminants commonly associated with effluent discharges do not impact these communities. If adequate information is not currently available concerning pinnacle sensitivity to discharge contaminants, MMS should initiate monitoring of these communities.

NOAA-10

(2) Mitigating Measures Considered But Not Analyzed

Page I-11, Paragraph 3. Sebree, Big Adam, Little Adam, and Phleger Banks should be included with those features currently listed under the Topographic Features Stipulation.

4. Interrelationship with Other Federal Policies Governing OCS Environmental Resources

NOAA-11

Pages I-35 through I-45. A discussion of the applicability of the Fish and Wildlife Coordination Act (FWCA) should be included in this section. The discussion should address how the FWCA applies to offshore OCS activities, nearshore and onshore OCS activities, and to other permits for OCS development activities. If MMS maintains its view that the Outer Continental Shelf Lands Act (OCSLA) exempts their proposed OCS activities from requirements of the FWCA, the FEIS should cite and discuss the parts of the OCSLA that support this determination.

NOAA-12

As previously requested in the DEIS for Lease Sales 142 and 143, in which the MMS partially responds to in the FEIS for Lease Sales 142 and 143, a more relevant discussion of the MFCMA is needed. For example, coordination between the DOI/MMS, the DOC/National Oceanic and Atmospheric Administration (NOAA)/NMFS, and the Gulf of Mexico Fishery Management Council should be addressed in relation to the regulatory requirements of the MFCMA. Particular emphasis should be placed on onshore and offshore habitat and living marine resources impacts and their relationship to Title I - United States Rights And Authority Regarding Fish And Fishery Resources, Title III - National Fishery Management Program, and Title IV - Miscellaneous Provisions.

II. ALTERNATIVES INCLUDING THE PROPOSED ACTIONS.**A. PROPOSED CENTRAL GULF SALE 147****1. Alternative A-The Proposed Action****b. Summary of Impacts**

NOAA-13

Page II-5, Paragraph 2. Since a decision by the Secretary of the Interior has not been made regarding either the Topographic Feature Stipulation or the Live Bottom (Pinnacle Trend) Stipulation, we believe it is inappropriate to provide a summary of reduced impacts unless stipulation implementation is confirmed.

Live Bottoms (Pinnacle Trend)

NOAA-14

Page II-6. This section should be revised to state that impact minimization will not occur unless the Live Bottom Stipulation implementation is implemented.

NOAA-15

Topographic Features

Page II-7. This section should be revised to state that impact minimization to topographic features requires implementation of the protective stipulations.

NOAA-16

**Endangered and Threatened Species
Gulf Sturgeon**

Page II-11. This section should summarize potential impacts to all life stages of the Gulf sturgeon, including eggs and larvae.

c. Mitigating Measures**(2) Live Bottom (Pinnacle Trend) Stipulation**

NOAA-17

Page II-18 and Page II-19. This section should be revised to include a discussion of other mitigative measures that have been required by the Regional Director (RD) in addition to (a) and (b) which are described in the DEIS.

Effectiveness of the Lease Stipulation

NOAA-18

Page II-19, Paragraph 3. The RD should consult with the NMFS when determining potential pinnacle impacts and appropriate mitigation. The NMFS, under authority of the FWCA, MFCMA, and other statutes, reviews and comments on activities that would impact fishery resources in estuarine and marine waters seaward to the outer margin of the OCS.

NOAA-19

Page II-19, Paragraph 4. The MMS should provide scientific documentation concerning the sensitivity of the Pinnacle Trend community to contaminants commonly associated with produced waters and drill cuttings. Even though Pinnacle Trend features are commonly impacted by sedimentation, it is unlikely that the community is naturally exposed to contaminants associated with drilling related discharges. If it is determined that the Pinnacle Trend community is sensitive to these contaminants, the MMS should revise their restrictions to mitigate those impacts. If available information is not adequate, the MMS should develop a monitoring program to assess Pinnacle Trend community responses to effluent discharges. This section also should include a review of mitigation measures that have been enacted under previous leases when surveys determined that a feature would be disturbed and OCS activities were subsequently conducted.

2. ALTERNATIVE B - THE PROPOSED ACTION EXCLUDING THE BLOCKS NEAR BIOLOGICALLY SENSITIVE TOPOGRAPHIC FEATURES**b. Summary of Impacts Marine Mammals and Marine Turtles
Conclusion**

Page II-29, Paragraph 4. Comments related to the Gulf sturgeon should be moved to a section titled "Gulf Sturgeon" rather than the section titled "Marine Mammals and Marine Turtles."

B. PROPOSED WESTERN GULF SALE 150

1. Alternative A - The Proposed Action

c. Mitigating Measures

(1) Topographic Features Stipulation

Pages II-52 through II-56. The first paragraph of this section states, "The topographic features of the Western Gulf provide habitat for coral and coral community organisms (Section III. B. 2.). As discussed in Section IV.D.2.a.(2)(b) of the FEIS for Sales 131, 135, and 137 (USDOI, MMS, 1990a), these communities would be severely and adversely impacted by oil and gas activities resulting from the proposed action if such activities took place on or near these communities and without the Topographic Features Stipulation and if such activities were not mitigated." This statement provides justification for Secretarial implementation of the Topographic Features Stipulations. These stipulations, which have been included in recent lease sales, have helped prevent adverse impacts to the biota of major topographic highs and live bottom areas in the Gulf of Mexico.

In response to earlier NOAA comments concerning Sebree Bank's coralline assemblages on rock outcroppings and large populations of snappers, groupers, and other reef fishes, the MMS states at Response F1/12, Page V-22 (in the FEIS for those lease sales) that "In response to similar comments from NOAA (FEIS for Sales 139 and 141, response F3-14, page V-30), the MMS has stated: "No new information on the bank (Sebree) has been presented, and the biota of Sebree Bank do not merit protection by either the Topographic Features Stipulation or the Live Bottom Stipulation." The MMS stated in the FEIS for Sales 131, 135, and 137, Volume I (USDOI, MMS, 1990a), at Page III-56, third Paragraph, that "Sebree Bank is a low-profile feature located in 36.5 m (120 ft) of water. The highest area of the bank is about 31 m (102 ft) deep. The bank appears composed of large boulders mostly veneered by fine sediments. The low relief of the bank and the fine sediments covering the bank indicate that Sebree Bank frequently exists in turbid conditions. The biota of the bank appears sparse due to these conditions. Specimens of *Oculina diffusa* have been located.

The bank attracts abundant nektonic species including red snapper (Tunnel, 1981)." MMS stated in the FEIS for Sales 139 and 141, Volume I (USDOE, MMS, 1991), at page III-21, third paragraph, that "Sebree Bank attracts commercially and recreationally important finfish (Tunnel, 1981). Structure emplacement would enhance this attracting aspect. Impacts to the biota of the nepheloid zone of Sebree Bank or Phleger Bank are not expected to

be significant. Big and Small Adam Banks are also low-relief features subject to sedimentation. ... The biota of Big and Small Adam Banks are not expected to be significantly affected." Nowhere do these statements imply that Sebree Bank is biologically depauperate.

The MMS further states in FEIS response F1/14, page V-22 that "There are no new data to offer. As explained by MMS in response to comment F3-16 in the FEIS for Sales 139 and 141: "Listing the four banks of concern as topographic features in the FEIS for Sales 131, 135, and 137 ... was not meant to imply that they warranted the protection of the stipulation. Since they are not subject to the stipulation, they were removed from the comparable tables in the EIS to avoid confusion." We believe that sensitive environmental features subject to project impacts should be addressed regardless of whether special stipulations are appropriate.

Based on existing MMS statements and information, NOAA continues to believe that, at a minimum, the Live Bottom Stipulation should be implemented in the Central Gulf of Mexico, on or within 1,000 meters of Sebree Bank. This recommendation was also provided in our previous comments on DEIS's for Sales 131, 135, 137, 139, 141, 142 and 143. Implementation of this recommendation would ensure development of updated information just prior to oil and gas exploration on the bank. An additional reason for implementing protective measures on this bank is the indication that Sebree Bank attracts abundant red snapper..." Commercial and recreational fishery harvest restrictions are being proposed on this species due to declining populations.

To date, the MMS has not presented any new data or analyses to support their decision concerning the protection of Sebree Bank. In a meeting with a NOAA representative on April 8, 1993, MMS personnel indicated their intention to reexamine Sebree Bank in an interagency dive this summer. If new information resulting from reexamination of this bank is included in the FEIS, we will reevaluate our above recommendation. The FEIS also should discuss the federal regulations governing the Coral Fishery Management Plan (50 CFR Part 638), the Reef Fish Fishery Management Plan, e.g., red snapper (50 CFR Part 641), and the Shrimp Fishery Management Plan (50 CFR Part 658), as they may relate to oil and gas exploration and development, and prohibitions against unpermitted fishing, taking, or harvesting of these living marine resources.

III. DESCRIPTION OF THE AFFECTED ENVIRONMENT

B. BIOLOGICAL RESOURCES

2. Sensitive Offshore Resources

c. Topographic Features

NOAA-22

Pages III-33 through III-42. This section lists and locates (on Figure III-4) 23 topographic feature banks in the Western Gulf of Mexico. In the comparable section of the FEIS for Sales 131, 135 and 137, MMS states that 27 topographic features are located in the Western Gulf of Mexico. In the comparable section of the FEIS for Sales 139 and 141, four topographic features located in the western Gulf of Mexico (Sebree Bank, Phleger Bank, and Big and Small Adam Bank's) were deleted without an acceptable explanation. In the DEIS for Lease Sales 147 and 150, Sebree, Phleger, Big Adam, and Small Adam Banks continue to be omitted, with no acceptable explanation. Since MMS continues to offer no new information indicating that these banks are less ecologically sensitive than they were in 1990, they should be listed and mapped. Continuing to address them in the environmental reviews will help assure that they will be reevaluated whenever the protective measures for topographic features are updated.

3. Marine Mammals
 - a. Non-endangered and Nonthreatened Species
 - b. Endangered and Threatened Species

NOAA-23

Page III-45. The minke whale is identified as both non-endangered and endangered in the above sections. The minke whale should be identified as not being endangered.

IV. ENVIRONMENTAL CONSEQUENCES

c. OTHER CUMULATIVE IMPACTS SCENARIO

NOAA-24

Pages IV-67 and IV-68. This section should more thoroughly review and summarize the past OCS leasing activities. This information also should be addressed in the sections cited (IV.A. and B.).

D. ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTIONS AND ALTERNATIVES

1. Proposed Central Gulf Sales 147
 - a. Alternative A-The Proposed Action
 - (1) Impacts on Sensitive Coastal Environments
 - (a) Coastal Barrier Beaches and Associated Dunes

NOAA-25

Because of its limited application, the beneficial use of dredged material is relatively insignificant in the coastal region of the Central Gulf Sale area. The DEIS review of dredging activities (Pages IV-73 and 74) in Louisiana states that beneficial use options were proposed for dredged material placement in only two percent of oil and gas related dredging projects implemented during 1988. Beneficial dredged material disposal options often add significant expense to project costs making such use uneconomical during dredging of petroleum access canals and federally maintained channels. Therefore, it is inappropriate to assume beneficial use of dredged material will be practiced

NOAA-25

commonly or that beneficial use of dredged material will significantly mitigate coastal barrier erosion. This applies to both the Base and High Case Scenarios.

- (2) Impacts to Sensitive Offshore Resources
- (b) Deepwater Benthic Communities

NOAA-26

Pages IV-97 through IV-99. This section should be expanded to include a discussion of the potential impacts of drill cutting and effluent associated toxic constituents on these communities under both the Base and High Case Scenarios. A summary of MMS actions concerning restrictions to past OCS activities when chemosynthetic communities were identified during the MMS required surveys also should be included.

(10) Impacts on Commercial Fisheries

NOAA-27

Pages IV-155 through IV-161. This section should be revised to discuss cumulative impacts to commercial fisheries including continued habitat loss and water quality degradation. The significance of these impacts in combination with the existing conditions in the nearshore Gulf of Mexico also should be examined. Fisheries habitat in this area is already impacted by both commercial activities in the coastal zone and the high volume of urban and agriculture non-point source runoff. While this section concludes that only a small portion of the commercial fishery population will be eliminated, chronic habitat degradation and destruction will continue to lower fishery productivity and could further accelerate the decline of fishery populations.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

NOAA-1 Currently, only 43 sites are known in the Gulf of Mexico where the presence of hydrocarbon seep organisms (tube worms, clams, and mussels) has been confirmed. It is suspected that many more of these communities exist. With regard to the effectiveness of Notice to Vessels 88-11 in protecting these communities, an ongoing study funded by the MMS, entitled "Chemosynthetic Community Ecosystem Study," may provide further information. The study contractors have selected a small number of the most dense, significant communities known for detailed submersible visits. Any major oil and gas-related disturbance to these communities would be readily apparent. So far, no impacts to protected organisms have been noted. The Final Report for this study is still pending. More extensive efforts targeted to monitor oil and gas activities in lease blocks deeper than 400 m will undoubtedly be limited by high costs and logistical difficulties associated with deep-water studies. Dredging the blocks containing the 43 known chemosynthetic communities would not prove an effective protection measure because it is suspected that many more of these communities exist, but remain undiscovered.

NOAA-2 The decision of whether to adopt Alternative B or the Topographic Features Stipulation (if neither) will be made by the Secretary of the Interior in accordance with Departmental policy at the time of the issuance of the Final Notice of Sale. Similarly, the Secretary will make the decisions regarding the Pinnacle Trend (i.e., adoption of the Live Bottom Stipulation) at the same time. (See Section I B 2 a (3) for a more detailed rationale regarding deletion of Pinnacle Trend blocks.) Protection of the sensitive offshore habitats of the topographic features and the Pinnacle Trend can be adequately accomplished by adoption of the Topographic Features and the Live Bottom Stipulations without the need to delete the tracts from the lease sale. Although the decision of whether to adopt these protective stipulations is a matter of discretion for the Secretary of the Interior, he has never failed to adopt these measures once they were first put in place.

NOAA-3 A meeting between MMS representatives and the Chief, Galveston Field Branch, National Conservation Service of NMFS was held on April 1, 1993, to discuss Seabree Bank and the other banks discussed in the paragraph of your letter. (See Section I B 2 a (2) for a more complete discussion of this meeting.) It was agreed upon at this meeting that a subsequent dive effort between MMS and NMFS would take place on Seabree Bank. This dive effort took place on August 25, 1993. The results of these dives are being compiled and analyzed and will serve as the basis for further discussions of the merits of extending stipulated protection to this bank.

NOAA-4 The only beneficial use of dredged materials specifically referred to is in respect to Berle Pass (page IV-85, paragraph 1). The discussion acknowledges that the project has not yet been described, hence, it is too early in the planning process for specific speculation upon volume, use, or benefits of the material to be dredged for that project. No specific wetland creation or barrier erosion mitigation is applied in this section.

Typically, the dredged material from new pipeline canals is beneficially used on-site to bank the canal, rather than as off-site mitigation, which is quite expensive, usually unsuccessful, and hence rarely applied. The only wetland creation through the beneficial use of dredged material that is accredited to OCS activities in this section is in relationship to deepening of the Port Fourchon Channel. The 142 acres of interior wetlands to be created is part of the preliminary project design of that specific project. No wetland generation resulting from general maintenance dredging activities is accredited to the OCS Program or proposed lease.

With regard to the comment referencing the "new mission statement" for the OCE, it is assumed that dredged material will be increasingly used to enhance wetlands, as was

confirmed in the comment. However, no effort has been made in this EIS to quantify acreage of wetlands to be created because no information has been found to support such a quantification. Hence, no acreages associated with that new mission are accredited to the OCS Program in this EIS.

NOAA-5 Baseline estimates for the existing OCS infrastructure and activities are described in Section III (Description of the Affected Environment) of this document. Sections V A and V B discuss the cumulative activities in question. As described on page V A-8, past OCS activities are included in the "OCS Program" figures. The OCS Program figures encompass all OCS of Mexico OCS oil and gas activities occurring during the life of the proposed activity (approximately 35 years) from past, proposed, and future sales.

A cumulative assessment of the additive impacts of past, present, and reasonably foreseeable future actions is provided for each of the individual resource topics identified. Each analysis contains four basic elements: (1) A brief description of the resource to be analyzed. The description provides a current status or existing condition of the resource and reflects the effects of past or prior OCS and non-OCS related impacts on the resource. (2) A discussion of the specific OCS related and non-OCS related activities and impact producing actions that may potentially affect the resource are provided in Sections V A and V B (3) A discussion of the effects of OCS and non-OCS activities and (PE)s, both individual and additive, on the resource. (4) A summary of the analysis with the indication of the cumulative and additive synergistic cumulative effects or change to the resource. (5) A statement of the overall cumulative conclusion which incorporates the nature, magnitude, and duration of the effects or change to the resource.

NOAA-6 As previously stated in our response to comment NOAA-2, the decision of whether to adopt Alternative B or the Topographic Features Stipulation (if neither) will be made by the Secretary of the Interior in accordance with Departmental policy at the time of the issuance of the Final Notice of Sale.

NOAA-7 See the response to comment NOAA-6.

NOAA-8 Section I B 2 a (3) of the Final EIS contains a more detailed rationale regarding deletion of Pinnacle Trend blocks. As previously stated in the response to comment NOAA-2, the decision to adopt the Live Bottom/Pinnacle Trend Stipulation will be made by the Secretary of the Interior in accordance with Departmental policy at the time of the issuance of the Final Notice of Sale. (See the response to comment NOAA-6 for a discussion of a change in the value of the Live Bottom/Pinnacle Trend stipulation.)

NOAA-9 Section III B 2 a of the EIS contains a description taken from the Mississippi-Alabama Marine Ecosystems Study as described by Brooks et al. (1989). They found human impacts throughout the live bottom habitats of the Pinnacle Trend to be minimal. This includes impacts from oil and gas activities. A monitoring study for the pinnacle trend, entitled "Mississippi-Alabama Topographic Features Monitoring Study," has been proposed by MMS. This study could yield valuable information on the potential chronic effects of oil and gas activities on the pinnacle trend and the effectiveness of the existing stipulation. At the time the study is pending and has been given a high priority for funding but no funding has been dedicated. Due to budget considerations it is unlikely to receive funding in the fiscal year. The impact discussions of effluent discharges are based on the stipulation to equitably detect and avoid live bottom habitats. It has been well established that dilution reduces and eliminates impacts from oil and gas discharges in the open Gulf. (See Section V B 2 a (2) of the EIS and NRC (1983) for further detail.)

- NOAA-10 See Section III B 2c for a discussion of these four banks. As stated in the response to comment NOAA-9, MMS representatives met with the Chief, Conservation Field Branch, Habitat Conservation Service of NMFS on April 1, 1993. All four of these banks were discussed. See Section I B 2b (2) for a discussion of this meeting. With regard to Big Adam, Little Adam and Phleger Banks, MMS discussed why they felt that these banks lacked the features of the other banks currently protected by the Topographic Features Stipulation. The NMFS accepted this rationale, and it was agreed that the three Banks would continue to be addressed in future EIS discussions. See the response to comment NOAA-9 regarding the discussions about Sebree Bank.
- NOAA-11 In February 1982, the Department of the Interior's Solicitor opined on the applicability of the Fish and Wildlife Coordination Act to OCS leases and permits issued by the Secretary of the Interior. The Solicitor determined that the Secretary of the Interior does not have to consult with NOAA before issuing OCS leases and permits. The opinion found that the Act applies to water-resource development projects, not to mineral development projects. The opinion further went on to state that the Secretary of the Interior may seek the advice of the Commerce Department on questions pertaining to various leases or permits, but all decisions are to be left to his discretion.
- NOAA-12 Section I of the EIS provides a brief discussion of the major Federal regulations that have a bearing on OCS oil and gas activities. In accordance with NEPA, these, including the Magnuson Fishery Conservation and Management Act of 1976, are presented in a concise manner.
- As issues and potential problems from OCS development arise, MMS, NMFS, and the Gulf of Mexico Fishery Management Council (GMFMC) coordinate aspects of fishery conservation and management. For example, the GMFMC is very concerned over the declining stocks of reef fish in the Gulf of Mexico and, in 1991, expressed a need to examine sources of mortality on reef fish species. The MMS and NMFS have formally entered into an Interagency Agreement (IA-17912) to study the comparative severity of the effect of explosive platform removals in the Gulf of Mexico. During 1993 several test cruises were performed and one explosive platform removal was studied to acquire data toward completion of this study. This work was accomplished through the coordinated efforts of both MMS and NMFS. A meeting with the GMFMC and MMS to discuss the study and its progress took place in Tampa, Florida, on June 25, 1993.
- NOAA-13 In a previous response (NOAA-2), reasons were given as to why it is considered likely that the proposed stipulations will remain in place. For this reason, the discussion assumes this will be the case. As a result of your comments, however, this section has been modified to refer the reader to the appropriate EIS section in case the stipulations are not applied.
- NOAA-14 As a result of your comments, this section has been modified to refer the reader to the appropriate EIS section in case the stipulations are not applied.
- NOAA-15 As a result of your comments, this section has been modified to refer the reader to the appropriate EIS section in case the stipulations are not applied.
- NOAA-16 Section II represents a summary of Section IV D analyses. A discussion of the potential impacts to all life stages of the Gulf sturgeon, including eggs and larvae can be found in Section IV D 1a (9) (Impacts on the Gulf Sturgeon).
- NOAA-17 In virtually all of the cases where the Live Bottom Stipulation is applicable, protective efforts have been centered around avoidance of suspected live bottom features. During the era where the old Central Gulf of Mexico Live Bottom Stipulation was used, numerous live

bottom photodocumentation surveys were conducted to determine if live bottom, which would require relocation/avoidance, were present. Outside of efforts centered on avoidance, no other measures have been required.

- NOAA-18 At the post-lease stage of mineral leasing, the NMFS has requested, and continues to receive, Plans of Exploration and Environmental Reports for approximately 250 different lease blocks in the Central and Western Gulf of Mexico and for all lease blocks in the Eastern Gulf of Mexico. None of these lease blocks are in the Pinnacle Trend, however, it is suggested that NMFS update their list of lease blocks in which they request the opportunity to receive and comment on post-lease plans. The MMS allows this opportunity to comment on a voluntary basis, however, this is not through any requirements under the Fish and Wildlife Coordination Act. The Fish and Wildlife Coordination Act applies only to "water resource development, planning and programs" and not to mineral development and production activities.
- NOAA-19 This section is presented only as a summary of the Live Bottom Stipulation, what it does, and how it works. The assessment of the impacts of produced water and drilling discharges are presented in the Environmental Impacts section of the EIS (Sections IV D 1a (2a) and (3), as well as Section IV D 1a (3)). See the response to comment NOAA-9 for a discussion of proposed monitoring for the Pinnacle Trend. See the response to comment NOAA-17 for mitigation measures.
- NOAA-20 As NMFS points out, comments related to the Gulf sturgeon were erroneously placed in this section. The comments have been removed. Estimated impacts to the Gulf sturgeon under Alternative B are located within a discussion of coastal resources (Section III A 2).
- NOAA-21 See the response to comment NOAA-2 for discussions about implementation of the Topographic Features Stipulation. See the response to comment NOAA-9 for a discussion regarding the pending re-investigation of Sebree Bank.
- See the responses to comments NOAA-3 and NOAA-10 concerning discussions of the four topographic features referred to in the NMFS comments. Section I provides a brief discussion of the major Federal regulations that have a bearing on OCS oil and gas activities. In accordance with NEPA, these are presented in a concise manner. Discussion of the Federal regulations governing the Fishery Management Plans can be found in Section I B 4c.
- NOAA-22 See the responses to comments NOAA-3 and NOAA-10 concerning discussions of the four topographic features referred to in the NMFS comments. The figure referred to in this comment has been modified to show the location of these four topographic features.
- NOAA-23 The text has been changed to correct this oversight.
- NOAA-24 As indicated by the text on page IV-68, Sections IV A, and IV B, discuss the activities in question. As described on page IV-3, past OCS activities are included in the OCS Program figures. The OCS Program figures encompass all Gulf of Mexico OCS oil and gas activities occurring during the life of the proposed actions (approximately 35 years from past, proposed, and future sales). The cumulative analysis does not examine those OCS activities that occur outside this 35-year period, past or future.
- NOAA-25 See the response to comment NOAA-4.
- NOAA-26 As discussed throughout the EIS (Section IV D 1a (3)), drilling muds and cuttings typically have low toxicities or limited bioavailability to marine organisms. See the response to

United States Department of the Interior

BUREAU OF MINES
U.S. DEPARTMENT OF THE INTERIOR
Building 20, Denver Federal Center
Denver, Colorado 80202

May 4, 1993

Memorandum

To: Regional Director, Mineral Management Service, Gulf of Mexico Region, 1201 Elmwood Park Boulevard, New Orleans, Louisiana 70123

From: Supervisory Physical Scientist

Subject: Draft Environmental Impact Statement (EIS) for the Proposed 1994 Outer Continental Shelf Oil and Gas Lease Sales 147 and 150 in the Central and Western Gulf of Mexico

Staff of the U.S. Bureau of Mines Intermountain Field Operations Center reviewed the subject Draft Environmental Impact Statement as requested. The section on the geology of the area(s) under consideration is adequately discussed. Although there is no mention of nonfuel mineral resources, there is no known data to support such a discussion. We find the document adequate with regard to non fuel mineral resources. We believe, however, that if pipelines in the area would be affected the document should discuss plans for protecting them. If pipelines would not be affected, the document should so state.

If you have questions regarding this review, please contact Dess H. White at (205) 759-9465.

dhw/cv

RECEIVED
MAY 11 1993

Mark H. Hibbsman

MINERALS MANAGEMENT SERVICE
LEASING & ENVIRONMENT

NOAA-2

comment NOAA-1 for a discussion on summarizing past OCS activities and their impacts on chemical communities

The section in question (Section IV.D.1.a.10) discusses impacts expected from the proposed action only. Coastal environmental degradation resulting from the proposed action includes some wetland habitat loss and a decrease in water quality. Although their effects may be indirect, they are defined, discussed, and analyzed as impacting factors on commercial fisheries in the section cited above. Cumulative impacts of chronic coastal environmental degradation alone and in combination with other impacting factors, such as nonpoint source runoff, are analyzed in Section IV.D.1.d.

BOM-1

BUREAU OF MINES

BOM-1

The existing offshore pipeline network will not be affected by activities resulting from the proposed actions. Prior to any exploration, drilling, or development activities, companies must submit detailed plans to MMS for review and approval. Detailed site-specific requirements required, and specific criteria relative to operating conditions and environmental considerations must be met. Further discussion of the review, coordination and approval of exploration, development, and production activities can be found in Section I.B.4.

ADDRESS ONLY THE DIRECTOR
FISH AND WILDLIFE SERVICE

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Washington, D.C. 20240

In Reply Refer To:
FWS/DHC, BFA EC93-0034

JUL 23 1993

Memorandum

To: Regional Director, Gulf of Mexico Region
Minerals Management Service

From: Director

Subject: Review of Draft Environmental Impact Statement, Gulf of Mexico
Oil/Gas Lease Sales 147 and 150 (EC 93-0034)

The Fish and Wildlife Service has reviewed the subject document and we have no comments to offer on it, because it has incorporated all our earlier views.

We appreciate the opportunity to review this document. If you have questions, please contact Ralph Swanson of our Division of Habitat Conservation at 703/358-2183.

cc: 2327-MIB-OEA
4210-MIB-LMS
2010-Hrmdr VA-LMS
3012-MIB-Directorate Reading File
3012-MIB-DDChron
3012-MIB-CCU
3024-MIB-FWS/AES
400-ARLSQ-FWS/DHC RF
400-ARLSQ-FWS/DHC/BFA-ERT
400-ARLSQ-FWS/DHC/BFA RF

FWS/DHC:RSwanson:mc:7/19/93:703/358-2183:Q:\dmc.swanson:MMS-GOM.RGS
Rev:BB1anchard:7/23/93

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Mountain Prairie Region

WALLING, ALBERT
 Regional Director
 Fish and Wildlife Service
 Mountain Prairie Region

WALLING, ALBERT
 Regional Director
 Fish and Wildlife Service
 Mountain Prairie Region

July 15, 1993

Memorandum

To: Regional Director, Minerals Management Service
 Gulf of Mexico Region

From: Chief, Air Quality Branch

Subject: Minerals and Management Service (MMS) Draft Environmental
 Impact Statement (DEIS) for the Outer Continental Shelf
 (OCS) Leases 147 and 150

The Air Quality Branch (AOB) has reviewed the MMS DEIS for proposed offshore
 gas development in OCS Leases 147 and 150. Our comments on the DEIS are as
 follows:

The DEIS does not address possible air quality impacts on the Breton
 Wilderness Area (BWA), a Class I air quality area as specified in the
 Air Act - CAA administered by the U.S. Fish and Wildlife Service.
 I air quality areas are afforded a high degree of protection under the
 and very little deterioration of air quality is allowed in these areas.
 The Prevention of Significant Deterioration Program established Class
 increments for sulfur dioxide (SO₂), total suspended particulate matter
 (TSP), and nitrogen dioxide (NO₂). These Class I increments are the
 increases in ambient pollutant concentrations allowed over baseline
 conditions in Class I areas, and are intended to protect the air quality
 and air quality related values in those areas. The DEIS should have
 evaluated the impact of all proposed options on air resources and
 consumption in the Breton BWA.

The AOB does not agree with MMS that a "box model" is the best approach
 to address onshore impacts from the OCS lease area. We believe that the
 of terrain to define the horizontal sides of a box eliminates the
 possibility to apply such a model in this scenario. We recommend that the
 CALPUFF dispersion model and CALMET meteorological processor program is the
 modeling system to apply in this situation to calculate concentrations for
 the criteria pollutants. The CALPUFF model system can address long range
 transport and area sources which is appropriate since the exact location of
 the proposed well sites is not yet known, and CALMET has coefficients to
 better address the reduced dispersion over water. CALPUFF has the capability
 to realistically calculate the effects of the diurnal and seasonal winds
 between onshore and offshore winds.

We suggest that CALPUFF receptors be placed in the Breton BWA in order to
 assess the impact to the area's sensitive resources. We also recommend
 that a regional haze calculation be performed following the guidance in
 the recently released EPA document, Interagency Workshop on Regional Haze
 Modeling (EPA-600/R-92/001).

The AOB agrees with the proposal to model the entire lease area with the
 EPA Regional Oxidant Model. This model should provide a reasonable
 estimate of the increase in ozone concentrations due to the nitrogen oxide
 and volatile organic compound emissions.

We hope that these comments will be helpful. If you have any questions,
 would like additional information, please call Ellen Porter at 202-254-1000.

Sandra V. Silva
 cc: Director
 Minerals Management Service
 Room 4230
 1849 C Street, NW
 Washington, D.C. 20240

1-844-338-2747
 1-844-338-2747
 1-844-338-2747

FWS-1

Breton National Wildlife Refuge and National Wilderness Area located in the southwestern part of the Mississippi Delta is a Class I air quality area administered by the U.S. Fish and Wildlife Service (FWS). Following discussions with FWS personnel, the U.S. Fish and Wildlife Service (FWS) has decided to address their concerns. The revision to Section III.A.3 of the EIS now identifies the Class I area, the nitrogen dioxide (NO₂) Significant Determination levels, and information on an MMS study designed to measure NO₂ emissions in the Breton National Wildlife Refuge and meteorological measurements needed to assess potential impacts. The new model criticisms have been reviewed with the U.S. Fish and Wildlife Service (FWS) and the results from the Regional Ozone Model Study, Section IV.D.1.4 and IV.D.1.5 have been modified to address the FWS concerns. Regarding the new baseline study upon receipt of the recent USEPA report entitled "Intermittent Modeling of Air Quality Modeling Phase I" the MMS will review this document and work with FWS to address their concerns.

FWS-1

United States Department of the Interior

NATIONAL PARK SERVICE

1661 N. Lincoln Avenue

2-619 940-REC

JUL 1 1993

Memorandum

To: Regional Director, Gulf of Mexico Region,
Minerals Management Service, New Orleans, Louisiana

From: Associate Regional Director, Resources Management,
Southwest Region

Subject: Draft Environmental Impact Statement for the Proposed
1994 Outer Continental Shelf (OCS) Oil and Gas
Lease Sales 147 and 150 in the Central and Western
Gulf of Mexico (DEIS-93/14)

We have reviewed the subject statement and have the following comments pertaining to air quality issues. Comments relating to Breton Islands National Wildlife Refuge are provided pursuant to the Interagency Agreement between the National Park Service and the U.S. Fish and Wildlife Service.

We do not agree that a "box model" is the best approach to address methane air quality impacts from the OCS lease area. We believe that the use of terrain to define the horizontal sides of a box eliminates the possibility of applying such a model in this scenario.

We therefore recommend application of the CALPUFF dispersion model, and CALMET meteorological processor program modeling system in this situation to calculate concentrations for the criteria pollutants. Use of the CALPUFF model system would be appropriate since the exact location of the proposed well sites is not yet known and CALPUFF can address long-range transport and area sources. Use of the CALMET program would be appropriate because CALMET has coefficients to better address the reduced dispersion over water. We anticipate that CALPUFF would perform much more realistically in calculating the effects of the diurnal and seasonal shifts between onshore and offshore winds.

We support the proposal to model the entire lease area with the Environmental Protection Agency (EPA) Regional Dispersal Model. This model should provide a reasonable estimate of the increase in ozone concentrations due to the nitrogen oxide and volatile organic compound emissions.

