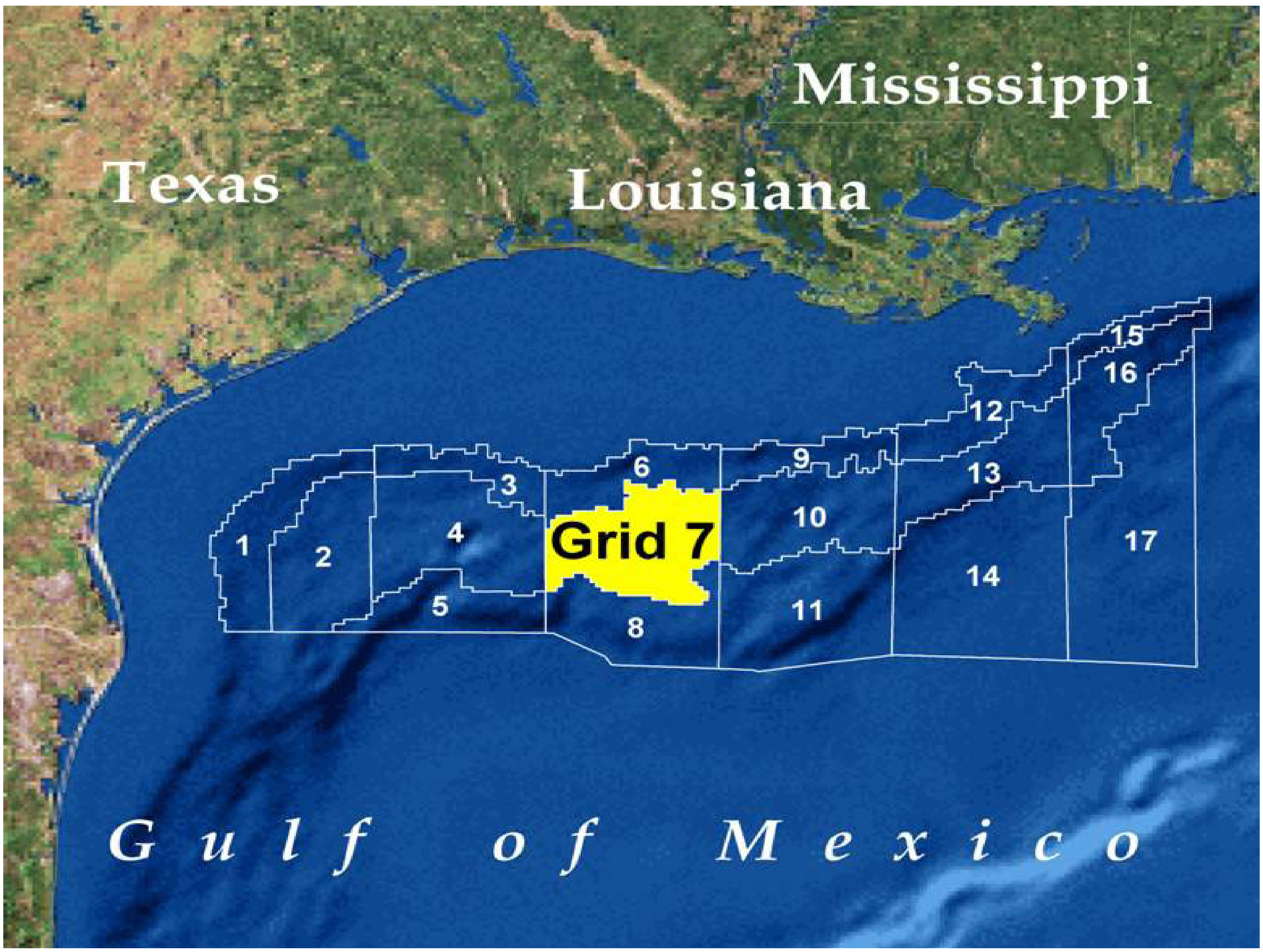
OCS EIS/EA
MMS 2003-019

Programmatic Environmental Assessment for Grid 7

Evaluation of Conoco Inc.'s Initial Development Operations Coordination Document, N-7506

Magnolia Project
Garden Banks Blocks 783 and 784



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

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MMS 2003-019

Programmatic Environmental Assessment for Grid 7

Evaluation of Conoco Inc.'s Initial Development Operations Coordination Document, N-7506

Magnolia Project
Garden Banks Block 783 and 784

Prepared by

Minerals Management Service
Gulf of Mexico OCS Region

Published by

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

New Orleans
February 2003

PROGRAMMATIC ENVIRONMENTAL ASSESSMENT FOR GRID 7 DETERMINATION

FINDING OF NO SIGNIFICANT IMPACT

Conoco Inc.'s Initial Development Operations Coordination Document (DOCD) and its amendment, propose to complete nine wells, install a tension leg platform, and commence production of hydrocarbon resources from Garden Banks Blocks 783 (OCS-G 11573) and 784 (OCS-G 11574). Our programmatic environmental assessment (PEA) on the subject action (N-7506) is complete and results in a Finding of No Significant Impact (FONSI). Based on this PEA, we have concluded that the proposed action will not significantly (40 CFR 1508.27) affect the quality of the human environment. Preparation of an environmental impact statement (EIS) is not required. The following mitigations will be required and included in the operator's approval letter to ensure environmental protection, consistent environmental policy, and safety as required by the National Environmental Policy Act (NEPA) of 1969, as amended; or as needed for compliance with 40 CFR 1500.2(f) regarding the requirement for Federal agencies to avoid or minimize any possible adverse effects of their actions upon the quality of the human environment.

1. A deviation from your DOCD (such as additional drilling time, changes in the drilling schedule, and/or use of higher horsepower equipment, especially for the drilling rig and construction barges) could potentially cause the annual emissions exemption level for NO_x to be exceeded. Therefore, if such a deviation occurs, please be advised that you will immediately prepare a revised DOCD pursuant to 30 CFR 250.204(q)(2) to include the recalculated emission amounts and the air quality modeling required by 30 CFR 250.303(e). You will not proceed with the actions that could cause the potential exceedance until the revised DOCD has been submitted to and approved by this office. (2.2)

2. Your plan indicates well test flaring for more than 48 continuous hours. Please be reminded that 30 CFR 250.1105(a)(3) requires you to obtain approval from the Regional Supervisor for Production and Development prior to conducting the proposed flaring activities. (2.6)

3. In response to the request accompanying your plan for a hydrogen sulfide (H_2S) classification, the area in which the proposed drilling operations are to be conducted is hereby classified, in accordance with 30 CFR 250.417(c), as "H_2S absent." (8.3)

4. In accordance with NTL No. 2001-G04, the MMS has determined that you will not need to conduct the two ROV surveys you proposed in your plan. (19.3)

Jack Irion
Supervisor, Social Sciences Unit
Leasing and Environment, GOM OCS Region

2-27-03
Date

Dennis Chew
Supervisor, NEPA/CZM Coordination Unit
Leasing and Environment, GOM OCS Region

2/27/03
Date

Joe Christopher
Chief, Environmental Assessment Section
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2/28/03
Date

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Regional Supervisor, Leasing and Environment
GOM OCS Region

2/28/03
Date

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ABBREVIATIONS AND ACRONYMS

ASI	Airborne Support Inc.
BOD	biochemical oxygen demand
B.P.	before present
CEI	Coastal Environments, Inc.
CFR	*Code of Federal Regulations*
CPA	Central Planning Area
CSA	Continental Shelf Associates
DDT	Dichlorodiphenyltrichloroethane
DGoMB	Deepwater Program: Northern Gulf of Mexico Continental Slope Habitats and BenthicEcology
DOCD	Development Operations Coordination Document
DO	dissolved oxygen
DOI	Department of the Interior (U.S.) (also: USDOI)
EB	East Breaks
E&D	exploration and development
EA	environmental assessment
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EIS	environmental impact statement
EP	Exploration Plan
EPA	Eastern Planning Area
et al.	and others
et seq.	and the following
FMC	Fishery Management Council
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
FR	*Federal Register*
FWS	Fish and Wildlife Service
GB	Garden Banks
GERG	Geochemical and Environmental Research Group
GIS	geographical information system
GMFMC	Gulf of Mexico Fishery Management Council
GOM	Gulf of Mexico
H_2S	hydrogen sulfide
HMS	highly migratory species
HMWHC	high molecular weight hydrocarbons
ITC	Intertribal Council
LATEX	Louisiana-Texas Shelf Circulation and Transport Process Program (MMS-funded study)
MARPOL	International Convention for the Prevention of Pollution from Ships
MBO	million bbl of oil
MMS	Minerals Management Service
MSA	Metropolitan Statistical Area
MWA	military warning area
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act, as amended
NGOMCS	Northern Gulf of Mexico Continental Slope Study
NMFS	National Marine Fisheries Service
NOEC	No observable effect concentration
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant and Discharge Elimination System
NRC	National Response Corporation
NS&T	National Status & Trends Program (NOAA)
NTL	Notice to Lessees and Operators
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act, as amended
OSRA	Oil Spill Risk Analysis
OSRO	Oil Spill Removal Organizations
P&A	plugged and abandoned
PAH	polynuclear aromatic hydrocarbon
PEA	Programmatic Environmental Assessment
P.L.	Public Law
PCB	polychlorinated biphenyl
PLEM	pipeline end manifold
ppb	parts per billion
ppt	parts per thousand
ROSRP	Regional Oil Spill Response Plan
SEA	site-specific environmental assessment
SIC	Standard Industrial Classification
SOP	suspension of production
TA	temporarily abandoned
TLP	tension leg platform
USCG	U.S. Coast Guard
USDOC	U.S. Department of Commerce
USDOI	U.S. Department of the Interior (also: DOI)
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compounds
WPA	Western Planning Area

INTRODUCTION

The Minerals Management Service (MMS) developed a comprehensive strategy to comply with the National Environmental Policy Act (NEPA) for postlease activities in deepwater areas (water depths of greater than 400 m) of the Central and Western Planning Areas of the Gulf of Mexico (GOM). You can find an in-depth discussion of this strategy on our Internet site at the following address:

www.gomr.mms.gov/homepg/regulate/environ/strategy/strategy.html.

The MMS's strategy led to the development of a biologically based grid system to ensure broad and systematic analysis of the GOM's deepwater region. The grid system divided the Gulf into 17 areas or "grids" of biological similarity. Under this strategy, MMS will prepare a programmatic environmental assessment (PEA) to address a proposed development project within each of the 17 grids. These grid PEA's will be comprehensive in terms of the impact-producing factors and environmental and socioeconomic resources described and analyzed.

Once a PEA for a grid has been completed, it will serve as a reference document, and future environmental evaluations may reference appropriate sections from the PEA to reduce reiteration of issues and effects previously addressed in the "grid" document. This will allow the subsequent environmental analyses to focus on specific issues and effects related to the proposals. This PEA has also addressed categorical exclusion criterion C.(10)(1) by summarizing information to characterize the environment of Grid 7.

This PEA will characterize the environment of Grid 7 and also examine the effects that could result from Conoco Inc.'s (Conoco) Initial Development Operations Coordination Document (DOCD) (N-7506) for the Magnolia Development Project.

Figure 1 shows the relationship of Grid 7 to the Gulf's coastline and to the other 16 grids. Figure 2 depicts the protraction diagrams and blocks that are contained in Grid 7. Garden Banks (GB) Area, Blocks 783 and 784, which are highlighted, encompass the proposed location for the Magnolia Project.

Current Status of Grid 7

The purpose of this section is to provide the reader with a "state of the grid." Information in this section is based on current MMS data and publicly announced prospects that are projected for Grid 7. See Appendix F for additional information and supportive data.

Grid 7 includes portions of the Garden Banks and Keathley Canyon Outer Continental Shelf (OCS) protraction diagrams. Table 1 provides information on the protraction diagrams, blocks, leases, and acreage in Grid 7.

Table 1

Protraction Diagrams, Blocks, Leases, and Acreage in Grid 7

Protraction Diagrams	No. of Grid Blocks	Approximate Acreage in Grid	No. of Grid Blocks Leased	Percentage of Grid Blocks Leased
Garden Banks	239	1,376,640	165	44
Keathley Canyon	387	2,229,120	206	56
Grid Totals	626	3,605,760	371	60

Garden Banks constitutes approximately 38 percent of the total number of blocks in the grid. It also contains about 44 percent of the total number of leases in the grid. Keathley Canyon contains approximately 62 percent of the total number of blocks in the grid and has slightly over 55 percent of the total leases.

Figure 3 depicts the bathymetry of Grid 7 in 500-m contour intervals.

In response to the operator's request accompanying the plan for hydrogen sulfide (H_2S) classification, the area in which the proposed drilling operations are to be conducted is hereby classified in accordance, with 30 CFR 250.417 (c), as "H_2S absent."

Grid 7 contains 626 blocks. Of these blocks, 371 blocks (59.3%) were leased as of August 2002. At present, there are 28 operators with leases in Grid 7. These operators include:

Amerada Hess	Exxon Asset Holding	Oxy USA
Amoco	Exxon Mobil	Phillips Petroleum
BP Exploration	Kerr-McGee	Pioneer Natural
Callon Petroleum	Marathon Holding	Shell
Chevron USA	Mariner Energy	Shell Offshore
Conoco Inc.	Mobil Producing	TotalFinaElf
Devon Energy	Murphy Exploration	Union Oil
Dominion	Nexen Petroleum	Woodside Energy
EEX Corp	Norsk Hydro	
EnCana GOM	Ocean Energy	

Figure 4 geographically depicts the leasehold position of these operators within Grid 7.

The grid's active lease status and plans submitted data are portrayed in Figure 5. No other DOCD's have been submitted besides Conoco's Magnolia Development Project in this grid since the inception of MMS's deepwater PEA strategy. Five leased blocks are currently producing within the grid. There are 49 blocks within the grid that are included in a unit.

Figure 6 shows the locations of publicly announced prospects and fields within Grid 7. Drilled well locations within the grid and its surrounding area are also shown in Figure 6.

There are active and proposed right-of-way pipeline routes contained within the grid. Figure 7 shows these routes in relationship to the grid.

There are numerous onshore support bases that are available along the Gulf Coast that could serve as logistical infrastructure for Grid 7. In the current proposal, Conoco has chosen Port Fourchon, Louisiana as its onshore base to support the proposed operations. Figure 8 shows the relationship of Grid 7 to this shore base. The distance in miles from the grid to the shore base is also depicted on Figure 8.