Breton Islands National Wildlife Refuge (offshore Louisiana) is an area administered by the U.S. Fish and Wildlife Service. Modeling performed with the Off Coast Dispersion (OCD) model at the 100-meter level showed that nitrogen dioxide concentrations of 1.9 micrograms per cubic meter (ug/m³) would be over three times the Class I Prevention

NPS-1

100-1

2

Significant Deterioration (SD) annual increment of $2.5 \mu\text{g}/\text{m}^3$. This OCD modeling has sources located closer to land than does the proposed lease. But the proposed lease will have many more sources and emissions than the example OCD case.

Therefore, we recommend that CALPUFF receptors be placed on the islands within Bristow Islands National Wildlife Refuge in order to model impacts to the refuge's sensitive resources. We also recommend that a regional haze calculation be performed, following the guidance in the recently released EPA document, Interagency Workshop on Air Quality Modeling Phase 1 Report.

R.B. Smith

cc:
Director
Minerals Management Service
Department of the Interior
Room 4230
1849 C Street Northwest
Washington, D.C. 20240

NATIONAL PARK SERVICE

NPS-1

Please see the response to comment FWS-1

V-64

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 6
1445 ROSS AVENUE, SUITE 1000
DALLAS, TX 75202-2732

JUL 29 1993

Mr. Joseph A. Innisbopner
Chief, Environmental Assessment Section
Office of Leasing and Environment
Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Dear Mr. Innisbopner:

In accordance with our responsibilities under Section 309 of the Clean Air Act, the National Environmental Policy Act (NEPA), and the Council on Environmental Quality Regulations for Implementing NEPA, the U.S. Environmental Protection Agency (EPA) Region 4 and 6 offices in Atlanta, Georgia and Dallas, Texas have completed their review of the Draft Environmental Impact Statement (EIS) for the proposed 1994 oil and gas lease sales 147 and 150 in the Gulf of Mexico Outer Continental Shelf (OCS).

The Minerals Management Service's (MMS) Draft EIS evaluates the proposed leasing of unleased blocks in the Central and western Planning Area of the OCS for oil and gas production. Three alternatives, including the no action alternative, have been analyzed in the Draft EIS for each of the proposed lease sales. The preferred alternatives (Alternative A) for sales 147 and 150 are identified as the oil and gas lease sales with existing regulations and proposed lease stipulations designed to reduce environmental risks. Alternative B would offer for lease all unleased blocks offered under the proposed action, with the exception of blocks on or near biological or sensitive areas of the topographic features.

While four stipulations (Live Bottom, Topographic Features, Archaeological Resource, and Military Areas) have been analyzed as part of the proposed actions, EPA continues to have concerns that a commitment has not been made in the Draft EIS to ensure the protection and mitigation for direct and indirect impacts to important resources within the project area through the use of these stipulations. Rather, the Draft EIS states that actual applications of these stipulations to leases are options available to the Secretary of the Interior. EPA continues to believe that those stipulations that have been applied to previous lease sales in the OCS should be applied to proposed sales 147 and 150.

In accordance with EPA's policies, we have noted this Draft EIS as a "disproportionate" while the EPA recommends the selection of Alternative B as the environmentally preferred alternative. We have no specific objections to lease sales 147 and 150, provided the mitigation measures proposed as lease stipulations are applied.

Our classification will be published in the Federal Register according to our responsibilities to inform the public of our views on the proposed Federal action, under Section 309 of the Clean Air Act.

We appreciate the opportunity to participate in the preparation of this Draft EIS as a cooperating agency. Please contact Ms. Rhonda Vallette or Mr. Smith at (214) 655-6400 if you require further explanation of our comments. We request that you send our office 12 copies of the Final EIS at the same time that it is sent to the Office of Federal Activities, U.S. Environmental Protection Agency, 401 M Street S.W., Washington, D.C. 20460.

Sincerely yours,

Joe P. White
Acting Regional Administrator

cc: Dave Powers, Office of Federal Activities, A-104

U.S. ENVIRONMENTAL PROTECTION AGENCY

The biological stipulations were as useful, workable, and effective as those that have allowed development of OCS oil and natural gas resources while protecting biologically sensitive areas. Over the years, it has been a Department of the Interior policy to treat biological stipulations as managing measures, left to the Secretary's discretion on whether to accept or reject them. In treating proposed lease stipulations as proposed managing measures, the EIS reflects that the potential impacts of the proposal are both with and without the stipulations, thereby the merit for their adoption by the decisionmaker is ascertainable. If a stipulation is treated as a "comment" managing measure, the decisionmaker may not have a clear basis on which to decide a stipulation if that is his decision. Since the Secretary is an active participant in the OCS lease sale decision process, his latitude in making sale decisions should not be limited by the premature adoption of a lease stipulation as a comment measure. Therefore, the Secretary has accepted these on even sale since they were established.

Copy: Director, Minerals Management Service
By direction of the Commandant
Branch
Chief, Environmental Coordination
Commander, U.S. Coast Guard
B. A. RUSSELL

Sincerely,

This is in response to the undated letter, received in this office on April 26, 1993, which transmitted the draft Environmental Impact Statement (EIS) for the proposed 1994 Outer Continental Shelf Oil and Gas Lease Sales 147 and 150 in the Central and Western Gulf of Mexico. We have reviewed the EIS and have no comments to offer. We appreciate the opportunity to review the OCS Oil and Gas Lease Sales 147 and 150 EIS.

Dear Sir:

Regional Director
Minerals Management Service
Gulf of Mexico Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123

May 6, 1993

16004

G-MEP-3
(202) 267-0500

U.S. Department
of the Interior
United States
Coast Guard

U.S. Coast Guard
U.S. Coast Guard

U.S. Department of the Interior
U.S. Coast Guard
U.S. Coast Guard

Letters from the States

HOUSE OF REPRESENTATIVES

ALABAMA STATE HOUSE
MONTGOMERY, ALABAMA 36130

July 19, 1993

DISTRICT NO. 105
MOBILE COUNTY
TAYLOR F. HARPER
P. O. BOX 229
GRAND BAY, ALABAMA
36541
OFFICE 208/432 0482
MONTGOMERY 205 242 7682

COMMITTEES
CHAIRPERSON, RAILS AND MEANS
TOURISM, ENTERTAINMENT AND SPORTS
LOCAL LEGISLATION NO. 1

Mr. J. Rodgers Percy
Regional Supervisor
Office of Leasing and Environment (MS 5400)
Gulf of Mexico OCS Region
Room 311
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Dear Mr. Percy:

I am writing to add my comments to the public record in support of Proposed Central Gulf Sale 147 and 150. If prior commitments had not regrettably prevented My attending the public hearing on June 10 in Mobile, I would have offered these comments at that time.

Alabama has enjoyed a prosperous relationship with the offshore oil and gas industry. From 1979, the beginning of Alabama's offshore exploration, to 1988, when the first natural gas was produced, the state worked toward incorporating this new and potentially lucrative industry with established tourism, fishing and commercial shipping industries. This was not easy. There were many concerns that the regular flow of business would be disrupted while wells were drilled and platforms were located. Others worried over the potential for environmental harm resulting from accidents.

The State successfully safeguarded all concerns in regulations adopted regarding all exploration, drilling production and shipping operations. As a result, tourism has not only not been negatively impacted; conversely, the growth of Alabama's Gulf Coast tourism industry has been quite remarkable. Our beaches are just as sugar white and pristine as ever, with continually increasing property values. Fishing and shrimping are always difficult industries, but the presence of the offshore oil and gas industry has had no negative impact -- in fact, many fishermen utilize offshore structures as lucrative fishing grounds.

Mr. J. Rodgers Percy
July 19, 1993
Page 2

Now, for the even better news: We created two trust funds with royalty, lease and bonus payments raised from the three major lease sales in the 1980's. The corpus of these funds has grown to \$1 billion; during fiscal year 1992, the General Fund received approximately \$100 million in interest payments from the trusts. This revenue has greatly improved the fiscal soundness of our State government reducing the need for general tax increases on our citizens.

Of particular note, the prosperity from our dealings with the offshore oil and gas industry has allowed us to begin preserving one natural resource while exploiting another. In 1992, the Alabama Legislature created the "Alabama Forever Wild Trust Fund" to buy and preserve historic, pristine, or otherwise notable natural areas of our state. This Fund diverts a small portion of the annual interest payouts from each oil and gas trust fund from the General Fund into the Forever Wild Trust Fund, which should allow the state to begin buying and preserving land by 1995.

The responsible approach taken by MMS to offer these new areas for lease, coupled with the remarkable track record of the offshore oil and gas industry in safeguarding the environment during operations, I believe warrants full development of the proposed leases. Because America's offshore oil and gas industry has been forced to seek opportunities in foreign countries in order to add to their reserve bases, the industry has suffered extremely limited access within which to develop new domestic areas over the past ten years. If these lease sales are successful and exploration can begin by 1995, it will give a much-needed boost to our "home" companies at a time when oil and natural gas prices can support full development of these fields.

I appreciate this opportunity to express my opinion. If I can be of further assistance to your office in any way, please let me know.

Sincerely,

Taylor F. Harper

TFH.ep

JIM FOLSON
GOVERNOR

STATE OF ALABAMA

GOVERNOR'S OFFICE
MONTGOMERY 36130

May 18, 1993

Mr. J. Rogers Percy, Regional Director
Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, LA 70123-2394

Dear Mr. Percy:

With respect to your requests of April 30, 1993, regarding proposed Notices of Sales (NOS) and April 19, 1993, regarding the draft Environmental Impact Statement (EIS) for proposed Lease Sales 147 in the Central Gulf of Mexico and Lease Sale 150 in the Western Gulf of Mexico scheduled to be held in 1994, we offer the following comments.

We have no comments regarding the NOS or draft EIS for the Western Gulf of Mexico Lease Sale 150.

Regarding the NOS and draft EIS for the Central Gulf of Mexico Lease Sale 147, we have the following comments.

As you may be aware, Alabama is emerging as a significant oil and gas producing state. We anticipate being a major supplier of natural gas for the nation when the deep natural gas resources in offshore Alabama are at optimum production. We have consistently supported energy programs that expedite oil and gas exploration and production, while providing careful and due consideration of environmental concerns. The discovery of new oil and gas reserves and a continued focused inventory of our potential oil and gas resources, particularly those resources of the OCS area are vital to national energy security. We believe, however, that those coastal states and communities affected by OCS activities should receive a fair share of the financial benefits of such development and production.

The majority of the natural gas production from OCS tracts off our coast apparently will be brought ashore by pipelines to cleansing and processing facilities in southern Mobile County, Alabama. This plan of action is logical because the industry infrastructure necessary for such operations is in place in Mobile County. The infrastructure was established to process the natural gas produced from state coastal tracts. We support the centralization of these cleansing and processing facilities in southern Alabama but maintain that our affected coastal communities should have an opportunity to share in the financial benefits resulting from this OCS production.

We support the existing live bottom stipulation applied to the pinnacle trend areas in the Main Pass and Viosca Knoll Areas. We have been much encouraged by the recent efforts of the Minerals Management Service to determine the extent and significance of these live bottom areas. Recent videotape reconnaissance of some of these areas supports our previous contentions that these live bottom areas could be important recruitment areas for inshore fisheries and may be much larger and more significant than is currently assumed by Minerals Management Service.

We look forward to working cooperatively with the Minerals Management Service in the successful and safe utilization of the hydrocarbon resources located offshore Alabama and in sharing in the benefits of OCS leasing and production activities.

Sincerely,

Jim Folson
Jim Folson
Governor

JF:md
cc: Dr. Ernest A. Mancini
Geological Survey of Alabama
P.O. Box 0
Tuscaloosa, Alabama 35486-9780

CURTIS TUNNELL
EXECUTIVE DIRECTOR

TEXAS HISTORICAL COMMISSION

P.O. BOX 12276

AUSTIN, TEXAS 78711

(512)463-6100

DEPARTMENT OF ANTIQUITIES PROTECTION

April 20, 1993

Rick Anuskiewicz
Staff Archeologist
DOI, Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Blvd.
New Orleans, LA 70123-2394

Re: DE15, Gulf of Mexico Sales 147 & 150 (Multiple, F2, F30)

Dear Rick:

Thank you for sending the above referenced documents for review. Cultural resources are adequately addressed. We look forward to continuing to work with your agency on these matters.

Yours truly,

James E. Bruseeth, Ph.D.
Deputy State Historic Preservation Officer
JEB/BA/drm

Barto Arnold
State Marine Archeologist

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MINERALS MANAGEMENT SERVICE
LEASING & ENVIRONMENT

The State Agency for Historic Preservation

Letters from Industry

**Mid-Continent
Oil & Gas Association**

1201 Elmwood Park Blvd., Room 311
New Orleans, LA 70123-2394

July 30, 1993

Mr. Ken Adams
Regional Supervisor
Office of Leasing and Environment (MS 5400)
Gulf of Mexico OCS Region
1201 Elmwood Park Blvd., Room 311
New Orleans, LA 70123-2394

Dear Mr. Adams:

The Mid-Continent Oil and Gas Association, Mississippi/Alabama Division, would like to compliment the Minerals Management Service on the thorough job the staff has done in preparing the Draft Environmental Impact Statement (DEIS) for Gulf of Mexico Sales 147 and 150.

There are a number of our member companies who operate in the Gulf and do so in an exemplary manner indicative of a healthy respect for the ecosystem. These operators have actually produced for almost four decades oil and gas resources in an environmentally safe manner in the Gulf of Mexico.

The MMS will play a key role in future development of offshore supplies of crude oil and natural gas. As you are aware, federal offshore areas potentially contain as much as 29 billion barrels of recoverable oil and almost 205 trillion cubic feet of recoverable natural gas. Therefore, the industry and the Department of Interior must continue to seek a balance between fostering a pro-development climate and environmental protection answers which demonstrate benefits.

Regarding the Association's comments, we would like to offer our general support for the statement made by Harold Cargol with Texaco Exploration and Production Company and on behalf of the American Petroleum Institute. In addition, we support the specific comments and recommendations of Shell Oil Company, which were provided to you in a July 12, 1993 letter. We were not able to attend the Mobile public hearing

William H. Lott

James H. Lott

Thomas J. McMillan Jr.

Joseph A. Sims

William H. Lott

Mr. Ken Adams
Page Two
July 30, 1993

on June 10, 1993. We would, however, appreciate your consideration of these comments as you go forward in the evaluation of the Draft Environmental Impact Statement even though these comments are late.

If you or your staff have any questions or desire further assistance from the Association, please feel free to contact me.

Sincerely,

Joseph A. Sims

JKS:st

Shell Offshore Inc.

An Offshore of Shell Oil Company

One Shell Square
PO Box 51933
New Orleans, LA 70112

July 12, 1993

Mr. Ken Adams
Regional Supervisor
Office of Leasing and Environment MS 1411
Bureau of Mexican OCS Region
1201 Biwold Park Blvd., Room 311
New Orleans, LA 70112-2194

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR
SALES 147 AND 150

Dear Mr. Adams:

Shell Offshore Inc. SOI has reviewed the Draft Environmental Impact Statement (DEIS) for Gulf of Mexico Sales 147 and 150 in the Central and Western Planning Areas. In addition to the testimony presented at the public hearing, we are submitting the following written comments.

Generally speaking, SOI believes the Minerals Management Service (MMS) has done a good job in preparing this DEIS. It is comprehensive and evaluates in detail a vast array of issues related to OCS operations and their potential environmental impact. Shell believes the document and the proposed actions included therein insure that the integrity and the environment of the GOM are protected while allowing for the development of the Gulf's petroleum resources. Shell offers the following specific comments on the DEIS document.

1. Shell supports the MMS recommendation of Alternative A, which is Alternative B for both Sales 147 and 150. The Central and Western GOM are mature oil and gas provinces. Without denying access to valuable oil and gas resources, GOM areas of potential and confirmed environmental significance have been protected by the MMS biological stipulations since the 1970s and U.S. Environmental Protection Agency's (EPA) National Pollution Discharge Elimination System (NPDES) discharge rate limitations since 1966. EPA has recently issued a new NPDES permit and released new Offshore Guidelines which will be incorporated into the permit.

Biological stipulations were developed by MMS in consultation with various federal agencies and with input from state officials, industry, environmental organizations and academia. Protection of biological resources and the effectiveness of MMS EPA regulations have been substantiated by over 10 years of environmental studies at the Flower Gardens where the co-existence of oil and gas operations and the marine biota without degradation of valuable biological resources has been confirmed. Attached is an article by Dr. Steve Gittings, Manager of the Flower Garden Banks National

Marine Sanctuary for the National Oceanographic and Atmospheric Administration, published in the May 1993 *Oceanic Magazine*. This article states that lease stipulations have been effective and development can proceed in sensitive environments with proper regulations as presently applied.

These biological stipulations have been applied extensively to tracts of biological significance throughout the Central and Western GOM. As an example, the topographic features stipulations is applicable to 367 GOM tracts. "No activity zones" have been established in those areas that have been scientifically shown to be too sensitive to disturb and for which the MMS and EPA do not feel their stipulations can provide adequate protection. Close to 50 GOM "no activity zones" have been designated.

Under Alternative B, 174 released biologically sensitive blocks and blocks in the Central GOM and 111 in the Western GOM near topographic features would be deleted from the 1994 Central and Western GOM lease sales. The DEIS does a good job of detailing direct impacts of the deferral, however, potential indirect impacts are not fully evaluated. Again, SOI believes lease stipulations, NPDES discharge limitations and no activity zones provide proper protection for scientifically verified areas of biological importance. Unnecessary deferral of entire blocks sets a troubling precedent. In a worse case scenario, block deferrals such as those outlined in Alternative B could lead to cessation of prospects outside of the deferral area, blockage of pipeline routes, and detours causing long circuits pipeline routes.

In summary, to facilitate development of this valuable oil and gas resource, Central and Western GOM tract deletions should be kept to a minimum. Therefore, SOI strongly supports Alternative A for both Sales 147 and 150. SOI believes areas of potential biological uniqueness should be studied to scientifically verify their significance and to insure that biological resources are protected. Application of MMS biological stipulations and NPDES discharge limitations provide proper protection for scientifically verified areas of biological importance.

2. Shell supports the MMS proposed action, Alternative A, for Sale 147, the 1994 Central GOM sale, in its entirety.

3. Shell supports the MMS proposed action, Alternative A, for Sale 150, the 1994 Western GOM sale, with the exception of the 117 block deferral off Port Mansfield, Texas. Shell opposes the deferral. The decision to defer a million acres in the Western GOM to accommodate Naval operations was previously agreed upon without significant input from industry and other interested parties. This deferral represented a significant departure from the way multiple use areas historically have been managed in the Western GOM.

SHELL-1

SHELL-2

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According to the U.S. Navy, about 30 percent of its basic air carrier training is conducted in the Gulf of Mexico. The training area is defined by lease stipulations, the Navy's operations and petroleum activities co-existed with few incidents for many years. Putting from the DEIS itself page 1-11. "The effectiveness of the stipulation may be illustrated by the fact that there have been no reported accidents in the Gulf resulting from conflicts between oil and gas operations and military activities." Shell firmly believes that lease stipulations and drilling windows, coupled with a strong commitment to cooperation and communication, provide the necessary framework for successful co-existence of petroleum and naval operations in the Western GOM.

As you well know, industry's knowledge of the resource potential of the GOM is constantly evolving. Ten years ago the deepwater GOM was generally an area of low interest to industry and virtually unevaluated. Today, it is considered a promising frontier area in this country's domestic energy future. Similarly, while the area proposed for military deferral is currently an area of low industry activity, it is nonetheless a prospective, unevaluated area. Until the seismic and drilling occurs, it is premature to write it off as an area of low resource potential or to limit industry access for further evaluation.

SOI clearly recognizes the importance of maintaining a combat ready Navy, even during peace times, and is committed to a cooperative and flexible approach in multiple use areas. However, the fact remains that explorers must have access to areas where oil and gas accumulations are expected to be found if this country hopes to reverse its growing dependence on foreign oil. Given the fact that most other highly prospective sedimentary basins outside the GOM have been drilled with disappointing results or put off limits due to perceived environmental sensitivities or for other reasons, this country cannot afford to unnecessarily limit exploration and production opportunities in the prolific GOM. Domestic oil and gas production and a strong Navy are both important to this country's national security. Every effort must be made to accommodate the needs of both while insuring that the Gulf of Mexico marine environment is protected.

As stated in the DEIS page V-3, the military deferral would be subject to 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. The last such meeting was held on August 27, 1991. We encourage the MMS to hold another meeting in the next few months so that all interested parties (MMS, SOI, and industry) can discuss the issues and work towards a multiple use solution.

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4. Shell supports the MMS decision, discussed in page 1-11 of offering annual lease sales and not restricting the number of blocks offered, especially in deepwater areas of the Gulf of Mexico. The MMS is correct when they conclude that a "large portion of the remaining oil and gas resources lie in the deepwater areas 400-700 m of the Central and Western Gulf. Removing tracts would restrict industry's opportunity to explore and limit their efforts to areas having a lower resource potential."

5. Specific comments on issues addressed in the DEIS. We would like to offer some specific comments on several issues discussed throughout the DEIS.

A. One conclusion in the Summary Section, page VII, "Offshore Resources," sentences 3-5 overstates the actual situation. "Drilling muds and cuttings are expected to contaminate a localized area around platforms out to 3,000 m for up to 10 years after drilling process. Production wastes will change water quality parameters within several hundred meters around each platform for up to 20 years. These discharges will contribute to long-term, regional contamination. Impacts to marine mammals would result in physiological stress, would alter normal behavior, and would bring avoidance of affected areas."

Drill muds and cuttings will not contaminate the area out to 3,000 m. Although a barrier signal can be measured out to 3,000 m, the levels are so low as to be of no environmental consequence. Virtually all of the other "contaminants" are at low levels and restricted to within 200 m of the platform in almost all cases.

Production discharges will not degrade the water quality for up to several hundred meters around each platform for up to 20 years. The discharges leave the platform as a narrow plume, and only encompass a small segment in 1/2 of the water column. Only a few percent of the entire water mass within the 200 m radius is even contacted by the plume at any one time. The concentrations of "contaminants" are so low by the time they reach 200 m that it is questionable whether or not pollution occurs in an ecological sense. In addition, there is no indication of scientific studies or other data that can support that discharge activities from offshore platform in the Gulf of Mexico have lead to direct physiological impacts to marine mammals.

B. We would also like to note that under the section titled "Operational Waste Discharged Offshore" page IV-42, the statement is made that "In general, only wastes, such as produced water and sands, and processing fluids, are collected into one drainage system and then sent into a sump tank where the oil is separated, often by gravity."

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This statement can be misinterpreted since there are many other pieces of production and treatment equipment which are used on the platform to treat and clean these discharges. Only a small portion of water, mainly washdown water and rain water go into the surge. The oil that is removed from the stream, which is very small in volume, can also be returned to the production stream.

- C. Many of the operations that occur in deepwater areas will not impact the chemosynthetic communities as stated in the DEIS (page IV-97, second paragraph). Some of the rigs utilized in these areas are equipped with dynamic positioning which does not require the placement of anchors. Also, support boats and ships working in deepwater are equipped in the same manner, tie-up to the rig or platform, or tie-up to stationary anchors set on the seafloor with floating buoys.

We appreciate the opportunity to comment on this DEIS. If you have any questions or would like to discuss our comments, please contact Peter Velez at (504) 588-6982.

Sincerely,

J. M. Funk
J. M. Funk
General Manager
E&P - Shelf Division

PKV:BWD

Attachment

R. A. Pittarozzi
R. A. Pittarozzi
General Manager
E&P Deepwater Division

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Historic data on Gulf of Mexico reef shows compatibility with drilling, production

Regulation of Flower Gardens helps protect fragile US marine environment

Dr. Steve Gittings
Flower Garden Banks
National Marine Sanctuary
(US-NOAA)

Can hydrocarbon reservoirs be tapped near sensitive ecosystems without jeopardizing the integrity of the environment at the same time? The response to this question depends on who is asked. The answer, however, demands clear thinking, the input of environmental science, and monitoring. Too often, decisions on whether or not to develop an area rely on none of these. In some cases, it is clear that development has resulted in significant environmental modification. Such has been the case in a number of wetland areas. In other cases, development has been blocked primarily because of vociferous opposition by an environmentally sensitive public. Unfortunately, those who oppose development often do so without considering the possibility that development and resource protection might be compatible under certain circumstances. While responses to the question of compatibility between development and environmental health are easily obtained, the question itself is, unfortunately, not always debated in a sensible manner.

Escalating development on the outer continental shelf of the north-west Gulf of Mexico in the 1970s coincided with the first rigorous examinations of the unique biological communities on a number of offshore banks in the region. The two were linked, however, because the US Minerals Management Service (MMS) (then part of the Bureau of Land Management), which regulates offshore development, recognized that some of the banks harbored sensitive tropical marine communities.

Reef communities

Such communities require stable environments and do not tolerate unfamiliar changes in water quality. They

Figure 1. The two Flower Garden reefs are among a number of seamounts lying along the Gulf of Mexico continental shelf.

would be especially vulnerable to the effects of unusual levels of sedimentation by drill mud plumes and to other discharges that might degrade water quality. MMS funded studies which employed submersibles, scientific diving, and geological and physical oceanographic tools to characterize the environment and conditions on and around the banks.

Much of the effort in the late 1970s centered on two particularly unique banks on the shelf-edge, the East and West Flower Garden Banks. The features contain well developed coral reefs on their summits (55-65 ft).

These reefs extend to depths of over 120-ft deep, but are quite limited in area. On the East Bank, the highly diverse coral reef occupies roughly 250 acres; on the West Bank, 100 acres. In the 120-170 feet range, the bottom is dominated by a low diversity coral community. Below this, extensive plateaus and gentle slopes - many times larger than the reefs themselves - are composed of coralline algae pavements, algal nodules, sponges, and

other bottom-dwelling animals and plants to a depth of over 270 ft.

Communities dominated by deep-water sea fans, sea whips, sponges, solitary hard corals, and crinoids exist on the lower reaches of the banks above about 300 feet. Ancient reefs, long since drowned by rising sea levels, also occur on the deeper portions of the banks, and remind us that the world changes, even without human help.

Leasing restrictions

In 1972, MMS developed lease stipulations in areas around a number of banks, including the Flower Gardens, in order to protect them from damage. At the Flower Gardens, a "No-Activity Zone" out to approximately 100 meters depth prohibited all industry activity.

A "1-Mile Zone" beyond the "No-Activity Zone" was established that required shunting of drill cuttings and discharges to within 10 meters of the seafloor. It was determined that the local currents at these depths would preclude sediments and other d.s.

INDUSTRY/ENVIRONMENT

charges from reaching the shallow reef communities.

Monitoring studies were also required in conjunction with drilling in this zone. A "Four Mile Zone" was established in which shunting was required but not monitoring.

One of the goals of research in the mid to late 1970s was to develop scientific techniques to allow researchers to quantitatively monitor critical aspects of the unique reefs on the Flower Garden Banks. Coral populations, cover, diversity, and coral growth rates were studied in detail as early as 1976. Data collected then were gathered in much the same way as is done today, allowing long-term comparisons. Unlike the Flower Gardens, few reefs in the world have had the luxury of sustained, long-term and standardized data collection.

Data collection

In 1981, Mobil placed a platform in a position approximately one mile southeast of the shallowest portions of the East Flower Garden Bank, just outside the "No-Activity Zone." A contract for environmental monitoring was awarded to Continental Shelf Associates (Troyes, La.).

Subcontracts were awarded to scientists at Texas A&M University (College Station) mainly for the coral studies. The monitoring efforts included studies on drill mud content, discharge rates, sedimentation, current patterns, water quality, bioassays, coral populations, coral growth, and recruitment (larval settlement).

Monitoring showed that discharges of drilling muds did not reach the coral reef zone on the East Bank, just over a mile to the northwest, and no data showed any immediate effects on corals.

Coral community monitoring ended in 1982 following the completion of two wells by Mobil. In 1986, Union placed a platform in the "Four Mile Zone" of the West Flower Garden Bank. By this time, monitoring requirements had changed substantially and focused primarily on measurement of coral populations and growth rates. CSA was again awarded a contract to conduct monitoring and established a permanent monitoring station measuring 100 meters by 100 meters on the top of the West Bank. Within this area, 40 one-meter tall posts were implanted in the reef rock to per-

manently mark, repetitively, photographed sites eight square meters in size.

Bolts and nails were installed to mark 100 repetitively photographed coral margins to monitor increasing growth rates, and spikes were driven into the tops of 30 coral colonies to monitor upward coral growth. Coral populations, cover, and diversity were measured using random transect photography, a method used in earlier studies on the banks.

In late 1988, Texas A&M was awarded a three-year contract by MMS to continue the monitoring study on the West Bank and also to establish a comparable study site on the East Bank. Since that time, monitoring studies have been conducted twice a year, the first being in September and the second

Few changes

in late May. Since monitoring studies at the Flower Gardens began in 1976, significant changes have been documented that might be attributed to increasing hydrocarbon development in the vicinity of the banks. Coral populations and cover have not changed measurably.

Coral growth rates have remained enviable, even by tropical standards. Coral reproduction has been documented by studies using artificial settlement plates and by observations of mass spawning of corals in 1986 and 1989. Mass spawning is the synchronous release of eggs and sperm by multiple coral species. The phenomenon is frequently observed on Pacific reefs, but comparable observations elsewhere in the Atlantic are limited.

Studies of long-term water quality changes that may be recorded in the skeletons of coral colonies are ongoing. Data increasingly suggest that the Flower Gardens contain fully functional, well-developed, healthy, and pristine coral communities. This is not to say that changes have not been documented on the reefs.

• **Urchin die-off.** Between 1983 and 1984, nearly all the black spined sea urchins in the Western Atlantic and the Gulf of Mexico died. This sea urchin was a very important herbivore and consumed algae that might otherwise crowd and smother corals and other bottom-dwelling animals.

On some Atlantic reefs, algae cover rose dramatically following the

Figure 2. A diver is shown conducting a monitoring station in the Flower Garden Banks, used to determine reef condition. Most of the damage on the reef has come from unrestricted anchoring. (Photo by G.S. Boland)

die-off and coral cover dropped significantly following the die-off of the urchins. The Flower Gardens, however, have bottom-dwelling animals that are more than a match for the coral-smothering urchins.

Algae cover diminished after 1984 and has remained near or below 10% since then. Recently, water data have shown an increase in one species of coral that consumes algae. This may have been the result of the sea urchin die-off and may explain the lack of profuse high algae cover on the reefs.

• **Coral bleaching.** Coral bleaching occurs when stressed coral colonies expel internal symbiotic algae (zooxanthellae) that typically release wastes, enhance growth, and simplify food production. Under normal conditions, corals get their greenish-brown color from these symbionts. During stressful events, which can be caused by unusually high or low temperatures, high or low light levels, exposure to excessive sedimentation, and other factors, corals expel the algae. This results in a bleached, white appearance.

Coral bleaching was observed to some extent every summer between 1985 and 1989. The most significant event occurred in 1987. The summer

INDUSTRY/ENVIRONMENT

Figure 3. No-activity zones have been set up by the US Minerals Management Service for the reef areas. The reef was monitored in past years when drilling and production activity took place nearby.

with, and it thought to have resulted from unusually high summer temperatures. Nevertheless, no significant mortality occurred and colonies generally appeared to completely recover in their algae populations within several months of bleaching.

Both the mass mortality of sea urchins and coral bleaching are thought to have been natural phenomena. Both have been observed in many areas of the Atlantic and Gulf of Mexico.

One highly unlikely, but hydrocarbon production in the region had anything to do with either event. Nevertheless, human impacts on the coral communities at the Flower Gardens have been documented.

• **Anchoring damage.** On several occasions, large vessels have been seen at anchor on the banks. Side-scan sonar has shown evidence of enormous anchor marks, no doubt from tankers or other floating vessels, on some of the deeper portions of the banks.

Small boats frequently anchored on the reefs before the installation of permanent moorings in 1980 by volunteers from the Gulf Breeze Environmental Action Team (GREAT) and other organizations. All these anchoring incidents caused mechanical damage that can take many years to heal. Other evidence of humans include discarded chains and cables and lost anchors.

A number of industry vessels have also contributed to the problem. Anchoring on the shallow reefs saves time and effort, and crews often take time to fish while at anchor. Ironically, fishing is poor in the coral reef zones of the Flower Garden Banks. The best fishing "shoppers" groups is on the deeper reaches of the banks, over 150 feet.

Human pressure

It is becoming more evident that a wide range of human activities can be blamed for the demise of many nearby habitats, including coral reefs. The viability of reefs at the Flower Gardens is no doubt, due in part to their remote location. They are over 100 miles from shore and out of range of most human influence, particularly problems caused by excessive coastal development.

No one knows what the Flower Gardens might look like today without the regulations imposed on drilling operations around the banks. It is possible that discharges at the ocean surface would have settled to the reefs and smothered corals.

Toxic components of some discharges could have caused the death of plants and animals, increases of disease incidence, or other signs of environmental stress. Unrestricted anchoring, by industry and other vessels would almost certainly have affected the small reefs.

Proper regulation

But regulations were imposed. And the all indications that have been effective. The "No-Activity Zone" established in 1980 has been the most effective measure to date. It has been the only one that has been strictly enforced. The "No-Activity Zone" has been the only one that has been strictly enforced. The "No-Activity Zone" has been the only one that has been strictly enforced.

The "No-Activity Zone" has been the only one that has been strictly enforced. The "No-Activity Zone" has been the only one that has been strictly enforced. The "No-Activity Zone" has been the only one that has been strictly enforced.

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The National Oceanic and Atmospheric Administration (NOAA) has been the only one that has been strictly enforced. The "No-Activity Zone" has been the only one that has been strictly enforced. The "No-Activity Zone" has been the only one that has been strictly enforced.

AUTHOR

Dr. John C. Goff, Jr., is manager of the Flower Garden Banks National Marine Sanctuary. He is a retired U.S. Navy officer and a member of the U.S. Navy Reserve. He was also a member of the U.S. Navy Reserve. He was also a member of the U.S. Navy Reserve. He was also a member of the U.S. Navy Reserve.

SHELL OFFSHORE INC.

Shell-1 The decision of whether to adopt various alternatives or stipulations will be made by the Secretary of the Interior in accordance with Departmental policy at the time of the issuance of the Final Notice of Sale. We feel that protection of the sensitive offshore habitats of the topographic features and the Pinnacle Trend can be adequately accomplished by adoption of the Topographic Features and the Live Bottom Stipulations without the need to delete the tracts from the lease sale. It should also be noted that although the decision of whether to adopt the Topographic Features Stipulation and the Live Bottom Stipulation is a matter of discretion for the Secretary of the Interior, he has never failed to adopt these protective measures since they were first put in place.

Shell-2 In late 1990, MMS and the Department of Defense (DOD) agreed to the deferral of the Western Naval Operations Area. The area consisted of 377 blocks (1.8 million acres) located off Corpus Christi, Texas. At that time, 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. In August 1991, a meeting was held between the MMS, DOD, and industry representatives to discuss the current and planned operational conditions in the deferral area and to allow industry to further express its concerns over the deferral. Industry representatives requested that MMS and DOD reconsider adjusting the configuration and location of the area based on industry's interest in this area. Following this meeting, MMS and DOD entered into an agreement deferring the area for Sales 143 and 150.

Shell-3 The summary section takes conclusions reached in various sections and combines them. These two conclusions relating to changes in water quality around platforms and impacts to marine mammals are not related. The summary section will be modified to correct this error.

The following discussion is in response to your comments regarding conclusions derived in the water quality analysis. Again, this section drew simplified conclusions about potential future impacts from the analysis sections. The discussion provided in Section IV.D.1.a.1. agrees closely with your conclusions, identifying the elevated contaminant as harmful. Furthermore, the description of changes in water column parameters or contamination (defined as the condition when compounds exceed natural conditions) is not linked with adverse effects. In fact, in the general discussion provided prior to the Base Case analysis in Section IV.D.1.a.1, the author states "... (drilling and production discharges) are rapidly diluted in the water column, are not significantly soluble, and are not expected to produce adverse effects in water column organisms."

Your point noting that the summary statements regarding production discharges can be interpreted to mean that contamination is occurring in the entire water column is well taken and the statement has been modified in the Final EIS.

Shell-4 The statement in question has been changed to reflect updated information.

Shell-5 The MMS concurs that many oil and gas support operations involving ships and barge would not result in anchor impacts because they would tie up directly to rigs, platforms, or mooring buoys. In addition, we are aware of two dynamically positioned drill rigs operating in the Gulf of Mexico at the present time.

SECTION VI

BIBLIOGRAPHY AND SPECIAL REFERENCES

VI. BIBLIOGRAPHY AND SPECIAL REFERENCES

The following references are cited in the text:

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These references are available for review by the public in the Gulf of Mexico OCS Region's library. Most of these references may also be found in public or university libraries. The library will, upon request, provide assistance to anyone having difficulty locating any of these publications.

Contact: Librarian
Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394
Telephone: (504) 736-2522

SECTION VII

PREPARERS

VII

VII. PREPARERS

Joseph A. Christopher, Chief, Environmental Assessment Section
Dennis L. Chew, Offshore Unit Chief, Supervisory Environmental Protection Specialist

R. Mark Rouse, Senior Environmental Scientist, Coordinator
George Hampton, Senior Environmental Scientist, Coordinator

Kathleen I. Bell, Office Automation Clerk
Darice K. Breeding, Environmental Protection Specialist
Margaret P. Britz, Office Automation Clerk
Patricia R. Bryars, Statistical Assistant
Ann Scarborough Bull, Biologist
Elmo J. Cooper, Visual Information Specialist
Deborah J. Cranswick, Environmental Scientist
Janet K. Diaz, Secretary
Kenneth L. Graham, Biologist
John R. Greene, Archaeologist
Charles W. Hill, Jr., Natural Resource Specialist
Samuel W. Holder, Jr., Natural Resource Specialist
Bonnie Laborde Johnson, Physical Scientist
Alexis Lugo-Fernández, Physical Oceanographer
Molly Lutcavage, Biologist
Anne M. Maranto, Office Automation Clerk
Deborah H. Miller, Technical Publications Editor
Gail B. Rainey, Physical Oceanographer
Villere C. Reggio, Jr., Outdoor Recreation Planner
John L. Rodi, Supervisor, Sales and Support Unit
Katherine M. Ross, Petroleum Engineer
Wilfred W. Times, Visual Information Specialist
Stephen T. Viada, Biologist
Darcel D. Waguespack, Visual Information Specialist

SECTION VIII
GLOSSARY

VIII. GLOSSARY

Acute -- Sudden, short term, severe, critical, crucial, intense, but usually of short duration.

Anaerobic -- Capable of growing in the absence of molecular oxygen.

Anthropogenic -- Coming from human sources, relating to the effect of humankind on nature.

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. The API gravity equals $[(141.5/\text{specific gravity at } 60^{\circ}\text{F}) - 131.5]$.

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 naphthas.

Attainment area -- An area that is shown by monitored data or by air-quality modeling calculations to be in compliance with primary and secondary ambient air quality standards established by the USEPA.

Barrel (bbl) -- A volumetric unit used in the petroleum industry; equivalent to 42 U.S. gallons or 158.99 liters.

Base Case -- An estimate of the resources expected to be leased, developed, and produced, based on the assumption 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 in the earth's crust 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.

Benthic -- Organisms living on or in the bottom of the sea; associated with live bottoms, hard-bottom banks, patch reefs, and reef complexes.

Biological Opinion -- FWS or NMFS evaluation of the impact of a proposed action on endangered and threatened species.

Block -- A geographical area, as portrayed on an official MMS protraction diagram or leasing map, that contains approximately 2,331 ha (nine square miles).

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.

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.

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Central Planning Area (CPA) -- The sale area south from the 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 -- An aquatic mammal of the order Cetacea, such as whales, dolphins, porpoises, and related forms.

Chemosynthetic -- Organisms that obtain their energy from the oxidation of various inorganic compounds rather than from light (photosynthetic).

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 tidal activity. Included in forested wetlands are hardwood hammocks, mangrove swamps, spoil banks, cypress-tupelo gum swamps, and bottomland hardwoods. Nonforested wetlands include fresh, brackish, and salt marshes. These areas directly contribute to the high biological productivity of coastal waters by input of detritus and nutrients, by providing nursery and feeding areas for shellfish and finfish, and by serving as habitat for many birds and other animals.

Coastal zone -- The coastal waters (including the lands therein and thereunder) and the adjacent shorelands (including the waters therein and thereunder) strongly influenced by each other and in proximity to the shorelines of the several coastal states; the zone includes islands, transitional and intertidal areas, salt marshes, wetlands, and beaches and extends seaward to the outer limit of the United States territorial sea. The zone extends inland from the shorelines only to the extent necessary to control shorelands, the uses of which have a direct and significant impact on the coastal waters. Excluded from the coastal zone are lands the use of which is by law subject to the discretion of or which is held in trust by the Federal Government, its officers, or agents.

Completion -- Conversion of a development well or an exploratory well into a production well of oil or gas or both.

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 -- Estimates of the volumes of undiscovered oil or gas resources under the assumption that economically recoverable resources actually occur within the area of interest.

Continental margin -- The ocean floor that lies between the shoreline and the abyssal ocean floor, includes the continental shelf, continental slope, and continental rise.

Continental shelf -- 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 lease operator as part of the Development Operations Coordination Document.

Critical habitat -- Specific areas essential to the conservation of a protected species and that may require special management considerations or protection.

Crude oil -- Petroleum in its natural state as it emerges from a well, or after it passes through a gas-oil separator but before refining or distillation. An oily, flammable bituminous liquid that 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.

Delineation well -- A well that is drilled for the purpose of delineating an oil or gas reservoir, thereby enabling the lessee to determine whether to proceed with development and production.

Demersal -- Living at or near the bottom of the sea.

Designated environmental preservation areas -- Gulf of Mexico shorefront areas recognized for the quality and significance of their natural environments. They have been legislatively, administratively, or privately protected from the development 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.

Detritus -- Particulate organic matter originating primarily from the physical breakdown of dead animal and plant tissue; loose rock and mineral material produced by mechanical erosion.

Development -- Activities that take place following discovery of economically recoverable mineral resources, including geophysical surveying, drilling, platform construction, operation of onshore support facilities, and other activities that are for the purpose of ultimately producing the resources.

Development Operations Coordination Document (DOCD) -- A document that must be prepared by the operator and submitted to MMS for approval before any development or production activities are conducted on a lease in the Western Gulf. The DOCD meets the requirements of 30 CFR 250.34. Environmental information, archaeological report, biological report (monitoring and/or live-bottom surveying), or other information, as determined, may be required in support of the DOCD.

Development well -- A well drilled to a known producing formation to extract oil or gas; a production well; distinguished from a wildcat or exploratory well and from an offset well.

Draplr -- A dome or anticlinal fold in which a mobile core, such as salt or shale, has been squeezed up and has broken through the more brittle overlying rocks.

Direct employment -- Consists of those workers involved the primary industries of oil and gas exploration, development, and production operations, including geophysical and seismic surveying, exploratory drilling, well operation, maintenance, and other contract support services (Standard Industrial Classification Code 13--Oil and Gas Extraction).

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Discharge -- Something that is emitted; flow rate of a fluid at a given instant expressed as volume per unit of time.

Dispersion -- A suspension of finely divided particles in a medium.

Dome -- A roughly symmetrical upfold, the beds dipping downward 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 continuously downhole through the drill pipe and drill bit, and back up in the annulus between the pipe and the walls of the hole to a surface pit. The mud lubricates and 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; drill rig.

Eastern Planning Area (EPA) -- The sale area south from the 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 resources -- An assessment of hydrocarbon potential that takes into account the physical and technological constraints on production and the influence of costs of exploration and development and market price on industry investment in OCS exploration and production.

Effluent -- The liquid waste of sewage and industrial processing.

Effluent limitations -- Any restriction established by a State or the USEPA on quantities, rates, and concentrations of chemical, physical, biological, and other constituents discharged from point sources into U.S. waters, including schedules of compliance.

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; a NEPA document.

Epifaunal -- Animals living on the surface of hard substrate.

Essential habitat -- Specific areas crucial to the conservation of a species and that may necessitate special considerations.

Estuary -- Coastal semienclosed body of water that has a free connection with the open sea and where freshwater meets and mixes with seawater.

Eutrophication -- Enrichment of nutrients in the water column by natural or artificial methods accompanied by an increase of respiration, which may create an oxygen deficiency.

Exclusive Economic Zone (EEZ) -- The maritime region 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 identifies, to the maximum extent possible, the geology of the potential hydrocarbon accumulations and the type and sequence of exploration activities (including drilling exploratory wells) that are proposed to evaluate the accumulations within the entire area of the lease(s) covered by the plan. Under 30 CFR 250.33, lease operators are required to formulate and obtain approval of such plans by the Director of Minerals Management Service before the proposed exploration activities may commence.

Exploration well -- A well drilled in unproven or semi-proven territory for the purpose of ascertaining the presence of a commercial petroleum or natural gas deposit; exploratory well

Fault -- A fracture in the earth's crust along which one side of the fracture is displaced with respect to the other.

Field -- An area within which hydrocarbons have been concentrated and trapped in economically producible quantities in one or more structurally or stratigraphically related reservoirs.

Floating production system (FPS) -- Converted tanker used in deep water for a production base.

Frasch technique -- Technique used for mining sulphur whereby hot seawater injected into the mineral bearing formation melts the elemental sulphur. Air pumped down to the level of the molten sulphur lifts the sulphur to the surface.

Gathering lines -- A pipeline system used to bring oil or gas production from a number of separate wells or production facilities to a central trunk pipeline, storage facility, or processing terminal.

Geochemical -- Of or relating to the science dealing with the chemical composition of and the actual or possible chemical changes in the crust of the earth.

Geologic hazard -- A naturally occurring or manmade geologic condition or phenomenon that may pose a risk or is a potential danger to life and property, for example subsidence and submarine landslides.

Geomorphic -- Of or pertaining to the general configuration of the earth's surface and its relationship to the underlying structure and geologic history.

Geophysical -- Of or relating to the physical properties of the earth, including its atmosphere and hydrosphere; the measurement and interpretation of geophysical properties of the rocks and fluids of the earth's crust.

Geophysical survey -- A method of exploration in which geophysical properties and relationships are measured by one or more geophysical methods.

Habitat -- A specific type of environment that is occupied by an organism, a population, or a community.

Hermatypic coral -- Reef-building corals that produce hard, calcium carbonate skeletons and that possess symbiotic, unicellular algae within their tissues.

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.

Hydrocarbons -- Any of a large class of organic compounds containing primarily carbon and hydrogen. Hydrocarbon compounds are divided into two broad classes: aromatic and aliphatics. They occur primarily in petroleum, natural gas, coal, and bitumens.

Hydrology -- As used in relation to river development and flood control projects, means alteration of the physical configuration of the drainage basin and channels, including dredging of channels to deepen or widen them; construction of dams, levees, or canals; and addition of irrigation or municipal waters to the natural runoff.

Hypoxia -- Depressed levels of dissolved oxygen in water, usually resulting in decreased metabolism.

Incidental take -- Takings that result from, but are not the purpose of, carrying out an otherwise lawful activity (e.g., fishing) conducted by a Federal agency or applicant (see Taking).

Indirect employment -- Secondary or supporting oil- and gas-related industries, such as the processing of crude oil and gas in refineries, natural gas plants, and petrochemical plants.

Induced employment -- Tertiary industries that are created or supported by the expenditures of employees in the primary or secondary industries (direct and indirect employment), including consumer goods and services such as food, clothing, housing, and entertainment.

Infrastructure -- The facilities associated with oil and gas development, e.g., refineries, gas processing plants, etc.

Jack-up rig -- A barge-like, floating platform with legs at each corner that can be lowered to the sea bottom to raise the platform above the water.

Landfall -- The site where a marine pipeline comes to shore.

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 a coastal Subarea.

Land use -- The function for which people make use of 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 -- The initial period for oil and gas leases, usually a period of 5, 8, or 10 years (a longer period is necessary to encourage exploration and development in areas because of unusually deep water or other adverse conditions).

Lessee -- A party authorized by a lease, or an approved assignment thereof, to explore for and develop and produce the leased deposits in accordance with regulations at 30 CFR 250.

Lightering -- Offloading oil from a large tanker onto smaller vessels or barges for transport to coastal facilities.

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.

Nonattainment area -- An area that is shown by monitored data or by air-quality modeling calculations to exceed primary or secondary ambient air quality standards established by the USEPA.

NORM -- Naturally occurring radioactive materials; any naturally occurring material that emits low levels of radioactivity, originating from processes not associated with the recovery of radioactive material. The radionuclides of concern in NORM are Radium-226, Radium-228, and other isotopes in the radioactive decay chains of uranium and thorium.

OCS Program activities -- All oil and gas activities occurring Gulfwide during the life of the proposal 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.

Operational discharge -- Any incidental pumping, pouring, emitting, emptying, or dumping of wastes generated during routine offshore drilling and production activities.

Operator -- An individual, partnership, firm, or corporation having control or management of operations on a leased area or portion thereof. The operator may be a lessee, designated agent of the lessee, or holder of operating rights under an approved operating agreement.

Organic matter -- Material derived from living plants or animals.

Outer Continental Shelf (OCS) -- All submerged lands that comprise the continental margin adjacent to the United States and seaward of State offshore lands.

Pelagic -- Of or pertaining to the open sea; associated with open water beyond the direct influence of coastal systems.

Penaeids -- Chiefly warm water and tropical prawns belonging to the family Penaeidae.

Pipeline (oil or gas) -- A length of pipe or a series of pipes connected to valves and other control devices and used for transporting oil or gas.

Plankton -- Passively floating or weakly motile aquatic plants (phytoplankton) and animals (zooplankton).

Platform -- A steel or concrete structure from which offshore development wells are drilled. A minor platform has fewer than six completions of production equipment. A major platform has at least six completions and two pieces of production equipment.

Primary production -- Organic material produced by photosynthetic or chemosynthetic organisms.

Produced water -- Total water discharged from the oil and gas extraction process; production water or production brine.

Production -- Activities that take place after the successful completion of any means for the extraction of resources, including bringing the resource to the surface, transferring the produced resource to shore, monitoring operations, and drilling additional wells or workovers.

Province -- An area throughout which geological conditions have been historically similar or that is characterized by distinct structural, petrographic, or physiographic features; a large region unified in some way and considered as a whole.

Recoverable reserves -- The portion of the identified hydrocarbon or mineral resource that can be economically extracted under current technological constraints.

Recoverable resource estimate -- An assessment of hydrocarbon or mineral resources that takes into account the fact that physical and technological constraints dictate that only a portion of resources can be brought to the surface.

Recreational beaches (major) -- Those frequently visited sandy areas along the shorefront exposed to the Gulf of Mexico that support multiple recreational activities, most of which are 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.

Recreational fishing (marine) -- Hook-and-line sport fishing for fun, food, and occasional incidental profit, inclusive of spearfishing, from a boat seaward of the beach.

Refining -- Fractional distillation, usually followed by other processing (for example, cracking).

Relief -- The difference in elevation between the high and low points of a surface.

Reserves -- Proved oil or gas resources.

Reservoir -- A subsurface volume of porous and permeable rock in which oil or gas has accumulated; a natural or artificial pond or lake from which water is drawn for irrigation of water supply.

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.

Royalty -- A share of the minerals produced from a lease paid in either money or in kind to the land owner 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 that has been transported and deposited by water, wind, glacier, precipitation, or gravity; a mass of deposited material.

Seeps (hydrocarbon) -- Gas or oil that reaches the surface along bedding planes, fractures, unconformities, or fault planes.

Seismic -- Pertaining to or characteristic of waves or produced by earthquakes or earth movements; having to do with elastic or acoustic waves travelling through the earth's crust.

Sensitive area -- An area containing species, populations, communities, or assemblages of living resources, that is susceptible to damage from normal OCS-related activities. Damage includes interference with established ecological relationships.

Shunting -- A method used in offshore oil and gas drilling and production activities where expended cuttings and fluids are discharged through a downpipe, which terminates no more than 10 m from the ocean floor, rather than discharged at the ocean surface.

Structure -- Any OCS facility that extends from the seafloor to above the waterline; in petroleum geology, any arrangement of rocks that may hold an accumulation of oil or gas.

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Subarea -- A discrete analysis area; offshore subareas are within the larger planning areas, coastal subareas include several counties or parishes.

Subsidence -- Sinking of part of the earth's crust.

Supply vessel -- A boat that ferries food, water, fuel, and drilling supplies and equipment to an offshore rig or platform and returns to land with refuse that cannot be disposed of at sea.

Symbiont -- Either of two organisms of different species living together in intimate association with each other.

Taking -- To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any endangered or threatened species, or to attempt to engage in any such conduct (including actions that induce stress, adversely impact critical habitat, or result in adverse secondary or cumulative impacts).

Tension leg platform (TLP) -- A production structure that consists of a buoyant platform tethered to concrete pilings on the seafloor with flexible cable. Assumed to be on the OCS and at water depths greater than 450 m.

Total dissolved solids -- The total amount of dissolved solids in water.

Total suspended particulate matter -- The total amount of suspended solids in water.

Total suspended solids -- The total amount of suspended solids in water.

Trunk line -- A large-diameter pipeline receiving oil or gas from many smaller tributary gathering lines that serve a large area; common-carrier line; main line.

Turbidity -- Reduced water clarity due to the presence of suspended matter.

Undiscovered resources -- Oil and gas resources estimated to exist outside known fields or known accumulations.

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 (of oil) -- 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.

"Wipe-out" zone -- Anomalies on seismic reflection profiles caused by scattering of the acoustic energy.

SECTION IX
APPENDICES

Appendix A

Blocks Affected by the Topographic Features Stipulations in the Central and Western Gulf of Mexico

East Cameron, South Addition (continued)

Block	OCS-G No. (if leased)	Bank
363	11854	McGrail
377	13874	McGrail
378	12856	McGrail
379		McGrail

Vermillion, South Addition

Block	OCS-G No. (if leased)	Bank
284	9508	Sonnier
285		Sonnier
286	11883	Sonnier
297	11885	Sonnier
298	11886	Sonnier
299	13890	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		McGrail and Bouma
392		Bouma
393		Bouma and Rezak
394	11900	Bouma and Rezak
395	11901	Rezak
396		Rezak
403		Rezak
404	8678	Rezak

Central Gulf of Mexico

A total of 167 blocks in the Central Gulf would be affected by the topographic features stipulation, 96 of which are currently leased. The blocks affected, leasing status, and affected bank follow (as of August 1993).

West Cameron, South Addition

Block	OCS-G No. (if leased)	Bank
569		29 Fathom
570	5188	29 Fathom
589	5352	29 Fathom
590		29 Fathom
591		29 Fathom
592	13851	29 Fathom
611		29 Fathom
612		29 Fathom and MacNeil
613	3286	MacNeil
614		MacNeil
633	2238	MacNeil
634	10603	Rankin
635	12811	Rankin
636		Bright
637		Bright
638		Bright
645	3973	Geyer
646		Geyer
648	4268	Bright
649		Bright
650		Bright
651		Bright
652		Rankin and Bright
653	12812	Rankin
654	13853	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

Vermilion, South Addition (continued)

Block	OCS-G No. (if leased)	Bank
405		Rezak
406		Rezak and Bouma
407	11902	Bouma
408		McGrail
409		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		Alderdice
179	9556	Alderdice
180	9557	Alderdice
185	9559	Alderdice and Parker
186	9560	Alderdice and Parker
187	13611	Alderdice and Parker
188	13612	Alderdice and Parker
193	13613	Parker
194	11926	Parker
195	11927	Parker
196		Parker
197	11928	Parker
200		Parker
201		Parker
202		Parker
203		Parker
204	13614	Parker

Eugene Island, South Addition

Block	OCS-G No. (if leased)	Bank
335	12927	Fishnet
355	13626	Fishnet
356	13627	Fishnet

Eugene Island, South Addition (continued)

Block	OCS-G No. (if leased)	Block
381		Jakkula
382		Jakkula
383	10756	Jakkula
390		Jakkula
391		Jakkula
397		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		Ewing
338		Ewing
339	12007	Ewing
348	10807	Ewing
349	12008	Ewing
350	13924	Ewing
351	12959	Ewing
352	10808	Ewing
353	13632	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		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		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, 91 of which are currently leased. The blocks affected, leasing status, and the affected bank follow (as of June 1993).

North Padre Island, East Addition

Block	OCS-G No. (if leased)	Bank
A-30		Dream
A-31		Dream
A-40		Dream
A-41		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		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	13802	Stetson
A-514		Stetson
A-527		Stetson
A-528	13803	Stetson
A-529		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		29 Fathom
A-327	2418	29 Fathom
A-328		29 Fathom
A-329	11403	29 Fathom
A-330	2421	29 Fathom
A-331	13806	29 Fathom
A-332	2422	29 Fathom
A-340	2426	Coffee Lump
A-346		MacNeil
A-347		MacNeil
A-348		MacNeil
A-349	2743	MacNeil
A-350	2428	MacNeil
A-351	2429	MacNeil and East Flower Garden
A-352		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		East Flower Garden
A-355	2745	East Flower Garden
A-358		Coffee Lump
A-359		Coffee Lump
A-360		Coffee Lump
A-361		Coffee Lump and West Flower Garden
A-362		West Flower Garden
A-363		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		Rankin
A-372		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	13807	West Flower Garden
A-379	13808	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		East and West Flower Garden
A-387		East Flower Garden
A-388		East Flower Garden
A-389	2759	East Flower Garden
A-390		East Flower Garden and Rankin
A-391		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	13809	West Flower Garden
A-398		West Flower Garden
A-399		West Flower Garden
A-400		West Flower Garden
A-401		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		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	13810	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		East Flower Garden and Rankin
98		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	13811	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		Rankin
142		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		Elvers
155		Elvers
177		West Flower Garden
178		West Flower Garden
179		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		Elvers
237	2812	Geyer
238		Geyer
239	11475	Geyer

Appendix B

Biological Opinions

National Marine Fisheries Service
Biological Opinion
Gulf of Mexico
Sales 147 and 150

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
1305 East-West Highway
Silver Spring, MD 20910
THE DIRECTOR

JUL 30 1993

Mr. Thomas Gernhofer
Associate Director for
Offshore Minerals Management
Minerals Management Service
U.S. Department of the Interior
Washington, D.C. 20240

Dear Mr. Gernhofer:

This responds to a request by Minerals Management Service (MMS) for formal consultation under section 7 of the Endangered Species Act with the National Marine Fisheries Service concerning proposed Gulf of Mexico oil and gas lease sales 147 and 150. Information provided with your letter indicated that the proposed action may adversely affect listed sea turtles.

NMFS has previously 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 Gulf. NMFS concluded that while these activities may adversely affect endangered or threatened species under NMFS jurisdiction, they were not likely to jeopardize the continued existence of these species. NMFS also consulted on lease sales 142 and 143 in August 1992. This consultation addressed activities covered in the 1987 opinion and the abandonment phase of oil and gas operations. The consultation concluded that the 1987 opinion was valid for lease sales 142 and 143 and that nonexplosive removal of oil and gas structures was not likely to adversely affect listed species under NMFS jurisdiction.

Since issuing the 1987 opinion, MMS and NMFS have conducted cooperative research to assess potential interactions between listed species and oil and gas activities. Data collected have provided important information regarding the frequency and location of sea turtle and marine mammal associations with oil and gas platforms.

Three current research programs may provide additional information for future consideration. One program includes radio, sonic, and satellite turtle tracking experiments in the vicinity of the Chandeleur Islands, Louisiana, where turtle occurrence was found to be correlated with the 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

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Also, NMFS and MMS are conducting exploratory aerial surveys of deep water areas in the north-central Gulf including underwater canyons and a sea mount with depths ranging from 200-1,800m. Over 2,900 dolphins and whales were counted in 113 sightings. The endangered sperm whale was the most commonly sighted species. NMFS conducted a pilot study in 1990 to evaluate the feasibility of using vessel surveys to determine marine mammal abundance and trends in the deeper waters of the Gulf. Sighting rates from the research vessels were comparable to those observed in research cruises in Pacific waters, indicating that vessel surveys are viable means of assessing cetacean populations in deep waters of the Gulf. NMFS is continuing vessel surveys on a regular basis to further assess deepwater cetacean and turtle populations.

A cooperative research program started in 1991 (NMFS, MMS and Texas A&M University) includes surveys and studies of cetaceans in the central and western Gulf, and is expected to provide valuable insights into cetacean occurrence and abundance in association with offshore oil and gas structures.

However, the results of studies conducted since 1987 have not provided any new information that would change NMFS' previous opinion, and the areas and species affected by the proposed activities are the same. Therefore, the conclusions reached in the 1987 opinion are valid and continue to apply to proposed lease sales 147 and 150 in the central and western Gulf.

This concludes consultation responsibilities under Section 7 of the ESA. However, consultation must be reinitiated if (1) new information reveals impacts of the project that may affect listed species in a manner or to an extent not considered previously; (2) the identified activities are modified in a manner that causes an adverse effect to listed species not considered previously; (3) a new species is listed; or (4) critical habitat is designated that may be affected by the project.

I look forward to continued cooperation in future consultations.

Sincerely,

Nancy Foster, Ph.D.
for Nancy Foster, Ph.D.
Acting Assistant Administrator
for Fisheries

Enclosure

B-5

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 3,100 m. MMS has provided a mean-case scenario resource estimate of 0.200 billion barrels of oil and 1,440 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 spills (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 2.36 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	<u>Physeter catodon</u>	E	12/2/70
Fin whale	<u>Balaenoptera physalus</u>	E	12/2/70
Humpback whale	<u>Megaptera novaeangliae</u>	E	12/2/70
Sei whale	<u>Balaenoptera borealis</u>	E	12/2/70
Right whale	<u>Eubaleana glacialis</u>	E	12/2/70
Blue whale	<u>Balaenoptera musculus</u>	E	12/2/70
Kemp's ridley	<u>Lepidochelys kempi</u>	E	12/2/70
Green	<u>Chelonia mydas</u>	I E*	7/28/78
Hawksbill	<u>Eretmochelys imbricata</u>	E	6/2/70
Leatherback	<u>Dermochelys coriacea</u>	E	6/2/70
Loggerhead	<u>Caretta caretta</u>	I	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 (*Eubalaena 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 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, borer, 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 (Hemwood and Stuntz 1986).

The green turtle (*Chelonia mydas*)

Green turtles are circumglobally distributed mainly in waters between the northern and southern 20° C isotherms (Mirth 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 1973; Carr and Carr 1978). However, in the continental U.S., the only known green turtle nesting occurs on the Atlantic coast of Florida (Enghart 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 (Mirth 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 in 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 1880's (Wildebrand 1980; 1982; Doughty 1984). Green turtles occurring in other areas of the GOM may be in the voracious 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 1981; Hildebrand 1983). Virtually the entire world population of adult females nest annually in this single locality (Pritchard 1969b).

When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Milnebrand 1963). By the early 1970's, the world population estimates of mature female Kemp's ridleys had been reduced to 7500-5000 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 1981), suggests that post-nesting females move in considerable numbers to the north (mostly to Louisiana) and to the south (mostly to Campeche) (Pritchard and Marquez 1971). The movements of hatching 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 one-half of the annual hatching production from Rancho Nuevo will recruit to the nearshore waters of the central GOM.

Leop's ridley turtles feed primarily in shallow coastal waters on soft-bottoming crustaceans (Wildebrand 1982). Organisms identified from stomachs include crabs (Palaonchus, Hepatus, Callinectes, Callinectes, Menippe, Ovalipes, Portunus, Arenaeus), fish (Lutjanus, Leiostomus) and molluscs (Nucula, Corbula, Natica, Nassarius) (Doble et al. 1961; Pritchard and Marger 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 (Hemwood 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 a unhealthy or injured condition (Wilderaud 1980, 1982). The lack of sponge-covered reefs and the cold winters in the northern U.S. 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:

Certificates

The effects of oil and gas activities on whales in the Gulf of Mexico have never been studied, but the DZIS (1983, 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:

- Increased ship traffic associated with OCS-related activities increases the potential for collisions with whales. Ellis et al. (1983) noted that this source of injury/mortality could increase the danger to sperm whale populations in the OCS. Numerous accounts of accidental collisions between sperm whales and a variety of boat/vessel classes have been documented (Barzin 1971; Casari 1964; Silber 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, MPRs 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 (Walse et al. 1984), with more pronounced behavioral reactions observed on the breeding/calving grounds (Dahmsen 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 NMFS (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 unsoiled 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 petroleum.
- (4) After analyzing Florida's sea turtle stranding data (1980-1984), it was determined that 3.2% (53 turtles) of the strandings were petroleum related. Approximately 95% 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). Hatching 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 (Norris et al. 1976; Burns and Teal 1973).

WMS is particularly concerned with the potential impacts of a major oil spill in the GOM on hatching Kemp's ridley turtles, whose distributions are believed controlled by current patterns and driftlines (Hildebrand 1982).

WMS 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 (WMS 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 drilling and anticipated future production through the year 2023. Therefore, it is necessary to examine not only the impacts of the proposed sale, 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 impacting on the survival of listed species constitutes a jeopardy

to the species.

There is little doubt that the overall effect of OCS oil and gas activities in the GOM to listed species is negative. In this opinion, WMS has discussed some of the major potential effects 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 WMS 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 gas balls from natural seeps, barge 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 WMS 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 Tamalipa, 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 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 eastern Gulf could impact Mexican beaches. However, based on WMS 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 each 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 NWS 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 FWS 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 147

United States Department of the Interior

FISH AND WILDLIFE SERVICE

75 Spring Street, S.W.
Atlanta, Georgia
30303

May 7, 1993

Memorandum

MINERALS MANAGEMENT SERVICE
LEASING & ENVIRONMENT

To: Deputy Associate Director for Resources and
Environmental Management, Minerals Management Service,
Washington, D.C.

From: Regional Director, Fish and Wildlife Service, Atlanta,
Georgia (AES/TS)

Subject: Endangered Species Act Section 7 Consultations for
Proposed Oil and Gas Lease Sales 147 and 150

We have reviewed the information that was provided on the proposed Outer Continental Shelf (OCS) Lease Sale 147 in the Central Gulf of Mexico. The Fish and Wildlife Service (Service) concurs that OCS Lease Sale 147 does not represent a substantive modification of the Lease Sale considered in the Biological Opinion issued on March 15, 1991, for the Central Gulf of Mexico Planning Area. The Service's Region 2 Office will provide information on the OCS Lease Sale 150.