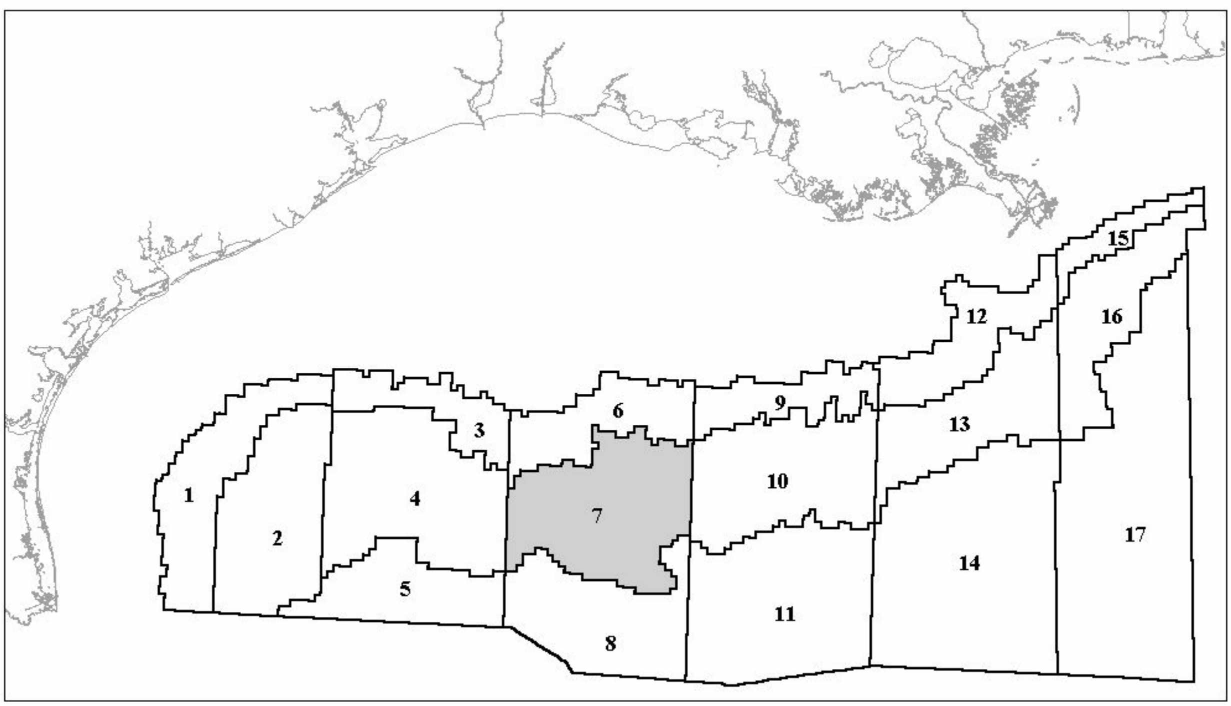


Figure 1. Grid 7 in Relationship to the Gulf Coastline and to Other Grids.

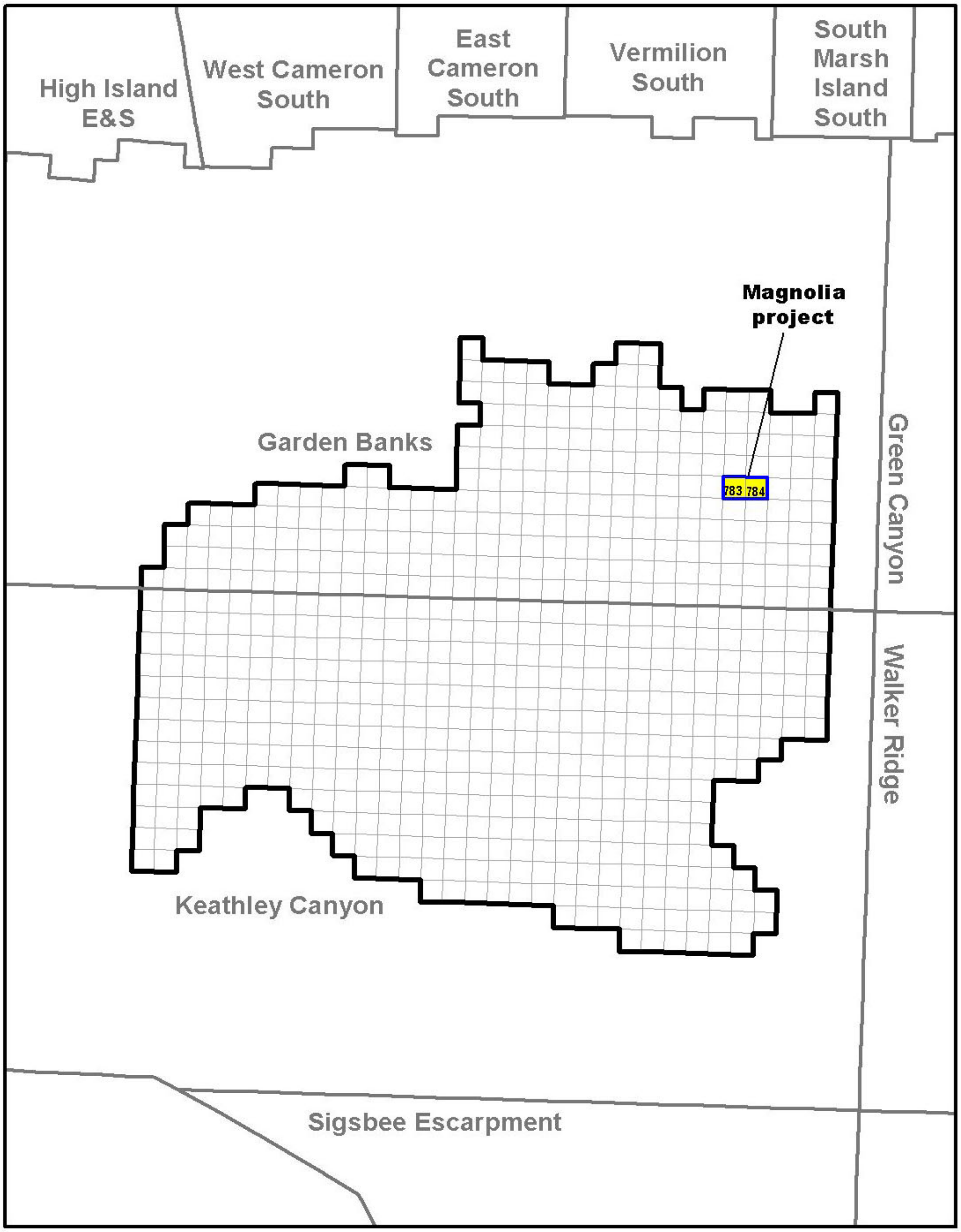


Figure 2. Protraction Diagrams and Blocks in Grid 7.

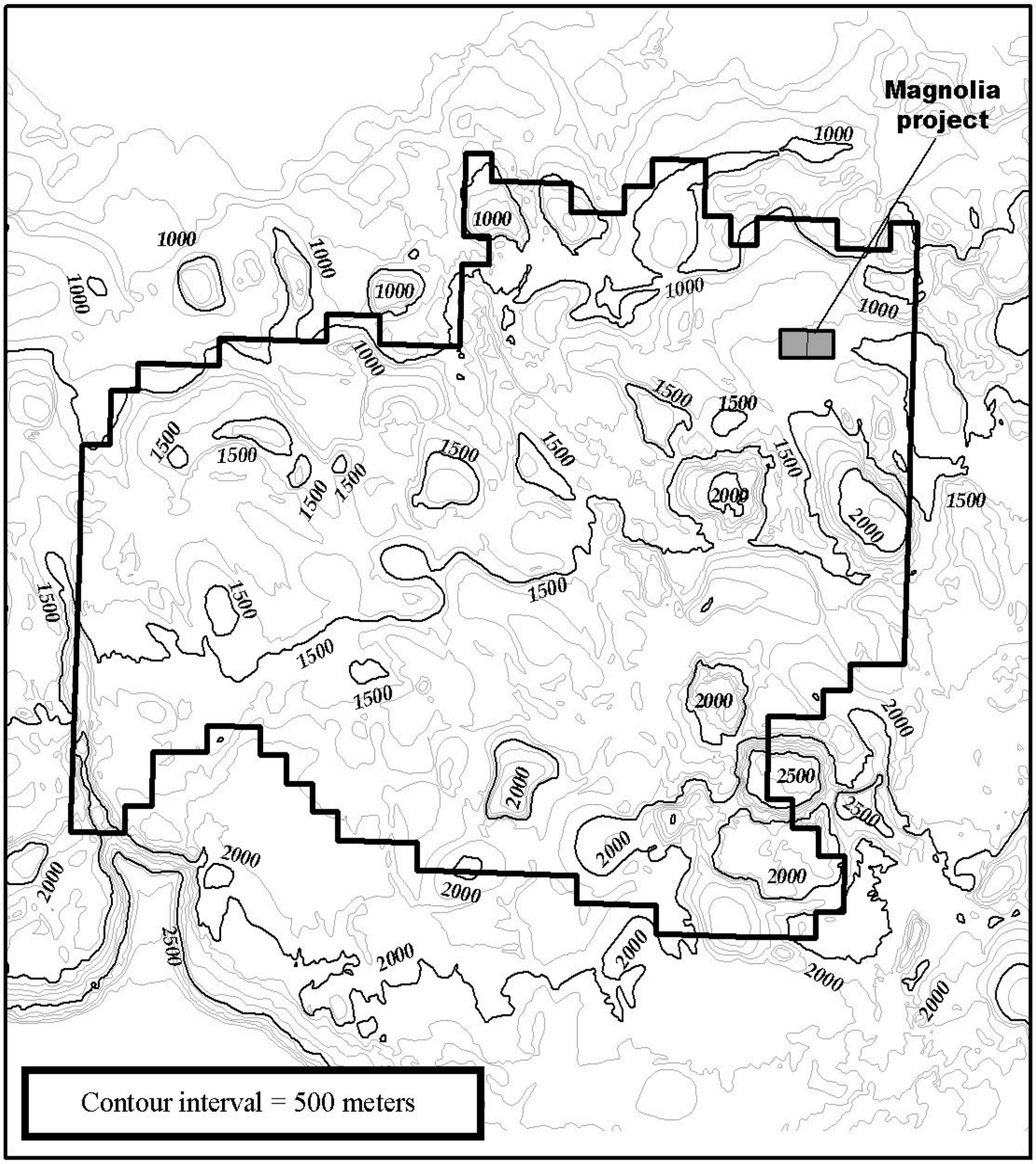
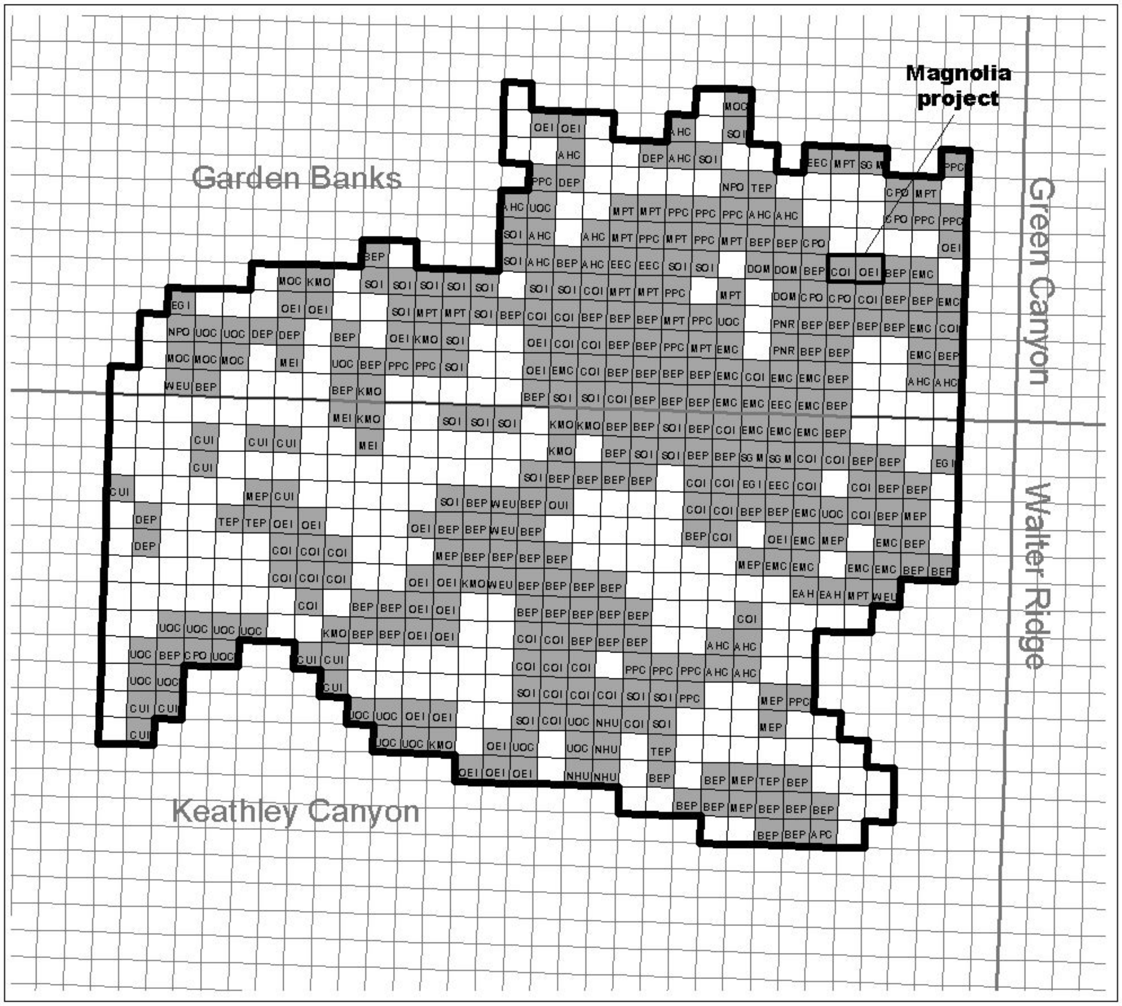


Figure 3. Bathymetry of Grid 7.



Grid boundary

AHC	AMERADA HESS	EGI	ENCANA GOM	NHU	NORSK HYDRO
APC	AMOCO	EAH	EXXON ASSET	OEI	OCEAN ENERGY
BEP	BP EXPLORATION	EMC	EXXON MOBIL	OUI	OXY USA
CPO	CALLON PETROLEUM	KMO	KERR-MCGEE	PPC	PHILLIPS PETROLEUM
CUI	CHEVRON USA	MOC	MARATHON OIL	PNR	PIONEER NATURAL
COI	CONOCO INC	MEI	MARINER ENERGY	SGM	SHELL
DEP	DEVON ENERGY	MPT	MOBIL PRODUCING	SOI	SHELL OFFSHORE
DOM	DOMINION	MEP	MURPHY EXPLORATION	TEP	TOTALFINAELF
EEC	EEX CORP	NPO	NEXEN PETROLEUM	UOC	UNION OIL
				WEU	WOODSIDE ENERGY

Figure 4. Leasehold Position of Operators within Grid 7.