This concludes consultation on the actions outlined in the request. As required by 50 CFR 402.16, reinitiation of consultation is required if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner, or to an extent, not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed, or critical habitat designated, that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations that are causing such take must be stopped in the interim period between the initiation and completion of the new consultation if any additional taking is likely to occur.

cc: MMS/LE, New Orleans, LA (ATTN: DR. MOLLY LUTCAVAGE)

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United States Department of the Interior
FISH AND WILDLIFE SERVICE

15 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: Regional Director, Fish and Wildlife Service, Atlanta, Georgia
(AMS/TB)

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. Mr. 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 Dapone, 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 preparatory 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 of 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 20,000-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 50 of 42,000 barrels, spilled on August 1, 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 100 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, 5-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 (RFL 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 1986). In addition, the Minerals Management Service has promulgated regulations (30 CFR 150.40) 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. Smaller 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 aircraft, 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. Further, the rules explicitly state that fixed and floating platforms or all floating 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 farm colonies (Wigington 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 in April 10, 1979. Consultation for the Central Gulf of Mexico Planning Area was reintroduced 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 25,

1986, and June 22, 1987, concluded that formal consultation need not be reintroduced. The above referenced Opinions covered only oil and gas leasing and exploration. Consultation was reintroduced 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 13, 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 reintroduced.

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 (<i>Pelecanus occidentalis</i>)	1	1	1
Bald eagle (<i>Haliaeetus leucocephalus</i>)	1	1	1
Piping plover (<i>Charadrius melodus</i>)	1	1	1
Arctic peregrine falcon (<i>Falco peregrinus tundrius</i>)	1	1	1
Loggerhead sea turtle (<i>Caretta caretta</i>)	1	1	1
Alabama beach mouse (<i>Peromyscus polionotus alabamae</i>)	1	1	1
Perdido Key beach mouse (<i>Peromyscus polionotus mississippiensis</i>)	1	1	1
Proposed Species			
Gulf of Mexico sturgeon (<i>Acipenser oxyrinchus desotoi</i>)	1	1	1
Candidate Species			
Southeastern snowy plover (<i>Charadrius alexandrinus semipalmatus</i>)	1	1	1

1 = Endangered
2 = Threatened
3 = Critical Habitat
4 = 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 (*Mareca americana*), 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 minimus*), 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 breeds freely along with other terns and shorebirds along the coast. The red wolf has been placed on North Island of 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 existence 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, rehabilitation of Section 7 consultation may be required.

Brown Pelican *Pelearia hydralia*

The brown pelican was originally listed throughout its range as endangered on October 11, 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 in North Island, one in North Grosier Island, and one at the "aud jumps" of the Mississippi River. The colony at the aud jumps (Plaquemines Parish) was established in 1990. No nesting rookeries have been identified in Mississippi (Wigington 1990; Rader 1990).

Historically, the brown pelican used the Shell Keys National Wildlife Refuge (Barataria Parish). However, it is unknown whether the brown pelican nests on the refuge (Wigington 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 (Wigington 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 in or near all islands in Breton and Chandeleur Sound (Curlew, Grand Gosier, and Breton Islands) (Wigington 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 1,111 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 61 nests with eggs were counted in June 1990 (Wigington 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 in 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 offshore 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 offshore oil and gas-related facility construction is expected to be limited in the Central Gulf of Mexico Planning Area from this lease sale. Impacts to the brown pelican from ingestion, contact, or entanglement in trash and debris are not anticipated to be significant. The Gulf of Mexico Outer Continental Shelf Region Ocean Minerals Management Service (by letter dated August 30, 1990) recommends to assess and report on any required all aircraft used in support of their Outer Continental Shelf oil and gas operations to maintain altitudes of 1,000 feet or more when flying over all lands located within National Wildlife Refuges and National Parks and Seashores (Perry 1990).

Pelicans may be susceptible to oil spills. Even though the island nesting sites in Louisiana might be partially protected from direct impact by an offshore oil spill by the seaward position of the barrier islands, the birds

changing 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 hindering survival.

U.S. Fish and Wildlife Service (1980).

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 1 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 10 miles from 1,000 barrels occurring from the proposed lease sale area, high lease, or low lease, is 1 percent chance. The conditional probability of an oil spill greater than 10 miles from 1,000 barrels occurring from the proposed lease sale area, high lease, or low lease, is 1 percent chance. The conditional probability of an oil spill greater than 10 miles from 1,000 barrels occurring from the proposed lease sale area, high lease, or low lease, is 1 percent chance. The conditional probability of an oil spill greater than 10 miles from 1,000 barrels occurring from the proposed lease sale area, high lease, or low lease, is 1 percent chance.

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 1 percent chance. The conditional probability of an oil spill greater than 10 miles from 1,000 barrels occurring from the proposed lease sale area, high lease, or low lease, is 1 percent chance. The conditional probability of an oil spill greater than 10 miles from 1,000 barrels occurring from the proposed lease sale area, high lease, or low lease, is 1 percent chance. The conditional probability of an oil spill greater than 10 miles from 1,000 barrels occurring from the proposed lease sale area, high lease, or low lease, is 1 percent chance.

It is projected that there may be a total of three and four shuttle tanker trips for the proposed sale 5 case and high case scenarios, respectively. The planning and analysis area where the trips would originate is Central coastal area 1 C-1, which encompasses the west 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 is a 5 percent chance within the C-1 area. The highest annual conditional probability within the C-1 area is a 1 percent chance.

U.S. Minerals Management Service (1990).

Since new offshore facilities construction is anticipated to be annual, and the possibility of an oil spill occurring and contacting remains

probably 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-evaluation 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 all of the contiguous 48 States and threatened in the remaining five States on February 14, 1970.

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 Chesapeake Bay to the Florida Keys and north along the west coast to Florida to the panhandle. The nesting range also appears to have been continuous along the entire Mississippi and other major rivers, including Louisiana and into east Texas with a few nesting along the Gulf coast. The breeding range has been reduced to the remnant populations in Louisiana, Louisiana, and east Texas, with apparently secure nesting still in Florida.

The bald eagle actively nests in Louisiana and Mississippi. There is no known nesting in Alabama. In Alabama, in Bon Secour National Wildlife Refuge, bald eagles are listed, but none are known to nest. The refuge has started a banding program to reintroduce the eagle. From 1960 to 1980, three birds were introduced at the refuge. However, there are no plans for banding any eagles in the refuge in 1981. Hicks (1981) All the bald eagles to be introduced into Alabama in 1991 will be the minimum pair of the State Hicks (1991).

There were 15 active bald eagle nests located in coastal Louisiana estuaries during the 1989 to 1990 winter nesting period. The majority of the nesting sites are west of the Mississippi River to the Nueces Bay 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 the 1989 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 Baytown and Mississippi River in 1988. However, the status of that nest for 1990 is unknown Bay, 1990, Report 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. Louisiana 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 offshore facilities and aircraft and boat traffic, trawling, trawling, and the possibility of an oil spill reaching the coast and contaminating the eagle and its food source (U.S. Fish and Wildlife Service 1989c).

Future offshore 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 trawling and debris is not expected to be significant. The Gulf of Mexico Outer Continental Shelf Region Office, Minerals Management Service, letter dated August 30, 1990, recommends to leaseless and operators that they require all aircraft used in support of their Outer Continental Shelf oil and gas operations to maintain altitudes of 1,000 feet or more when flying over all lands located within national wildlife refuges and national parks and seashores (Perry 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 oil spill volume, 10,000 barrels, is in segment 14. The highest annual oil spill volume in the existing and proposed lease sale area and contacting these land segments within 10 days is 2 percent, 15 percent, 36 percent, 2 percent, 16 percent, 16 percent, 9 percent, and 15 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 a more robust contact with the water from which they are taking prey. However, some direct mortality of young bald eagles from oiling was observed after the 1980 tanker ship 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 an 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 un-oiled areas (Schnapp 1990).

The conditional probability of an oil spill greater than or equal to 1,000 barrels occurring from the proposed sale lease case, high risk, is 9, 11, or 36 percent chance, respectively. The conditional probability of an oil spill greater than or equal to 1,000 barrels occurring and reaching a bald eagle nesting or foraging habitats within 10 days has a high of a 1 percent chance for the sale lease and high risk, and a high of a 12 percent chance for the Central Gulf Planning Area Hannon and Pear 1990.

Annual and seasonal conditional probability spill estimates for a spill originating from a pipeline starting and including bald eagle nesting or foraging habitats within 10 days are moderate to high, 10 to 18 percent chance. The conditional probability of an oil spill greater than or equal to 1,000 barrels occurring from the proposed sale lease, high risk, is 9, 11, or 36 percent chance, respectively. The mean number of birds from pipelines for the above conditions is 2, 20, 2, 15, and 4, 17, respectively (Hannon and Pear 1990).

It is projected that there may be a total of three and four million barrels spilled for the proposed sale lease and high risk scenarios, respectively. The planning and analysis area where the birds could originate is Central Gulf of Mexico. This area encompasses the west eastern portion of Louisiana. The highest seasonal spring conditional probability for a spill to reach bald eagle habitats within 10 days from a multiple tanker spill is a 94 percent chance within the 2-1 area. The highest annual conditional probability within the 2-1 area is a 41 percent chance (U.S. Minerals Management Service 1990).

Since new offshore facilities construction is anticipated to be minimal, and the possibility of an oil spill occurring and contacting nesting or foraging habitats is low, the conditional probability of an oil spill greater than or equal to 1,000 barrels occurring and reaching a bald eagle nesting or foraging habitats within 10 days is low, 10 to 18 percent chance. The conditional probability of an oil spill greater than or equal to 1,000 barrels occurring and reaching a bald eagle nesting or foraging habitats within 10 days is a 1 percent chance for the sale lease and high risk, and a high of a 12 percent chance for the Central Gulf Planning Area Hannon and Pear 1990.

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 18, 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 123 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 are: Audubon Islands and Rockefeller Refuge, Louisiana; and Little Dauphin Island, Alabama. Along with these sites, Buckner 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, Hanes 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 mudflats 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 10, 20, and 30) have a

10, 7, and 11 percent chance, respectively, of receiving oil within 10 days of an oil spill occurring in the existing and proposed lease area (Hannon and Lear 1992).

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 3, 15, 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 3, 15, or 98 percent chance, respectively. The mean number of spills from pipelines for the above conditions is 0.07, 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 1 (C-1) 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-1 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 20, 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 1,000 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 12, 1978. 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 10 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 (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, 12, or 36 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 36 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 1 (C-1) 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 11 percent chance within the C-1 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 in their wintering grounds or along their migration route. The Gulf of Mexico Outer Continental Shelf Region Office, Minerals Management Service by letter dated August 29, 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 1,000 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 18, 1978 (U.S. Fish and Wildlife Service 1979a, 1990).

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 in 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 1979a, 1990; 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 hatching predation (U.S. Fish and Wildlife Service 1979b; Ogden 1990; Possardt 1990).

Loggerhead nesting in the Central Gulf Planning Area begins in Alabama where one nest per mile is usually found in Bon Secour National Wildlife Refuge in Baldwin County (Fulton 1990). In 1989, 11 nests were counted at Gulf Shores and Fort Morgan (Eley 1989; Eley and Papacostas 1990). In Mobile County, Alabama, the sea turtle nests in the western end of Dauphin Island and has had a nesting density ranging from a low of 1 per year to a high of 11 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 Papacostas 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 5 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 trussing efforts on the islands since 1982 (Faller 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 (Ogden 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 (Forte and McGee 1981). 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 in the beach. In addition, it has been proposed that olfactory cues are imprinted in the turtle and guide it back to the natal beach for nesting when it reaches maturity. Oil in the beach could interfere with these chemical guides (Lutz et al. 1985; Ogden 1990; Possardt 1990).

Studies have shown that sea turtles do not seem to avoid oil spills and do ingest oil during contact with the oil. The direct effects of oil include 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 10 percent and a 10 percent chance, respectively. The highest seasonal (summer) conditional probability for the above scenario is a 45 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 3, 11, or 20 percent chance, respectively. The highest limited 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 13 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 36 percent chance, respectively. The mean number of spills from pipelines for the above conditions is 2.89, 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 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 3.5 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 hatching 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 alabamae*

Perrito Key beach mouse *Peromyscus polionotus perritensis*

The Alabama beach mouse and the Perrito 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 distinct tracks 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 the 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 1989c). However, the mouse appears to be absent from this area (Holler 1991).

The Perrito 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 in Perrito 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, 1989c).

Critical habitat for the subspecies has been designated at three distinct sites on Perrito 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 Perrito Key State Preserve and in the Perrito Key Unit of the Gulf Islands National Seashore, Escambia County (U.S. Fish and Wildlife Service 1987, 1989c).

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 threat 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 grass *Echinochloa polystachya* burrows. The Perrito Key and Alabama beach mice are nocturnal, terrestrial. It is thought that the beach mice feed primarily on the seeds of beach grass *Panicum sp.* and *P. sp.* and sea oats *Uniola paniculata*, and on insects and

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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 3, 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 0.29, 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 oxyrinchus 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. g. 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 a 3, 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, Pettis 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 50 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 base, or all Central Gulf of Mexico Planning Area oil and gas platform activities is a 3, 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 base, or all Central Gulf of Mexico Planning Area oil and gas pipeline activities is 3, 13, or 98 percent, respectively. The mean number of spills from pipelines for the above conditions is 0.09, 0.16, and 4.7 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 20, 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 (Pearry 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 8, 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 179,000 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, 851-874, 898-918, 942-962, 987-1006
- South Pass Area blocks 28, 32-34, 36-38, 43-58, 59-69, 70-71, 73
- South Pass South Addition Area blocks 74-96
- Mississippi Canyon Area blocks 11, 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, 85-104
- West Cameron Area blocks 13-30, 34-48, 53-63, 80-113, 129-156, 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 Timbalter Area blocks 10-127, 133-139
- 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 17.34 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.

H. J. Deady

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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 150

Attachment 1

United States Department of the Interior

FISH AND WILDLIFE SERVICE
POST OFFICE BOX 1906
ALBUQUERQUE, N.M. 87103

RECEIVED
JUN 5 1993

April 1, 1993

Memorandum

To: Minerals Management Service, Gulf of Mexico OCS Region

Attn: Leasing and Environment, New Orleans, Louisiana

From: Field Supervisor, U.S. Fish & Wildlife Service

Clear Lake Ecological Services, Houston, Texas

Subject: Endangered Species Act Section 7 Consultation for Proposed Oil

and Gas Lease Sale 150, Western Gulf of Mexico

By memorandum dated March 5, 1993, the Deputy Associate Director for Resources and Environmental Management, MMS, Washington, DC requested formal Section 7 consultation with the Service concerning the subject lease sale.

The request pointed out that the latest biological opinion from Region 2 for the Western Gulf of Mexico (dated June 19, 1987) was believed to remain valid without modification. We concur with this view that our existing biological opinion is still valid. Onshore development impacts to endangered and threatened species are accurately identified in our biological opinion, and we have continuing opportunity and authority through national permit programs to obtain compliance with Section 7 requirements for pipeline landfalls, OCS-associated industries, and other facilities supporting exploration, development, tankering, barging, and spill cleanup.

Our biological opinion concluded that no incidental take was anticipated from leasing and development, but that reinstatement of consultation should be done if an incident occurs during OCS operations and related activities. This would be especially important if an oil spill were to make landfall on the Texas coast at high use areas for the piping plover, brown pelican, whooping crane, or branches of the Padre Island National Seashore or Rancho Nuevo, Mexico where the Kemp's Ridley sea turtle nests.

cc: Dep Assoc Dir for Resources and Environmental Management, MMS, Washington, DC
Regional Director, Attn: ARD-Ecological Services, Region 2, Albuquerque, NM
Regional Director, Attn: ARD-Ecological Services, Region 4, Atlanta, GA

United States Department of the Interior

FISH AND WILDLIFE SERVICE
POST OFFICE BOX 1906
ALBUQUERQUE, N.M. 87103

In Reply Refer To:
Region 2 FWS

JUN 19 1997

Consultation No.: 2-13-87-FWS

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 reinstatement 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 proposed 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 reinstatement 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 spill 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

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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 Huecos 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 in 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 100 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.

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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 development 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 mexicanus*), Attwater's greater prairie-chicken (*Tyrannus calurus*), white-tailed, red-cockaded woodpecker (*Picoides borealis*), black lace catfish (*Echinocentrus taylori*), slender-rum pike (*Hoplostethus atlanticus*), and Texas bitterweed (*Bignonia 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 action. 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, menidia, 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 Huecos 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.

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 jaguarundi cacomitli*)

The jaguarundi was listed as an endangered species on June 14, 1978. 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 (Pritt 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 kempi*)

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.

Loggerhead Sea Turtle (*Caretta caretta*)

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 (*Eretmochelys imbricata*)

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.

BIOLOGICAL OPINION

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.

INCIDENTAL TAKE

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.

CONSERVATION RECOMMENDATIONS

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 (*Probabilistic Resource ESTimates Offshore*). The MMS requires a model that provides a range of estimates, both conditional and risky.

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 calculated 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 distribution. 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 (0.25×2.8), 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 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			
Riskd			
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			
Riskd			
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*			
Riskd			
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 riskd 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.

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 147 and 150, 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 147 are the following:

	Conditional Oil (BBO)	Conditional Gas (tcf)	Conditional BOE (BBOE)
Low Case	N.A.*	N.A.*	N.A.*
Base Case	0.12	1.21	0.34
High Case	0.27	2.58	0.73

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 150 are the following:

	Conditional Oil (BBO)	Conditional Gas (tcf)	Conditional BOE (BBOE)
Low Case	N.A.*	N.A.*	N.A.*
Base Case	0.04	0.65	0.16
High Case	0.12	1.66	0.42

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

SUBSTITUTE ENERGY SOURCES AS AN ALTERNATIVE TO OIL FROM OCS PROGRAM

A. INTRODUCTION

Petroleum is used extensively as fuel or as raw material in many applications. For many of these applications there are substitutes for crude petroleum. The selection of crude oil is based largely on economical considerations. Delay or elimination of the proposed sale would reduce OCS oil and gas production. This action could result in increased imports of oil and gas and/or development of alternative energy sources to replace potential OCS contributions to the domestic production.

Available substitutes or alternative energy sources to OCS oil and gas production include:

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)
Ocean Energy	(See Section J)
Wind-Turbine Power	(See Section K)
Hydroelectric Power	(See Section L)
Nuclear Power	(See Section M)
Conservation	(See Section N)

This appendix briefly discusses these alternatives and their potential role as substitutes for OCS production. The discussion also addresses environmental effects of these energy substitutes.

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. 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 and prices escalated from \$7.74 per barrel in 1970 to \$24.40 per barrel in 1975. The second major jolt occurred during the 1979-1980 Iranian revolution, which once again reduced oil-supply levels and resulted in 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.

Consumption of oil in the U.S. from 1950 to 1989 showed a more or less steady level of around 44-45 percent, peaking at 49 percent in the late 1970's and dropping to about 42 percent by 1989 (Bodansky, 1991). Gas consumption exhibited the same trends, peaking around 30 percent in mid-1970's and dropping to 24 percent in 1989. Oil consumption in 1989 was absorbed mostly in transportation (63%) and for industrial applications (24%). Gas was used almost equally in industry and by residential and commercial sectors (Bodansky, 1991). Proven estimates of gas in trillion cubic feet (Tcf) are 384, and total estimates are placed from 540-1,600 Tcf, which at current consumption rates will last 35-95 years. Oil resources (proven and

undiscovered) are estimated at 130 billion barrels, which at present production and consumption will last 28-43 years if imports do not increase (Fairberg, 1991).

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.D. of this EIS. Unintentional 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, the *Amoco Cadiz* in 1978, or the *Exxon Valdez* in 1989--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 (USDOL, MMS, 1992) 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 1.37 spills per billion barrels transported. Further, only one-half of the 1.37 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 40-year period--was equal to 81 spills of 1,000 barrels or greater. This compares with an estimated most likely number of 116 spills from all sources (all past and future OCS leasing, all domestic and import tankering). Thus, oil spills associated with imports represent nearly 70 percent of all oil spills greater than 1,000 barrels over the 40-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 (USDOE, 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	693.5	41.1	75.4	7.8
1986	685.1	35.9	75.6	7.7
1987	717.9	37.0	75.2	6.9
1988	758.4	41.9	76.3	7.1
1989	766.9	40.5	76.1	6.2
1990	773.4	38.9	76.3	6.7

Source: U.S. Department of Energy, Energy Information Administration, 1993.

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	883.6	818.0	2.0	92.7
1986	890.3	804.2	2.2	85.5
1987	918.8	836.9	1.7	79.6
1988	950.3	883.6	2.1	95.0
1989	980.7	889.7	2.9	100.8
1990	1,029.1	895.5	2.7	105.8

Source: U.S. Department of Energy, Energy Information Administration, 1993.

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 (USDOL, 1984a).

Table D-3
Demonstrated Reserve Base of the Major Coal Provinces in the United States

Province	Demonstrated reserves (in millions of tons)		Total
	Underground	Surface	
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: U.S. Department of Energy, Energy Information Administration, Annual Energy Review 1985.

Coal production increased since 1984 (Table D-2). Coal usage indicated an increase of coal consumption (Table D-2), particularly by the utilities and steel industries (Table D-1). Coal production has increased steadily to a record 1,029 million tons in 1990.

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 the Federal Office of Surface Mining's 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's (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 (USDOE, 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 (Section 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 ft³) 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-Tetzel, 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 biodegradation 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 from 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.

The U.S. oil shale potential is estimated as 26,000 billion barrels (Hinman, 1991) at 10-25 barrels per ton of shale. 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 2,800 billion barrels of oil with an assay of 10-25 gallons per ton. In the central and eastern U.S., the shale deposits underlie Indiana, Ohio, Illinois, Kentucky, Tennessee, Michigan, and Pennsylvania. The oil content of this area is estimated at 1,000 billion barrels at an assay of 10-25 barrels per ton of shale. 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. The remaining U.S. areas have an estimated 22,200 billion barrels of oil at an assay of 10-25 gallons per ton. Therefore, these resources are very large and estimated to last for hundreds of years at current rates of consumption (Hinman, 1991). 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). Up to 1980 there were 11 major projects in the U.S. 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.

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 (c) 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 heat 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. Groundwater supplies and surface water supplies fed by groundwater 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 be compacted 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. The cost of producing oil from shale is so high that commercial production is not likely to occur for the next 10-20 years.

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 CO₂ 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: U.S. Department of Energy, 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
Parabolic 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. OCEAN ENERGY

1. Background Considerations

The average rate of solar energy deposited in the atmosphere and oceans is about 8,000 times the current world energy consumption (Sanders, 1991). In addition to solar energy, oceanic tides dissipate energy at a rate of 3 billion kW. At present, there are three main avenues for extracting energy from the oceans: ocean thermal energy conversion (OTEC), tidal power, and energy from the waves. Most of the following discussion is derived from Sanders (1991).

a. Ocean Thermal Energy Conversion

Ocean thermal energy conversion is simply a heat engine that operates between warm and cold reservoirs. The warm reservoir constitutes the warm surface waters of the tropical ocean; the cold reservoir is the cold

deep ocean waters. The stored solar energy is converted to mechanical energy via a turbine that drives an electric generator. There are two competing technologies for OTEC. Even though the thermodynamic efficiency of the OTEC cycle (approximately 5%) is lower than that of the fossil fuel cycles (approximately 30%) and given the large amount of solar energy available, it is estimated that OTEC technology can contribute about 10,000 GW of electricity worldwide. There are two working OTEC cycles: the open cycle and the closed cycle. The open cycle, which uses water as the working fluid in the thermal engine, is more attractive because it eliminates the need for heat exchangers, which are inefficient and expensive. The closed cycle uses another fluid, such as ammonia, as the working fluid. In this case the fluid is evaporated by the warm water, drives a low-pressure turbine, and then is condensed by the deep, cold water. In both cases a main component of the system is the long pipe that is needed to pump up the deep, cold water.

b. Tidal Power

Most practical proposals for extracting energy from the tides use the potential energy stored from low to high tide. A dam is installed with sluice gates that allow the free entrance of water until high tide. At high tide the gates are closed, and the water is released through turbines at low tide. The amount of power generated depends on the number of turbines. The maximum energy per tidal cycle is obtained by releasing all the water instantaneously through turbines of perfect efficiency. The energy produced occurs at spurts, which change through time as high tide times change throughout the year. A way around spurt production is level production. In this case, water is pumped into the basin after closing the water gates for about one hour after the tide is ebbing. After another hour, the water is allowed to flow through the turbines at a rate such that the level difference between high and ebb tide remains constant. Power output is kept constant for about 4 hours under these conditions. In the U.S., appropriate tidal plant sites are located in eastern Maine (1 GWe production) and in Alaska (2.6 GWe production).

c. Wave Energy

Extracting energy from surface waves is not a new idea; such attempts have been around for at least 200 years. Most devices proposed and patented for extracting wave energy are based on five basic principles: (1) up and down wave motion, (2) rocking wave motion, (3) oscillatory water columns, (4) surging motions, and (5) underwater pressure changes. However, the amount of available wave energy is only a small fraction of the present U.S. energy requirements. At present, the cost of producing electricity by these wave based technologies is 9-15 cents/kW from a wave field of 5 kW/m. The bottom line is that present technology for extracting energy from waves is not an economical alternative to fossil fuel technology. If actual trends in this field continue, wave energy could make a contribution to the U.S. energy needs in the future.

2. Environmental Effects

Extracting energy from the oceans can have environmental effects on the marine environment, sea life, the oceanic chemical equilibrium, and possible local weather patterns.

a. Ocean Thermal Energy Conversion

Operation of an OTEC plant can lower the local sea surface temperature (SST) and change its pattern by upwelling of deep, cold water. Simple models indicate that the SST can be lowered due to the production of 60 billion kWe by OTEC plants. Also, the upwelling created by these plants could result in the release of large amounts of CO₂. Deep, cold water is supersaturated with respect CO₂, and when brought to the surface, the drop in pressure allows the excess gas to escape from solution into the air. Such releases can contribute to the greenhouse global warming by increasing the amount of atmospheric CO₂. The OTEC plant that is operated by the closed cycle could also result in spills of fluids such as freon, ammonia, and propane. Finally,

the effects of SST changes on the marine life and local meteorological patterns need to be examined in detail at the planning stages of such plants.

b. Tidal Power

The main environmental consequences by these plants result from the construction of dams to block the basins. This construction alters the flow patterns that influence the basins' ecosystems. Most impacts depend on changes to the tide's amplitude within the basin. The only way to estimate such changes is by analog or numerical models of the specific basin. Once tidal amplitude changes are determined, changes to flow, circulation, and mixing can be assessed. Environmental assessments of the different systems within the basin will then be made.

3. Conclusions

The OTEC is a demonstrated technology; however, it still needs refinements and development. Because of the large amounts of energy stored in the oceans, its pursuit is well justified. This active research should develop the technology to a mature stage, such that it is a viable alternative to energy production. Tidal power on the other hand is a well established technology. It needs no development, has low costs for operation and maintenance, and has long lifetimes; however, initial costs are high. The major drawback of tidal power is the need for other baseload systems, given the transient production of energy. At present, there are no impediments to having tidal plants operating and contributing to our present and future energy needs.

K. 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 (USDOL, 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.

The 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 totalling 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 Geronimo 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 USDOL (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.

I. 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.

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

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.

M. 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

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.

N. 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.

Table D-7
Comparison of NEPPP-Reference and High-Energy-Efficiency Cases
(Quads)

Year	Total Energy to U.S.	Energy Losses Transfor- mation	Energy Used by Final Consumers Excluding Inputs to Utilities and Synthetics								Industrial	Trans- portation
			Liquids	Gases	Coal Solids	Electricity	Renew- able ¹	Total	Residential	Com- mercial		
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	19.2
1995												
Ref. Case	93.1	-25.2	32.3	17.5	3.7	10.3	4.0	67.9	11.2	7.8	29.6	18.5
High Effic.	85.4	-23.3	30.0	15.5	3.3	9.5	3.7	62.1	9.7	7.2	27.0	19.4
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

¹Renewable central electric is included in electric column

Source: U.S. Department of Energy, National Energy Policy Plan Projections to 2010, December 1985.

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.

O. 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.
- 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.

Replacement Energy Needs
Central and Western Planning Areas
(Base Case)

	<u>Central Gulf</u> <u>Sale 147</u>	<u>Western Gulf</u> <u>Sale 150</u>
Btu equivalents: *(trillion Btu)		
Oil - 0.12 billion barrels	672.0	
0.04 billion barrels		224.0
Gas - 1.21 trillion cubic feet	1,235.4	
0.65 trillion cubic feet		663.7
Oil equivalents: *(billion barrels)		
Oil from other sources needed to directly replace expected oil production	0.120	0.040
Oil from other sources needed to replace expected gas production	0.221	0.119
Gas equivalents: *(trillion cubic feet)		
Gas from other sources needed to replace expected oil production	0.658	0.219
Gas from other sources needed to directly replace expected gas production	1.210	0.650
Coal equivalents: *(billion short tons)	0.079	0.037
Electrical equivalents: *(billion kilowatt/hour)		
Substitutes for end uses**	290.7	135.3
Substitutes for input to electricity generation***	178.9	83.2

Notes: *Conversion factor used:
 1 barrel of oil = 5.6×10^6 Btu.
 1 cubic foot of natural gas = 1,021 Btu.
 1 short ton of bituminous coal = 24×10^6 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: USDOl, Minerals Management Service, Gulf of Mexico OCS Region, 1993.

Appendix E

Oil Spill Contingency Planning and Response

As a means of addressing the recent rash of tanker spill incidents occurring in U.S. waters nationwide, the Oil Pollution Act of 1990 (OPA) was enacted in August 1990. On October 18, 1991, the President signed the Executive Order delegating the provisions of OPA to various departments and agencies within the U.S. Government, including the USCG, USEPA, NOAA, and DOI. Pending implementation of the provisions of the Act, the MMS spill-response program as described in this section is expected to undergo further assessment and change.

a. Responsibility and Authority

The President (through the USCG) must ensure the removal of a discharge under the recently enacted Oil Pollution Act of 1990. The USCG is responsible for ensuring an "effective and immediate removal of a discharge" into water (OPA, Title IV, Subtitle B, Sec. 4201). This can be accomplished in a number of ways; the USCG can either conduct (and fund) the cleanup itself and request reimbursement from the spills, direct others as to how to cleanup the spill, or monitor the cleanup activities.

Coordination among the USCG, MMS, and industry has historically been required in order for an effective spill response to an OCS-related operation discharge to take place. The OPA established a response system in which the responsible party has a greater role in spill-response operations. In many cases, the responsible party will be in charge of the entire operation. The On-Scene Coordinator (OSC), however, retains the ultimate authority for decisions relating to a response operation.

A Memorandum of Understanding (MOU) dated August 29, 1989, outlines the responsibilities between USCG and MMS. The Minerals Management Service is responsible for spill abatement and mitigation measures on or within 500 m of a platform, drilling rig, or other OCS facility. The USCG has the ultimate responsibility for ensuring that the oil-spill incident is effectively cleaned up. The OCS operators are required to prevent pollution, inspect and maintain oil-spill response equipment, develop oil-spill contingency plans, and conduct drills and training for oil-spill response personnel. Section I.B.3.d.(3) further outlines industry requirements for environmental safeguards.

b. Oil Spill Contingency Planning

Oil spill contingency plans (OSCP's) provide spill response guidelines to responsible parties when a spill occurs. These plans provide for the preplanning, management, and coordination of all of the operations at the scene of a spill, as well as of the communications between involved parties at the time of a spill. The goal of the development of such plans is having the ability to provide an efficient, coordinated, and effective response to oil spills.

The Federal Government's statutory requirements for contingency planning are outlined in the Federal Water Pollution Control Act (commonly called the Clean Water Act), as amended by the Oil Pollution Act of 1990, and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The National Oil and Hazardous Substance Pollution Contingency Plan (commonly called the National Contingency Plan) calls for the establishment of a system of tiered oil spill contingency plans (Regional Contingency Plans (RCP's) and Area Contingency Plans (ACP's)) that would fulfill the same requirements on a regional or area level as the National Contingency Plan.

The Oil Pollution Act of 1990 requires that the National Contingency Plan be revised and republished to include the amendments made by this Act. This monumental effort is ongoing. The National Contingency Plan is in its final stages of coordination between the USEPA and the USCG, who are jointly reviewing the draft appendix for oil discharge response. A Notice of Proposed Rulemaking will be published once this review is complete. Provisions of this Act require, in part, that the National Contingency Plan contain (1) an assignment of duties among Federal, State, and local agencies; (2) an identification, procurement, maintenance, and storage of equipment and supplies; (3) designation of USCG strike teams consisting of personnel, equipment, and a detailed oil and hazardous substance pollution and prevention plan; (4) a system of surveillance and notice to safeguard against and ensure the early notification of discharges of oil; (5) establishment of a national center to coordinate and direct operations in carrying out the Plan; (6) procedures and techniques to be employed

in identifying, containing, dispersing, and removing discharges; (7) a State coordinated dispersant use plan; (8) a system whereby a State can act to remove a spill or be reimbursed by the Oil Spill Liability Trust Fund; (9) designation of the Federal On-Scene Coordinator for each area for which an Area-Contingency Plan is prepared; and (10) a fish and wildlife response plan, developed in consultation with the FWS, NOAA, and other interested parties for the immediate and effective protection, rescue, and rehabilitation of fish, wildlife, or their habitat that are harmed or may be jeopardized by a discharge.

The two RCP's in the Gulf cover the Regional Response Teams (RRT) for USEPA Regions IV and VI. When the spill occurs in coastal and offshore navigable waters of the United States, the USCG Captains-of-the-Port are designated as the OSC's. Duties of the OSC include notifying the responsible party of the spill, encouraging the party to undertake proper countermeasures to mitigate the effect, directing and monitoring cleanup progress, and providing advice and counsel to the spiller as necessary. To provide support to the OSC, an RRT, which consists of representatives from Federal agencies as well as representatives from State and local agencies, has been established. The RRT serves as a regional body for oil spill preparedness planning and can be convened at the request of an OSC for coordination and advice during a spill incident. The DOI is a member of the RRT. The DOI assists the OSC at the time of a spill by providing special expertise relating to land management, fish and wildlife habitat, and water resources management. A Scientific Support Coordinator is provided by NOAA to coordinate and develop scientific response information as needed. The National Contingency Plan also requires Federal local plans (Local Contingency Plans) for areas in which the Coast Guard provides the pre-designated OSC's. Each level of planning is designed to contain more site-specific information to allow the USCG to quickly organize an effective response to a pollution incident, if necessary.

The OPA also calls for the designation of areas for which Area Committees will be established and for which Area Contingency Plans will be required. The designated coastal areas for which Area Committees will be established will generally coincide with the USCG Captain of the Port boundaries. Inland areas will be established under joint concurrence between USCG and USEPA. Some of the content requirements for Area Contingency Plans require that (1) when implemented in conjunction with the National Contingency Plan provisions an Area Plan would be adequate to remove a worst case discharge, (2) the area covered by the plan including areas of specific economic or environmental importance are discussed, (3) the procedures for obtaining an expedited decision regarding the use of dispersants are described, and (4) details regarding how the Plan is integrated into other Area Plans and the vessel, offshore facility, and onshore facility response plans, also required pursuant to this Act, are provided. Area committees are currently being formed and work is progressing on the ACP's for the Gulf of Mexico. Operators of a tank vessel or facility are also required to submit a vessel or facility response plan sufficient to respond, to the maximum extent possible, to a worst case discharge.

To effectively accomplish oil spill containment and removal actions, the MMS requires that all Exploration Plans (EP), Development and Production Plans (DPP), and Development Operations Coordination Documents (DOCD) be accompanied by an OSCP. In order to facilitate this requirement in the Gulf of Mexico region in a practical manner, it is expedient for each OCS operator to submit for approval a regional OSCP that covers all of their operations in the Gulf of Mexico. The approved regional OSCP is then referenced when EP's and DOCD's are submitted. However, the operator may elect or may be required by MMS to include a site-specific OSCP in a EP or DOCD when the approved regional OSCP does not provide adequate oil spill protection or when lease stipulations for leases in the Eastern Gulf of Mexico require response capabilities beyond those described in the operator's approved regional OSCP. Effective December 1, 1992, an OSCP is also required for all right-of-way pipelines (NTL 92-04 dated July 1, 1992).

The OCS operators are required to prepare OSCP's in accordance with the requirements of 30 CFR 250.42. However, since OCS operators in the Gulf of Mexico region prepare regional OSCP's, the MMS has issued a Letter to Lessees (LTL) dated February 1, 1989, which outlines the requirements for regional OSCP's. In addition, LTL's dated October 12, 1988; September 5, 1989; and November 4, 1991, were issued. These LTL's list the oil spill information that must accompany every EP or DOCD when the EP or DOCD references an approved regional OSCP. This information includes (1) an identification of the primary location of containment and removal equipment; (2) an estimation of the individual times for procurement of the equipment, the equipment transportation vessel, and the personnel to load and operate the equipment as well

as equipment load-out, travel time to the deployment site, and equipment deployment; and (3) a discussion that identifies the zones that appropriate and available trajectory analysis indicate may be impacted by an oil spill, the environmentally sensitive resources and areas within the impact zones, and the strategies to be used to protect these resources from oil spills. Site-specific OSCPs are prepared in accordance with the requirements of 30 CFR 250.42 and, in addition, address those items that the MMS has identified as necessary or those that are required by lease stipulation.

In addition to plans by the Federal Government and private industry, there are contingency plans developed at the State and local authority levels. The States of Florida, Texas, Alabama, and Mississippi have oil and hazardous substances pollution contingency plans for their coastal areas. The State of Louisiana recently passed the Oil Spill Prevention Response Act, which requires the State's appointed oil spill response coordinators to develop a statewide oil-spill prevention and response plan. This plan shall be fully operational no later than one year after the latest effective date of the area and regional contingency plans designated for Louisiana pursuant to Federal law.

At the time of a spill on the OCS, a network of contingency plans is put into effect. The provisions of the Oil Pollution Act of 1990 will not alter this basic procedure; however, the existing policies may change somewhat with the implementation of the provisions of the Act. Generally, if a spill results from an oil and gas facility, an operator would notify the National Response Center, which was established under the auspices of the National Contingency Plan; the MMS, Gulf of Mexico OCS Region, and his oil spill response coordinator, who may activate the operator's oil spill response operating team. At this time, equipment and manpower would be mobilized, if deemed necessary. The ACP of the closest Captain of the Port (the OSC) would also be activated. At the request of the OSC, or if the spill crosses regional boundaries or poses a substantial threat to the environment, the Regional Response Team would be activated.

Review of Contingency Plans

The Federal Government's current network of contingency plans as outlined above is reviewed through two mechanisms. Draft National and Regional Contingency Plans are published in the *Federal Register* for an appropriate time period to allow review of the plans by all interested parties. All members of the RRE are given an opportunity to review the draft plans to ensure that the plans recognize and integrate their agency's responsibilities. Through the DOI's Regional Response Team member, MMS can provide comments on Regional and Area Contingency Plans to assure that the plans conform with MMS policies and procedures and that the notification process addresses MMS responsibilities regarding oil-spill response planning.

The Gulf of Mexico OCS oil industry's oil spill contingency plans, as well as the supplemental information submitted with EP's or DOCD's, are reviewed by MMS. This review attempts to ensure that an operator's identified response time is reasonable, accurate, and sufficient to protect the adjacent environmental resources. Response times are further reviewed to determine whether they include sufficient time for the procurement of a vessel, for load-up and mobilization of cleanup equipment, and for transportation and deployment of the equipment. Based on the results of this review, it is determined whether the primary oil-spill response equipment location identified by the operator is appropriate for the subject plan and whether the projected response time allows sufficient containment/cleanup time prior to a spill potentially hitting the shoreline.

If the analysis indicates that a potential spill could possibly contact the shoreline in an environmentally sensitive area prior to the operator reaching the spill site and/or without allowing sufficient time for cleanup, the operator's response would be required to be reduced if possible; and/or as a condition of plan approval, the operator would be required to be capable of implementing the appropriate shoreline oil-spill protection methodology identified or referenced in their EP or DOCD to protect those resources that potentially would be impacted within a time period designated by this office.

Section VII of the MOU between the MMS and the USCG concerning the regulation of activities and facilities on the Outer Continental Shelf of the U.S., as amended in August 1989, sets up a mechanism by which coordination of an oil spill contingency plan review will be handled between the USCG and the MMS. In response to this MOU, the USCG's Eighth Coast Guard District is provided a copy of all MMS required OSCPs submitted for the Gulf of Mexico in order that a library of these plans is available to the USCG as a guide to the planned action to be taken by these facilities in the event of a spill.

c. Spill Response Training/Drills

Containment and cleanup operations are labor intensive due to the complexity of the environment they are conducted in and the constant monitoring/planning efforts associated with these types of operations. It is therefore essential that personnel be well trained in the use of the equipment and in the methodology of spill containment and cleanup. The MMS addresses this training by requiring through regulation (30 CFR 250.43) that the lessee ensures that the oil-spill response operating team is provided with annual hands-on training classes in the deployment and operation of pollution-control equipment. Those responsible for supervising the oil-spill response operations are required to be trained in directing the deployment and the use of all response equipment.

Drills for familiarization with pollution-control equipment and operational procedures are required to be held when equipment is initially placed and thereafter on an annual basis by the lessee or his contractor. The personnel identified as the oil-spill response operating team in the OSCP are required to participate in these drills. The drills are required to simulate conditions in the area of operations and include the deployment and operation of the equipment. Records of these drills are required to be maintained for 2 years. The MMS, Gulf of Mexico OCS Region, requires that these drills result in the deployment and operation of each piece of oil spill equipment maintained by Clean Gulf Associates (CGA) at least once every 4 years and that each oil-spill response team participate in enough exercises such that they will have deployed every type of pollution-control equipment maintained by CGA at least once every 4 years. As lessees generally depend on contract employees for their oil-spill response operation team members, the number of drills and training classes required annually to accommodate all of the OCS lessees results in the contract personnel participating in several drills and training classes within the annual timeframe. The MMS may initiate unscheduled drills and may require an increase in the frequency or a change in the locations of the drills, equipment to be deployed, or deployment procedures and strategies.

The MMS, Gulf of Mexico OCS Region, conducts unscheduled drills of five or six randomly selected operators each year. The various drills include different stages of deployment of equipment and personnel. The four types of drills developed by the MMS for use in the Gulf of Mexico include (1) unannounced drills with equipment mobilization only, (2) unannounced drills with equipment mobilization and deployment, (3) spot "Table Top" drills, and (4) announced "Table Top" simulations of a large oil spill. A written report of each unannounced drill will be required to be submitted to MMS within 15 days of the conclusion of the unannounced drill. The MMS evaluates the results of these drills and advises the lessee of any necessary changes in response equipment, procedures, or strategies.

Since the implementation of the program in 1989, MMS has conducted unannounced drills in the Gulf of Mexico of operators and offshore locations ranging from Florida to Louisiana. In all instances, a team of MMS officials initiated the drills and monitored the timing and actions taken by various company officials at several key locations. Although most of the drills were initiated early in the day, one drill held February 1, 1990, was conducted as a night exercise. Varying scenarios were utilized ranging from a simulated 200-bbl diesel fuel spill from a storage tank in the Destin Dome area that resulted in onsite equipment deployment to a simulated 1,000 bbl storage tank rupture combined with a 600-bbl/hr pipeline spill some 6.2 mi south of New Orleans that resulted in a combination of equipment mobilization and simulated table-top exercises. After each drill, recommendations for improvement were provided to the participating operator by MMS.

Oil-spill responders are also required, through the National Contingency Plan (40 CFR 300) effective April 19, 1990, to adhere to the training and safety requirements outlined in the U.S. Department of Labor, Occupational Safety and Health Administration's (OSHA) Hazardous Waste Operations and Emergency Response regulations at 29 CFR 1910.120. Effective April 13, 1990, the OSHA requirements generally provide that spill responders involved in post-emergency response, such as the equipment operators and general laborers, having a potential for minimal exposure to a hazardous substance are required to have 24 hours of initial oil-spill response instruction and 8 hours of actual field experience. Those spill responders having potential exposure to a hazardous substance at levels exceeding the permissible exposure limits (generally, those situations requiring the use of a respirator and protective clothing) are required to have 40 hours of initial training off site and 24 hours of actual field experience. Onsite management and supervisors are required to receive the same amount of training as the equipment operators and general laborers, with the addition of 8

hours of specialized training in hazardous waste management. Eight hours of annual refresher training is required of both general employees and managers.

The OSHA regulations at 29 CFR 1910.120(q) also include provisions that would relax the training requirements in emergency response situations. For response efforts considered as a part of emergency operations, 4 hours of OSHA training are required for those first on-scene during a spill incident. Those involved in the initial operational level of emergency response, such as bird washing and laying sorbent boom, are required to complete 8 hours of OSHA training. Hazardous material technicians are those personnel involved in the emergency operation of spill-response equipment such as skimmers and booms. Hazardous material specialists fill those positions requiring spill-response knowledge beyond that required for the operation of spill-response equipment. Both hazardous material technicians and specialists are required to complete 24 hours of OSHA training. All personnel involved in emergency spill response are required to attend annual refresher courses.

d. Equipment Response and Capability

(1) Equipment Locations

In the Gulf of Mexico region, oil-spill response equipment, identified in each operator's regional oil spill contingency plans, is generally maintained at nine strategically located onshore bases by the oil industry cooperative, CGA, or on the three identified vessels prestaged offshore (Table E-1). This equipment is currently the primary equipment used to respond to an oil spill associated with OCS operations. In addition, when there is drilling activity in the EPA, oil-spill equipment may be strategically located at the rig site or at other staging leases (e.g., Panama City). All MMS approved OSCPs are required to contain an inventory of backup equipment or sources that are available locally, regionally, or through contract to augment the initial response equipment.

Although the CGA equipment is acquired and maintained for use by member companies, it is also available to nonmembers for a scheduled fee. Table E-1 also identifies the types of equipment stockpiled at the nine onshore bases or on the identified vessels prestaged offshore. All CGA bases have offshore skimmer systems known as Fast Response Systems (FRS). The High-Volume Open Sea Skimmer System (HOSS) barge is maintained at the Grand Isle base in coastal Louisiana because of this base's proximity to a large number of oil-related activities. Further discussion of this spill-response equipment is provided in Section IV.C.6.d.(2). Other types of equipment strategically sited at CGA bases throughout the Gulf of Mexico include boat and helicopter spray systems, communications equipment, and 50-bbl oil storage barges.

The oil industry can also contract for cleanup with an extensive number of independent spill-cleanup contractors and industry cooperatives located throughout the Gulf Coast. The number of companies included in the Marine Industry Group's Oil Spill Response manuals that have various pieces of available equipment are listed by State in Table E-2. It should be noted that, due to the recent equipment acquisitions made by the local Gulf States, the USCG, the Marine Spill Response Corporation, the National Response Corporation, and other local cooperatives and contractors available in the Gulf Region that are not included in Table E-2, the information provided in this table under represents the current and future Gulf spill-response equipment inventory. Details of these equipment acquisitions will be added when the national inventory of spill-response equipment is in place. The task of keeping a national inventory of spill-response equipment has been delegated to the USCG National Response Unit, renamed the National Strike Force Coordination Center (NSFCC), located in Elizabeth City, North Carolina, in response to the mandates of OPA. This inventory database, expected to be in place and accessible in early 1993, will replace the U.S. Coast Guard SKIM inventory initiated in 1978 and ceased in the early 1980's.

Besides the equipment operated by numerous contractors, coastal booms and skimmers are housed near refineries and other oil and chemical industry operations to respond to spills that may occur from their own facilities. One of the most extensive stockpiles of equipment, particularly open-ocean cleanup equipment, is maintained by the Louisiana Offshore Oil Port (LOOP) located at Port Fourchon, Louisiana.

Historically, if the USCG OSC determines that the OCS operator responsible for the spill is not taking appropriate response measures, the OSC may hire a cleanup contractor to conduct the spill cleanup. Under certain situations, the USCG National Strike Force would be called to provide assistance to the OSC. The Gulf

Table E-1

	CGA's Oil Response Equipment ¹								Identified Vessels ⁴
	<u>Offshore Booms</u>	<u>Coastal Booms</u>	<u>Offshore Skimmers</u>	<u>Shallow Water Skimmer Vessels</u>	<u>Sorbents</u>	<u>Surface Collecting Agents</u>	<u>Chemical Dispersants</u>	<u>Bird Care Equipment</u>	
Texas									
Galveston	x		x						
Port Aransas	x		x		x	x	x	x	
Louisiana		x			x	x	x		
Cameron	x		x						
Intracoastal City	x		x						
Houma	x		x		x	x		x	
Grand Isle ²	x		x	x					
Venice	x	x	x	x	x	x	x	x	
Alabama		x	x	x	x	x	x	x	
Theodore	x								
Florida			x						
Panama City ³	x		x						
Offshore					x	x	x	x	
West Cameron 71	x		x						
South Marsh Island 240	x		x						x
South Timbalier 26	x		x						x
			x						x

¹As of May 1990.²Main base.³When there is a drilling activity in the EPA, equipment is strategically located at nearby offshore staging bases: for example, Panama City. When there is no EPA drilling, the equipment is stored in Houma, Louisiana.⁴Identified vessels are Field Utility Boats on the payroll of CGA members. The boats are equipped with skimmers and boom and two extra personnel. They will be released by the operator to respond to CGA member's spill.

Source: CGA, 1991.

Table E-2

Number of Oil Spill Cleanup Contractors/Operators by State Stocking Various Cleanup Equipment

	<u>Offshore Booms</u>	<u>Inland/Coastal Booms</u>	<u>Offshore Skimmers</u>	<u>Inshore Skimmers</u>	<u>Sorbents</u>	<u>Surface Collecting Agents</u>	<u>Chemical Dispersants</u>	<u>Bird Care Equipment</u>
Texas	5	27	1	13	12	2	4	1
Louisiana	4	16	1	8	9	1	1	4
Mississippi	0	0	0	0	0	0	0	0
Alabama	2	6	0	2	1	0	0	0
Florida	8	25	0	14	9	7	2	0

Source: Marine Industry Group, 1991.

Area Strike Team, located in Mobile, Alabama, is part of the National Strike Team and is equipped with specialized containment and removal equipment with rapid deployment capabilities.

In compliance with the revisions made through the Oil Pollution Act of 1990 to the Federal Water Pollution Control Act, the USCG has recently, August 1991, established a National Response Unit in Elizabeth, North Carolina. Spill response staff was increased for USCG District Response Groups throughout the U.S.

The Seventh and Eighth USCG District Response Groups are available to provide quick first aid to a spill in the Gulf of Mexico. One of the primary assets available to the USCG District Response Groups will be pollution control and cleanup equipment, which will be prestaged at 19 locations throughout the country. These locations and the selection of the equipment were based on several USCG studies that considered known and proposed stockpiles of industry provided response equipment and the risk of a spill occurring in specific geographical areas. Sites selected in the Gulf Coastal States include Corpus Christi and Galveston, Texas; New Orleans, Louisiana; and Tampa, Miami, and Mayport, Florida. Equipment for each of the 19 sites (at a cost of approximately \$1 million to equip each site) includes containment boom (610 m of harbor and 762 m of open ocean boom), two vessel of opportunity skimming systems (VOSS's), and two portable collapsible barges to hold collected oil. The equipment is in the procurement and delivery stage, but all will not be on sight until the end of 1993.

The VOSS's are designed to be used on vessels over 20 m in length that would be available in the area. It is expected that offshore supply vessels or fishing vessels may be used. The equipment will be stored on flat beds for quick transport; however, a truck would need to be hired to transport the equipment in the event of a spill. The 610 m of harbor boom will be packaged to be easily transported by helicopter.

The Gulf Area Strike Team is expected to receive additional equipment similar to that being purchased for the aforementioned 19 sites. The Gulf Area Strike Team equipment is expected to be available by April 1993. Although the recently created (commissioned September 1991) NSFCC located in Elizabeth City, North Carolina, will not warehouse equipment, it is available to administer the three USCG Strike Teams, to conduct training exercises, to serve as a public information assist team, and to keep a computerized national and international inventory of spill-response equipment.

Approximately 49 Marine Safety Offices nationwide, which are not located in proximity to one of the 19 staging sites, have received equipment to enhance their response capability. Equipment placed at these sites include a small skimmer system, 305-610 m of harbor boom, a mooring system, and a trailer.

Equipment purchased by the Marine Spill Response Corporation (MSRC) and the National Response Corporation is discussed in Section IV.C.6.f. Recent equipment acquisitions and future procurement plans to increase CGA's equipment inventory are discussed in Section IV.C.6.d.

(2) Equipment/Response Options and Effectiveness

(a) Mechanical Equipment

A wide variety of mechanical equipment is available to aid in the containment and cleanup of spilled oil. Some general categories of oil spill cleanup and containment devices include booms, skimmers, pumps, and sorbents.

Oil-spill control booms are floating barriers designed to contain spilled oil for recovery, to divert oil to areas where recovery is more easily carried out, and to act as a barrier in pathways to areas containing commercially valuable or environmentally sensitive resources. Boom designs vary considerably, but all of them usually incorporate the following features: freeboard to prevent or reduce splashover; subsurface skirt to prevent or reduce the escape of oil under the boom; flotation by air or some buoyant material; and a longitudinal tension member (chain or wire) to withstand the effects of winds, waves, and currents. The length and size of boom sections are important considerations. The optimum size of a boom is largely related to the sea state under which it is to be used. As a general rule, the minimum height of freeboard to prevent oil splashover should be selected; and the depth of the skirt should be of similar dimensions. Short section lengths of boom are easier to handle and can protect the integrity of the boom as a whole, should one section fail; however, this should be weighed against the difficulty of connecting the sections effectively. A boom is typically

constructed of modern lightweight/high-impact materials (high strength-to-weight ratio) and packaged compactly to allow for ease in transportation and deployment. Booms generally cannot contain oil against water velocities much in excess of 1 knot (kn) (0.5 m/s) acting at right angles to it. The escape velocity for most booms is around 0.7 kn (0.35 m/s), irrespective of skirt depth (Oil Spill Intelligence Report, 1984a).

Skimmers are mechanical devices designed to collect spilled oil from the water surface for disposal without chemically or physically altering the oil. Skimmers are classified on the basis of their operating principles into the following major groups: weir skimmers (provide gravity drain off to oil); vacuum skimmers (similar to weir, but use a power source to actively remove the oil); centrifugal skimmers (where a power source is used to create a vortex that drains the oil for collection); submersion skimmers (force the oil below the water level and use its buoyant property in the collection process); and oleophilic skimmers (collect oil on a moving sorbent material and mechanically squeeze it into collection areas) (Oil Spill Intelligence Report, 1984b).

Each of these skimmer types has its advantages and disadvantages, although the efficiency of each model depends on several parameters, including oil thickness, oil viscosity, sea state, and storage capability. Each type of skimmer is best suited for a particular situation; no skimmer is effective in all conditions. In addition, since the skimmer is part of a system involving the containment and recovery of the spilled oil, as well as the separation of the oil/water mixture and the transportation of that mixture to receptacles, the overall efficiency of a skimmer depends on the effectiveness of the individual components of the system (Oil Spill Intelligence Report, 1984b).

Pumps are used in oil spill cleanup operations to transfer collected oil from a collecting device, such as a boom, to a vessel or facility for separation, reprocessing, storage, or transportation to other facilities. Although specifications of the various pumps available are not relevant to this discussion, it should be recognized that pumps are necessary for cleanup operations.

Sorbents are those materials that recover oil by either absorption or adsorption. In absorption, oil penetrates the solid structure of the adsorbents' fibers or particles, which then swell in size to accommodate the oil. In adsorption, oil adheres to the surface of the adsorbent material but does not penetrate the fibers or particles themselves. Sorbent materials are generally classified by their composition: (1) natural organic products, such as hay, peat moss, straw, or wood pulp; (2) mineral compounds, such as ash, perlite, or vermiculite; and (3) synthetic products, such as polyethylene, polypropylene, or polystyrene. Sorbents are usually marketed in particulate form or as booms, pillows, rolls, or sheets. Synthetic products are generally preferred over natural sorbents because they are able to absorb more oil while taking on less water. For this reason, they take up less storage space and pose less of a disposal problem (Oil Spill Intelligence Report, 1984c).

As previously stated, winds and sea state have a significant effect on the performance of the aforementioned oil spill equipment. In general, 15-20 kn are the maximum wind speeds for dynamic upwind recovery, and recovery over sea states of 0.9-1.2 m is essentially undocumented (Tennyson, personal communication, 1988). Of additional importance is the period of the waves. When an increase in winds produces short-period, localized seas, the efficiency of oil spill containment/cleanup devices decreases because the equipment tends to get swamped in the wash of these choppy waves. Large rolling waves (long period) present less problems due to the ability of the equipment to follow the waves' contours (Oil Spill Intelligence Report, 1984b).

Initial response to an oil spill occurring due to OCS oil-development activities is available through equipment owned by CGA. Open-ocean equipment available through CGA includes FRS and the HOSS barge. The FRS is essentially a vessel of opportunity skimming system (VOSS) in that it is designed to be loaded onto a single vessel supplied by the lessee. Vessel length can range from 20 to 30 m. Fast Response Systems are staged at onshore locations throughout the Gulf as indicated by Table E-1. Once an FRS unit is loaded onto a vessel, the vessel is generally capable of a 10- to 15-kn response dependent upon the size of the vessel utilized. Clean Gulf Associates' FRS consists of a barrier (two sections of 7.3-m length of 48-in boom) connected to a weir skimmer and towed alongside a single vessel with an outrigger, an oil-water separator system, and recovered oil-storage capacity.

Due to the problems of equipment and manpower coordination inherent in an oil-spill response, skimming systems deployed from single, independent vessels are an attractive means of recovering spilled oil offshore. Whereas a large sweep system is advantageous on large, unified slicks, a VOSS can be deployed more quickly, is more maneuverable (for skimming windrows of oil, for example), and requires only one vessel (Crocker, 1985). Operations of single-vessel systems are presently limited by the deployment and retrieval of the skimming system in rough conditions rather than by barrier performance in waves (Crocker, 1985). The CGA reports that the FRS weir skimmer will pick up essentially all the slick presented to it at boat speeds of 3/4 to 1 1/4 kn in seas up to 0.6 m. As seas pick up and/or boat speed increases, however, effectiveness of the system decreases. This system has been tested at the Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) under varying conditions with both heavy and medium oils. The tests showed that throughput efficiencies ran as high as 100 percent for speeds of 1.25 kn, with an oil recovery rate of 293 bbl of oil per hour in a slick that was 2 mm thick. The skimmer was tested under severe harbor-chop conditions of 0.6 m, resulting in throughput efficiencies of 70 percent (USDOL, MMS, 1987c).

The HOSS barge located in Grand Isle, Louisiana, consists of a skimming system built into a specially designed 53-m barge. Boom (305 m total) is stored on two sides of the barge and is launched off the stern by means of a trolley running down ramps cut into the hull. Mounted in slots in the barge's stern are four oleophilic belt skimmers, each followed by a weir skimmer. The HOSS barge is designed to be utilized to skim extensive long-duration spills where chasing after slicks is not required and to provide offshore operational support for spill recovery. This system must be towed to an oil spill site. Tow speed is typically 4-7 kn. The HOSS barge is capable of working in up to 1.8-m waves with boom and 2.1-m waves without boom.

Clean Gulf Associates has also initiated the establishment of four identified vessels strategically sited at various locations offshore and equipped to provide an initial response effort in the event of an oil spill. These boats are strategically located in areas having a high concentration of oil production. The first three identified vessels are currently staged offshore and are available to the general CGA membership. A skimming system, including a crane, power pack, outrigger and boom, skimmer (designating 200 gpm) and a 2,100-gal oil separator, are skid mounted on each vessel. Five hundred feet of open-ocean boom, which is to be used for containment in conjunction with skimming operations, is also stored on the vessel. The identified vessels are located offshore at South Timbalier Area Block 26, West Cameron Area Block 71, and in South Marsh Island Block 239. The fourth identified vessel is expected to be in place in South Pass Block 62 by the end of the first quarter of 1993.

In the event of a spill by a member CGA company, the member would call the Halliburton dispatcher for release of the ID boat. Upon approval by a member of the CGA Executive Committee or the Executive Director, the operator contracting the vessel (Shell, Mobil, or Texaco) would release it to respond to the spill. The identified vessel would be the first responder to the incident and would remain on scene until the backup equipment reaches the scene from the CGA shore base locations. At this time the identified vessel would be returned to service for the operator.

The main objective in any offshore spill response effort is to prevent the oil from damaging resources by containment and recovery of the spill. The CGA has available 5,486 m of open-ocean boom that has been strategically sited along the Gulf Coast at existing CGA bases. Approximately 450-900 m of the boom are stockpiled at each of the CGA bases. The boom chosen can be easily stored, deployed, and retrieved. As previously stated, each identified vessel prestaged in the Gulf of Mexico is equipped with 150 m of this open ocean boom. The CGA is also expecting delivery of 3,050 m of tricompartiment shoreline boom that will also be strategically sited along the Gulf Coast in January 1993. The shoreline boom will be used to isolate an oiled section of the beach from a clean or biologically sensitive area to protect the adjacent areas from being oiled. The CGA also has 150 m of 1.8-m offshore boom stockpiled at Grand Isle, Louisiana, primarily as a replacement boom to the HOSS barge. Other offshore booms, which may currently be available through Gulf of Mexico oil and gas operators, would include the 230 m of boom that is required to be located at each rig site or staging area in the Florida panhandle during drilling activity in those areas located in the EPA. Booms procured by CGA for open-ocean use are generally capable of being deployed in less than 1 hour and can generally operate effectively in waves up to 1.8 m.

Another planned addition to the CGA stockpile are two additional shallow-water skimmers. These skimmers are essentially self-propelled barges with a skimmer mounted on them and were selected because of their durability, storage capacity, shallow draft, unmanned operation potential, and ability to handle weathered oil. Lengths of 36-in nearshore containment booms, self-propelled skimming vessels, hand skimming systems, floating suction oil skimmers for use in shallow water, and sorbents make up a portion of the remaining inventory available through CGA.

(b) Chemicals/Dispersants Usage

Chemical dispersants may potentially be used as an oil-spill mitigation tool. Tables E-1 and E-2 delineate the major locations presently stockpiling dispersants in the Gulf of Mexico. The key components of chemical dispersants are surface-active agents (surfactants), which are molecules that have both water-soluble (hydrophilic) and oil-soluble (hydrophobic) ends. These molecules, when applied to an oil spill, orient themselves at the oil/water interface such that the hydrophilic ends of the molecules are in the water and the hydrophobic ends are in the oil. The result is a reduction of interfacial tension between the oil and water. This action reduces the cohesiveness of the oil slick and, with agitation, finely dispersed oil droplets (ranging in size, depending on the effectiveness of the surfactant formulation, from about 10 microns to 0.5 mm in diameter) are formed in the near-surface water. The hydrophilic surfactant groups prevent droplet recoalescence.

Dispersant formulations have changed since the Torrey Canyon spill in attempts to develop more effective and less toxic products. These so-called second-generation dispersants, introduced in the late 1970's, are being manufactured today. Therefore, only the current (late 1970's to the present) literature on effects of dispersed oil is relevant. Some studies have investigated the toxicity of dispersants alone (Wells, 1984). Studies that have considered species indigenous to the Gulf of Mexico, such as mangroves, seagrasses, and corals, include those by Baca and Getter (1984), Getter and Baca (1984), Getter and Ballou (1985), Teas et al. (1986), and Thorhaug et al. (1986).

Concern that chemical dispersants could be toxic to marine life has led to considerable caution in authorizing their use at spill sites. Laboratory studies of dispersants currently in use have shown that their acute lethal toxicities are usually lower than crude oils and their refined products. A wide range of sublethal effects of dispersed oil has been observed in the laboratory. These occur in most cases at concentrations comparable to or higher than those expected in the water column during treatment (1 to 10 ppm), but seldom at concentrations less than those found several hours after treatment of a oil slick (less than 1 ppm). The times of exposure in the laboratory (24 to 96 hr) are much longer than predicted exposures during slick dispersal in the open sea (1 to 3 hr), and the effects would be expected to be correspondingly less in the field. Laboratory bioassays have shown that acute toxicity of dispersed oil generally does not reside in the dispersant, but in the more toxic fractions of the oil. Dispersed and untreated oil show the same acute toxicity. The immediate ecological impact of dispersed oil varies. In open waters, organisms on the surface will be less affected by dispersed oil than by an oil slick, but organisms in the water column, particularly in the upper layers, will experience greater exposure to oil components if the oil is dispersed. In shallow habitats with poor water circulation, benthic organisms will be more immediately affected by dispersed oil. Although some immediate biological effects of dispersed oil may be greater than for untreated oil, long-term effects on most habitats, such as mangroves, are less, and the habitat recovers faster if the oil is dispersed before it reaches that area (NRC, 1989).

The LOOP, Inc. has completed static and flow through toxicity tests on five Gulf species--brown and white shrimp, blue crab, eastern oyster, and red fish--in August 1988. The test results showed that when the test species were exposed to chemically dispersed Mayan or Saudi Arabian light crude oil, the observed toxicity occurred rapidly, usually within 6 hours after addition of the dispersed oil. The test animals that survived the first 6-12 hours of exposure usually recovered and survived for the remainder of the test period. In almost all cases, surviving test organisms were swimming normally and were not lethargic 12-24 hours after test material addition. Test results indicated that if the organisms were exposed to dispersed Mayan or Saudi Arabian light crude oil but survived long enough for the material to decrease in concentration, the organisms could recover

and survive without any apparent short-term effects (Shuba and Heikamp, 1989). Also, MMS has recently awarded Continental Shelf Associates a contract to conduct an Oil and Oil Dispersant Toxicity Study. The objective of this study is to collect additional data on the toxicity of dispersed oil to selected Gulf species, particularly the eggs and larvae of a few important commercial and recreational fisheries species of the north-central Gulf. A final report will be available by winter 1993.

The decision to use dispersants must be made soon after the spill occurs. Weathering of oil will increase the viscosity and decrease the capability of chemically dispersing the oil. Factors to be considered in making this decision are oil type and properties, environmental conditions, the availability of dispersant and application equipment, and the probable fate of the oil without treatment. Highly viscous oils (greater than 5,000 centistokes), oils with pour points near or above ambient temperature, and oils with a high wax or asphaltene content may not be amenable to dispersant treatment (International Tanker Owners Pollution Federation, Ltd., 1982; Canevari, 1985). Dispersants are not recommended for use on spills on very calm waters. Some dispersants are formulated for use on marine (saltwater) spills only.

Dispersants may be applied by boat or aircraft. Boat application is limited to small spills or those within a few miles of shore. Aerial spraying is the preferred method because it offers rapid response, coverage of large areas per unit of time, good control of treatment rates, optimum use of dispersants, and much better evaluation of treatment results than is possible from boats. Regardless of the method used, the application system must deliver the proper dosage of dispersant in a uniform spray of droplets to the slick. Most oil slicks considered for dispersion will be 0.25 mm thick or less (a 0.25 mm thick slick contains over 4,000 bbl per square mile of oil). The dispersant must penetrate the oil to reach the oil/water interface. The proper dosage of dispersant (5 gal/acre is an average amount, depending on the dispersant and the oil types) must be used to attain the maximum reduction of interfacial tension. Finally, some form of energy (e.g., wind, wave, or mechanical) must be applied to the oil/water interface to cause the dispersion of oil into the upper part of the water column. Newer types of dispersants require very little mixing energy.