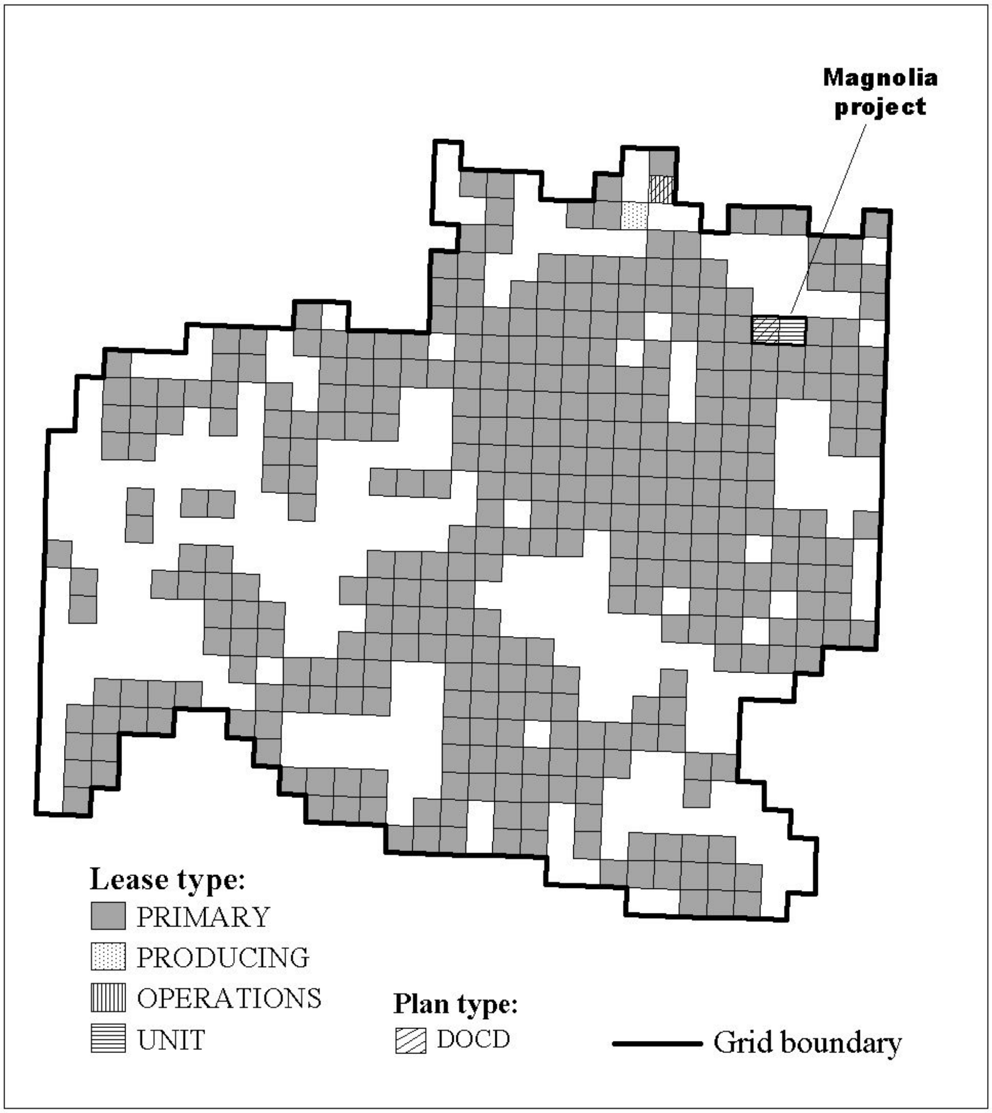


Figure 5. Active Lease Status and Plans Submitted.

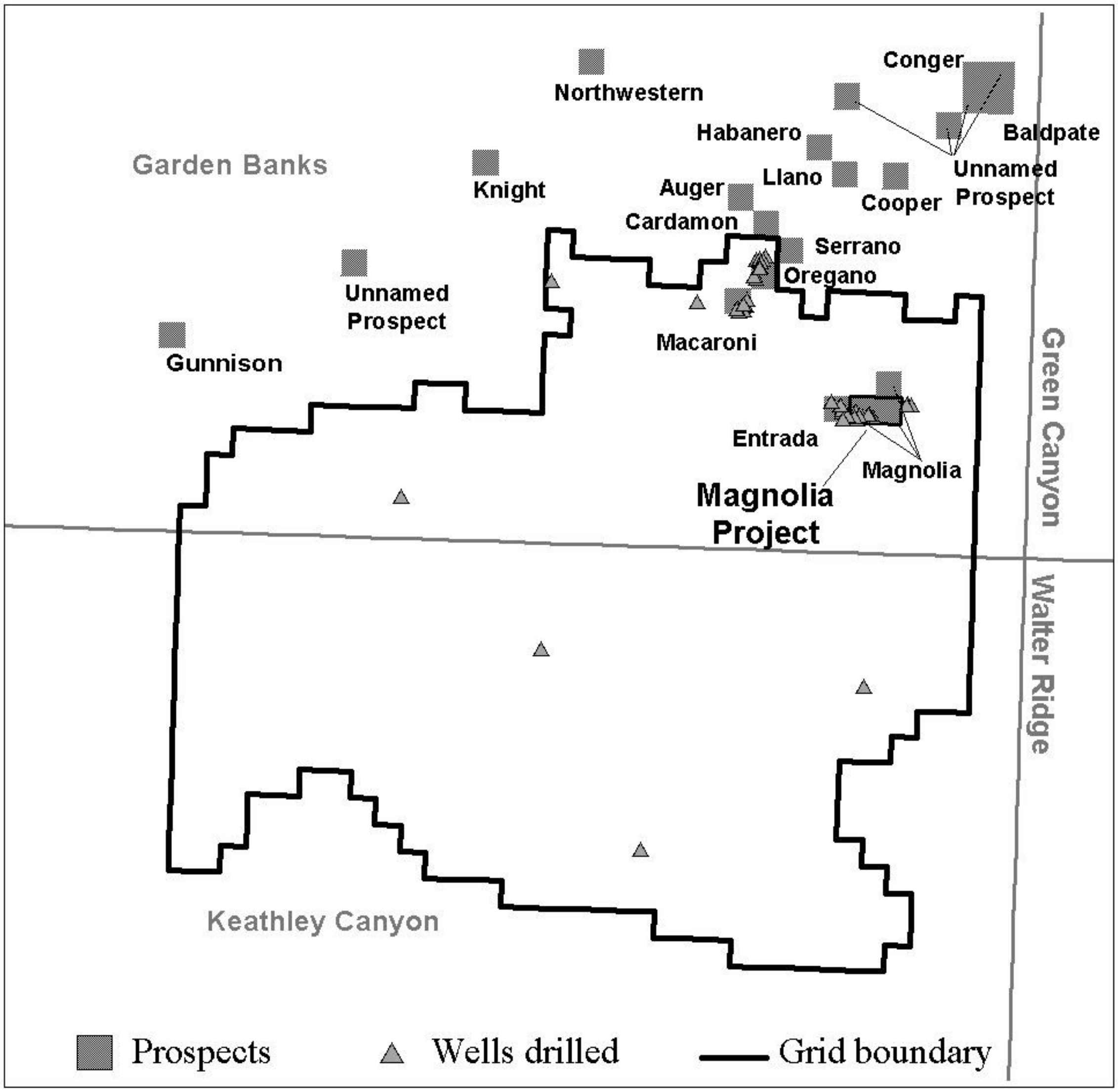


Figure 6. Publicly Announced Prospects and Wells Drilled in Grid 7.

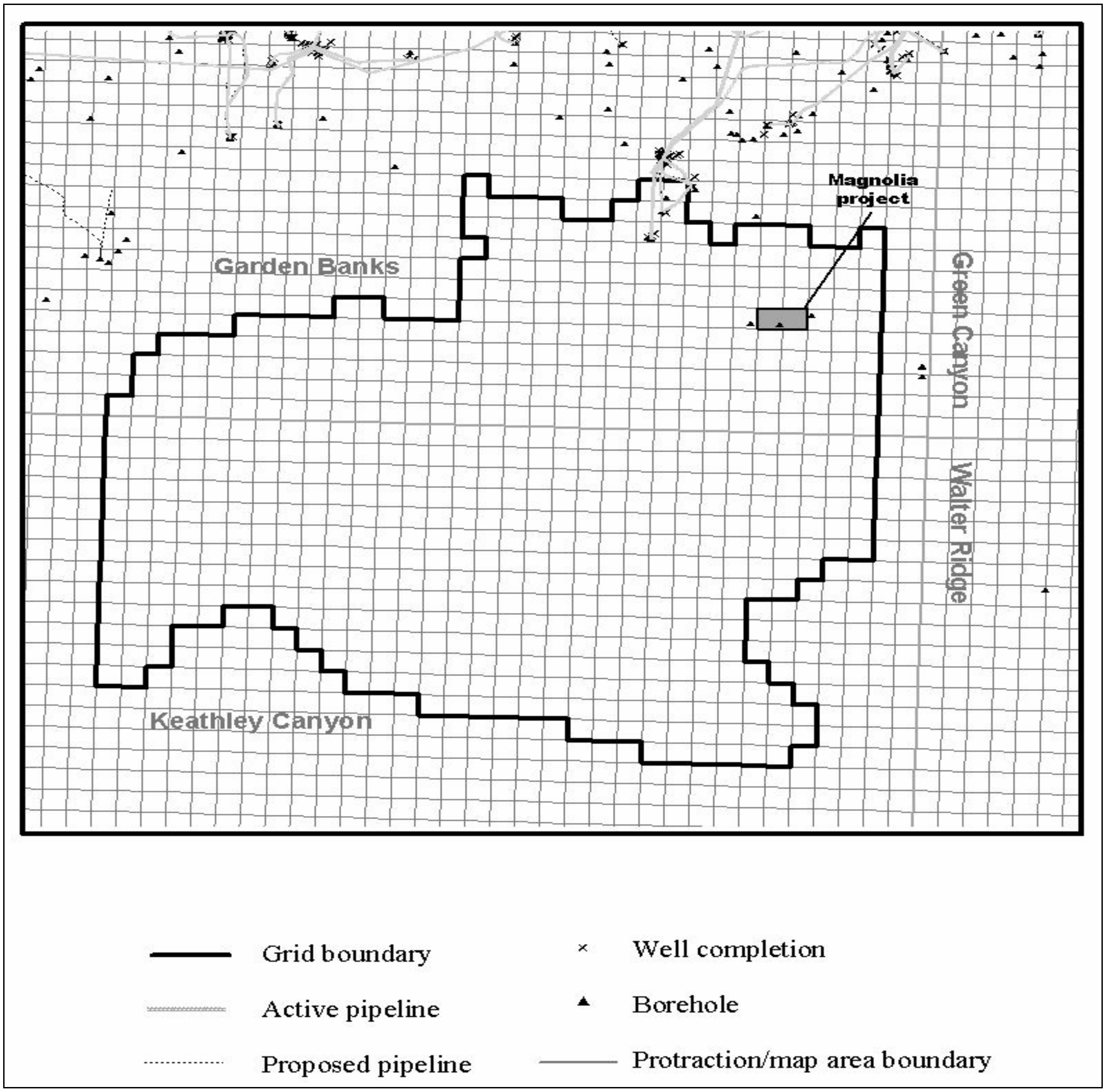


Figure 7. Existing and Proposed Pipeline Rights-of-Way within Grid 7.

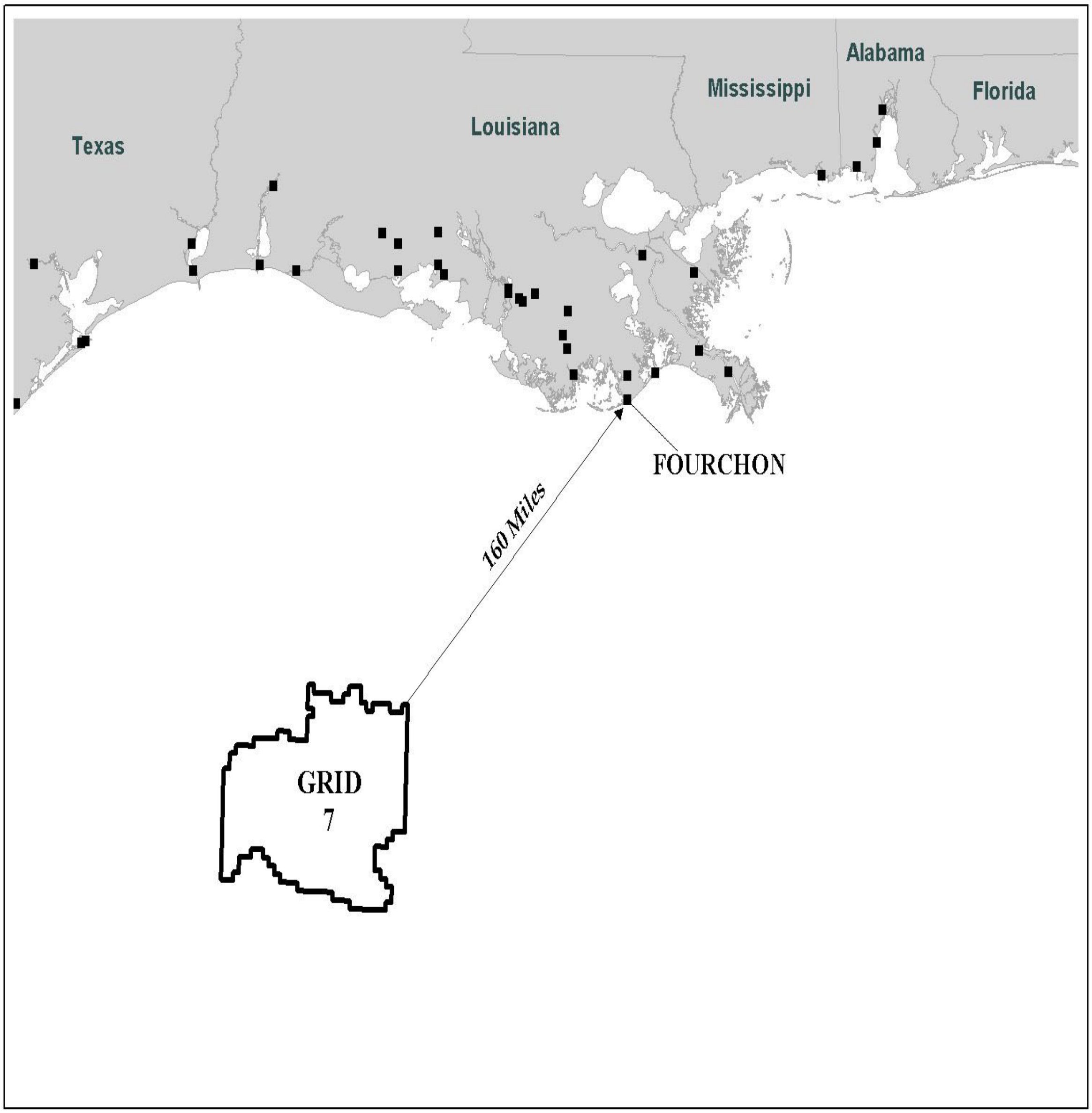


Figure 8. Distance from Grid 7 to Conoco's Selected Shore Base.

1. THE PROPOSED ACTION

1.1. PURPOSE AND NEED FOR THE PROPOSED ACTION

Under the Outer Continental Shelf Lands Act (OCSLA), as amended, the U.S. Department of the Interior (DOI) is required to manage the leasing, exploration, development, and production of oil and gas resources on the Federal OCS. The Secretary of the Interior 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.

Conoco Inc.'s Initial Development Operations Coordination Documents (DOCD) represents an action that cannot be categorically excluded because it represents activities in relatively untested deep water [516 DM Chapter 6, Appendix 10, C.(10)(1)].

This Programmatic Environmental Assessment (PEA) of the Grid implements the "tiering" process outlined in 40 CFR 1502.20, which encourages agencies to tier environmental documents, eliminating repetitive discussions of the same issue. By use of tiering from the most recent Final Environmental Impact Statement (EIS) for Western Planning Area Sales 187, 192, 196, and 200 (USDOI, MMS, 2002), and by referencing related environmental documents, this PEA concentrates on environmental effects and issues specific to the proposed action and other activities within the Grid.