In a few carefully planned, monitored, and documented field tests, as well as in laboratory tests, several dispersants have been shown to be effective---that is, they have removed a major part of the oil from the water surface when properly applied to oils that were dispersible. However, at other field tests and at accidental spills, dispersants have been reported to have low effectiveness. The latter results may have been due to the use of inadequate application techniques, such as poor targeting and distribution of aerial sprays, as well as the possibilities that the oils were not dispersible, that some dispersants were poorly formulated, or that the results were inconclusive. Resolution of these ambiguities will require further studies. Much is known of how dispersants work, but one aspect inadequately understood is the interaction of various physical and chemical processes involved in oil dispersion (NRC, 1989).

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) requires that the USCG on-scene coordinator 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, when practicable, 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 substantially reduce a hazard to human life. Consistent with this, a Memorandum of Understanding between the Department of the Interior and the Department of Transportation dated August 16, 1971, allows MMS the authority to grant approval to OCS operators to use chemical agents within a 500-m radius of the source of pollution only when such agents are deemed necessary to abate the source of pollution as a measure for the safety of personnel and operations.

Dispersant use in the Gulf of Mexico is controversial and has not yet been fully accepted by the five Gulf States, which, along with USEPA, have approval authority regarding the use of dispersants in waters off their shores. The States, however, by their participation in the Regional Response Teams (RRT) are reviewing relevant data with an eye to approving dispersant use under certain specific conditions. Recent Federal and State progress made toward the designation of areas in the Gulf for which dispersant use may be preapproved

has been encouraging. In acknowledgment that an effective dispersant response is an immediate one, the USEPA Region VI Regional Response Team granted pre-spill authorization for the use of dispersants within a designated geographic area surrounding the LOOP facility to the Federal OSC in 1991 and granted interim pre-spill authorization for the use of dispersants within a designated lightering area offshore Louisiana and Texas to the Federal OSC in 1992. A plan requesting preapproval of the use of dispersants in the Pascagoula, Mississippi, lightering area is currently undergoing review by both the region 4 and region 6 RRT.

The report went on to make several recommendations regarding future studies; it also recommended that dispersants be considered as a potential, first-response option to oil spills, along with other response options.

An oil-treating agent called "Elastol," which is not a dispersant, aids in the containment and recovery aspects of oil-spill cleanup. Elastol is a nontoxic powder that dissolves rapidly when dispensed on hydrocarbon liquids. It modifies the oil, giving it a viscoelastic property and making recovery more efficient, and is usable on light and heavy crude oils, kerosene, diesel, gasoline, bunker, and many other hydrocarbons. In recent tests, the application of Elastol on offshore oil spills in 500-900-ppm quantities increased the performance of skimming equipment 2-5 times over untreated performance recovery rates. It also minimized oil spreading, streaking, and breakup due to wind and wave conditions of up to 15 kn. When used with booms, it shows successful containment in currents over 1 knot. It should be noted, however, that the effectiveness of Elastol has not yet been fully proven under field conditions; and, like dispersants, its usefulness is still the subject of some controversy. Additional information on Elastol can be obtained from a technical paper entitled Laboratory and Tank Test Evaluation of Elastol, which was presented at the "Tenth Arctic and Marine Oil Spill Program Technical Seminar" (Bobra et al., 1987).

(3) Response Times

Although regional oil spill contingency plans submitted for the Gulf of Mexico do not specify response times, the supplemental oil-spill information submitted for EP's and DOCD's does provide a response time for operations on a particular lease. Review procedures for an operator's response time submitted as supplemental information to a EP or DOCD are discussed in Section IV.C.6.b.

Initial response times to an oil spill in the Gulf of Mexico from a CGA shorebase would vary dependent upon the chosen spill-equipment base, the distance of the block to the chosen spill-equipment base, the travel speed of the chosen vessel, the amount of time needed to procure and deliver a vessel to the spill-equipment staging area, the time needed to transport the oil-spill response crew to the spill-equipment loading base, the load-up time, and the deployment time. The utilization of some staging areas would require a longer period of inland water travel at reduced speeds, which could significantly increase a response time. Additionally, although most OCS operators are members of CGA, the few that are not may incur delays at the time of a spill while negotiating an agreement with the co-op for the use of the equipment. The use of the identified vessels staged at strategic offshore locations by CGA should alleviate many of the aforementioned variables affecting response times and consequently should effectively reduce initial response times to some areas of the Gulf.

If one of the CGA identified vessels is not chosen or appropriate as the preferred first response alternative, first response to an oil- and gas-drilling-related spill in the Gulf of Mexico would be made using CGA equipment staged at onshore locations. Each operator would be responsible for supplying their own vessels, cranes, and personnel when using shore-based CGA equipment. The majority of the facilities located more than 97 km from an onshore equipment base currently have response times greater than 12 hours. These response times are based on an estimate of 4 hours for the procurement and mobilization of both personnel and a vessel to a subject base, an estimate of 2 hours to load the equipment onto the support vessel, an estimate that the procured vessel would travel at 10 mph in open water, and an estimated channel run time. An internal study of the projected response times submitted to date by Gulf of Mexico OCS operators was made to determine these estimates. Some variance of these estimated times can be expected depending upon the availability of a vessel and the distance of the spill response personnel headquarters from the subject CGA base location, as well as the wind and weather conditions at the time of a spill. It should be noted, however, than an oil spill at these distances from shore would not normally be an immediate threat to coastlines in the

Gulf because (a) prevailing currents and winds do not tend to move spills directly toward shorelines, (b) the greater the distance from shore of a facility, the greater the time available before a coastline could be impacted, and (c) Gulf crude oils are generally light and, therefore, easily and naturally dispersed.

The establishment and offshore staging of CGA's identified vessels provide the first stage of a tiered response. The equipped, identified vessels are sufficient to handle smaller size spills and to provide initial response to larger spills until back up equipment could reach the spill site. Back-up equipment is available through CGA bases located throughout the Gulf Coast, the USCG Atlantic Area Strike Team base in Mobile, Alabama, and from numerous contractors and oil companies in the Gulf Coast area.

A large number of operators in the Gulf of Mexico presently propose the use of contract personnel to load and operate the CGA equipment. These operators typically enter into a "no fee" type of contract with one or more of these companies to provide spill response on a 24-hour basis if they are available at the time of a spill. Because these companies are not located in close proximity to all of CGA's spill-equipment bases, the delivery of the contract personnel to a spill base for loadout could increase a projected response time. Trained oil-spill response personnel can generally be transported from locations throughout the Gulf Coast to CGA's nine base locations by helicopter in time periods ranging from 40 minutes to 2 1/2 hours. This timeframe may be longer depending upon the weather conditions at the time of a spill, as it could require up to 6 hours to drive contract personnel to some of the bases.

Vessel procurement has been identified by numerous OCS operators as one of the biggest limiting factors in attempting to reduce response times in the Gulf of Mexico. Vessel procurement times over 12 hours have been projected in some instances. It is hoped that CGA's effort to locate four identified and equipped vessels at strategic offshore sites in the Gulf of Mexico will be a start in successfully alleviating many of the vessel procurement problems identified in the Gulf.

(4) Offshore Cleanup Capability for Handling Various Size Spills

The MMS-required OSCP's describe response actions for two types of spills--continuous spills and spills of short duration and limited maximum volume. Response to a very large spill, if the spill results from an instantaneous release, is not described; however, the discussion of response actions to continuous spills included in MMS required OSCP's would be equivalent to a "very large spill" that may result from oil and gas drilling or production activity. If the spill were very large, in addition to company-owned and CGA equipment, industry would attempt to access available uncommitted equipment (generally that equipment available regionally that is not part of CGA's stockpile) that could help in containing the spilled oil as identified in their OSCP's. Logistics for transporting and deploying this uncommitted equipment would, however, have to be worked out at the time of a spill. The OPA requires that offshore facility plans identify and ensure by contract the availability of private personnel and equipment necessary to remove, to the maximum extent practicable, a worst case discharge.

An examination of the daily cleanup capacity of CGA's major cleanup equipment described above can be used to estimate the amount of oil that industry could remove from the slick daily. The identified vessels, FRS, and HOSS barge serve the industry in cleaning up spilled oil in open seas. The HOSS barge would only be used for spills of long duration, such as blowouts, because of the amount of time to transport the barge to the spill site. This system can recover a nominal amount of 4,300 bbl of fluid per day. The oil tanks can hold about 4,100 bbl and can be offloaded to other oil storage barges. The equipped, identified vessels are sufficient to handle smaller spills and to provide initial response to larger spills until backup equipment can reach the spill site. The FRS's would be used for spills of short duration and to supplement the HOSS barge and identified vessels. The recovery pumping system of the FRS is conservatively estimated to handle 1,000 bbl per 12-hour day (Union Exploration Partners, Ltd., 1988). As previously stated, during OHMSETT testing under varying conditions with both heavy and medium oils, throughput efficiencies for the FRS ran as high as 100 percent for speeds of 1 1/4 kn, with an oil recovery rate of 293 bbl of oil per hour in a slick 2 mm thick (USDOL, MMS, 1987c). The CGA currently has 13 FRS units and 3 identified vessels, which could be used during a spill staged at locations throughout the Gulf of Mexico. Obviously, the response capability in the Gulf of Mexico would vary depending upon the number of FRS units and identified vessels deployed to the spill site.

In the event of a 10,000-bbl oil spill, one medium-size skimmer capable of picking up 600 bbl of fluid/hr, which would have similar capacity to one FRS, would be required for a maximum of 7 days working 12 hr/day to recover the total fluid to be recovered (50,000 bbl--20% oil and 80% water). A 63,000-bbl oil spill would require six medium-size skimmers to recover the total fluid necessary (315,000 bbl of fluid) over the same timeframe (Exxon, 1979). The recovered oil-storage capacity of an FRS is 100-180 bbl. Recovered oil in excess of the 100- to 180-bbl FRS storage capacity could be temporarily offloaded to the supply-vessel tanks. However, a waiver from the USCG would have to be obtained to utilize the mud tanks in the supply vessel for auxiliary recovered oil storage. Other options for additional recovered oil storage would include the 50-bbl oil storage barges available through CGA or oil barges located throughout the Gulf of Mexico. Contacts for the procurement of these oil barges are provided in the Gulf of Mexico lessees' OSCP's.

It should be noted that offshore cleanup operations to open-water spills have, for the most part, been ineffective, as evident in the Alaskan oil-spill response efforts. Despite the massive effort to clean up the oil in Alaska, cleanup crews were able to recover no more than 15 percent of the spilled oil. According to the U.S. Congressional Office of Technology Assessment (OTA) report entitled *Coping With An Oiled Sea: A Background Paper* some experts feel that the most oil that can be recovered after a major spill is 10-15 percent. Information obtained by OTA from several documented open ocean tanker spills show that the actual oil recovered at sea has usually been much less than 10 percent of the oil discharged (Johnson et al., 1990).

Mechanical containment and recovery remains the primary spill response method utilized in the U.S. The current technology available for mechanical oil spill cleanup has many limitations. The OTA report indicates that while new designs have appeared over the years, the basic technology has not changed much over the past decade. The report also indicates that while improvements in mechanical recovery technologies can be expected from stepped-up research and development efforts, they are unlikely to result in dramatic increases in the amount of oil that can be recovered from a catastrophic spill. In general, the OTA report stated that the improvements made in mechanical oil spill clean up technology that would be more likely to offer greater effectiveness for large offshore spills would involve larger, more costly equipment, strategically located for a quick response (Johnson et al., 1990).

(5) Coastal Cleanup Techniques and Effects

Whenever possible, spill response should be carried out on water, as most equipment and techniques have been designed for such an approach. However, when a spill contacts a coastline, several techniques can be used. The selection of the type of treatment onshore will depend on the type and the amount of oil on the shore, the nature of the coast, the depth of oil penetration into the sediments, the accessibility and trafficability of the shoreline, and the possible ecological damage of the treatment to the shoreline environment (CONCAWE, 1981). Types of cleanup techniques, along with the advantages and disadvantages of their use in shoreline cleanup, are discussed in Table E-3.

Direct-Suction: If a beach, rocky area, or marsh has been contaminated with large volumes of oil and if the oil has pooled naturally in low spots or poorly drained areas, the use of direct suction can be a viable cleanup method. However, the effectiveness of this technique requires thick accumulations of oil. Direct suction can be accomplished with a pump, hoses, and a storage container. Recovered oil can be stored in metal storage containers, natural depressions lined with an impervious material, or a truck used for storing liquids. Another option is to use a vacuum truck equipped with a pump. Direct suction also can be applied to spills that have saturated porous soil types, such as sand and silt, by mechanically cutting a trench to act as a collection area for the oil (USDOL, MMS, 1987c).

Manual Removal: Where oil contamination is low or sporadic, or when penetration of the oil into the sediment is low, manual removal of the oil is preferred. Manual removal usually is used to some extent on any shoreline cleanup, in combination with other techniques or alone. Due to logistical constraints or to access constraints placed on heavy equipment in some areas, manual recovery may be the only cleanup technique possible for some shoreline spills. This type of response is very time-consuming, costly, and

Table E-3
Shoreline Cleanup Methods

Method	Description	Applicability	Effect
High-pressure Hoses	<ul style="list-style-type: none"> - high-pressure stream of water washes oil from the substrate 	<ul style="list-style-type: none"> - can be effective on rock, boulder, and manmade surfaces - oil flushed onto water surface for removal or channeled to beach collection site 	<ul style="list-style-type: none"> - can damage flora and fauna - can flush oil into sediments - if beach is backed by unconsolidated cliffs, hosing of cliff can cause slumps, falls, or slope failure
Steam or Hot-Water Cleaning	<ul style="list-style-type: none"> - steam or hot-water washes oil from the substrate 	<ul style="list-style-type: none"> - very effective on rock, boulder, and manmade surfaces - oil flushed onto water surface for collection or channeled to beach collection site - expensive method 	<ul style="list-style-type: none"> - can be very harmful to flora and fauna - can flush oil into sediments
Sandblasting	<ul style="list-style-type: none"> - high-velocity sand removes oil from the substrate 	<ul style="list-style-type: none"> - effective but slow method for rock, boulder, and manmade surfaces - can remove oil stains - expensive method 	<ul style="list-style-type: none"> - can be very harmful to flora and fauna - scatters oil and sand - can cause deeper penetration of oil into sediments
Low-pressure Hoses	<ul style="list-style-type: none"> - low-pressure stream of water washes oil from the substrate 	<ul style="list-style-type: none"> - effective but slow method for rock, boulder, and manmade surfaces - oil flushed onto water surface for collection or channeled to beach collection site 	<ul style="list-style-type: none"> - biologically preferable to high-pressure hoses, steam cleaning, or sandblasting - can flush oil into sediments
Mixing	<ul style="list-style-type: none"> - A - mechanical equipment such as rakes, discs, or harrows used to break up oil cover and mix surface sediments 	<ul style="list-style-type: none"> - accelerates natural cleaning - useful for light-grade oils or to break up "asphalt pavements" - increases surface area of exposed oil and increases dispersal and degradation rates 	<ul style="list-style-type: none"> - does not remove oil - can cause burial of the oil

Table E-3. Shoreline Cleanup Methods (continued)

Mixing	<ul style="list-style-type: none"> - B - mechanical equipment used to push oil/sediment down beach into water 	<ul style="list-style-type: none"> - accelerates natural cleaning - wave action disperses and degrades oil - sediment is returned to the beach - applicable for "asphalt pavements" or coarse-sediment beaches 	<ul style="list-style-type: none"> - does not remove oil - should not be used if storm waves are expected before sediment is returned to the beach; could result in waves overtopping the beach and/or causing backshore erosion
<u>Removal</u>			
Graders, Scrapers	<ul style="list-style-type: none"> - remove thin layer of oiled sediments - graders form windrows for scraper or front-end loader to remove - scraper removes oil/sediment layer directly 	<ul style="list-style-type: none"> - effective on sand or pebble beaches with low oil penetration depths (less than 3 cm) - scraper can remove up to 25-cm layer of oil/sediment - some spillage which can be removed manually 	<ul style="list-style-type: none"> - removes sediment from the beach, amount of sediment removed usually not sufficient to affect beach stability
Front-end Loaders	<ul style="list-style-type: none"> - loader removes material directly from beach to collection sites 	<ul style="list-style-type: none"> - used on beaches with poor traction or for high oil penetration depths (25 cm or more) - high spillage - usually large amounts of uncontaminated sediment are recovered - rubber-tired vehicles are preferred to tracked vehicles 	<ul style="list-style-type: none"> - can result in excessive sediment removal that could cause beach or backshore erosion - grinds oil into the beach
Bulldozers	<ul style="list-style-type: none"> - push material into collection sites for removal 	<ul style="list-style-type: none"> - can remove oil/sediment where penetration is 25 cm or greater - not recommended unless other equipment unavailable or traction is too low for other equipment 	<ul style="list-style-type: none"> - can result in excessive sediment removal that could cause beach or backshore erosion - large spillage and grinds oil into sediments
Dragline, Clamshell	<ul style="list-style-type: none"> - sediment collected in bucket dragged towards equipment, or by crane-operated bucket 	<ul style="list-style-type: none"> - useful where beach access or trafficability is poor 	<ul style="list-style-type: none"> - can result in excessive sediment removal that could cause beach or backshore erosion

Table E-3. Shoreline Cleanup Methods (continued)

Sump Collection and Pump Removal	<ul style="list-style-type: none"> - sump excavated and used to collect oil, which is then removed by pump or vacuum systems 	<ul style="list-style-type: none"> - useful for large spills with oil washed onshore over a period of days 	<ul style="list-style-type: none"> - does not remove all the oil from the beach
Manual	<ul style="list-style-type: none"> - A - oil scraped from the substrate - B - oil collected with buckets, shovels, rakes, forks, etc. (with or without sorbents) - C - cutting of oiled vegetation 	<ul style="list-style-type: none"> - A/B - useful for areas inaccessible to equipment or small spills - A/B/C - labor-intensive methods; slow rate of oil removal - C - oil/vegetation collected in containers for removal 	<ul style="list-style-type: none"> - A - selective oil removal, not all oil is removed - C - labor-intensive method; pedestrian traffic can disturb marsh vegetation and can cause oil/sediment mixing
<u>In Situ Cleaning</u>			
Burning	<ul style="list-style-type: none"> - oil ignited, usually with ignition agents - continued burning may require wicking agents 	<ul style="list-style-type: none"> - seldom completely successful - useful for oil on surface of ice - can be used in marshes with appropriate biological advice - oil residues remain 	<ul style="list-style-type: none"> - causes heavy air pollution - can increase the penetration of oil into the sediments - can damage root systems of marsh vegetation
Beach Cleaning Machines	<ul style="list-style-type: none"> - cleaner picks tar lumps from the beach 	<ul style="list-style-type: none"> - useful on beaches with tarballs 	<ul style="list-style-type: none"> - little sediment removal

Source: USDOI, MMS, 1987b.

labor-intensive; however, it might be the only way to deal with a spill. Manual removal is a very selective method of removing contaminated sediment and vegetation, making it an extremely effective response technique. The effectiveness of a manual response is directly related to the amount of time, labor, and money the operator wants to devote to the problem. The more money and time invested in a manual cleanup operation, the greater the amount of oil that may be recovered (USDOL, MMS, 1987c).

Manual recovery involves the use of hand tools--such as rakes, shovels, buckets, pickaxes, brush cutters, scythes, and power brush-cutting tools--to remove contaminated sediment and vegetation. Oil-contaminated sediment or vegetation is collected and put into heavy-duty plastic or burlap bags for disposal. Bags may be removed manually, by vehicle, by boat or barges, or airlifted by helicopters to the disposal site (USDOL, MMS, 1987c).

Sorbents: Sorbent pads, booms, or rolls are often used as part of a manual response, or they can be used in conjunction with other techniques. Small, isolated pools of oil on the sediments or on nearshore waters can be removed by using sorbents. Once the sorbent materials have become soaked with oil, they can be removed by the methods described above, or they can be burned (USDOL, MMS, 1987c).

Heavy Equipment: For certain areas, heavy equipment can be used as an effective cleanup technique. Its use would require either the availability of roads or a means of air-lifting or barging the equipment to the contaminated area. Only certain soil types, such as sand or rocks, could withstand heavy equipment. Graders, scrapers, loaders, bulldozers, and backhoes are equipment that may be used in cleaning up shoreline areas. This equipment can be used in areas where the soil-bearing capacity is adequate and habitats are not harmed by removal of soils (USDOL, MMS, 1987c).

Flushing or Washing:

- **Low Pressure:** For cleaning light oils, such as fuel oil, from lightly contaminated sediments or vegetation, low-pressure flushing or washing can be a viable cleanup technique. In performing this operation, water is pumped from the ocean and is flushed over the lightly contaminated sediment to remove the oil. The removed oil is trapped downstream in a manmade trench or in a boomed-off area of the ocean close to shore. Once the oil is trapped, it can be removed by direct suction, skimming, burning, or sorbent pads. This technique is applicable only to shoreline areas because a nearby water source must be available. Additionally, this technique is easier to carry out if the trench or boom can be located downslope from where the flushing operations are being conducted.

Low-pressure flushing or washing operations are extremely labor intensive and may damage the sediment by erosion or by driving the oil farther into the sediment. (USDOL, MMS, 1987c).

- **High Pressure:** High-pressure flushing is basically the same technique as low-pressure flushing except that higher water pressures are used for high-pressure flushing. Typical specifications for high-pressure flushing are a 10 gal/min flow rate at 4,000 lbs/in² (272 atm). The penetration of oil deeper into the sediment with high-pressure flushing is an even greater danger than for low-pressure flushing (USDOL, MMS, 1987c).

Steam Cleaning and Sandblasting: Steam cleaning and sandblasting are techniques that can be used to remove oil from rocks, boulders, and manmade structures. These techniques use high-pressure jets of steam or sand to physically remove oil from the contaminated surface. Care must be taken in using these techniques because the high-pressure streams can severely erode the sediment or damage any uncontaminated flora or fauna in the area (USDOL, MMS, 1987c).

Natural Dispersion: Another option in dealing with shoreline cleanup that could prove very effective in certain environments is natural dispersion. For contaminated shorelines close to high-energy ocean environments--such as sand, gravel, or cobble beaches--natural dispersion of the oil into the ocean could be

very effective. Natural dispersion may be the only possible alternative when logistics or weather problems preclude a response effort (USDOL, MMS, 1987c).

(6) *In Situ Burning*

In situ burning of spilled oil appears to have merit under certain spill conditions, especially if the oil can be contained and thickened with fireproof booms. In order to ignite oil on water, the oil must be relatively fresh and the slick must be at least three millimeters thick. Some oil residue (about one millimeter thick layer) will remain in the water after burning oil because the flame is always quenched by heat losses to the water surface when the oil layer gets thin (Johnson et al., 1990).

Several techniques have been devised for igniting oil spills. Devices used include floating igniters that can be deployed by air and the helitorch igniter, which is a tank system containing gelled gasoline suspended on cables below a helicopter. One device under design is a laser ignition system using two coupled lasers from a helicopter to ignite oil spills (Johnson et al., 1990).

Although not currently an important oil-spill countermeasure, this technique is currently being investigated further in the U.S. *In situ* burning is being viewed with growing interest as a response tool, particularly in areas such as remote high latitude waters where other techniques may not be possible or advisable to use because of the physical environment (e.g., ice floes and extreme temperatures) or the remoteness of the impacted area. Some experiments have resulted in high burn percentages and thus high removal rates. Burn efficiencies of over 90 percent can be obtained, particularly if the oil is confined with booms or other means to keep the oil layer as thick as possible. Burning is, however limited in its applications. Igniting and keeping a slick burning may be a problem in some instances; in others, burning may jeopardize a vessel or facility; and the resultant visible air pollution may be unacceptable. The burning of an oil spill produces a visible smoke plume containing smoke particles and other products of combustion that may persist several kilometers from the burn. This fact gives rise to public health concerns related to chemical content of the smoke plume and the downwind deposition of particulates. To answer questions on health effects, MMS, with support from the USCG, sponsored and completed a series of six meso-scale burn experiments and two evaporation experiments between October 26 and November 10, 1992. Analysis of the 1992 data is just beginning. A complete technical report of the experiments will be compiled by MMS following analysis of all test data. In general, the data from the meso-scale experiments indicate burn components reach levels considered safe within several kilometers of the burn site and that ultimate depositional concentrations of particulates and associated pollutants are several orders of magnitude below acutely toxic levels. This visible air pollution must, however, be weighed against the invisible air pollution caused by allowing evaporation of the toxic volatile compounds of an oil (Johnson et al., 1990).

(7) *Bioremediation*

Bioremediation is the *in situ* use of microbes to biodegrade and oxidize hydrocarbon molecules. Biodegraders can be marine bacteria occurring naturally in the spill area, nonindigenous naturally occurring bacteria, genetically engineered microbes, and nutrients that can be added to enhance biological oxidation. Tests of this technique on water have shown little or no enhancement over the naturally occurring biodegradation. Use of bioremediation on impacted shorelines, however, has indicated effectiveness in some cases. Exxon, in conjunction with the USEPA, recently conducted a large-scale test of this technique in an attempt to clean up Alaska's oiled beaches as a result of the *Exxon Valdez* incident. Approximately 70 mi of shoreline were coated with two kinds of nitrogen- and phosphorous-bearing fertilizers to boost indigenous bacterial populations. Initial results are inconclusive, but the data are still being evaluated. One difficulty is measuring the effectiveness of the technique. The USEPA is also conducting separate bioremediation projects in this area.

Bioremediation was also recently used during the clean up of the *Mega Borg* tanker spill that occurred in waters located offshore Texas. Permission was granted by the USEPA to conduct a controlled bioremediation experiment on a 100-m² patch of oil. The experiment was modeled after a October 1989 test that was

conducted in Port Aransas, Texas. The reportedly successful bioremediation results during the Mega Borg response have been met with a great deal of criticism from the oil spill community. Many bioremediation experts are skeptical about the use of the procedure on open-water spills, mainly because such an undertaking can be difficult to control and because of the long timeframe needed for effective use (Oil Spill Intelligence Report, 1991).

Proponents of bioremediation indicate that it is potentially the least costly of cleanup techniques, particularly for soiled beaches. Its use on water, however, would appear to be limited except as a follow up to other actions. The major disadvantage of bioremediation is the long timeframe needed for effective use. On beaches where it could take 5-7 years for oil to break down under normal conditions, bioremediation with fertilizer could reduce that time to 2-5 years (Johnson et al., 1990).

A May 23, 1991 report, *Bioremediation for Marine Oil Spills*, released by the U.S. Congressional Office of Technology Assessment (OTA) stated that scientists are still evaluating the effectiveness of the use of bioremediation for marine oil spills (U.S. Congress OTA, 1991). The report concluded that recent research and field testing of bioremediation technologies on oiled beaches produced some encouraging if not altogether conclusive results. The report cited nutrient enhancement as the most promising use of bioremediation technology. The report also concluded that bioremediation has not proven to be an effective response to at sea oil spills.

e. Response Options for Handling Oiled Wildlife and Birds

Rehabilitation of oil-contaminated wildlife may be necessary to protect species that are endangered or of high aesthetic value. Successful programs are very labor intensive and have relied mostly on volunteer labor. Some of the studies that have been done regarding the effects of oil on marine mammals indicate that a few mammal species may rid themselves of oil by washing. Animals that groom themselves may ingest oil, which can result in mortality of the animal. Rehabilitation efforts may also stress certain animals, causing increased mortality and behavioral changes. Rehabilitation programs require extensive manpower to locate, capture, treat, and care for oiled wildlife. The success of such a program will be dependent upon the number of animals involved, the extent of oiling, the physiological condition of the animals, and the experience of the people undertaking the rehabilitation program (USDOL, MMS, 1987c).

Wildlife researchers are currently in disagreement about the effectiveness of Exxon's \$18 million otter rescue effort following the 1989 *Exxon Valdez* oil spill in Prince William Sound, Alaska. Some researchers question the value of such a research effort, particularly for lightly oiled otters, as prior research had shown that lightly oiled animals could recover without any treatment and that the stresses of capture, transportation, and cleaning itself may have been unnecessarily disruptive.

The current RCP for the Region VI Regional Response Team contains Annex 7, recognizes the importance of responding to contamination of waterfowl, and designates the FWS and names contacts for initiating bird collection and cleaning activities. The current RCP for the Region IV Regional Response Team contains no special Annex but lists the NPS and FWS as contacts for responding to potential impacts to sensitive resources, including bird rookeries, which are used at the time of an oil spill to determine where lines of response should be placed.

The Oil Pollution Act of 1990's revisions to the Federal Water Pollution Control Act require that a fish and wildlife response plan be developed, in consultation with the FWS, NOAA, and other interested parties (including State fish and wildlife conservation officials), for the immediate and effective protection, rescue, and rehabilitation of fish and wildlife resources or their habitats in the event of an accidental discharge. Consequently, some of the planning efforts currently identified in this section may change somewhat dependent upon the findings resulting from the development of these plans.

Deterrent methods and devices would need to be deployed along the shore in order to prevent birds from entering the contaminated water. Shell crackers, exploders, lights, reflectors, and mortars, together with continued use of aircraft, would be standard approaches. Distress and alarm calls would be useful if calls of the appropriate species existed and were available. The major limiting factors would be the logistical problems of deploying and operating a sufficient number of devices (Koski and Richardson, 1976).

Because of the less confined nature of coastlines and marshes, aircraft would probably be of most value for the initial dispersal of birds. If the section of coastline that was oiled or about to be oiled was extensive, use of aircraft would probably be the only practical dispersal method, and numerous aircraft would be necessary.

The most effective dispersal method offshore would probably be the use of aircraft. However, some species of seabirds are more likely to dive than to fly when an aircraft approaches, and some molting waterfowl would be unable to fly. Low-altitude (effective) operations would be impossible at night. Searchlights mounted on boats and mortars, rockets, flares, and shell crackers fired from boats would be useful at night, but their effectiveness in cases of large spills would be limited. Because of their large area of coverage, rockets and mortars would probably be more useful than shell crackers and flares both by day and by night. Clean Gulf Associates currently stockpiles a total of 10 sets of 12 bird scare guns strategically located at their bases in Port Aransas and Galveston, Texas; Intracoastal City, Venice, and Grand Isle, Louisiana; and Panama City, Florida. It is recommended that this equipment be manned continuously and that the guns be alternately turned on and off every hour in order that their use would remain effective in scaring birds from oiled areas. Approximately 90 of these bird scare guns were successfully used during the 1992 Greenhill spill, which affect East Timbalier Barrier Islands.

It is possible that creation of lure areas away from the contaminated area might attract birds out of the hazardous zone. The obvious approach would be to feed seabirds by throwing fish and other foods into the sea from a boat. However, it is quite probable that this would attract more birds into the general area of the oil spill and ultimately increase rather than decrease mortality. It is also possible that boats working in or near the spill for cleanup or even deterrent purposes might unintentionally attract seabirds, which commonly fly toward boats (Koski and Richardson, 1976).

The FWS has designated contacts in Clear Lake, Texas; Lafayette, Louisiana; Daphne, Alabama; and Panama City, Florida, who act as field coordinators for any waterfowl-rehabilitation actions. These coordinators can call upon the services of any local FWS office for assistance and equipment. The FWS also maintains a dedicated spill-response trailer in Daphne, Alabama, which contains equipment needed to prevent bird contamination or to care for oiled birds. This center serves the Gulf Coast region and can be relocated to a spill site upon demand. The FWS in Texas has an extensive oiled-bird rehabilitation program. Although, the CGA has a movable waterfowl rehabilitation station located in Grand Isle, Louisiana, it has been recognized that this equipment now needs updating. Therefore, CGA recently approved the purchase of a new trailer to stockpile with equipment necessary for successful oiled-bird rehabilitation. Approximately 350 gal of a recommended cleanser, enough to cleanse 1,000 birds, is currently stockpiled by CGA.

To care for 50, 100, and 500 birds in need of immediate treatment poses severe logistical and equipment challenges. To care for 100 birds over a single day would require three 8-hour shifts with an absolute minimum of 25 people per shift to provide medical care, wash teams, rinse teams, and facilities management. Cleaning teams would need 8,000 gal of hot water under pressure, and provision would have to be made for environmentally acceptable disposal of 5,000 gal of oily, soapy waste water. Compliance with OSHA requirements, human safety protocols, liability insurance, damage assessment protocols, and techniques for preventing animals from becoming contaminated would also need to be considered.

Survival of rehabilitated oiled birds may vary 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 stockpiling supplies and training 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). When the rehabilitation effort is managed by an experienced oil-spill response team, oiled bird rehabilitation has been carried out with particular success in *Anatidae* species, averaging over 90 percent release of ducks and geese.

f. Recent Developments in Spill-Response Planning/Capabilities

In light of all the recent tanker spills occurring in the U.S. coastal waters since the *Exxon Valdez* incident in March 1989, much effort has been expended from the national to the local level in assessing the adequacy

of the country's spill response planning and capabilities. As discussed throughout Section IV.C.5., the implementation of the Oil Pollution Act of 1990 has somewhat altered the country's existing oil-spill response planning structure and response capability. This section provides an update on some of the oil-spill response capability related developments enacted as a result of the aforementioned tanker spills, particularly those ongoing by the National Response Team (NRT), MMS, USCG, USEPA, and industry.