Purpose

The purpose of this PEA is two-fold. It assesses the specific and cumulative impacts associated with Murphy's proposed action and also provides information on the deepwater area within Grid 7. The document can be used as a basis to allow most subsequent activities proposed in the Grid to be processed via a categorical exclusion review. However, if it is determined that a subsequent proposal will require preparation of a site-specific environmental assessment (SEA), the PEA provides information that can be referenced in the SEA. The SEA would be then focus on selected key issues. The grid area was determined by the MMS's implementing regulations for the National Environmental Policy Act (NEPA) to be an area of "relatively untested deep water" [516 DM Chapter 6, Appendix 10, C.(10)(1)]. To properly characterize the grid, the PEA captures all of the available environmental and operational information for the area. Chapter 3 describes the environment at the specific site of the proposed activities and in the broader grid area. Analyses within Chapter 4 examine the potential effects of the proposed action and other reasonably foreseeable activities within the grid on the environment in the vicinity of the proposal and on the broader grid area.

Need for the Proposed Action

Consistent with its obligation to the Federal Government, Conoco filed a DOCD. Listed below are some of the reasons Murphy submitted this proposal to MMS:

- Commercial quantities of hydrocarbons have been encountered;
- Leaseholders have a legal right to secure development of the resources;
- Leaseholders are obligated by lease terms to diligently develop the resources; and
- Limited lease terms and failure to develop the resources could lead to loss of lease.

1.2. DESCRIPTION OF THE PROPOSED ACTION

The MMS's Gulf of Mexico OCS Region, Office of Field Operations, received an Initial DOCD from Conoco. The DOCD proposes to complete three wells previously drilled and temporarily abandoned, drill and complete six additional wells, setting a tension leg platform (TLP), and commence production. The planned wells will share a common surface location in GB Block 783 (Conoco Inc., 2002). This proposal is known as the Magnolia Development Project. Previous projects associated with these leases include N-6290, R-3241, and S-5673. Table 1-1 depicts the spar's proposed location.

Table 1-1

Proposed Location of the Magnolia TLP in GB Block 783

Surface Location	Distance from Lease Lines	Lambert X-Y Coordinates	Latitude/Longitude
Magnolia TLP	FSL 4,025 ft FEL 1,283 ft	X =1,899,517.12 Y =9,872,345.49	Lat. 27° 12′ 13.860″ Long. 92° 12′ 9.361″

Note: FSL is from the south line of the lease.
FEL is from the east line of the lease.

The Magnolia TLP would be a manned, floating production facility that will be moored by eight steel tendons and is designed to accommodate nine top-tensioned production risers and two export pipeline risers. The Magnolia TLP has been designed to accommodate a 2,000-horsepower (HP) workover/completion rig that would be used for the initial completion operations and for performing any well recompletion, workover, or sidetrack operations if necessary. A semisubmersible drilling rig (ENSCO7500 drilling rig in dynamically positioned mode) will be used to drill all wells as part of this plan. No additional onshore facilities would be built as a result of this proposed action.

Table 1-2 shows the activity schedule proposed by Conoco for their Magnolia Project.

Table 1-2

Proposed Activity Schedule for the Magnolia Development Project

Activity	Start Date	End Date	Number of Days
Batch set casing for 6 wells Drill 6 wells Sidetrack 3 wells Complete and flow test 2 wells	November 2002	March 2004	475
Install TLP foundation	March 2004	April 2004	35
Pre-install tendons	June 2004	June 2004	14
Install TLP, hook-up, and commissioning	July 2004	August 2004	50
Complete 7 wells	August 2004	April 2005	251
First production	October 2004		NA

The water depth at the spar location is approximately 4,674 ft (1,424 m). The deepwater development is located approximately 150 mi (90 km) from the nearest Louisiana shoreline. The project will use existing onshore support base at the Edison-Chouest C-port base in Fourchon, Louisiana, to support the proposed activities. Helicopter assistance will be out of the PHI base located in Amelia, Louisiana. The distance from the onshore support base to the proposed Magnolia TLP is approximately 180 mi (108 km).

Oil and gas production will be transported from the Magnolia TLP through two right-of-way (ROW) pipelines to be installed, owned, and operated by su

bsidiaries of Shell; however, the ROW applications are not part of this assessment.

2. ALTERNATIVES TO THE PROPOSED ACTION

2.1. NONAPPROVAL OF THE PROPOSAL

Conoco would not be allowed to drill, complete, and produce the nine wells proposed in its Initial DOCD. This alternative would result in no impact from the proposed action but could discourage the development of much needed hydrocarbon resources, and thereby result in a loss of royalty income for the U.S. and energy for America. Considering these aspects and the fact that we anticipate very minor environmental and human effects resulting from the proposed action, this alternative was not selected.

2.2. APPROVAL OF THE PROPOSAL WITH EXISTING MITIGATION

The measures that Conoco proposes to implement to limit environmental effects are discussed in the Initial DOCD. The MMS's lease stipulations, Outer Continental Shelf Operating Regulations, Notices to Lessees and Operators, and other regulations and laws were identified throughout this environmental assessment as existing mitigation to minimize potential environmental effects associated with the proposed action. Additional information can be found in the Final Environmental Impact Statement (EIS) for Western Planning Area Sales 187, 192, 196, and 200 (USDOI, MMS, 2002). Since additional mitigation(s) were identified to avoid or mitigate potential impacts associated with the proposed action, this alternative was not selected.

2.3. APPROVAL OF THE PROPOSAL WITH EXISTING AND ADDITIONAL MITIGATION

Measures that Conoco proposes to implement to limit potential environmental effects are discussed in the Initial DOCD. The MMS's lease stipulations, Outer Continental Shelf Operating Regulations, Notices to Lessees and Operators, and other regulations and laws were identified throughout this environmental assessment as existing mitigation to minimize potential environmental effects associated with the proposed action. Additional information can be found in the Final EIS for Western Planning Area Sales 187, 192, 196, and 200 (USDOI, MMS, 2002). Approval of the proposal with existing and additional mitigation is the selected alternative. The following additional mitigations have been identified.

Mitigation 2.2 (Advisory) — Potential to exceed exemption level, DOCD

> A deviation from your DOCD (such as additional drilling time, changes in the drilling schedule, and/or use of higher horsepower equipment, especially for the drilling rig and construction barges) could potentially cause the annual emissions exemption level for NO_x to be exceeded. Therefore, if such a deviation occurs, please be advised that you will immediately prepare a revised DOCD pursuant to 30 CFR 250.204(q)(2) to include the recalculated emission amounts and the air quality modeling required by 30 CFR 250.303(e). You will not proceed with the actions that could cause the potential exceedance until the revised DOCD has been submitted to and approved by this office.

Mitigation 2.6 (Reminder) — Flaring beyond 48 hours

> Your plan indicates well test flaring for more than 48 continuous hours. Please be reminded that 30 CFR 250.1105(a)(3) requires you to obtain approval from the Regional Supervisor for Production and Development prior to conducting the proposed flaring activities.

Mitigation 8.3 (Advisory) — H_2S absent (plans)

> In response to the request accompanying your plan for a hydrogen sulfide (H_2S) classification, the area in which the proposed drilling operations are to be conducted is hereby classified, in accordance with 30 CFR 250.417(c), as "H_2S absent."

Mitigation 19.3 (Advisory) — ROV Survey Not Required

> In accordance with NTL No. 2001-G04, the MMS has determined that you will not need to conduct the two ROV surveys you proposed in your plan.

3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1. Physical Elements of the Environment

3.1.1. Water Quality

3.1.1.1. Coastal

The bays, estuaries, and nearshore coastal waters of the north-central Gulf are highly important in that they provide important feeding, breeding, and/or nursery habitat for many commercially important invertebrates and fishes, as well as sea turtles, birds, and mammals. Water quality governs the suitability of these waters for animal as well as human use. Furthermore, the egg, larval, and juvenile stages of marine biota dependent upon these areas are typically more sensitive to water quality than adult stages. The quality of coastal waters is, therefore, an important issue.

Nearshore water quality along the north-central Gulf Coast is addressed because the Magnolia Project is located offshore the Louisiana coast. The service bases for the development are located on or near the coast, and marine transportation to and from the site would traverse coastal waters.

A comprehensive assessment of water quality in coastal and estuarine waters of the GOM is contained in USEPA (1999a) and is not repeated here. The following material briefly highlights some of the key points concerning water quality in this region and is incorporated by reference.

Water quality in coastal waters of the northern GOM is highly influenced by season. For example, salinity in open water near the coast may vary between 29 and 32 parts per thousand (ppt) during fall and winter but decline to 20 ppt during spring and summer due to increased runoff (USDOI, MMS, 1998a). Oxygen and nutrient concentrations also vary seasonally.

More than 30 percent of the estuaries along the north-central Gulf have impaired water quality to the point that they cannot support beneficial uses such as aquatic life support, or recreational and commercial fisheries (USEPA, 1999b). Some of the industries and activities contributing to water quality degradation include petrochemical, agricultural, power production, pulp and paper, fish processing, municipal waste, shipping, and dredging. There are over 3,700 known point sources of contamination that flow into the Gulf (Weber et al., 1992 in USDOI, MMS, 1998) with municipalities, refineries, and petrochemical plants accounting for the majority of these point sources. Most of the industrial sources are in Texas and Louisiana. Vessels from the shipping and fishing industries, as well as recreational boaters, add contaminants to coastal water in the form of bilge water, waste, spills, and leaching from antifouling paints. Many millions of cubic feet of sediments are moved each year in coastal areas due to channelization, dredging, dredged material disposal, and shoreline modification in support of shipping, oil and gas operations, and other activities. Water quality may be affected by these activities as they can facilitate saltwater intrusion, increase turbidity, and release contaminants. Point-source discharges are now regulated and water quality should improve.

Nonpoint sources of contamination such as forestry, agriculture, and urban runoff are difficult to regulate and probably have the greatest impact on coastal water quality. Inland cities, farms, ranches, and various industries drain into waterways that empty into the Gulf. About 80 percent of U.S. croplands are upstream of the northern Gulf coastal waters. The Gulf coastal area alone used 10 million pounds of pesticides in 1987 (USDOI, MMS, 1998 and 2001a). Nutrient enrichment (nitrogen and phosphorus), mostly from river runoff is another major water quality problem that can lead to noxious algal blooms, reduced seagrasses, fish kills, and oxygen depletion. The Mississippi River alone has been estimated to contribute more than 341,000 pounds of phosphorus and 1.68 million pounds of nitrogen to the Gulf per day (USDOI, MMS, 2001a).

Biological indicators of poor coastal water quality are evident in that 50 percent of the largest U.S. fish kills between 1980 and 1989 occurred in Texas and 50 percent of shellfish beds in Louisiana are closed annually because of contamination (USDOI, MMS, 1998). On the other hand, Gulf States, although they had a number of "hot spots" for certain locations and contaminants, did not fare that badly when compared to other U.S. coastal waters during the major NOAA National Status and Trends Mussel Watch Program (USDOI, MMS, 2001a).

Sediment contamination in U.S. coastal waters is highly related to proximity to large industrialized cities. High levels for certain contaminants have been reported for all Gulf States (O'Connor, 1995). At least some contaminants are bioavailable, as evidenced by the 1986-1999 Mussel Watch Program

(USDOI, MMS, 2001a). A more lengthy discussion of coastal sediment quality is presented in the EIS (USDOI, MMS, 1998 and 2002).

3.1.1.2. Offshore

Offshore marine waters in the GOM are characterized by higher salinity (36.0-36.5 ppt) than inshore waters (USDOI, MMS, 1998). The five watermasses identified in Appendix D (Physical Oceanography) can be recognized by their chemical characteristics such as salinity, dissolved oxygen (DO), nitrate, phosphate, and silicate. The Mississippi River exerts considerable influence on the Gulf, including the offshore.

The depth distribution of nutrients and DO in the deep water of the Gulf is similar to that of the Atlantic Ocean. The DO is highest at the surface due to photosynthesis and exchange with the atmosphere, and it generally decreases with depth due to respiration by various organisms (including bacteria), although higher oxygen concentrations may be encountered in cold watermasses. Nutrient concentrations are lowest in the upper water layers where they become depleted by photosynthetic activity and are highest in deep water. Nutrient and oxygen concentrations in the open water of the deep Gulf are not usually measurably affected by anthropogenic inputs.

Two unusual water quality phenomena occur in the Gulf: (1) hypersaline basins (e.g., 250 ppt in Orca Basin) and (2) mid-shelf freshwater vents (e.g., southwestern Florida shelf springs). Another feature is the nepheloid layer, a thin, near-bottom, highly turbid layer that may play a role in transporting material, including contaminants, from nearshore to offshore waters. Hypoxic or oxygen-depleted bottom waters may be present in the northern Gulf off the mouth of the Mississippi River. This hypoxic area may be very large (16,500 km^2), extending from the Mississippi River Delta to Freeport, Texas, and is probably exacerbated by human inputs (USDOI, MMS, 1998). Near-hypoxic conditions, unrelated to the river plume, may also be observed in the oceanic oxygen minimum at depths between 200 and 400 m; these conditions are low enough (2.5-3.0 mg/l) to affect the biota (USDOI, MMS, 2001b).

Offshore areas, particularly over deep water, could be considered almost pristine compared to the coastal waters, particularly the deep water off southern Texas and Florida (USDOI, MMS, 2001b). However, petroleum-related volatile organic carbons have been detected at offshore locations. Offshore Texas, Louisiana, and Alabama show detectable levels of petroleum hydrocarbons, likely from natural seeps (Kennicutt et al., 1988 in USDOI, MMS, 1998). Similarly, trace metal concentrations are low relative to coastal waters (Boyle et al., 1984 in USDOI, MMS, 2001b).

Deepwater sediments, with the exception of barium concentrations in the vicinity of previous drilling activity, do not appear to contain elevated levels of metal contaminants (USDOI, MMS, 1998). Limited exception to this is the presence of barium-enriched sediments in the vicinity of previous drilling activity. Reported total hydrocarbons, including biogenic (e.g., from plankton and other biological sources) hydrocarbons, in sediments collected from the Gulf slope range from 5 to 86 ng/g (Kennicutt et al., 1987 in USDOI, MMS, 2001a). Petroleum hydrocarbons, including aromatic hydrocarbons (<5 ppb) were present at all sites sampled, apparently varying more by distance along an isopleth than by depth (one transect from 300 to 3,000 m) (Gallaway et al., in preparation; USDOI, MMS, 1998). Land-derived material is widespread in the Gulf due to large riverine inputs and transport across the shelf to the slope by slumping, slope failure (Gallaway et al., in preparation), and other processes. Natural seepage is considered to be a major source of petroleum hydrocarbons in the Gulf slope area (Kennicutt et al., 1987; Gallaway et al., in preparation; USDOI, MMS, 2001b).

Recent research found that the concentration of hydrocarbons in slope sediments (except in seep areas) was lower than previous reports for shelf and coastal sediments. No consistent decrease with increasing water depth was apparent below 300 m (Gallaway et al., in preparation). In general, the Central Gulf had higher levels of hydrocarbons, particularly those from terrestrial sources than the Western and Eastern Gulf (Gallaway and Kennicutt, 1988). Total organic carbon was also highest in the Central Gulf. Hydrocarbons in sediments have been determined to influence biological communities of the Gulf slope, even when present in trace amount (Gallaway and Kennicutt, 1988).

3.1.2. Air Quality

These operations will occur west of 87.5° W. longitude and hence falls under MMS's jurisdiction for enforcement of the Clean Air Act. The air over the OCS water is not classified, but is presumed to be better than the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants. The blocks involved, Garden Banks 783 and 784 are offshore, south of Vermilion Parish, Louisiana. Vermilion Parish is in attainment of all of the NAAQS.

The influence to onshore air quality is dependent upon meteorological conditions and air pollution emitted from the proposed action. The primary meteorological conditions are the wind speed and direction, the atmospheric stability class, and the mixing height, which govern the dispersion and transport of emissions. The mixing heights offshore are quite low, generally 900 m (2,950 ft) or less where there are no influences from land. The general wind flow for this area is driven by the clockwise circulation around the Bermuda High, resulting in a prevailing southeasterly to southerly flow. Superimposed upon this circulation are smaller scale effects such as the sea breeze effect, tropical cyclones, and mid-latitude frontal systems. Because of the various factors, the winds blow from all directions in the area of concern.

Not all of the Pasquill-Gifford stability classes are routinely found offshore in the GOM. Specifically, the F stability class is rare. This is the extremely stable condition that usually develops at night over land with rapid radiative cooling. This large body of water is simply incapable of loosing enough heat overnight to set up a strong radiative inversion. Likewise, the A stability class is also rare. It is the extremely unstable condition that requires a very rapid warming of the lower layer of the atmosphere, along with cold air aloft. This is normally brought about when cold air is advected in aloft and strong insolation rapidly warms the earth's surface, which in turn warms the lowest layer of the atmosphere. Once again, the ocean surface is incapable of warming rapidly; therefore, you would not expect to find stability class A over the GOM. For the most part, the stability is slightly unstable to neutral.

The mixing heights offshore are quite shallow, generally 900 m or less. The exception to this is close to shore, where the influence of the land penetrates out over the water for a short distance. Transient cold fronts also have an impact on the mixing heights; some of the lowest heights can be expected to occur with frontal passages and on the cold air side of the fronts. This effect is caused by the frontal inversion.

3.2. BIOLOGICAL RESOURCES

3.2.1. Sensitive Coastal Environments

3.2.1.1. Coastal Barrier Beaches and Associated Dunes

The U.S. Gulf shoreline from the Mexican border to Florida is about 1,500 km long. Ocean-wave intensities around the Gulf are generally low to moderate. These shorelines are usually sandy beaches that can be divided into several interrelated environments. Generally, beaches consist of a shoreface, foreshore, and backshore. The shoreface slopes downward and seaward from the low-tidal water line, under the water. The nonvegetated foreshore slopes up from the ocean to the beach berm-crest. The backshore is found between the beach berm-crest and the dunes, and it may be sparsely vegetated. The berm-crest and backshore may occasionally be absent due to storm activity.

The dune zone of a barrier landform can consist of a single low dune ridge, several parallel dune ridges, or a number of curving dune lines that may be stabilized by vegetation. These elongated, narrow landforms are composed of wind-blown sand and other unconsolidated, predominantly coarse sediments.

Sand dunes and shorelines conform to environmental conditions found at its site. These conditions usually include waves, currents, wind, and human activities. When Gulf waters are elevated by storms, waves are generally larger and can overwash lower coastal barriers, creating overwash fans or terraces behind and between the dunes. With time, opportunistic plants will reestablish on these flat, sand terraces, followed by the usual vegetative succession for this area. Along more stable barriers, where overwash is rare, the vegetative succession in areas behind the dunes is generally complete. Vegetation in these areas of broad flats or coastal strands consists of scrubby woody vegetation, marshes, and maritime forests. Saline and freshwater ponds may be found among the dunes and on the landward flats. Landward, these flats may grade into wetlands and intertidal mud flats that fringe the shore of lagoons, islands, and embayments. In areas where no bay or lagoon separates barrier landforms from the mainland, the barrier vegetation grades into scrub or forest habitat of the mainland.

Larger changes to barrier landforms are primarily due to storms, subsidence, deltaic cycles, longshore currents, and human activities. Barrier landform configurations continually adjust, accreting and eroding, in response to prevailing and changing environmental conditions. Landform changes can be seasonal and cyclical, such as seen with the onshore movement of sand during the summer and offshore movement during the winter, which is due to seasonal meteorological and wave-energy differences. Noncyclical changes in landforms can be progressive, causing landform movement landward, seaward, or laterally along the coast.

Lateral movement of barrier landforms is of particular importance. As headlands and beaches erode, their sediments are transported offshore or laterally along the shoreline. Eroding headlands typically extend sand spits that may encape marshes or previously open, shallow Gulf waters. By separating inshore waters from Gulf waters and slowing the dispersal of freshwater into the Gulf, movements of barrier landforms contribute to the area and diversity of estuarine habitat along a coast. Most barrier islands around the Gulf are moving laterally to some degree. Where this occurs, the receding end of the island is typically eroding; the leading end accretes. These processes may be continuous or cyclic.

Accumulations and movements of sediments that make up barrier landforms are often described in terms of regressive and transgressive sequences. Although transgressive landforms dominate around the GOM, both transgressive and regressive barriers occur there. A regressive sequence deposits terrestrial sediments over marine deposits, building land into the sea, as would be seen during deltaic land-building processes. Regressive barriers have high and broad dune profiles. These thick accumulations of sand may form parallel ridges.

A transgressive sequence moves the shore landward, allowing marine deposits to form on terrestrial sediments. Transgressive coastal landforms around the Gulf have low profiles and are characterized by narrow widths; low, sparsely vegetated, and discontinuous dunes; and numerous, closely spaced, active washover channels. Landward movement or erosion of a barrier shoreline may be caused by any combination of subsidence, sea-level rise, storms, channels, groins, seawalls, and jetties. These influences are discussed under the cumulative activities scenario (Chapter 4.1.3.3). Movement of barrier systems is not a steady process because the passage rates and intensities of cold fronts and tropical storms, as well as intensities of seasons, are not constant (Williams et al., 1992).

Texas and Mexican Barrier Island Complex

The Gulf coastline of Texas is about 590 km long. The State of Tamaulipas, in northeastern Mexico, has a Gulf shoreline of about 378 km. The barrier islands of both areas are mostly accreted sediments that were reworked from river deposits, previously accreted Gulf shores, bay and lagoon sediments, and exposed seafloors (White et al., 1986). This reworking continues today as these barrier beaches and islands move generally to the southwest (Price, 1958). During the period of about 1850-1975, net coastal erosion occurred in the following three groups of counties in Texas: (1) Cameron, Willacy, and southern Kenedy; (2) northern Matagorda, Brazoria, and southern Galveston; and (3) Jefferson, Chambers, and far northern Galveston (Morton, 1982). These generalized trends seem to be continuing.

Elevations of Galveston Island and Bolivar Peninsula beach ridges generally range from 1.5 to 3 m above sea level (Fisher et al., 1972). The beaches of Galveston Island and Bolivar Peninsula are locally eroding or accreting. Accreting shorelines have a distinct beach berm and a wide back beach. Eroding beaches are relatively narrow, and the beach berm and back beach may be absent. Construction of seawalls and jetties on Galveston Island have contributed to erosion there, as discussed further in Chapter 4.1.3.3.

Padre Island is moderately regressive. It is typically 1.5-3 m above sea level and occasionally overwashed by hurricane surges. On the northern portion, some dunes may rise 6-9 m and the dune ridge is generally continuous. On the southern portion, the dune ridge is a series of short discontinuous segments. The dry winds and arid nature of this southern portion destabilize sand dunes. Sand flats and coppice dunes occupy the southern portion of the island. Any activity that reduces the sparse vegetation cover of this area initiates erosion. Vegetation on Padre Island is generally sparse, becoming more sparse on its southern portion. The vegetation largely consists of grasses and scrubby, woody growth (Brown et al., 1977).

Exceptions to the above are the once regressive Matagorda Peninsula and Rio Grande Headland. The Matagorda Peninsula accreted as the Brazos-Colorado River Delta. Later, the peninsula became transgressive and the sediments were reworked to form flanking arcs of barrier sand spits. Washover channels cut the westward arc of the peninsula, forming barrier islands. The Rio Grand Headland has also become transgressive and sand spits formed to its north and south. Today, longshore drift is southerly at these sites. Their northern spits are now eroding and their southern spits are accreting.

The Chenier Plain

The Chenier Plain of eastern Texas and western Louisiana began developing about 2,800 years ago. During that period, Mississippi River Delta sediments were intermittently eroded, reworked, and carried into the Chenier Plain area by storms and coastal currents. This deposition gathered huge volumes of mud and sand, forming a shoreface that slopes very gently, almost imperceptibly, downward for a very long distance offshore. This shallow mud bottom is viscous and elastic, which generates hydrodynamic friction (Bea et al., 1983). Hence, wave energies along the barrier shorelines of the Chenier Plain are greatly reduced, causing minimal longshore sediment transport along the Chenier Plain (USDOI, GS, 1988). More recently, this shoreline has been eroding as sea level rises, converting most of this coast to transgressive shorelines.

Today, the Red River and about 30 percent of the Mississippi River are diverted to the Atchafalaya River. The diversions have increased the sediment load in the longshore currents, which generally move slowly westward along the coast.

The barrier beaches of the Chenier Plain are generally narrow, low, and sediment starved due to the natures of coastal currents and the shoreface. Here and there, beach erosion has exposed relic marsh terraces that were buried by past overwash events. West of about Fence Lake, Texas, the beach is fairly typical, being composed of shelly sand; although, it is no more than 200 ft wide. Its shoreface sediments are similar (Fisher et al., 1973).

East of Fence Lake, the shoreface contains discontinuous mud deposits among muddy sands. During low tides, extensive mudflats are exposed east and west of Fence Lake. The beach in this area is much narrower and becomes a low escarpment, where wave action cuts into the salt marsh (Fisher et al., 1973). In the vicinity of Louisiana's Constance Beach and Peveto, the rapidly eroding beach may be as much as 60 ft wide, where it exists. In this vicinity, erosion threatens Louisiana State Highway 82 and a few houses. In these more rapidly eroding areas, the beach is replaced by rip-rap and bulkheads (Mann and Thompson, 2001). In 1988, the U.S. Geological Survey reported that general shoreline retreat along the Chenier Plain had been three or more meters per year. Since then, a series of offshore wave breaks have been placed from Constance Beach to Holly Beach, Louisiana, to reduce erosion and to retain sediments. These circumstances are discussed in greater detail in Chapter 4.1.3.3.

The dune ridges of the Chenier Plain's shoreline are generally well vegetated. Their elevations along the Texan segment are generally less than 5 ft (Fisher et al., 1973). Transects taken along the beach in the vicinity of Oceanview Beach to Holly Beach indicate that the dune ridge ranged between 7 and 12 ft National Geodetic Vertical Depth (NGVD). For comparison, the high-water shoreline position during October 1992 through July 1994 was estimated to be fairly stable, at about 3.5 ft NGVD (Byrnes and McBride, 1995).

The Mississippi River Delta Complex

Most barrier shorelines of the Mississippi River Delta in Louisiana are transgressive and trace the seaward remains of a series of five abandoned deltas. The Mississippi River is channelized through the Belize Delta, more commonly known as the Birdfoot Delta. Channelization isolated the river from most of this sixth delta, except near the distributary mouths. There, a small fraction of the river's sediment load is contributed to longshore currents for building and maintaining barrier shores. The bulk of river sediments are deposited in deep water, where they cannot be reworked and contribute to the longshore sediment drift. Most of southeastern Louisiana's barrier beaches are composed of medium to coarse sand.

The shorefaces of the Mississippi River Delta complex generally slope very gently seaward, which reduces wave energies at the shorelines. Mud flats are exposed during very low tidal events. The slope here is not as shallow as that found off the Chenier Plain. The steepest shoreface of the delta is found at the Caminada-Moreau Coast, where the greatest rates of erosion are seen. At this site, the long shore currents split to the east and west, which removes sand from the area without replenishing the area (Wolfe et al., 1988; Wetherell, 1992; Holder and Lugo-Fernandez, 1993).

Regressive shorelines do occur in Louisiana's deltaic region. The diversion of the Red River and about 30 percent of the Mississippi River to the Atchafalaya River has allowed transport of large volumes of sediment into shallow Atchafalaya Bay. There, inland deltas are forming at the mouths of that river and Wax Lake Outlet. Recent satellite photography of these deltas reveal that dredge-disposal islands were constructed off Point au Fer in very shallow water (3-5 ft) at the mouth of Atchafalaya Bay. These islands and the surrounding shallows are the foundations for a future barrier shoreline in this area, if the Atchafalaya River Delta continues to build seaward as expected.

Smaller shoreline regressions also occur as a result of jetties located on the eastern end of Grand Isle, the western end of Caminada-Moreau Beach, Empire navigational canal, and elsewhere. Most dune zones of the Mississippi River Delta contain low, single-line dune ridges that may be sparsely to heavily vegetated. Generally in this area, the vegetation on a dune ridge gets denser as the time between storms lengthens. The dune zone of the Chandeleur Islands is larger and more complex. Boyd and Penland (1988) reported that elevations of the Chandeleur Islands ranged between less than 1 m and 8 m MSL (above mean sea level). Since then, the hurricanes of the 1990's greatly lowered these elevations, which are slowly recovering. In 1997 the Chandeleur Islands contained about 1,930 ha of land, most of which was beach and dune complex (USDOI, GS, 1998).

Boyd and Penland (1988) reported that 52 percent of the Caminada-Moreau Coast had a vegetated, dune ridge of less than 1 m MSL and that the elevation of the remaining length ranges up to 3 m MSL. The mean water-level threshold for overwashing 75 percent of that beach is 1.42 m MSL. They estimated that this threshold is achieved about 15 times a year, on average. Mean water elevations exceeding 2.5 m MSL occur once every 2 years (Richie and Penland, 1985).

Boyd and Penland (1988) estimated that storms raise mean water levels 173-2.03 m above mean sea level 10-30 times per year. Under those conditions, the following would be overwashed: 67 percent of Timbalier Island; 100 percent of Isles Dernieres and the Barataria Bay Barriers (excluding Grand Isle); and 100, 89, and 64 percent of the southern, central, and northern portions of the Chandeleur Islands, respectively.

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

3.2.1.2. Wetlands

Wetlands are common along the Gulf Coast, especially along coastal Louisiana. They include seagrass meadows, mudflats, mangroves, marshes (fresh, brackish, salt), and hardwood and cypress-tupelogum swamps. These areas may occur in isolated pockets, narrow bands, or cover large areas of the coast (USDOI, MMS, 2001a).

High productivity, high detritus input, and extensive nutrient recycling characterize coastal wetlands. They are important habitats for a large number of invertebrate, fish, reptile, bird, and mammal species, including rare and endangered species, and high-value commercial and recreational species for at least part of their life cycles. Since the 1980's, wetland areas have declined significantly (USDOI, MMS, 2001a). For these reasons, wetlands are an important issue when assessing impacts of coastal developments and/or accidental spills, in situations where spills may impinge on the coast.