National Response Team

In May 1989, the National Response Team issued its Report to the President on the *Exxon Valdez* spill (Skinner and Reilly, 1989). Besides summarizing the status of the spill, the NRT identified actions that they felt should be taken to improve the nation's preparedness for spill response. They recommended a better response coordination between Federal, State, and local authorities, especially in regard to the concerns of States; that the National Contingency Plan needs to be changed; that oil spill planning should better incorporate the care of wildlife and should prepare for and mitigate for wildlife impacts; that exercises to test contingency plans should be conducted; and that more research should be conducted into improving cleanup technology. The NRT, under the leadership of the USCG, finalized a nationwide review of contingency plans by the entire Federal Government, including the 14 agencies that makeup the NRT and all of the U.S. Coast Guard's RRT. The review, which included a total of 75 reports from these various agencies, was directed toward examining the use of worst-case scenarios to ensure realistic planning, examining the adequacy of equipment and personnel for an effective response, and the importance of well-defined organizational responsibilities. The final report was published in October 1990.

Minerals Management Service

Executive Order (E.O.) 12777, which implemented the OPA on October, 18, 1991, delegated to the Secretary of the Interior Federal Water Pollution Control Act (FWPCA) authority over offshore facilities and associated pipelines (except deep-water ports) for all Federal and State waters. The Secretary's functions under the E.O. include spill prevention, OSCP's and equipment, and financial responsibility certification and civil penalties. The Secretary has, in turn, delegated these responsibilities to MMS.

The MMS currently enforces strict spill prevention and OSCP requirements for oil and gas production facilities on the Federal OCS under 30 CFR 250.42. These requirements will be upgraded to meet the "worst case" discharge provisions of OPA/FWPCA and expanded to cover offshore facilities and pipelines in both Federal and State waters. The MMS recently issued an Advanced Notice of Proposed Rulemaking to seek public and State comments on DOI responsibilities with respect to oil spill prevention and OSCP's. In order to meet the February 18, 1993, deadline, an interim rule will be forthcoming.

The OPA requires administration of a certification process to ensure that each responsible party (owner or operator) for an offshore facility and associated pipelines has established and maintained evidence of financial responsibility in the amount of at least \$150 million to meet potential pollution liability. The U.S. Coast Guard (USCG) was responsible in the past for certifying oil spill financial responsibility for OCS facilities pursuant to the OCS Lands Act. That function, with incumbent USCG personnel, has recently been transferred to MMS. The MMS is in the process of promulgating its own financial responsibility regulations under OPA for Federal and State waters. For the near term, MMS intends to enforce current USCG regulations and procedures.

Since April 18, 1989, MMS has conducted a stepped-up series of surprise visits by inspectors to OCS drilling rigs and production platforms. The MMS, Gulf of Mexico OCS Regional Office initiated the ongoing unannounced drill program in the summer of 1989.

On May 13, 1991, the MMS published in the Federal Register the Notice of Final Rule regarding changes in the methods by which MMS would assess civil penalties. This notice revised rules governing civil penalty assessment under section 24(b) of the OCSLA (43 U.S.C. 1350(b)) to implement revised authority for the Secretary of the Interior to assess civil penalties for failure to comply with regulations governing oil and gas and sulphur operations in the OCS. This action will enable MMS to assess a civil penalty without first providing notice and time for corrective action in cases where the failure constitutes or constituted a threat of

serious, irreparable, or immediate harm or damage to life, property, any mineral deposit, or the marine, coastal, or human environment.

The MMS also remains a lead agency in the continuing technology assessment and research to improve oil-spill response capabilities. The MMS has long been involved in oil-spill response research, although the program has been heightened somewhat in light of the recent large oil spills from tankers. Current research projects include the development of an airborne, laser-assisted fluorosensor; the development of improved strategies for gaining an improved understanding of the fate and behavior of spilled oil as it affects response strategies; the development of safe and environmentally acceptable strategies to burn spilled oil *in situ*; an evaluation of the effectiveness of different shoreline cleanup techniques and the environmental damage resulting from each of the techniques; the development of a prototype high-speed, water jet barrier boom; the development of realistic laboratory effectiveness test protocol for dispersants; testing of new oil-spill chemical agents that are nondispersants; the investigation of new chemical dispersant formulas that promise greater effectiveness; and the development of a portable oil analysis kit which was recently completed for responders.

In addition, as of April 27, 1990, the management of the Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT), located in Edison, New Jersey, was transferred to MMS for purposes of research to improve oil-spill response and capability. It was ceremonially reopened on July 22, 1992. The reactivation of this facility will allow the testing of the efficiency and effectiveness of response equipment and products against standard testing protocols.

U.S. Coast Guard

The OPA is the largest single legislative tasking that the USCG has ever received. The work required to implement the Act is extensive. The following discussion is limited to just a few of the many tasks assigned to the USCG through implementation of OPA. Required organizational actions included the establishment of two special staff elements to facilitate OPA implementation; a National Pollution Funds Center to develop and administer those parts of OPA dealing with financial responsibility and the Oil Spill Liability Trust Fund; and a separate multidisciplinary Headquarters staff to write implementing regulations and to oversee and coordinate the multiple studies and reports required by the Act.

The USCG also commissioned a third strike team at Fort Dix, New Jersey, on September 5, 1991. New equipment is being procured for the strike teams and full-response capability is expected by Spring 1993. The National Strike Force Coordination Center was also commissioned on September 3, 1991, in Elizabeth City, North Carolina. In addition, the USCG established District Response Groups consisting of all USCG personnel, vessels, and equipment assigned to the District as well as prepositioned response equipment that is strategically located within the District. In order to provide a ready supply of equipment necessary to combat a spill, the USCG has selected 19 sites nationwide for locating spill-response equipment. The criteria for this site selection included spill probability and environmental sensitivity. Equipment to be procured for these sites is discussed in Section IV.C.5.d.(1). The USCG is also procuring a small amount of additional equipment to be located at numerous other sites not located within proximity of the 19 selected equipment sites.

The USCG and USEPA are currently involved in the joint review of the revised National Contingency Plan for oil spills. Work also continues between USEPA and USCG to draft contingency plans for response areas. The USCG was delegated the responsibility of designating areas in the coastal zone for which area committees would be established. These areas were also designated as those requiring Area Contingency Plans. Similar mandates are given to USEPA for inland areas. The USCG is also in the process of developing final requirements for response plans for tank vessel and for certain oil-handling facilities. Because of the statutory deadline of February 18, 1993, for the submittal of tank vessel and facility response plans and because this final rule on the submittal of response plans has not been published, the USCG issued Navigation and Inspection Circulars Nos. 7-92 and 8-92 to provide guidance on the preparation and submission of these response plans.

Title VII of OPA establishes an Interagency Coordinating Committee on Oil Pollution Research charged with coordinating a comprehensive program of research, technology development, and technology demonstration among Federal agencies in cooperation with industry, universities, research institutions, State governments, and other countries. The Committee is chaired by the Department of Transportation (USCG). In addition to establishing the Interagency Committee, the Act addresses specific Federal activities including

development of a Federal Oil Pollution Research and Development (R&D) Plan outlining a comprehensive five-year effort to upgrade technology for oil spill prevention and response, a program to study the effects of specific oil spills to be monitored by the Department of Commerce and USEPA, demonstration projects in specific port areas to be conducted by the USCG in coordination with other agencies (New Orleans has been selected as the site of one of these demonstration projects), and a regional grants program addressing regional aspects of oil pollution such as prevention, removal, mitigation, and the effects of discharged oil on regional environments. Presently, there are 19 member agencies and 4 ex-officio member agencies participating on the Committee and involved in preparing the Interagency Oil Spill R&D Plan. The Committee has completed the Comprehensive 5-Year Oil Pollution R&D Plan.

Some of the significant research efforts underway include (1) a major joint effort between USCG and NOAA to develop an integrated, prototype Decision Support System for oil-spill response that will provide OSC's and SSC's with detailed maps of specific areas showing attributes relevant to managing spill-response operations, and databases with accurate and accessible technical information for spill response; (2) a study that focuses on the short-term upgrade of its oil-spill surveillance capability; (3) a study that focuses on a longer term upgrade within USCG's multi-mission remote-sensing surveillance system; (4) participation in the project to develop an oil-spill thickness sensor; (5) testing at the OHMSETT facility in Leonardo, New Jersey; (6) participation in a joint project with the U.S. Navy to streamline the current oil-spill recovery process by developing technologies to separate oil from water and provide for temporary storage of recovered oil and debris and to test and improve vessel-of-opportunity skimming systems; and (7) participation in the ongoing *in-situ* burn work.

U.S. Environmental Protection Agency

As implementation of OPA continues, the oil-spill response program at USEPA is expected to expand to meet its increased responsibilities. The OPA mandated that the NCP be revised to address a number of new issues, including area contingency planning and response procedures for "worst case discharges" and "substantial threats to health or welfare." The Act also added the requirement that spill mitigating devices and substances be addressed in the NCP Product Schedule where appropriate. The Product Schedule is currently a list of dispersants and other chemicals that may be used in spill mitigation. The USEPA has formed workgroups to address revisions to the NCP in general and to the Product Schedule specifically. In addition, USEPA is reconsidering the current toxicity and effectiveness tests for dispersants under Subpart J of the NCP and has proposed effectiveness criteria for products on the Product Schedule, which may reduce the number of products on the Schedule.

Activities underway to recognize the environmental significance of preventing oil spills include providing the funding to implement the programs already in place, coordinating with agencies and departments responsible for other aspects of oil pollution, promulgating additional regulations, issuing guidance, and conducting training. Currently, regulations mandated by OPA are being developed. The USEPA intends to develop a set of factors to determine which onshore fixed facilities must submit plans.

In the area of bioremediation, USEPA is undertaking a major R&D program to assess and improve this technology. This includes continuing post *Exxon Valdez* bioremediation research and development of a bioremediation use and monitoring protocol for application of bioremediation agents on subsequent spills. The USEPA has developed interim guidelines to help response officials consider bioremediation in their oil spill contingency plans. The guidelines are offered as a way for spill responders to collect necessary information on bioremediation to use in their contingency plan.

The USEPA is also developing a series of testing protocols to identify safe, effective, and efficient bioremediation techniques to clean up oil spills. The agency is putting together a database of available bioremediation technologies for use by spill responders to match a specific product with a specific spill. To support more extensive test and evaluation of bioremediation products, USEPA is developing a three-tiered protocol including initial vendor tests, more extensive laboratory effectiveness and toxicity tests, and microcosm tests. The establishment of an USEPA bioremediation testing center is also being considered.

*Industry**National Response Corporation*

The National Response Corporation is a for-profit corporation designed to provide a single source of trained personnel and specialized equipment for responding to marine oil spills in accordance with Federal and State oil pollution regulations. The National Response Corporation will enter into retainer agreements to provide spill response resources to those companies required to submit oil-spill contingency plans to Federal and State agencies.

The response strategy of the National Response Corporation is based upon managing the coordination of a network of contractors referred to as the Independent Contractor Network (ICN). The ICN consists of contractors that possess local knowledge and experience from areas throughout the Midwest, the East Coast, and the Gulf of Mexico and have been pre-qualified by the National Response Corporation. Twelve ICN contractors are located in Texas and Louisiana.

The National Response Corporation is investing in capital equipment such as high capacity oil skimmers totalling over 277,000 de-rated barrels per day (BPD) skimming capacity, over 60,000 m of containment boom, shallow water deployment craft, deep and shallow water temporary storage barges, and other related, capital-intensive equipment that the National Response Corporation deems necessary to augment the capabilities of the contractors in its ICN. A key element of the overall strategy is that the equipment acquired by National Response Corporation will be placed into the hands of the ICN contractors to store, maintain, deploy, and operate. Each of the ICN contractors will receive payments for and on behalf of the National Response Corporation. Furthermore, they will be allowed to use the National Response Corporation-owned equipment in their daily operations. Although ICN contractors will be allowed to use National Response Corporation resources in a spill response, they will not be able to specifically identify National Response Corporation-owned resources in spill response plans for non-National Response Corporation clients.

For its offshore response capability, the National Response Corporation will utilize existing offshore supply vessels, which will continue to engage in commercial activities when possible. The first of 12 planned vessels, the *M/V Seacor Osprey*, has been converted. The Osprey features two high capacity oil skimmers which provide 6,000 BPD of recovery, 762 m of 1.1-m (42-in) containment boom on the vessel's boom storage reel, 190,764 liters of on-board storage, an Inmarsat Satellite communications system, a computerized vessel management system, a 9,000-kg (10-ton) crane, boom deployment boat, and other support equipment. The Osprey will be used to transport supplies and materials to oil production platforms located in the West Delta Area off Southwest Pass at the mouth of the Mississippi River. The nature of the work that the Osprey will routinely perform will enable it to be released immediately in the event of an incident requiring its services as an oil-spill response vessel.

The National Response Corporation has also entered into a Letter of Intent to convert a lightering-assist supply vessel in the Galveston lightering area for use as an oil-spill response vessel. In addition, the National Response Corporation will also use dedicated response barges for the temporary storage of recovered oil. These barges will also be fitted with containment and recovery equipment. They will be strategically placed in ports on the Gulf Coast and East Coast to enable skimming operations to be carried out without the delays associated with the lack of temporary storage capacity.

Marine Spill Response Corporation

The Marine Spill Response Corporation (MSRC) is an independent, privately financed, nonprofit catastrophic oil-spill response organization in the U.S. Membership in MSRC is now also open to independent tanker operators, public utilities, or any company that handles petroleum or petroleum products in quantity over coastal waters. The MSRC is now in the process of activation and expects to be fully operational by August 1993.

The MSRC will be able to respond to large spills in offshore and tidal waters along the Pacific, Atlantic, and Gulf coasts, plus Hawaii, the U.S. Virgin Islands, and Puerto Rico. The MSRC will be available to help with smaller spills whenever the USCG determines that local response capabilities are inadequate. The

organization will augment, not replace, existing local spill co-ops and response coordinators. A separate nonaffiliated corporation, the Marine Preservation Association (MPA), will fund the MSRC. The MPA, whose membership will include owners, shippers, and receivers of crude oil and petroleum products, will not have any direction over MSRC operations.

The MSRC is headquartered in Washington D.C. with five regional centers each capable of responding to a 9-million-gallon oil spill. Each regional center will have four to six prestaging areas where responders will warehouse equipment and, in some instances, vessels and response personnel. The five general areas for response centers and their prestaging areas include (1) northeast region, with a response center in the New York/New Jersey metropolitan area; (2) southeast region, with a response center in Port Everglades, Florida; (3) Gulf region, with a response center in Lake Charles, Louisiana; (4) southwest region, with a response center in the Port Hueneme area of Southern California; and (5) northwest region, with a response center in Seattle, Washington. The prestaging areas in the Gulf region include Mobile, Alabama; Venice, Louisiana; Galveston, Texas; and Corpus Christi, Texas. The MSRC will employ a full-time staff of 400 employees and will require more than \$315 million worth of initial equipment, including booms, skimmers, vessels, trucks, dispersants, and wildlife rehabilitation and shoreline restoration tools.

The MSRC has purchased more than \$216 million worth of vessels and equipment. Sixteen 64-m offshore response vessels will be available. The vessels will be deployed around the U.S. and will be similar in design to standard offshore supply boats with deck space to deploy a full range of spill-response equipment. The MSRC has purchased 16 over-the-side high capacity skimmers and 16 boom containment systems designed to accumulate large quantities of oil in a V-shaped pocket to facilitate recovery. This equipment will be installed on each of the 16 response vessels. The over-the-side skimmers are reported to have a manufacturer's advertised removal capacity of up to 2,200 bbl/hr. Also to be purchased are 10 wier boom skimming systems and two heavy oil recovery skimmers that are transportable systems which can be deployed on a variety of platforms. A total of 10 viscous oil transfer pumps, 7 high capacity transfer pumps, 30 vacuum skimmers which have particular application in shallow water and for shoreline cleanup, and 20 mi of intertidal boom is also being procured.

The MSRC is developing a computer assisted spill management system, which will make a major improvement in the way large spills are fought in the future. Such system elements as spill tracking, resources at risk, and logistics are some of the kinds of information that will be available, on a real time basis, to regional general managers and the government OSC to facilitate decision making on-scene.

The organization will also provide a program to audit on a continuing basis, the readiness of the response forces to meet their objectives; and an active research and development program. The research and development program objectives are to improve the basic information about spills and the technology of oil-spill response and cleanup. Research programs will be funded to study chemical and biological effects of spilled oil on the environment, techniques for on-water recovery and treatment, and the prevention and mitigation of shoreline impacts. Patents or royalties will be donated to the public domain.

The MSRC successfully carried out field tests evaluating various remote airborne sensing devices. This is part of a larger project the MSRC is aggressively pursuing to develop an integrated remote sensing and imaging processing system. The goal is to provide the oil spill responder the ability to see oil on the sea under adverse conditions not currently possible.

Appendix F

Recent Mitigating Measures

U.S. DEPARTMENT OF THE INTERIOR
MINERALS MANAGEMENT SERVICE
GULF OF MEXICO OCS REGION

No. 88- 11

Effective: February 1, 1989

NOTICE TO LESSEES AND OPERATORS OF FEDERAL OIL AND GAS LEASES
IN THE OUTER CONTINENTAL SHELF
GULF OF MEXICO OCS REGION

Implementation of Measures to Detect and Protect Deepwater Chemosynthetic Communities.

A. Introduction and Background

Deepwater (greater than 400 m) chemosynthetic organisms have recently been discovered in the Gulf of Mexico (GOM). Chemosynthetic communities are assemblages of tubeworms, clams, mussels, bacteria mats, and other associated organisms. Many of the species, while similar to those of other deepwater areas, including the vent communities of the Galapagos Ridge, are new to science. While generally widespread and in low densities, there are examples of very high densities of the organisms in apparently very small, isolated areas. These areas of high-density communities are apparently associated with hydrocarbon seeps, vents or gaseous sediments. Oil and gas activities, which disturb the seafloor where such dense communities are located, will cause damage to any of these communities with which they come into contact. Such activities would include (but not be limited to) anchoring, placement of seafloor templates, and installation of pipelines.

Regulatory authority to require avoidance or protection of chemosynthetic communities and avoidance of shallow hazards, such as vents or gaseous sediments, appear at several places in 30 CFR 250. General provisions concerning protection of fish and other aquatic life are at 30 CFR 250.5(a) and 30 CFR 250.20(a). Specific provisions concerning sea bottom hazards at particular sites are at 30 CFR 250.33(b)(1)(ix) for exploration plans, 30 CFR 250.34(b)(1)(vii) for development and production plans, and 30 CFR 250.139(b)(2) for foundations.

Detailed data regarding the extent, location, structure, and relationship of these communities to the local geophysical environment are at present unavailable. Currently, operators in water depths greater than 400 m are required to provide certain data in order for Minerals Management Service (MMS) to make determinations regarding the possibility of chemosynthetic communities being present and the potential of their being harmed by exploration and development activities. These requirements were previously imposed on a case-by-case basis, however these requirements are now included in a letter to lessees dated October 12, 1988, which specifies information required for Plans of Exploration (POEs) and Development Operations Coordination Documents (DOCDs) for oil and gas leases in the GOM OCS Region.

B. Purpose and Scope

It is the purpose of this Notice To Lessees and Operators (NTL) to inform all operators of leases in water depths greater than 400 m of the requirements currently being imposed by MMS and to provide a consistent and comprehensive approach which will avoid damage to high-density chemosynthetic communities. The requirement of Part C below shall apply to all operations of GOM leases in water depths greater than 400 m and shall remain in effect until superseded.

C. Implementation

1. Beginning February 1, 1989, owners and operators of leases on blocks in water depths of 400 m or deeper in the GOM shall comply with the following:
 - a. Prior to approvals of Applications for Permit to Drill (APDs) and Pipeline Applications, the operators shall delineate all seafloor areas which would be disturbed by the proposed operations. Additionally, an analysis of geophysical information for these areas, as well as any other pertinent information available, shall be furnished which discusses the possibility of disturbing geological phenomena (such as hydrocarbon charged sediments, seismic wipe-out zones, anomalous mounds or knolls, gas vents, or oil seeps) that could support chemosynthetic organisms.
 - b. If the subsequent review by MMS of the analysis required by 1.a. above results in a determination that high-density chemosynthetic communities may be present and could potentially be harmed by the proposed activities, the operator will be required to:
 - (1) modify the application to relocate the proposed operations to avoid impacting possible chemosynthetic communities; or
 - (2) modify the application to provide additional information (perhaps including a photo-survey, a video-survey, or already available information) which documents whether high density chemosynthetic communities exist in the areas of concern; or
 - (3) adhere to certain conditions of plan or application approval, such as use of a remotely operated vehicle to precisely set anchors, or to ensure that the proposed anchor pattern does not impact chemosynthetic communities, to monitor impacts caused by the proposed work, or any other condition deemed necessary by the Regional Director.

2. The requirements of this section may be revised as new information is received.

D. Intent

The provisions of this NTL are intended to provide clarification, description, or interpretation of requirements contained in OCS operating regulations and lease stipulations. This NTL does not impose additional requirements.

Regional Director
Gulf of Mexico OCS Region
Minerals Management Service

DEC 29 1988

Date

Approved:

Associate Director for
Offshore Minerals Management
Minerals Management Service

12/19/88
Date

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

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.

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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.

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The provisions of this NTL shall become effective as of
February 17, 1992.

J. Rogers Percy
Regional Director

Enclosures

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. 2STANDARDS FOR ARCHAEOLOGICAL RESOURCE REPORTSI. 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 for each type 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 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. If relict channel features are referenced in the text of the archaeological report, representative copies of the subbottom profiler record of these geologic features shall 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

F-27

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

F-28

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.

UNITED STATES DEPARTMENT OF THE INTERIOR
MINERALS MANAGEMENT SERVICE
GULF OF MEXICO OCS REGION

F-29

NTL No. 92-02

NOTICE TO LESSEES AND OPERATORS OF FEDERAL OIL AND GAS LEASES ON THE
OUTER CONTINENTAL SHELF, GULF OF MEXICO OCS REGION

Minimum Interim Requirements for Site Clearance (and Verification) of
Abandoned Oil and Gas Structures in the Gulf of Mexico

This Notice to Lessees and Operators (NTL) supersedes NTL 90-03 and is provided pursuant to the authority prescribed in 30 CFR 250.4(b). In accordance with the provisions of 30 CFR 250.5(a), 250.112(i), 250.114, 250.143(a), (b), and (c), and Section 22 of the Lease Agreement which pertains to removal of property on termination of the lease, the Minerals Management Service (MMS) has established a program designed to ensure that any object (i.e., 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.

Based on knowledge gained from the application of NTL's 90-01 and 90-03 over the past two years, the site clearance committee recommended changes which would produce adequate, reasonable, and workable MMS Regulations regarding site clearance operations. Such Regulations are presently being formulated and, during the interim, this NTL has been developed based on the recommendations. It shall remain in effect from the date of issue until revoked, modified, or superseded by revised Regulations.

1. Paragraphs 250.112(i) and 250.143(b) of the Regulations require all abandoned well and platform locations to be cleared of all obstructions present as a result of oil and gas activities. For clearance purposes, the locations shall be as defined below:

a. Exploratory or delineation wells drilled with a Mobile Offshore Drilling Unit (MODU) - The area covered by a 300-foot radius circle centered on the well.

b. Platforms - The area covered by a 1,320-foot radius circle centered on the platform geometric center.

c. Single well caissons and well protectors - The area covered by a 600-foot radius circle centered on the well.

2. A procedural plan for site clearance verification of platform or structure abandonments (paragraphs 1.b. and c.) shall be developed by the lessee and submitted to the MMS Regional Supervisor, Field Operations, for approval with the permit application for platform or structure removal. For well abandonments (paragraph 1.a.), a similar plan shall be submitted to the District Supervisor for approval when submitting the Sundry Notice for well abandonment. As a minimum, site clearance shall be verified by the applicable method listed in paragraph 2.a. Vessels used for site clearance verification operations shall be equipped with a navigational positioning system capable of providing position accuracy of ± 30 feet. The navigational system proposed for use must be identified in the procedural plan.

a. Sites defined in paragraphs 1.b. and c. above and located in water depths less than 300 feet shall have their locations trawled over 100 percent of their limits in two directions (i.e., N-S and E-W) by a trawling contractor who has no corporate or other financial ties to the company that performed the salvage work. Sites defined in paragraph 1.a. above need not be trawled, but shall have a high frequency (≥ 500 KHz) sonar search conducted over the defined area, and the sonar instrument operating frequency scanning range and deployment method (stationary or towed) must be stated in the procedural plan submitted for approval.

(1) Trawling contractors performing site clearance verification work shall possess a valid commercial trawling license from one of the States of Louisiana, Texas, Mississippi, Alabama, or Florida, for both the vessel and its captain. Further, the captain must have prior experience in trawling operations.

(2) The trawling vessel used in verification activities must be equipped with a calibrated navigation system capable of producing a real-time paper track plot of the vessel position or capable of producing a hard copy post plot on board the vessel of all or any specific lines in order to verify that the area has been satisfactorily covered prior to departure of the trawling vessel. The track of the vessel on the plot must be shown as a continuous line and the track plot must have a minimum scale of 1 inch = 400 feet (1:4800).

(3) The trawling vessel must be outfitted with trawling nets that are representative of the accepted shrimping industry standard of up to No. 18 twine (ribbon strength) size net strength. These nets shall not be equipped with Turtle Excluder Devices (TED's), since they may serve as escape openings for objects picked up by the trawl. Trawls are to be picked up after a maximum drag time of 30 minutes and all shrimp caught in the trawl are to be released. The Eighth Coast Guard District Law Enforcement Branch should be notified of any site clearance verification trawling operations (where TED's are not used) 48 hours prior to commencing such activities.

Further, when trawling in areas where pipelines, shipwrecks, or hangs (i.e., fisherman's contingency fund hangs) are known to exist, the following guidelines are applicable:

(a) There are no restrictions to be placed on the trawling procedure or pattern for abandoned pipelines. It is the responsibility of the lessee (or operator) performing the site clearance verification activities to contact the former pipeline owner (or operator) and determine whether or not the pipeline will cause an obstruction to unrestricted trawling operations.

(b) In general, trawling should not be conducted closer than 300 feet to any existing shipwreck, but this distance may be reduced depending on the conditions existing at a particular site.

(c) Active pipelines which are buried, and for which no obstructions (such as valves) exist above the mudline, are to be trawled without any restrictions placed on the trawling procedure or pattern. It is the responsibility of the lessee (or operator) performing the site clearance verification activities to contact the pipeline owner (or

operator) and determine the condition of the pipelines within the area to be trawled.

(d) For unburied active pipelines which are eight inches in diameter or larger, and for unburied smaller diameter pipelines which have obstructions (e.g., valves) present, trawling shall be conducted no closer than 100 feet to either side and in the same direction as (parallel to) the pipeline. Trawling shall not be conducted across the pipeline.

(e) For unburied active pipelines which are smaller than eight inches in diameter and have no obstructions present, trawling is to be conducted parallel to the direction of the pipeline and trawling on top of the pipeline is acceptable. Trawling shall not be carried out across the pipeline.

(f) The MMS recommends that the operator or trawling contractor contact the MMS "Fisherman's Contingency Fund Hangs Data Base" to see if any recorded hangs are located within the area to be trawled.

(4) Trawling grid patterns shall be as follows for the trawling equipment specified:

(a) 40-foot grid pattern for vessels trawling with two 50 to 65-foot nets or four 30-foot nets.

(b) 60-foot grid pattern for vessels trawling with two 66 to 80-foot nets or four 31 to 40-foot nets.

(c) 80-foot grid pattern for vessels trawling with two 81-foot or larger nets or four 41-foot or larger nets.

b. Any modification of the trawling requirements at a site must be approved by the Regional Supervisor, Field Operations. All oil and gas related objects encountered by the trawl shall be removed from the seabed and reported as specified below unless otherwise approved by the Regional Supervisor, Field Operations. Any snag on a grid line that is not recovered by the trawl must be removed and the line retrawled. For those cases where the trawling effort is interrupted for any reason and then resumed, specification of the necessary overlap of areas trawled (or to be trawled) to ensure 100 percent coverage of the location shall be at the discretion of the trawling contractor.

c. For a well site (paragraph 1.a.), the lessee shall notify the District Supervisor at least 48 hours prior to conducting the clearance survey. For a caisson or platform site (paragraph 1.b. or c.), the Regional Supervisor, Field Operations, must receive at least a 48-hour prior notice.

3. Within 60 days after completion of a platform or structure removal/abandonment operation, or as otherwise approved by the Regional Supervisor, Field Operations, site clearance verification shall be completed as specified in the approved plan. Until site clearance verification procedures have been completed, the location shall be marked as a hazard to navigation in accordance with U.S. Coast Guard regulations unless otherwise approved by the

Regional Supervisor, Field Operations. Verification letters from the trawling contractor shall be submitted with the subsequent Sundry Notices and Reports on Wells, Form MMS 9-331, or report of platform or structure removal and, as appropriate, shall include the following:

a. The date(s) the work was performed and vessel involved.

b. A statement from the trawling contractor that no objects were recovered, or categorical descriptions and estimated size, quantity, volume, and general location of the objects which were recovered in each category during the trawling activities. The trawler must note the contents of the nets on each trawling pass. However, objects weighing less than 40 pounds and which are of such a shape or configuration that they are unlikely to snag or damage shrimping or fishing devices need not be recorded. Categories of recovered debris to be reported include, but are not limited to, the following:

(1) pipe	(4) structural shapes	(7) long wire rope
(2) grating	(5) large tires	(8) large hoses
(3) plate	(6) batteries	

Additionally, items recovered from diver-assisted snag removals as well as instances of torn nets shall be recorded as described above.

c. Details and results of the trawling operations, i.e., post-trawling job plot or map showing (minimum scale 1"=200') the pattern in which the trawl was pulled, the size and description of the trawl, grid line numbers corresponding to those used in the trawler's report, center location latitude and longitude, the positioning system and calibration method(s) used, and any interruptions experienced during the survey.

d. A letter signed by an authorized lessee/operator company representative stating that he/she witnessed the verification trawling survey shall also be submitted with Form MMS 9-331 or report of platform or structure removal.

e. All reports, forms, and letters shall be submitted to the MMS no later than 30 days following completion of site clearance verification activities.

Regional Director
Gulf of Mexico OCS Region
Minerals Management Service

Date

Appendix G

**U.S. Environmental Protection Agency
Cooperating Agency Agreement**

Environmental Impact Statement (EIS)**COOPERATING AGENCY AGREEMENT**

between

The Mineral Management Services (MMS)
The Lead Agency

and

The U.S. Environmental Protection Agency (EPA)
Regions 4 and 6
The Cooperating Agency

INTRODUCTION

This agreement outlines the responsibilities agreed to by the above two Federal agencies with respect to the preparation of both the Draft and Final Environmental Impact Statements (EIS) for the proposed Central and Western Gulf of Mexico Outer Continental Shelf (OCS) Oil and Gas Lease Sales 147 and 150.

The Minerals Management Service (MMS) has initiated an EIS to determine the environmental impacts of the proposed lease sales. The proposed action is to allow for the development of economically recoverable oil and gas resources production in parcels to the public or private sector. The Secretary of the Interior oversees the OCS oil and gas program and is required to balance orderly resource development with protection of the human, marine, and coastal environments while simultaneously ensuring that the public receives an equitable return for these resources and that free-market competition is maintained. The oil and gas resources estimated to be leased and developed for the proposed lease sales are the basis for environmental analyses of resources that may be impacted by the proposed action.

The U.S. Environmental Protection Agency (EPA) has the authority under The Clean Water Act (CWA) Section 402 to issue National Pollutant Discharge Elimination System (NPDES) permits to regulate discharges to waters of the United States. EPA Regions 4 and 6 are presently developing new source NPDES general permits for effluent discharges from oil and gas operations in the OCS. Sections 403, 306 and 511(c) of the CWA require that NPDES permits for discharges to the territorial seas, the contiguous zone, and the ocean be issued in compliance with EPA regulations for preventing unreasonable degradation of the receiving waters, and with the Council on Environmental Quality (CEQ) regulations for implementing the National Environmental Policy Act (NEPA).

Section 1501.6 of the above mentioned CEQ Regulations, emphasizes agency cooperation in the NEPA process for any Federal agency which has jurisdiction by law. In addition, a March 31, 1984 Memorandum of Understanding (MOU) between EPA and the Department of Interior, outlines provisions for the coordination of NPDES permits issuance with OCS lease offerings and NEPA responsibilities.

EPA RESPONSIBILITIES

1. EPA will participate, as resources will allow, in the scoping and public meeting process and will consult with the lead agency as appropriate so that the discussions are consistent with the planned alternatives.
2. The comments EPA provides to the MMS will be advisory.
3. EPA will not be responsible for preparation of any portion of the Environmental Impact Statement or other related reports unless those sections pertain to the issuance of National Pollutant Discharge Elimination System (NPDES) general permits to new sources (Section 306 of the Clean Water Act) and the compliance of the CWA Section 403(c) Ocean Discharge Criteria.
4. EPA will comply during their participation in the review and comment of all materials, with the EIS preparation schedule outlined by the MMS.
5. This agreement will appear in all documents in which the EPA is designated as a cooperating agency.

LEAD AGENCY RESPONSIBILITIES

1. The lead agency will forward to EPA a summary of all comments received during the preparation of the documents including those arising out of the scoping process, public meetings, and circulation of the EIS's.
2. The lead agency will solicit the EPA for their views and input on regulatory and/or significant environmental issues associated with the proposed actions.
3. The lead agency will consult with EPA but will retain sole responsibility for determination of which alternative is selected and what mitigation will be included in the project.
4. The lead agency acknowledges that EPA will conduct an official Section 309 Review on all appropriate sections of the Draft and Final EIS's. The agreement does not affect EPA's independent responsibilities under Section 309 of the Clean Air Act.