The GOM coastal wetlands represent about half of the nation's wetland area. These wetlands help support the exceptionally productive coastal fisheries (e.g., Gulf ports account for four of the top five ports in the U.S. in terms of landed weight) and about 75 percent of the migratory waterfowl traversing the country (Johnston et al., 1995). The NOAA (1991) and Johnston et al. (1995) estimated that, although wetland area has decreased substantially over the last 30 years, about 1.3 million ha of marshes, estuarine shrub-scrub, and freshwater forested/shrub-scrub remain on the Gulf Coast. Of these three categories, 80 percent is marsh, 19 percent is estuarine scrub-shrub, and 1 percent forested wetland. Louisiana has the greatest area with 55 percent of the total (representing 69% of total marsh) followed by Florida (18%) (including 97% of total scrub-shrub, mostly mangrove), Texas (14%), and Mississippi (2%) (Johnston et al., 1995).

The National Biological Service (NBS) provides more recent calculations of wetland losses than the NOAA data, with updates every three years based on satellite imagery. The NBS suggests that wetland losses are greater than previously thought, although the rate of loss appears to be declining (Johnston et al., 1995).

3.2.1.3. Seagrasses

Seagrass communities are extremely productive, providing essential habitat for wintering waterfowl, as well as spawning and feeding habitat for several commercially and recreationally species of fish and shellfish, and endangered and threatened species of manatee and sea turtles. Seagrass habitat loss in the Gulf has been extensive over the last 50 years. Although found in isolated patches and narrow bands along the entire Gulf Coast in shallow, clear, estuarine areas, seagrass meadows occur extensively along the eastern coast between Mobile Bay and Florida Bay. Florida contains about 693,000 ha of the 1.02 million ha estimated for all the Gulf states (Handley, 1995). Louisiana has a large amount of submerged vegetation but only a small area of seagrass habitat (about 5,657 ha in 1988) (Handley, 1995).

3.2.2. Deepwater Benthic Communities/Organisms

3.2.2.1. Chemosynthetic Communities

Chemosynthetic communities are defined as persistent, largely sessile assemblages of marine organisms dependent upon symbiotic chemosynthetic bacteria as their primary food source (MacDonald, 1992). Chemosynthetic clams, mussels, and tube worms, similar to (but not identical with) the hydrothermal vent communities of the eastern Pacific (Corliss et al., 1979) have been discovered in association with hydrocarbon seeps in the northern GOM. Bacteria live within specialized cells in these invertebrate organisms and are supplied with oxygen and chemosynthetic compounds by the host via specialized blood chemistry (Fisher, 1990). The host, in turn, lives off the organic products subsequently released by the chemosynthetic bacteria and may even feed on the bacteria themselves. Free-living chemosynthetic bacteria may also live in the substrate within the invertebrate communities and may compete with their symbionts for sulfide and methane energy sources. Initial discoveries of cold-water seep communities indicated that they are primarily associated with hydrocarbon and H_2S seep areas (Kennicutt et al., 1985; Brooks et al., 1986a). Since the initial discovery in 1984 of chemosynthetic communities dependent on hydrocarbon seepage in the GOM off the west coast of Florida, their geographic range has been found to include the Texas, Louisiana, and Alabama continental slope with a depth range varying from less than 500 m to 2,200 m (Rosman et al., 1987; MacDonald, 1992). Four general community types have been described by MacDonald et al. (1990). These are communities dominated by vestimentiferan tube worms, mytilid mussels, vesicomyid, and infaunal lucinid or thyasirid clams. These faunal groups tend to display distinctive characteristics in terms of how they aggregate, the size of aggregations, the geological and chemical properties of the habitats in which they occur and, to some degree, the heterotrophic fauna that occur with them.

The reliance of deep-sea chemosynthetic communities on nonphotosynthetic carbon sources limits their distribution in the Gulf to areas where hydrocarbon sources are available. Within the northern Gulf, chemosynthetic communities are generally associated with slow oil and gas seeps, rapid expulsion mud volcanoes, and mineral seeps (Roberts and Carney, 1997). The most common hydrocarbon source is associated with seeps. Oil reservoirs beneath the Gulf include faults within source rock that have allowed oil and gas to migrate upward to the seafloor over the past several million years (Sassen et al., 1993). Hydrocarbons seeping to the surface diffuse through overlying sediments where bacterial degradation creates the chemosynthetic substrate taken up by symbiotic invertebrates. Vestimentiferan tube worms and lucinid and vesicomyid clams rely on H_2S, whereas mytilid mussels used dissolved CH_4. Mud volcanoes and mineral seeps provide similar chemosynthetic source material, but their occurrence in the Gulf is far less extensive than oil and gas seeps.

Hydrocarbon seep communities in the Central Gulf have been reported to occur at water depths between 290 and 2,200 m (Roberts et al., 1990; MacDonald, 1992). To date, there are 45 sites (in 42 blocks) across the northern GOM continental slope where the presence of chemosynthetic metazoans (dependent on hydrocarbon seepage) has been definitively documented (MacDonald, 1992; Boland, personal observations, 2000). There are no known chemosynthetic communities located in Grid 7; however, there are a number of known chemosynthetic communities located in Grid 6, immediately to the north of Grid 7. The closest community is more than 22 nmi distant from the Magnolia Project. The total number of these communities in the Gulf is now known to exceed 50 (Gallaway et al., 2000). Future identification of chemosynthetic communities will likely rely on a combination of broad-scale geophysical sensing surveys followed by more detailed site-specific protocols, including visual surveys by submersibles or remotely-operated vehicles (ROV's). A review for the potential occurrence of chemosynthetic communities associated with the Magnolia Project was performed separately from this EA. The conclusion of this analysis, determined that all impacting factors related to the Magnolia development in Garden Banks Block 783 are well removed from any area with potential for the existence of chemosynthetic communities pursuant to the requirements of NTL 2000-G20.

3.2.2.2. Coral Reefs

Coral reefs are particularly sensitive to human disturbance from increased sediments (e.g., from dredging), nutrient inputs (e.g., from sewage effluents), and physical damage (e.g., from anchoring). In the GOM, shallow-water coral reefs are associated with topographic highs such as the well-known East and West Flower Gardens and a number of others in the Central Planning Area (CPA). None of these are located in the deepwater areas of Grid 7.

At present, there is little information regarding deepwater coral reefs and their abundance in the Gulf (USDOI, MMS, 2000). Moore and Bullis (1960) collected more than 136 kg (300 lb) of scleractinian coral, *Lophelia prolifera*, from a depth of 421-512 m (1,381-1,680 ft), about 20 nmi from Viosca Knoll Block 907 (USDOI, MMS, 2000). Recently, there have been observed reports of large amounts of *L. prolifera* video recorded in Viosca Knoll Block 826 (Roberts, personal communication, 2002), as well as video recordings of *Madrapora oculata*, another deepwater scleractinian coral, found in Green Canyon Block 238 (Childs, personal observation, 2002). Known hard bottoms supporting potential unknown coral reef habitat are avoided as a consequence of the MMS's Chemosynthetic Community NTL (NTL 2000-G20).

3.2.2.3. Deepwater Benthos

Marine benthic communities consist of a wide variety of single-celled organisms, plants, invertebrates, and fish. Their lifestyles are extremely varied as well and can include absorption of dissolved organic material, symbiosis (e.g., chemosynthetic communities), collection of food through filtering, mucous webs, seizing, or other mechanisms.

It is convention in the Gulf region to classify benthic animals according to size as megafauna (large, usually mobile animals on the surface), macrofauna (retained on 0.25- to 0.50-mm mesh size sieve), meiofauna (0.063-mm screen; mostly nematode worms), and microfauna (protists and bacteria). The four types are discussed briefly below.

3.2.2.3.1. Megafauna

Animals of a size typically caught in trawls and large enough to be easily visible (e.g., crabs, shrimp, benthic fish, etc.) are called megafauna. In the Gulf, most are crustaceans, echinoderms, or benthic fish. Benthic megafaunal communities in the Central Gulf appear to be typical of most temperate continental slope assemblages found at depths from 300 to 3,000 m (984 to 9,843 ft) (USDOI, MMS, 2001a). Exceptions include the chemosynthetic communities discussed previously.

Megafaunal invertebrate and benthic fish densities appear to decline with depth between the upper slope and the abyssal plain (Pequegnat, 1983; Pequegnat et al., 1990). This phenomenon is generally believed to be related to the low productivity in deep, offshore Gulf waters (USDOI, MMS, 2001a). Megafaunal communities in the offshore Gulf have historically been zoned by depth strata which are typified by certain species assemblages (Menzies et al., 1973; Pequegnat, 1983; Gallaway et al., 1988; Gallaway, 1988a-c; Pequegnat et al., 1990; and USDOI, MMS, 2001a). These zones include the following:

- Shelf/Slope Transition Zone (100-500 m) — Echinoderms, crustaceans, and several species of abundant fish.

- Archibenthal Zone (Horizon A) (500-775 m) — Galatheid crabs, rat tail fishes, large sea cucumbers, and sea stars are abundant.
- Archibenthal Zone (Horizon B) (800-1,000 m) — Galatheid crabs and rat tail fishes are abundant; fishes, echinoderms, and crustaceans decline; characterized by the red crab, Chaceon quinquedens.
- Upper Abyssal Zone (1,000-2,000 m) — Number of fish species decline while the number of invertebrate species appear to increase; sea cucumbers, *Mesothuria lactea* and *Benthodytes sanguinolenta* are common; galatheid crabs include 12 species of the deep-sea genera Munida and Munidopsis, while the shallow brachyuran crabs decline.
- Mesoabyssal Zone (2,300-3,000 m) — Fish species are few and echinoderms continue to dominate the megafauna.
- Lower Abyssal Zone (3,200-3,800 m) — Large asteroid, *Dytaster insignis*, is the most common megafaunal species.

Carney et al. (1983) postulated a simpler system of zonation having three zones: (1) a distinct shelf assemblage in the upper 1,000 m; (2) indistinct fauna between 1,000 and 2,000 m; and (3) a distinct slope fauna between 2,000 and 3,000 m.

The baseline NGMCS Study conducted in the mid- to late 1980's trawled 5,751 individual fish and 33,695 invertebrates, representing 153 and 538 taxa, respectively. That study also collected 56,052 photographic observations, which included 76 fish taxa and 193 non-fish taxa. Interestingly, the photographic observations were dominated by holothurians, bivalves, and sea pens, groups that were not sampled effectively (if at all) by trawling. Decapod crustaceans dominated the trawls and were fourth in the photos from an abundance perspective. Decapod density generally declined with depth but with peaks at 500 m and between 1,100 and 1,200 m, after which depth abundance was quite low. Fish density, while variable, was generally high at depths between 300 and 1,200 m; it then declined substantially.

Gallaway et al. (in preparation) concluded that megafaunal composition changes continually with depth such that a distinct upper slope fauna penetrates to about 1,200 m depths and a distinct deep-slope fauna is present below 2,500 m. A broad transition zone characterized by low abundance and diversity occurs between depths of 1,200 and 2,500 m. The proposed Magnolia development, at a depth of 678 m, lies within the distinct upper slope zone described above.

3.2.2.3.2. Macrofauna

The benthic macrofaunal component of the NGMCS Study (Gallaway et al., in preparation) included sampling in Grid 12 and in nearby grids (Grids 13 and 14). A transect (the central transect) of 11 baseline stations from 305 m to nearly the 3,000-m contour was sampled in this study. All of these data are relevant to the proposed Magnolia development because they were taken from the same geographic area and encompass the same depths and substrates.

The NGMCS Study examined 69,933 individual macrofauna from over 1,548 taxa; 1,107 species from 46 major groups were identified (Gallaway et al., in preparation). Polychaetes (407 species), mostly deposit-feeding forms (196 taxa), dominated in terms of numbers. Carnivorous polychaetes were more diverse, but less numerous than deposit-feeders, omnivores, or scavengers (Pequegnat et al., 1990; Gallaway et al., 2001). Polychaetes were followed in abundance by nematodes, ostracods, harpacticoid copepods, bivalves, tanaidacids, bryozoans, isopods, amphipods, and others. Overall abundance of macrofauna ranged from 518 to 5,369 individuals/m^2 (Gallaway et al., 1988). The central transect (4,938 individuals/m^2) had higher macrofaunal abundance than either the eastern or western Gulf transects (4,869 and 3,389 individuals/m^2, respectively) (Gallaway et al., in preparation).

In the GOM, macrofaunal density and biomass declines with depth from approximately 5,000 individuals/m^2 on the lower shelf-upper slope to several hundred individuals/m^2 on the abyssal plain (USDOI, MMS, 2001a). This decline in benthos has been attributed to the relatively low productivity of the Gulf offshore open waters (USDOI, MMS, 2001a). However, Pequegnat et al. (1990) reported mid-depth maxima of macrofauna in the upper slope at some locations of high organic particulate matter, and Gallaway et al. (in preparation) noted that the decline with depth is not clear cut and is somewhat obscured by sampling artifacts.

There is some suggestion that sizes of individual macrofauna decrease with depth (Gallaway et al., in preparation) and that size of individuals are generally small. Macrofaunal abundance appears to be higher in spring than in fall (Gallaway et al., in preparation).

Macrofauna in the Gulf appears to have lower densities but higher diversities than the Atlantic, especially above 1,000 m, whereas at deep depths the fauna are less dissimilar in densities and very similar in diversities (Gallaway et al., in preparation).

3.2.2.3.3. Meiofauna

Meiofauna (primarily composed of small nematode worms), as with megafauna and macrofauna, also decline in abundance with depth (Pequegnat et al., 1990; Gallaway et al., in preparation; USDOI, MMS, 2001a). The overall density (mean of 707,000/m^2) of meiofauna is approximately two orders of magnitude greater than the macrofauna throughout the depth range of the slope (Gallaway et al., 1988). These authors reported 43 major groups of meiofauna, with nematodes, harpacticoid copepods (adults and larvae), polychaetes, ostracods, and Kinorhyncha accounting for 98 percent of the total numbers. Nematodes and harpacticoids were dominant in terms of numbers, but polychaetes and ostracods were dominant in terms of biomass, a feature that was remarkably consistent across all stations, regions, seasons, and years (Gallaway et al., in preparation). Meiofaunal densities appeared to be somewhat higher in the spring than in the fall. Meiofaunal densities reported in the NGMCS Study are among the highest recorded worldwide (Gallaway et al., in preparation). There is also evidence that the presence of chemosynthetic communities may enrich the density and diversity of meiofauna in the immediate surrounding area (Gallaway et al., in preparation).

The above conclusions were partially based on the collections from the NGMCS Study stations in the Central Gulf transect. The Central Gulf transect appeared to contain a higher abundance of meiofauna than transects in the Eastern or Western Gulf, and in general, there was a trend of decreasing meiofauna numbers with depth (Gallaway et al., in preparation).

3.2.2.3.4. Microbiota

Less is known about the microbiota than the other groups in the GOM, especially in deep water (USDOI, MMS, 2000). A recent MMS publication (USDOI, MMS, 2001b) provides information on this subject. An overview is provided below.

As reported by Rowe (CSA, 2000), the microbiota of the deep Gulf sediments is not well characterized. While direct counts have been coupled with some *in situ* and repressurized metabolic studies performed in other deep-ocean sediments (Deming and Baross, 1993), none have been made in the deep GOM. Cruz-Kaegi (1998) made direct counts using a fluorescing nuclear stain at several depths down the slope, allowing bacterial biomass to be estimated from their densities and sizes. Mean biomass was estimated to be 2.37 g $C \cdot m^{-2}$ for the shelf and slope combined, and 0.37 g $C \cdot m^{-2}$ for the abyssal plain. In terms of biomass, data indicate that bacteria are the most important component of the functional infaunal biota. Cruz-Kaegi (1998) developed a carbon cycling budget based on estimates of biomass and metabolic rates in the literature. She discovered that, on the deep slope of the Gulf, the energy from organic carbon in the benthos is cycled through bacteria.

3.2.3. Marine Mammals

Twenty-nine species of marine mammals are known to occur in the GOM (Davis et al., 2000). The Gulf's marine mammals are represented by members of the taxonomic Order Cetacea, which is divided into the suborders Mysticeti (i.e., baleen whales) and Odontoceti (i.e., toothed whales, dolphins, and their allies), as well as the Order Sirenia, which include the manatee and dugong. Within the GOM, there are 28 species of cetaceans (7 mysticete and 21 odontocete species) and 1 sirenian species, the manatee (Jefferson et al., 1992).

3.2.3.1. Nonthreatened and Nonendangered Species

Cetaceans — Mysticetes

Bryde's Whale

The Bryde's whale (*Balaenoptera edeni*) is the second smallest of the balaenopterid whales and it is generally confined to tropical and subtropical waters (i.e., between lat. 40º N. and lat. 40º S.) (Cummings, 1985). Unlike some baleen whales, it does not have a well-defined breeding season in most areas and thus, calving may occur throughout the year. The Bryde's whale feeds on small pelagic fishes and invertebrates (Leatherwood and Reeves, 1983; Cummings, 1985; Jefferson et al., 1993).

There are more records of Bryde's whale than of any other baleen whale species in the northern GOM. It is likely that the Gulf represents at least a portion of the range of a dispersed, resident population of Bryde's whale (Jefferson and Schiro, 1997). Bryde's whale in the northern Gulf, with few exceptions, have been sighted along a narrow corridor near the 100-m (328-ft) isobath (Davis and Fargion, 1996; Davis et al., 2000). Most sightings have been made in the DeSoto Canyon region and off western Florida, though there have been some in the west-central portion of the northeastern Gulf. Group sizes range from one to seven animals.

Minke Whale

The minke whale *(Balaenoptera acutorostrata*) is a small rorqual that is widely distributed in tropical, temperate, and polar waters. Minke whales may be found offshore but appear to prefer coastal waters. Their diet consists of invertebrates and fishes (Leatherwood and Reeves, 1983; Stewart and Leatherwood, 1985; Jefferson et al., 1993; Würsig et al., 2000).

The North Atlantic population migrates southward during winter months to the Florida Keys and the Caribbean Sea. There are 10 reliable records of minke whales in the GOM and all are the result of strandings (Jefferson and Schiro, 1997). Most records from the Gulf have come from the Florida Keys, although strandings in western and northern Florida, Louisiana, and Texas have been reported (Jefferson and Schiro, 1997). Sightings data suggest that minke whales either migrate into Gulf waters in small numbers during the winter or, more likely, that sighted individuals represent strays from low-latitude breeding grounds in the western North Atlantic (Jefferson and Schiro, 1997; Davis et al., 1998 and 2000).

Cetaceans — Odontocetes

Pygmy and Dwarf Sperm Whales (Family Kogiidae)

The pygmy sperm whale *(Kogia brevicep*s) and its congener, the dwarf sperm whale *(K. sima*), are medium-sized toothed whales that feed on cephalopods and, less often, on deep-sea fishes and shrimps (Leatherwood and Reeves, 1983; Jefferson et al., 1993; Caldwell and Caldwell, 1989). Hence, they inhabit oceanic waters in tropical to warm temperate zones (Jefferson and Schiro, 1997). They appear to be most common in waters over the continental slope and along the shelf edge. Little is known of their natural history, although a recent study of *Kogia* in South Africa has determined that these two species attain sexual maturity much earlier and live fewer years than other similarly sized toothed whales (Plön and Bernard, 1999).

Kogia have been sighted throughout the Gulf in waters that vary broadly in depth and seafloor topographies (Mullin et al., 1991; Davis et al., 1998 and 2000). The GulfCet I study reported these animals in waters with a mean bottom depth of 929 m (Davis et al., 1998). *Kogia* have been sighted over the continental shelf, but there is insufficient evidence that they regularly inhabit continental shelf waters. *Kogia* sightings made during GulfCet aerial surveys (1992-97) in all waters between the 100-m and 2,000-m isobaths. Data also indicate that *Kogia* may associate with frontal regions along the shelf break and upper continental slope, areas with high epipelagic zooplankton biomass (Baumgartner, 1995). During the GulfCet II study, *Kogia* were widely distributed in the oceanic northern Gulf, including slope waters of the Eastern Gulf. *Kogia* frequently strand on the coastline of the northern Gulf, more often in the Eastern Gulf (Jefferson and Schiro, 1997). Between 1984 and 1990, 22 pygmy sperm whales and 10 dwarf sperm whales stranded in the GOM.

Beaked Whales (Family Ziphiidae)

Two genera and four species of beaked whales occur in the GOM. These encompass (1) three species of the genus *Mesoplodon* (Sowerby's beaked whale [*M. biden*s], Blainville's beaked whale [*M. densirostri*s], and Gervais' beaked whale [*M. europaeu*s]) and (2) one species of the genus *Ziphiu*s (Cuvier's beaked whale *[Ziphius cavirostri*s]). Morphological similarities among species in the genus *Mesoplodon* make identification of free-ranging animals difficult. Generally, beaked whales appear to prefer oceanic waters, although little is known of their respective life histories. Stomach content analyses suggest that these whales feed primarily on deepwater cephalopods, although they also consume some mesopelagic fishes and deepwater benthic invertebrates (Leatherwood and Reeves, 1983; Heyning, 1989; Mead, 1989; Jefferson et al., 1993).

In the northern Gulf, beaked whales are broadly distributed in waters greater than 1,000 m over lower slope and abyssal landscapes (Davis et al., 1998 and 2000). Group sizes of beaked whales observed in the northern Gulf comprise 1-4 individuals per group (Mullin et al., 1991; Davis and Fargion, 1996; Davis et al., 2000). Sightings data indicate that Cuvier's beaked whale is probably the most common beaked whale in the Gulf (Jefferson and Schiro, 1997; Davis et al., 1998 and 2000). Wursig et al. (2000) indicate there are 18 documented strandings of Cuvier's beaked whales in the GOM. The Gervais' beaked whale is probably the most common mesoplodont in the northern Gulf, as suggested by stranding records (Jefferson and Schiro, 1997). Wursig et al. (2000) states that there are four verified stranding records of Blainville's beaked whales from the GOM. Additionally, one beaked whale sighted during GulfCet II was determined to be a Blainville's beaked whale (Davis et al., 2000). Sowerby's beaked whale is represented in the Gulf by only a single record, a stranding in Florida; this record is considered extralimital since this species normally occurs much farther north in the North Atlantic (Jefferson and Schiro, 1997).

Dolphins (Family Delphinidae)

Atlantic Spotted Dolphin

The Atlantic spotted dolphin (*Stenella frontalis*) is endemic to the Atlantic Ocean within tropical to temperate zones. Surveys in the northern Gulf documented the Atlantic spotted dolphin primarily over the continental shelf and shelf edge in waters that were less than 250 m in depth, although some individuals were sighted along the slope in waters of up to approximately 600 m (1,969 ft) (Davis et al., 1998). Mills and Rademacher (1996) found the principal depth range of the Atlantic spotted dolphin to be much shallower at 15-100 m water depth. Griffin and Griffin (1999) found Atlantic spotted dolphins on the eastern Gulf continental shelf in waters greater than 20 m (30 km from the coast). A satellite-tagged Atlantic spotted dolphin was found to prefer shallow water habitat and make short dives (Davis et al., 1996). Atlantic spotted dolphins are sighted more frequently in areas east of the Mississippi River (Mills and Rademacher, 1996). Perrin et al. (1994a) relate accounts of brief aggregations of smaller groups of Atlantic spotted dolphins (forming a larger group) off the coast of northern Florida. While not well substantiated, these dolphins may demonstrate seasonal nearshore-offshore movements that appear to be influenced by prey availability and water temperature (Wursig et al., 2000). They are known to feed on a wide variety of fishes, cephalopods, and benthic invertebrates (Leatherwood and Reeves, 1983; Jefferson et al., 1993; Perrin et al., 1994a).

Bottlenose Dolphin

The bottlenose dolphin *(Tursiops truncatu*s) is a common inhabitant of the continental shelf and upper slope waters of the northern Gulf. It is the most widespread and common cetacean observed in the northern GOM. Sightings of this species in the northern Gulf are rare beyond approximately the 1,200-m (3,937-ft) isobath (Mullin et al., 1994a; Jefferson and Schiro, 1997; Davis et al., 2000). There appears to be two ecotypes of bottlenose dolphins, a coastal form and an offshore form (Hersh and Duffield, 1990; Mead and Potter, 1990). The coastal or inshore stock(s) is genetically isolated from the offshore stock (Curry and Smith, 1997). Genetic data also support the concept of relatively discrete bay, sound, and estuary stocks (Waring et al., 1999). In the northern GOM, bottlenose dolphins appear to have an almost bimodal distribution: a shallow water (16-67 m) and a shelf break (about 250 m) region. These regions may represent the individual depth preferences of the coastal and offshore forms (Baumgartner, 1995).

Little is known of the behavior or ranging patterns of offshore bottlenose dolphins. Bottlenose dolphins are opportunistic feeders, taking a wide variety of fishes, cephalopods, and shrimp (Davis and Fargion, 1996; Jefferson and Schiro, 1997; Wells and Scott, 1999). Mating and calving occurs primarily from February through May.

Clymene Dolphin

The Clymene dolphin *(Stenella clymene*) is endemic to the Atlantic Ocean and found only in tropical and subtropical waters (Perrin and Mead, 1994). Data suggest that Clymene dolphins are widespread within deeper Gulf waters (i.e., shelf edge and slope) (Davis et al., 2000; Würsig et al., 2000). The Clymene dolphin represents a significant component of the northern GOM cetacean assemblage (Mullin et al., 1994b). However, the few records of the Clymene dolphin in the northern Gulf in the past were probably a result of this species' recently clarified taxonomic status and the tendency for observers to confuse it with other species (Jefferson and Schiro, 1997). Sightings made during GulfCet surveys indicate the Clymene dolphin to be widely distributed in the western oceanic Gulf during spring and in the northeastern Gulf during summer and winter. Also, most sightings tended to occur in the central portion of the study area, west of the Mississippi Delta and east of Galveston Bay. Clymene dolphins have been sighted in water depths of 612-1,979 m (Davis et al., 1998). This species appears to feed on fishes and cephalopods (Leatherwood and Reeves, 1983; Jefferson et al., 1993; Mullin et al., 1994a).

False Killer Whale

The false killer whale (*Pseudorca crassidens*) occurs in oceanic waters of tropical and warm temperate zones (Odell and McClune, 1999). Most sightings have been made in waters exceeding 200 m, although there have been sightings over the continental shelf (Davis and Fargion, 1996). Although sample sizes are small, most false killer whale sightings have been east of the Mississippi River (Mullin and Hansen, 1999). False killer whales primarily eat fish and cephalopods, but they have been known to attack other toothed whales (Leatherwood and Reeves, 1983; Jefferson et al., 1993).

Fraser's Dolphin

The Fraser's dolphin (*Lagenodelphis hosei*) has a pantropical distribution (Perrin et al., 1994b) in oceanic waters and in areas where deep water approaches the coast. Fraser's dolphins feed on fishes, cephalopods, and crustaceans (Leatherwood and Reeves, 1983; Jefferson et al., 1993; Jefferson and Schiro, 1997). This species was previously known to occur in the northern Gulf based on a mass stranding in the Florida Keys in 1981 (Hersh and Odell, 1986). From 1992 to 1996, there were at least three strandings in Florida and Texas (Würsig et al., 2000). GulfCet ship-based surveys led to sightings of two large herds (greater than 100 individuals) and first-time recordings of sounds produced by these animals (Leatherwood et al., 1993). Fraser's dolphins have been sighted in the western and eastern Gulf at depths of around 1,000 m (3,281 ft) (Leatherwood et al., 1993; Davis and Fargion, 1996; Jefferson and Schiro, 1997; Davis et al., 2000).

Killer Whale

The killer whale (*Orcinus orca*) is a cosmopolitan species that occurs in all oceans and seas (Dahlheim and Heyning, 1999). Generally, they appear to inhabit coastal, cold temperate, and subpolar zones. Most killer whale sightings in the northern Gulf have been in waters greater than 200 m deep, although there are sightings made over the continental shelf (Davis and Fargion, 1996). Killer whales are found almost exclusively in a broad area of the north-central Gulf (Jefferson and Schiro, 1997; O'Sullivan and Mullin, 1997; Mullin and Hansen, 1999). There was a sighting in May 1998 of killer whales in DeSoto Canyon (Ortega, personal communication, 1998). Worldwide, killer whales feed on marine mammals, marine birds, sea turtles, cartilaginous and bony fishes, and cephalopods (Leatherwood and Reeves, 1983; Jefferson et al., 1993). An attack by killer whales on a group of pantropical spotted dolphins was observed during one of the GulfCet surveys (O'Sullivan and Mullin, 1997).

Melon-headed Whale

The melon-headed whale *(Peponocephala electra*) is a deepwater, pantropical species (Perryman et al., 1994) that feeds on cephalopods and fishes (Leatherwood and Reeves, 1983; Jefferson et al., 1993; Mullin et al., 1994c; Jefferson and Schiro, 1997). Sightings of this species in the northern Gulf have been primarily in continental slope waters west of the Mississippi River (Jefferson and Schiro, 1997; Davis et al., 1998 and 2000; Mullin and Hansen, 1999). The first two records of this species occurrence in the Gulf are recent strandings, one in Texas in 1990 and the other in Louisiana in 1991 (Barron and Jefferson, 1993). GulfCet surveys resulted in many sightings of melon-headed whales, suggesting that this species is a regular inhabitant of the GOM (e.g., Mullin et al., 1994c).

Pantropical Spotted Dolphin

The pantropical spotted dolphin *(Stenella attenuat*a) is distributed in tropical and subtropical marine waters of the world (Perrin and Hohn, 1994). It is the most common cetacean in the oceanic northern Gulf (Mullin et al., 1994a; Davis and Fargion, 1996; Davis et al., 2000). Pantropical spotted dolphins are typically found in waters deeper than 1,200 m deep (Mullin et al., 1994a; Davis et al., 1998 and 2000) but have been sighted over the continental shelf (Mullin et al., 1994a). It feeds on epipelagic fishes and cephalopods (Leatherwood and Reeves, 1983; Jefferson et al., 1993).

Pygmy Killer Whale

The pygmy killer whale (*Feresa attenuata*) occurs in tropical and subtropical waters throughout the world (Ross and Leatherwood, 1994), although little is known of its biology or ecology. Its diet includes cephalopods and fishes, though reports of attacks on other dolphins have been reported (Leatherwood and Reeves, 1983; Jefferson et al., 1993). The pygmy killer whale does not appear to be common in the Gulf; most records are of strandings (Jefferson and Schiro, 1997). Fourteen strandings have been documented from southern Florida to south Texas. Four ship sightings occurred during the GulfCet surveys, once off the south Texas coast in November and three in the spring in the west-central portion of the GulfCet study area. Sightings of this species have been at depths of 500-1,000 m (1,641-3,281 ft) (Jefferson and Schiro, 1997; Davis et al., 1998 and 2000).