5. EPA will be given preliminary copies of both the Draft and Final EIS's for review prior to final lead agency approval and distribution of the documents.
6. A statement that describes the extent of EPA's role as a cooperating agency will be placed in the introduction section of the EIS.
7. This agreement is terminated when the lead agency Record of Decision is signed or when written notice is given by either agency.

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

Dated: February 1, 1993

Joe D. Winkle
Acting Regional Administrator
The Environmental Protection Agency
Region 6

Dated: 3-1-93

Patrick M. Tobin
Acting Regional Administrator
The Environmental Protection Agency
Region 4

Dated: February 12, 1993

Appendix H

Coastal Zone Management Plans and Land Use

Coastal management policies apply to Sales 147 and 150 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 Sales 147 and 150 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 Sections IV.A. and IV.B.

(1) Alabama

The sale analysis area closest to the submerged lands of the State of Alabama is Central coastal Subarea LA-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 147, 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.B., 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).

Section 8(g) of the OCS Lands Act Amendments of 1978 requires a distribution of revenues between the Federal government and a coastal State for Federal lease blocks within 3 mi of the seaward boundary of the State that may contain oil and gas pools underlying both OCS and State lands. 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. 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 et al., 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 Proposed Action and Alternatives 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 147 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.

The presence of offshore platforms causes space-use conflicts. However, the extent of trawl space lost to fisheries is expected to be less than 0.1 percent in the Gulf. 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 (Section II.A.1.c.) 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. 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.B., 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 shoreline erosion 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. 1.A.6., ACAMP).

As indicated in Section IV.B., 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(c) 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 requiring the operator 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. 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. 1.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. Existing transportation corridors would facilitate specific lease projects, but their existence or continued maintenance would not be dependent on project-related vessel movements.

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. The State of Alabama expressed support for future transportation of natural gas produced from OCS tracts off the coast of Alabama in southern Mobile County, Alabama (Response to Proposed Notice of Central Gulf Sale 142, dated June 11, 1992). 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 a 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.

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).

Water quality in Alabama's coastal and nearshore areas may be altered by a number of OCS-related activities resulting from proposed Sale 147 dependent on the extent of OCS operations occurring either off the coast of Alabama or within the State's coastal zone. As will be shown, projected activity is not sufficient to result in any changes in water quality characteristics, except for minor, localized, very short-term changes.

Activities that could result in impacts include onshore support facility operations, support vessel traffic, channel construction and maintenance dredging, pipeline emplacements, and onshore disposal of OCS-generated oil-field wastes. Disturbances of the physical surroundings and resultant runoff occurring from the construction and presence of onshore facilities can result in water quality degradation. The operation of onshore facilities may also impact coastal water quality by routine discharges and accidental spills. Furthermore, spills occurring offshore and reaching coastal waters can affect water quality conditions. Vessel usage of coastal waters may degrade water quality from bilge and ballast water discharges, discharges of treated sanitary and domestic wastes, vessel erosion of channel banks, trash and debris loss, and spills. Indirectly, vessel usage degrades water quality when the channels used must be maintenance dredged or new channels are built to reach support bases. Spills are most likely to occur in connection with the offloading and onloading of crude from shuttle tankers and barges and from fueling activities associated with service boat support.

No onshore support infrastructure is expected to be built solely in support of Sale 147 operations. There is new infrastructure projected in Alabama in the future, but this infrastructure will be built to support operations offshore resulting from a number of lease sales (Table IV-14). The existing infrastructure in the Mississippi/Alabama area that might be used for Sale 147 operations includes two refineries, three platform yards, four service bases (three in Alabama), three navigation channels, and one helicopter hub. The service bases in Alabama expected to be used are located in Bayou LaBatre, Mobile, and Theodore. There are

presently two pipeline landfalls and 179 km of onshore pipeline carrying OCS-generated gas; two new pipeline landfalls are projected, one oil and one gas (Table IV-14).

No oil from offshore Sale 147 leases is projected to come ashore in Alabama (Table IV-13). There will be 190 vessel trips to the service bases in Alabama and 4500 helicopters to all bases in Mississippi/Alabama. There is one transfer station for receipt of OCS-generated oil-field waste that is located in Alabama. A few of the 190 vessel trips will take drilling muds and cuttings and production solids to this transfer station to be loaded on a barge and transported to Texas for processing.

About 63,000 liters of bilge waters are expected to be discharged from service vessels into coastal waters of Alabama and Mississippi during the 220 vessel trips projected (Tables IV-13 and IV-18). This is about an average of 5 liters a day. The vast majority of this discharge will be to Mobile Bay (about 4.5 liters per day). This quantity of discharge is not expected to result in any significant changes in the water quality of the Bay.

No onshore spills are projected to occur, and no offshore spills are projected to reach coastal waters as a result of Sale 147.

The proportion of expected future water quality degradation associated with discharges from the use of onshore support facilities for Sale 147 operations would be very small and can be approximated by an examination of the number of vessel trips expected to enter Alabama. It is estimated that during the 35-year time period, 190 of the 8,400 service-vessel trips will be to bases in Alabama. This is 2 percent of the vessel traffic related to Sale 147 and only 0.07 percent of the total vessel traffic expected to occur in the future in support of all OCS operations.

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).

Typical operations for drilling an offshore well in the Gulf of Mexico use only seawater to about 1,000 ft, a seawater gel mud to about 6,000 ft, and convert to a freshwater lignosulfonate mud at greater depths. 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. Additionally, no new service bases are likely to be constructed in Alabama (Base Case).

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.

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).

The OCSLA (43 U.S.C. 1334(a)(8)) requires the Secretary of the Interior to promulgate and administer regulations that comply with the National Ambient Air Quality Standards (NAAQS) pursuant to the Clean Air Act (42 U.S.C. 7401 et seq.) and to the extent that authorized activities significantly affect the air quality of any State. Under provisions of the Clean Air Act Amendments of 1990, sources located in areas under MMS

jurisdiction regulations (which includes the State of Alabama west of 87°31' W. longitude) are promulgated by 30 CFR 250.44, 250.45, and 250.46 as a postsale activity. It is the intent of these regulations to protect onshore ambient air quality and to ensure that no new violations of NAAQS occur from OCS activities. The regulated pollutants include carbon monoxide, suspended particulates, sulphur dioxide, nitrogen oxides, and volatile organic compounds. In areas where hydrogen sulfide may be present, operations are regulated by 30 CFR 250.67. Emissions data concerning new or modified onshore facilities (directly associated with offshore activities) are required to enable each affected State to make a determination of the effects on its air quality.

Exploration plans (EP's) and Development Operations Coordination Document (DOCD's) address OCS activities that are determined by the Secretary as activities regulated under 30 CFR 250.44, 250.45, and 250.46. All new or supplemental EP's and DOCD's submitted on or after June 2, 1980, must include air emissions information sufficient to make an air quality determination. The Letter to Lessees dated October 12, 1988, outlines air emissions data that must be submitted by operators to MMS. The Clean Air Act Amendments of 1990 also require that MMS conduct and complete a study of the effects of offshore air emissions in nonattainment onshore areas within three years after the approval of the amendments in OCS areas not under USEPA jurisdiction. Based on the results of this study, the Secretary must consult with the USEPA Administrator and determine if any further actions are necessary.

On August 17, 1992, MMS issued NTL 92-06, with the purpose of establishing and clarifying 30 CFR 250.175 (relates to burning and flaring activities in the Gulf of Mexico). The NTL requires prior approval from the Regional Supervisor for unloading, cleaning, and testing operations that may exceed 48 cumulative hours in a single zone.

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.

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 3 of this Appendix (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. Deliberate disposal of any solid waste or garbage items anywhere in the marine environment is strictly prohibited under existing regulations (DOI-30 CFR 250; USEPA-40 CFR 435; and USCG-33 CFR 151). Because of increased concern with the prevalence and effects of persistent marine debris both offshore and on coastal beaches, in 1986, MMS issued a special advisory (NTL 86-11) strongly encouraging industry to take special educational, operational, and awareness measures that are designed to reduce or eliminate the oil and gas industry's contributions to marine debris in the Gulf. (See Appendix E for the text of NTL 86-11.) The MARPOL Protocol prohibits the dumping of all plastic wastes, including plastic packaging materials and fishing gear, from all ships at sea.

The Gulf Regional Technical Working Group (RTWG), which is a DOI advisory committee, develops transportation plans for OCS areas. The State of Alabama is represented on the Gulf RTWG. One of the purposes of this coordinated planning effort is to establish corridors for consolidating multiple pipelines. These and other RTWG efforts help to ensure effective coordination on postlease pipeline-related activities. 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.1.a.(1), potential effects of activities on these offshore leases to coastal habitats are projected to be low. According to the Base Case scenario, no new service bases are expected to be located in coastal Subarea MA-1, which includes portions of Alabama's coastal zone. In addition, no new pipeline landfalls or onshore pipeline projects are anticipated in Alabama as the result of activities on Sale 147 leases, and the chance of an oil spill reaching the coast of Alabama is remote. Terms and conditions adopted for proposed Sale 147 address potential adverse effects on aquatic life that may traverse both the OCS and the Alabama coastal zone. 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. Endangered and threatened species in the northern Gulf of Mexico include five species of sea turtles, great whales, piping plover, brown pelican, and Gulf sturgeon. Onshore protected species include several species of whooping cranes and a mouse.

The results of the formal interagency consultations indicate that the FWS and NMFS have determined that the proposed lease sale is unlikely to jeopardize the continued existence of an endangered or threatened species and/or result in adverse modification or destruction of critical habitat.

As a result of the consultation process, MMS has implemented the FWS conservation recommendations, contained in its Biological Opinion, by incorporating in the MMS regulations (30 CFR 250.42) a section that requires an OSCP for all activities. The MMS has also worked with the Offshore Operators Committee's Helicopter Safety Advisory Conference to develop and distribute to all aircraft operators a booklet and maps on environmentally sensitive areas, urging that aircraft supporting offshore facilities maintain an altitude of 2,000 ft or more above national parks, seashores, and wildlife refuges.

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). Oil and gas produced from these leases will decrease the Nation's dependence for foreign supplies and will have a positive impact on the Nation's balance of payments. The State has previously determined the development of oil and gas resources vital to national security, thus providing further support for future lease sales.

(2) Mississippi

The Sale 147 analysis area closest to the submerged lands of the State of Mississippi is Central coastal Subarea LA-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 147, 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. and IV.B. indicate that proposed Sale 147 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 MA-1, 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 RTWCI, 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 RTWCI, which include representation from the State of Mississippi, will help to promote consistency with State wetlands management guidelines.

Hypothesized transportation activities related to activities on these offshore leases may include delivery of supplies to onshore service bases and the 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 processing locations. Existing transportation corridors would facilitate specific lease projects, but their existence or continued maintenance would not be dependent on project-related vessel movements.

Offshore Operations

A spill resulting from offshore oil and gas operations could affect Mississippi coastal wetlands. See Section 3 of this Appendix (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 147 leases (Section IV.A.3.1) will cause little degradation of onshore air quality with no significant effect on nonattainment or Prevention of Significant Deterioration Class I areas.

Water quality in Mississippi's coastal and nearshore areas may be altered by a number of OCS-related activities resulting from proposed Sale 147 dependent on the extent of OCS operations occurring either off the coast of Alabama or within the State's coastal zone. As will be shown, projected activity is not sufficient to result in any changes in water quality characteristics, except for minor, localized, very short-term changes.

Activities that could result in impacts include onshore support facility operations, support vessel traffic, channel construction and maintenance dredging, pipeline emplacements, and onshore disposal of OCS-generated oil-field wastes. Disturbances of the physical surroundings and resultant runoff occurring from the construction and presence of onshore facilities can result in water quality degradation. The operation of onshore facilities may also impact coastal water quality by routine discharges and accidental spills. Furthermore, spills occurring offshore and reaching coastal waters can also affect water quality conditions.

Vessel usage of coastal waters may degrade water quality from bilge and ballast water discharges, discharges of treated sanitary and domestic wastes, vessel erosion of channel banks, trash and debris loss, and spills. Indirectly, vessel usage degrades water quality when the channels used must be maintenance dredged or new channels are built to reach support bases. Spills are most likely to occur in connection with the offloading and onloading of crude from shuttle tankers and barges and from fueling activities associated with service boat support.

No onshore support infrastructure is expected to be built solely in support of Sale 147 operations. There is new infrastructure projected in Mississippi in the future, but this infrastructure will be built to support operations offshore resulting from a number of lease sales (Table IV-14). The existing infrastructure in the Mississippi/Alabama area that might be used for Sale 147 operations includes two refineries, three platform yards, four service bases (one in Mississippi), three navigation channels, and one helicopter hub. The service base in Mississippi expected to be used is located in Pascagoula, along Bayou Casotte. There are presently two pipeline landfalls and 179 km of onshore pipeline carrying OCS generated gas; two new pipeline landfalls are projected, one oil and one gas (Table IV-14).

No oil from offshore Sale 147 leases is projected to come ashore in Mississippi (Table IV-13). There will only be 30 vessel trips to the service bases in Alabama and 4,500 helicopters to all bases in Mississippi/Alabama. There is one oil-field waste disposal site that may receive OCS-generated waste that is

located in Mississippi. A few of the 30 vessel trips will take drilling muds and cuttings and production solids to this transfer station to be loaded on a barge and transported to Texas for processing.

Only about 9,000 liters of bilge waters is expected to be discharged from service vessels into coastal waters of Mississippi during the 30 vessel trips projected (Tables IV-13 and IV-18). This is an average of about 0.7 liters a day. This quantity of discharge is not expected to result in any significant changes in the water quality of the Bayou Casotte.

No onshore spills are projected to occur, and no offshore spills are projected to reach coastal waters as a result of Sale 147.

The proportion of expected future water quality degradation associated with discharges from the use of onshore support facilities for Sale 147 operations would be very small and can be approximated by an examination of the number of vessel trips expected to enter Mississippi. It is estimated that during the 35-year time period, 30 of the 8,400 service-vessel trips will be to bases in Mississippi. This is 0.4 percent of the vessel traffic related to Sale 147 and only 0.01 percent of the total vessel traffic expected to occur in the future in support of all OCS operations.

Refer to Section IV.D.1.c.(2). (Louisiana State Air and Water Quality Regulatory Provisions) for additional relevant information.

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). Refer to Section 1 of this appendix (Alabama Water Resources) for additional relevant information. Activities on Sale 147 leases are not likely to cause waste, unreasonable use, or unreasonable method of use of water in the State of Mississippi.

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. Refer to Section 1 of this appendix for additional relevant information.

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. Refer to Section 1 of this appendix (commercial fishing) for additional relevant information.

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.B., this lease sale is not expected to result in construction of new onshore support facilities in the coastal areas of Mississippi.

(3) 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 LA-1, LA-2, and LA-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.

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.3.d. It is expected that OCS waste resulting from Sale 147 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. Conflicts with local land use plans or ordinances are not expected to occur as a result of Sale 147, as existing onshore infrastructure is expected to be sufficient.

Issues identified in LCZMP include the following: general coastal use guidelines; levees; linear facilities (pipelines); dredge 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 147 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 Appendix E. 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 147 is 0.21. 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 and resolved to the maximum extent practicable by the Louisiana Department of Natural Resources and U.S. Army Corps of Engineers in their permitting processes.

An MMS study determined 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. There are 148 OCS-related landfalls and an estimated 4,720 km of related pipelines in Louisiana. Pipeline canal widening is expected to result in loss of approximately 2,000 ha of wetlands over 35 years. Approximately 60 ha of this loss is attributable to the proposed action. The State of Louisiana has established a coastal trust fund dedicating a percentage of oil and gas royalty revenues to fund coastal restoration projects as compensation for coastal wetlands loss.

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 also funded a major study of the effects of marsh management practices on wetlands (Cahoon and Groat, 1990).

One new pipeline is expected to make landfall in the vicinity of Freshwater Bayou, Louisiana. 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 less frequently than in the past because the network currently in place is adequate to accommodate oil and gas production from future resource development. Belle Pass 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(c) 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 (DOI--30 CFR 250; USEPA--40 CFR 435; and USCG--35 CFR 151). 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 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 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. The chance of an oil spill from these leases occurring and reaching the Louisiana coast is remote. 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 associated with offshore oil and gas operations. Structures placed on leases from this proposed sale would serve to increase biological habitat available to marine fauna, thus increasing long-term biological productivity.

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 et al., 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. Section 8(g) of the OCS Land Act Amendments of 1978 requires a distribution of revenues between the Federal Government and a coastal state for Federal lease blocks within 3 mi of the seaward boundary of the State that may contain oil and gas pools underlying both OCS and State lands. 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 Proposed Action and Alternatives Memorandum for this sale.

The cumulative effects of the proposed actions that relate to the LCZMP are addressed in Sections IV A and 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 147; 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. Coastal use guidelines anticipate the conduct of activities that, it is assumed, will result in some adverse effects to the coastal zone. Avoidance of any adverse effects to the coastal zone could only be achieved by banning all human activity. 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 cumulative effects of oil and gas activities "to the maximum extent practicable." 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 147 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 147 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 147 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. 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 FWPCA requires the USEPA to establish national effluent limitation standards for wastewater discharges (Title III) and to develop requirements for Federal permits called the National Pollutant Discharge Elimination System (NPDES) (Title IV). At present, the USEPA is actively developing two sets of rulemakings that will result in (1) the reissuance of the expired general NPDES permit for the Gulf of Mexico and (2) the promulgation of proposed standards of performance for new sources and new effluent limitations guidelines for existing sources. To implement the Clean Water Act's requirements to restore and maintain the integrity of the Nation's water, identified in Sections 301, 304(b), 304(c), 304(e), 306, 307, and 501 of the Act, USEPA develops and issues technology-based effluent limitation standards and new source performance standards.

The USEPA issued a final NPDES permit for existing sources in the Western Gulf of Mexico Outer Continental Shelf, which includes all area west of Mississippi River, on November 19, 1992. Once the effluent limitations are finalized, the NPDES permit will be modified to incorporate these standards. The USEPA must still issue a NPDES permit for new sources. This permit issuance is awaiting the promulgation of the effluent limitations.

Offshore wastes not discharged offshore because of USEPA regulatory constraints are either piped ashore or loaded on supply boats or barges and transported onshore to industry shorebases. Louisiana is the only state that has established strict management of oil-field waste, provided by LAC Title 43: Part XIV (Amendment to Statewide Order No. 29B). Once onshore they are loaded on other barges to reach a commercial waste disposal facility. The State of Louisiana has a manifest system for tracking the movement of oil-field wastes from the point of generation to the final disposal site. Onshore disposal alternatives include disposal at a Louisiana licensed commercial oil-field waste site (NOW site) where the wastes are usually landfarmed, buried in abandoned wells, or injected into specially designated wells or salt domes. Other options are chemical

treatment of the waste to create a product that is less contaminated and can be recycled as solid material for road fill. Although common practice in other areas of the United States, oil-field wastes are not brought to hazardous waste sites along the Gulf because of the additional costs for use of these sites over other disposal methods. Louisiana law also requires that these wastes are not disposed of at landfills.

Most recently, the public has expressed considerable confusion and concern regarding radionuclide contamination in oil-field wastes generated in the Gulf of Mexico. Over the past several years, measurements of elevated levels of radiation in used oil-field equipment and produced water have raised the sensitivity of the public and regulators to the fact that naturally occurring radioactive materials (NORM) are generated from the mineral-extraction process. The principal wastes containing NORM disposed of onshore include equipment and production solids.

Because wastes containing NORM have relatively low activity levels compared to nuclear industry man-made isotopes and because of their natural presence, they have been largely ignored until now by regulators. The NORM were not covered by the Atomic Energy Act of 1954 and, thus, are not regulated by the Nuclear Regulatory Authority or USEPA as radioactive wastes. At present, there are no Federal regulations for handling and disposing of NORM-contaminated materials. The Louisiana Department of Environmental Quality (DEQ) is the only State agency to have adopted NORM regulations (Chapter 14, Regulation and Licensing of Naturally Occurring Radioactive Materials (NORM), LAC 33:XV). On September 20, 1989 (revised June 20, 1992), the DEQ developed regulations that provide strict disposal requirements for all NORM materials emitting radiation greater than 50 microroentgens per hour and that establish guidelines for conducting NORM confirmatory surveys of suspected contaminated land.

Guidelines for Uses that Result in the Alteration of Waters Draining into Coastal Waters (9.1 through 9.3)

These 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 147 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 147, however, will not result in any oil, gas, or other mineral operations in the State's coastal area or sensitive environmental areas, 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 92-02. 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. The OCSLA (43 U.S.C. 1334(a)(8)) requires the Secretary of the Interior to promulgate and administer regulation that comply with the National Ambient Air Quality Standards (NAAQS) pursuant to the Clean Air Act (42 U.S.C. 7401 et seq.) and to the extent that authorized activities significantly affect the air quality of any State. Under provisions of the Clean Air Act Amendments of 1990, sources located in areas under MMS jurisdiction (which includes the State of Alabama west of 87°31' W. longitude) are promulgated by 30 CFR 250.44, 250.45, and 250.46 as a postsale activity. It is the intent of these regulations to protect onshore ambient air quality and to ensure that no new violations of NAAQS occur from OCS activities. The regulated pollutants include carbon monoxide, suspended particulates, sulphur dioxide, nitrogen oxides, and volatile organic compounds. In areas where hydrogen sulfide may be present, operations are regulated by 30 CFR 250.67. Emissions data concerning new or modified onshore facilities (directly associated with offshore activities) are required to enable each affected State to make a determination of the effects on its air quality.

Exploration plans (EP's) and Development Operations Coordination Document (DOCD's) address activities that are determined by the Secretary as activities regulated under 30 CFR 250.44, 250.45, and 250.46. All new or supplemental EP's and DOCD's submitted on or after June 2, 1980, must include air emissions information sufficient to make an air quality determination. The Letter to Lessees dated October 12, 1988, outlines air emissions data that must be submitted by operators to MMS. The Clean Air Act Amendments of 1990 also require that MMS conduct and complete a study of the effects of offshore air emissions in nonattainment onshore areas within three years after the approval of the amendments in OCS areas not under USEPA jurisdiction. Based on the results of this study, the Secretary must consult with the USEPA Administrator and determine if any further actions are necessary.

On August 17, 1992, MMS issued NTL 92-06, with the purpose of establishing and clarifying 30 CFR 250.175 (relates to burning and flaring activities in the Gulf of Mexico). The NTL requires prior approval from the Regional Supervisor for unloading, cleaning, and testing operations that may exceed 48 cumulative hours in a single zone.

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. This EIS analysis (Section IV.A.3.E) 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)

Water quality in coastal and nearshore areas of Louisiana may be altered by a number of OCS-related activities resulting from proposed Sale 147. These include onshore support facility operations, support vessel traffic, channel construction and maintenance dredging, pipeline emplacements, and onshore disposal of OCS-generated oil-field wastes. These activities result in spills and discharges into coastal waters. Spills occurring offshore and reaching coastal waters are also expected to affect water quality conditions. Disturbances of the physical surroundings from these activities can result in runoff and also result in water quality degradation.

The existing onshore infrastructure base in the Central Gulf is expected to be sufficient to support proposed Sale 147 activities. There are 261 facilities located in Louisiana that are expected to support all future OCS operations. The subset that will support Sale 147 is not provided. Also, not included in these numbers are the 10 onshore transfer stations and 5 disposal sites used to landfarm wastes generated offshore and brought onshore for disposal (Section IV.B.1.a.(3)(c)). Because the number and types of existing onshore support facilities are expected to remain the same or decline over time (discussed in Section IV.B.1.a.), historical trends in surrounding water quality conditions are assumed to be indicative of future conditions (Louisiana Dept. of Environmental Quality, 1990; Louisiana Dept. of Transportation, 1984). The percent utilization of these facilities in the future to support Sale 147 operations is assumed to be very small, considered about 3 percent of their operating capacities (see Section IV.B.1.a. for individual utilization assumptions). Given this, the proportion of expected future water quality degradation associated with discharges and chronic spills from the use of these facilities for Sale 147 would be very small but will be widespread and continuous, especially in the Mississippi River deltaic area of Louisiana where support operations are concentrated.

The improper storage and treatment of OCS-related oil-field waste have resulted in adverse impacts to surrounding waters near disposal facilities, cleaning sites, and scrap yards (Section IV.B.2.c.). Regulatory restrictions passed by the State of Louisiana and new precautions taken by the oil industry regarding the storage and disposal of NORM contaminated drums will prevent much of the type of damage documented in the past. No impacts at the 4 landfarms in Louisiana or at any of the pipe cleaning or storage yards are expected, but some impact around a few temporary storage facilities (usually service bases) will occur due to human error.

Twelve navigation channels located in Louisiana will be used by service vessel traffic to various degrees (Table IV-18). The Calcasieu Ship Channel to Cameron (1.A-1), Atchafalaya River waterway to Morgan City (1.A-2), Freshwater Bayou to Intracoastal City (1.A-1), and Mississippi River passes, particularly the reach to Venice (1.A-3), are expected to receive the bulk of sale-related support vessel trips in the CPA (Table IV-18). Besides barge trips to and from platforms, about 18 percent of the barge traffic carrying oil from terminals to other terminals or refineries is expected to be OCS-related (less than 1 percent of this will be linked to Sale 147 oil movement) (Section IV.B.1.b.(2)). Vessel usage of these channels may degrade water quality from bilge and ballast water discharges, discharges of treated sanitary and domestic wastes, vessel erosion of channel banks, trash and debris loss, and spills. Section IV.D.1.a.(3) estimates that, for confined channels, about 160 liters of bilge water will be discharged per km during the peak year or about a half a liter per km per day. Channel bank erosion will average about 0.068 ha/yr for the 811 km of confined channels or 0.002 m³/day/km of canal. This erosion and level of discharge will cause increased contaminant levels and turbidity in the confined portions of the 12 channels resulting in minor, localized, long-term changes in water quality characteristics.

There is no new channel dredging projected in support of Sale 147 operations. Dredging activities associated with maintenance of the 12 channels (Sections IV.B.1.b. and IV.B.2.a.(1)) are expected to occur every two years and will result in localized impacts (primarily elevated water-column turbidity) occurring over the duration of the activities (up to several months). In addition, Pass Fourchon will be deepened to support OCS activities. Three percent of this activity will be attributable to leases resulting from the proposed action.

Spills can occur from both offshore and onshore operations, as discussed above. Section IV.A.3.h.(2) and Table IV-10 show that offshore spills are not likely to contact Louisiana and therefore are not expected to cause impacts. Onshore spills projected (Section IV.B.2.d.(1)) to occur from barge and pipeline operations,

and near refineries and terminals, will cause some water quality degradation. Spills less than 50 bbl related to the sale (estimated at around one per year in Louisiana) will occur more frequently than the larger spills but are more likely to be contained at the facilities within the spill prevention levee systems. Within these confined water bodies, background water quality conditions will return to normal in 6 weeks for spills 1 bbl or less, and in 6 months for spills less than 50 bbl. Two larger spills estimated at 500 bbl each are projected to occur also (Section IV.B.2.d.(1)). It is assumed that these two spills will occur outside of the facility catch systems and will enter coastal waters. Section IV.B.2.d.(1) assumes each spill this size can affect up to 27 ha of marsh and cause changes in water quality parameters for up to 5 years. In summary, low-level petroleum contamination of coastal waters will occur from onshore spills associated with Sale 147 operations in Louisiana and will affect localized, confined areas for up to 6 months in 11 locations along the Louisiana coast, up to 6 weeks in 26 locations along the Louisiana coast, and will persist up to 5 years in 54 ha of marsh.

(4) Texas

The Sale 150 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 150, as existing onshore infrastructure is expected to be sufficient.

The State of Texas is seeking Federal approval by NOAA of the Texas Coastal Management Plan (TCMP). The State-approved TCMP 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 State 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 TX-1) is being studied for possible deepening to -50 ft NGVD. The present depth is -45 ft NGVD. 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, Yarrowborough 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. Refer to Section 3 of this appendix (Louisiana Guidelines Applicable to All Uses) for additional relevant information.

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 Appendix 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.

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.B, 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(c) 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 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. Numerous Federal and State water pollution control regulations for mitigating any potential adverse effects exist.

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. Refer to Section 3 of this appendix (Louisiana) for additional discussion on water quality and waste disposal.

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.

Appendix I

Environmental Studies Program for the Gulf of Mexico:

Fiscal Years 1992, 1993, and 1994 Program Status

This appendix contains status information for all active studies, studies proposed for funding during FY 1993, and studies with high priority for FY 1994.

Active Contracts

A. Environmental Mapping

14-12-0001-30201	Gulf Coastal Ecological Analysis
14-35-0001-30686	GIS Applications to Coastal and Offshore Analyses

B. Physical Oceanography

14-35-0001-30501	East Breaks Ship-of-Opportunity Cooperative Agreement, FY 1989-1993
14-35-0001-30506	Gulf of Mexico Data Buoy Interagency Agreement, FY 1989-1993
14-35-0001-30509	Texas-Louisiana Shelf Circulation and Transport Process Program
14-35-0001-30632	Mississippi River Plume Hydrographic Study
14-35-0001-30633	Gulf of Mexico Eddy Circulation Study

C. Marine Ecosystems

14-35-0001-30494	Mississippi-Alabama Shelf Pinnacle Trend Habitat Mapping
14-35-0001-30546	Solid Waste Pollution on Texas Beaches: A Post-MARPOL Annex V Study
14-35-0001-30555	Northern Gulf of Mexico Continental Slope Chemosynthetic Communities Program

D. Coastal Studies

There were no active studies in this series during this quarter.

E. Living Marine Resources

13339 (1A)	Sea Turtle Behavior Relative to Offshore Structures in the Western and Central Gulf of Mexico
17912 (1A)	Estimation of Fisheries Impacts Due to Underwater Explosions Used to Sever and Salvage Petroleum Platforms
14-35-0001-30619	Distribution and Abundance of Marine Mammals in the North-Central Gulf of Mexico
16197 (1A)	Distribution and Abundance of Marine Mammals in the North-Western Gulf of Mexico

F. Ecological Effects of Oil and Gas Activities

14-12-0001-30393	U.S. National Museum Oil Spill Recovery Study
14-35-0001-30470	Gulf of Mexico University Initiative: Studies of Long-Term Effects of Oil and Gas Production
14-35-0001-30582	Gulf of Mexico Offshore Operations Monitoring Experiment, Phase I: Sublethal Responses to Contaminant Exposure
14-35-0001-30604	Gulf of Mexico Air Quality Study
14-35-0001-30617	Oil and Oil Dispersants Toxicity Program
14-35-0001-30660	Coastal Marine Institute

14737 (IA)
16198 (IA)

Impact of Exploratory Drilling Offshore Florida
Preliminary Assessment of Gulf of Mexico OCS Contributions to
Ozone Formation in Onshore Areas Using the Regional Oxidant
Model

G. Socioeconomic Studies

14-12-0001-30335

Socioeconomic Impacts of Gulf of Mexico OCS Oil and Gas
Decline

H. Cultural Resources

There are no active studies in this series.

I. Environmental Information Management

14-35-0001-30690

Planning Workshop for Spill Remediation for Habitats and
Resources in the Gulf of Mexico

Studies in Planning and Procurement

A. Environmental Mapping

No studies in this series are in planning or procurement.

B. Physical Oceanography

Coastal Louisiana High Resolution Drifter Study
Northeastern Gulf of Mexico Physical Oceanography Planning Workshop

C. Marine Ecosystems

Long-Term Monitoring at the East and West Flower Garden Banks
Northeast Gulf of Mexico Marine Ecosystems Study

D. Coastal Studies

No studies in this series are in planning or procurement.

E. Living Marine Resources

No studies in this series are in planning or procurement.

F. Ecological Effects of Oil and Gas Activities

Benthic-Pelagic Coupling in the Gulf of Mexico: Implications for the Fate of Organic Matter
on the Continental Shelf

G. Socioeconomic Studies

No studies in this series are in planning or procurement.

H. Cultural Resources

No studies in this series are in planning or procurement.

I. Environmental Information Management

Gulf of Mexico Information Transfer Meeting, 1993-1995

FY 1992 Studies Deferred for '93 Awards

- o Gulf of Mexico Information Transfer Meeting - 1993
- o Long-Term Monitoring at the East and West Flower Garden Banks
- o Critical Review of MORG Oil Spill Response Planning System

FY 1993 Tentatively Approved New Starts

- o National Socioeconomic Planning Workshop
- o Analysis of Socioeconomic Issues in the Western Gulf of Mexico
- o The Impact of Decline in Federal Offshore Activity
- o Historical Demographic Study
- o Coastal Louisiana High-Resolution Drifter Study
- o Benthic-Pelagic Coupling in the Gulf of Mexico: Implications for the Fate of Organic Matter on the Continental Shelf
- o Northeastern Gulf of Mexico Physical Oceanography Planning Workshop
- o Northwestern Gulf of Mexico Data Buoy Continued Support
- o Northeastern Gulf of Mexico Marine Ecosystems Study

Proposed FY 1994 Studies Assigned the Highest Priority by the MMS, Gulf of Mexico OCS Region

- o Investigation of Remote-Sensing Techniques Applicable to the Delineation of Pipelines, Shallow Hazards, and Cultural Resources in the Shallow Subsurface of the Gulf of Mexico OCS Region
- o Mississippi-Alabama Shelf Monitoring Study
- o Naturally-Occurring Radioactive Materials (NORM): Management and Disposal Issues
- o Gulf of Mexico Protected Species

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