Risso's Dolphin

The Risso's dolphin (*Grampus griseus*) is a pantropical species that inhabits deep oceanic and continental slope waters of tropical and warm temperate zones (Kruse et al., 1999). Risso's dolphins in the northern Gulf have been frequently sighted along the shelf edge, along the upper slope, and most commonly, over or near the 200-m water isobath just south of the Mississippi River in recent years (Würsig et al., 2000). A strong correlation between Risso's dolphin distribution and the steeper portions of the upper continental slope is most likely the result of cephalopod distribution along the continental slope (Baumgartner, 1997; Davis et al., 2000). Risso's dolphins have been sighted over the continental shelf at water depths less than 200 m (Mullin et al., 1994a; Davis et al., 1998). Strandings and GulfCet sightings have occurred in all seasons in the GOM and it is likely that Risso's dolphins occur year round in the GOM. Risso's dolphins feed primarily on squid and secondarily on fishes and crustaceans (Leatherwood and Reeves, 1983; Jefferson et al., 1993; Baumgartner, 1997; Würsig et al., 2000).

Rough-toothed Dolphin

The rough-toothed dolphin (*Steno bredanensis*) occurs in tropical to warm temperate marine waters globally (Miyazaki and Perrin, 1994). Sightings in the northern Gulf occur primarily over the deeper waters (950-1,100 m) off the continental shelf (Mullin et al., 1994a; Davis et al., 1998). Most sightings of the rough-toothed dolphin have been west of the Mississippi River (Mullin and Hansen, 1999); however, a mass stranding of 62 rough-toothed dolphins occurred near Cape San Blas, Florida, on December 14, 1997. Four of the stranded dolphins were rehabilitated and released; three carried satellite-linked transmitters (Wells et al., 1999a). Water depth at tracking locations of these individuals averaged 195 m. Data from the tracked individuals, in addition to sightings at Santa Rosa Beach on December 28-29, 1998

(Rhinehart et al., 1999), suggest a regular occurrence of this species in the northern Gulf. This species feeds on cephalopods and fishes (Leatherwood and Reeves, 1983; Jefferson et al., 1993).

Short-finned Pilot Whale

The short-finned pilot whale (*Globicephala macrorhynchus*) is found in warm temperate to tropical marine waters of the world, generally in deep offshore areas (Bernard and Reilly, 1999). In the northern Gulf, it is most commonly sighted along the continental slope at depths of 250-2,000 m (Jefferson and Schiro, 1997; Davis et al., 1998 and 2000). Short-finned pilot whales have been sighted almost exclusively west of the Mississippi River (Mullin and Hansen, 1999). There was one sighting of short-finned pilot whales in the slope in the eastern Gulf during GulfCet II, in the extreme western part of the study area (Davis et al., 2000). Stranding records have declined dramatically over the past decade, which contributes to the evidence (though not conclusively) that this population may be declining in the GOM. Squid are the predominant prey, with fishes being consumed occasionally.

Spinner Dolphin

The spinner dolphin *(Stenella longirostri*s) occurs worldwide in tropical oceanic waters (Perrin and Gilpatrick, 1994; Jefferson and Schiro, 1997). In the northern Gulf, most sightings of spinner dolphins have been east of the Mississippi River at depths of 500-1,800 m (1,641-5,906 ft) (Jefferson and Schiro, 1997; Mullin and Hansen, 1999; Davis et al., 2000). Spinner dolphins have mass stranded on two occasions in the GOM, each time on the Florida coast. Spinner dolphins appear to feed on fishes and cephalopods (Würsig et al., 2000).

Striped Dolphin

The striped dolphin *(Stenella coeruleoalba*) occurs in tropical and subtropical oceanic waters (Perrin et al., 1994c). Sightings in the northern Gulf occur primarily over the deeper waters beyond the continental shelf (Jefferson and Schiro, 1997; Davis et al., 2000; Würsig et al., 2000). Striped dolphins feed primarily on small mid-water squid and fishes (especially lanternfish).

3.2.3.2. Threatened and Endangered Species

Cetaceans — Mysticetes

Blue Whale

The blue whale (*Balaenoptera musculus*) is the largest animal known. It feeds almost exclusively on concentrations of zooplankton (Yochem and Leatherwood, 1985; Jefferson et al., 1993). The blue whale occurs in all major oceans of the world; some blue whales are resident, some are migratory (Jefferson et al., 1993; USDOC, NMFS, 1998). Those that migrate move to feeding grounds in polar waters during spring and summer, after wintering in subtropical and tropical waters (Yochem and Leatherwood, 1985). Records of the blue whale in the northern Gulf consist of two strandings on the Texas coast (Lowery, 1974). There appears to be little justification for considering the blue whale to be a regular inhabitant of the GOM (Jefferson and Schiro, 1997).

Fin Whale

The fin whale (*Balaenoptera physalus*) is an oceanic species that occurs worldwide in marine waters and is most commonly sighted where deep water approaches the coast (Jefferson et al., 1993). Fin whales feed on concentrations of zooplankton, fishes, and cephalopods (Leatherwood and Reeves, 1983; Jefferson et al., 1993). The fin whale makes seasonal migrations between temperate waters, where it mates and calves, and polar feeding grounds that are occupied during summer months. Their presence in the northern Gulf is considered rare (Würsig et al., 2000). Sightings in the northern Gulf have typically been made in oceanic waters, chiefly in the north-central region of the Gulf (Mullin et al., 1991). There are seven reliable reports of fin whales in the northern Gulf, indicating that fin whales are not abundant in the GOM (Jefferson and Schiro, 1997). Sparse sighting data on this species suggest that individuals in the northern Gulf may be extralimital strays from their western Atlantic population (Jefferson and Schiro, 1997; Würsig et al., 2000).

Humpback Whale

The humpback whale (*Megaptera novaeangliae*) occurs in all oceans, feeding in higher latitudes during spring, summer, and autumn, and migrating to a winter range over shallow tropical banks, where they calve and presumably conceive (Jefferson et al., 1993). Humpback whales feed on concentrations of zooplankton and fishes using a variety of techniques that concentrate prey for easier feeding (Winn and Reichley, 1985; Jefferson et al., 1993). There have been occasional reports of humpback whales in the northern Gulf off Florida: a confirmed sighting of a humpback whale in 1980 in the coastal waters off Pensacola (Weller et al., 1996); two questionable records of humpback whale sightings from 1952 and 1957 off the coast of Alabama (Weller et al., 1996); a stranding east of Destin, Florida, in mid-April 1998 (Mullin, personal communication, 1998); and a confirmed sighting of six humpback whales in May 1998 in DeSoto Canyon (Ortega, personal communication, 1998). Most recently, a lone humpback whale was photographed at Main Pass Block 281 in December 2001. Humpback whales sighted in the GOM may be extralimital strays during their breeding season or during their migrations (Würsig et al., 2000). The time of the year (winter and spring) and the small size of the animals involved in many sightings suggest the likelihood that these records are of inexperienced juveniles on their first return migration northward (Weller et al., 1996).

Northern Right Whale

The northern right whale (*Eubalaena glacialis*) inhabits primarily temperate and subpolar waters. Northern right whales range from wintering and calving grounds in coastal waters of the southeastern United States to summer feeding, nursery, and mating grounds in New England waters and northward to the Bay of Fundy and the Scotian Shelf. During the winter, a portion of the population moves from the summer foraging grounds to the calving/breeding grounds off Florida, Georgia, and South Carolina. Right whales forage primarily on subsurface concentrations of zooplankton such as calanoid copepods by skim feeding with their mouths agape (Watkins and Schevill, 1976; Leatherwood and Reeves, 1983; Jefferson et al., 1993).

Confirmed historical records of northern right whales in the GOM consist of a single stranding in Texas (Schmidly et al., 1972) and a sighting off Sarasota County, Florida (Moore and Clark, 1963; Schmidly, 1981). The northern right whale is not considered a resident (year-round or seasonal) of the GOM; existing records probably represent extralimital strays from the wintering grounds of this species off the southeastern United States from Georgia to northeastern Florida (Jefferson and Schiro, 1997).

Sei Whale

The sei whale (*Balaenoptera borealis*) is an oceanic species that is not often seen close to shore (Jefferson et al., 1993). They occur in marine waters from the tropics to polar regions but are more common in mid-latitude temperate zones (Jefferson et al., 1993). Sei whales feed on concentrations of zooplankton, small fishes, and cephalopods (Gambell, 1985; Jefferson et al., 1993). The sei whale is represented in the northern Gulf by only four reliable records (Jefferson and Schiro, 1997). One stranding was reported for the Florida Panhandle and three strandings were in eastern Louisiana (Jefferson and Schiro, 1997). This species' occurrence in the northern Gulf is considered most likely to be accidental.

Cetaceans — Odontocetes

Sperm Whale

The sperm whale (*Physeter macrocephalus*) inhabits marine waters from the tropics to the pack-ice edges of both hemispheres, although generally only large males venture to the extreme northern and southern portions of their range (Jefferson et al., 1993). In general, sperm whales seem to prefer certain areas within each major ocean basin, which historically have been termed "grounds" (Rice, 1989). As deep divers, sperm whales generally inhabit oceanic waters, but they do come close to shore where submarine canyons or other geophysical features bring deep water near the coast (Jefferson et al., 1993).

Sperm whales prey on cephalopods, demersal fishes, and benthic invertebrates (Rice, 1989; Jefferson et al., 1993).

The sperm whale is the only great whale that is considered to be common in the northern Gulf (Fritts et al., 1983a; Mullin et al., 1991; Davis and Fargion, 1996; Jefferson and Schiro, 1997). Sighting data suggest a northern Gulfwide distribution over slope waters. Congregations of sperm whales are commonly found in waters over the shelf edge in the vicinity of the Mississippi River Delta in waters that are 500-2,000 m (1,641-6,562 ft) in depth (Mullin et al., 1994a; Davis and Fargion, 1996; Davis et al., 2000). Sperm whale sightings in the northern Gulf chiefly occur in waters with a mean seafloor depth of 1,105 m (Davis et al., 1998). Mesoscale biological and physical patterns in the environment are important in regulating sperm whale habitat use (Griffin, 1999). The GulfCet II study found that most sperm whales were concentrated along the slope in or near cyclones (Davis et al., 2000). Low-salinity, nutrient-rich water from the Mississippi River may contribute to enhanced primary and secondary productivity in the north-central Gulf, and thus provide resources that support the year-round presence of sperm whales south of the delta.

Consistent sightings in the region indicate that there is a resident population of sperm whales in the northern Gulf consisting of adult females, calves, and immature individuals (Mullin et al., 1994a; Davis and Fargion, 1996; Sparks et al., 1996; Jefferson and Schiro, 1997; Davis et al., 2000). Also, recent sightings were made in 2000 and 2001 of solitary mature male sperm whales in the DeSoto Canyon area (Lang, personal communication, 2001). Sperm whales in the Gulf are currently considered a separate stock from those in the Atlantic and Caribbean (Waring et al., 1997).

Sirenians

West Indian Manatee

The West Indian manatee (*Trichechus manatus*) is the only sirenian known to occur in tropical and subtropical coastal waters of the southeastern U.S., GOM, Caribbean Sea, and the Atlantic coast of northern and northeastern South America (Reeves et al., 1992; Jefferson et al., 1993; O'Shea et al., 1995). During warmer months, manatees are common along the west coast of Florida from the Everglades National Park northward to the Suwannee River in northwestern Florida and less common farther westward. In winter, the population moves southward to warmer waters. Manatees are uncommon along the Florida Panhandle and are infrequently found (strandings and sightings) as far west as Louisiana and Texas (Powell and Rathbun, 1984; Rathbun et al., 1990; Schiro et al., 1998). One manatee that died in Louisiana waters was determined to be from Tampa Bay, Florida; this determination was based on a photoidentification rematch (Schiro et al., 1998). The manatees occasionally appearing in south Texas waters might be strays from Mexico rather than Florida (Powell and Rathbun, 1984).

Manatees are herbivores that feed opportunistically on submerged, floating, and emergent vegetation (USDOI, FWS, 1995). Distribution of the manatee is limited to low-energy, inshore habitats supporting the growth of seagrasses (Hartman, 1979). Manatees primarily use open coastal (shallow nearshore) areas and estuaries; and they are also found far up freshwater tributaries. Shallow grass beds with access to deep channels are preferred feeding areas in coastal and riverine habitats (USDOI, FWS, 1995). Notwithstanding their association with coastal areas, a manatee was documented offshore at several OCS work barges where it was grazing on algae growing on the vessel's sides and bottom. Multiple sightings of the animal were made in October 2001 and occurred in waters exceeding 1,500 m in depth south of Mobile Bay, Alabama.

3.2.4. Sea Turtles

Of the seven or eight extant species of sea turtles, five are known to inhabit the waters of the GOM (Pritchard, 1997): the green turtle, the loggerhead, the hawksbil l, the Kemp's ridley, and the leatherback. As a group, sea turtles possess elongated, paddle-like forelimbs that are modified for swimming and shells that are depressed and streamlined (Márquez-M., 1990; Ernst et al., 1994; Pritchard, 1997). Sea turtles spend nearly all of their lives in the water and only depend on land (specifically sandy beaches) as nesting habitat. They mature slowly and are long-lived. Generally, their distributions are primarily circumtropical, although various species differ widely in their seasonal movements, geographical ranges, and behavior. There are also considerable differences in behavior among populations of the same species

(Márquez-M., 1990). All sea turtle species inhabiting the GOM are listed as either endangered or threatened under the Endangered Species Act of 1973 (Pritchard, 1997).

Hard-shell Sea Turtles (Family Cheloniidae)

Green Sea Turtle

The green sea turtle (*Chelonia mydas*) is the largest hard-shelled sea turtle; adults commonly reach 100 cm in carapace length and 150 kg in weight (USDOC, NMFS, 1990). The green sea turtle is commonly found in tropical and subtropical marine waters with extralimital occurrences generally between latitude 40 ^{o}N. and latitude 40 ^{o}S. (USDOC, NMFS and USDOI, FWS, 1991a; Hirth, 1997). In U.S. Atlantic waters, green sea turtles are found around the U.S. Virgin Islands, Puerto Rico, and Atlantic and Gulf Coasts of the U.S. from Texas to Massachusetts.

Green sea turtles primarily occur in coastal waters, where they forage on seagrasses, algae, and associated organisms (Carr and Caldwell, 1956; Hendrickson, 1980). Small green sea turtles are omnivorous. Adult green sea turtles in the Caribbean and GOM are herbivorous, feeding primarily on seagrasses and, to a lesser extent, on algae and sponges. The adult feeding habitats are beds of seagrasses and algae in relatively shallow, protected waters; juveniles may forage in areas such as coral reefs, emergent rocky bottom, sargassum mats, and in lagoons and bays. Green sea turtles in the Western Gulf are primarily restricted to the Texas coast where seagrass meadows and algae-laden jetties provide them developmental habitat, especially during warmer months (Landry and Costa, 1999). Movements between principal foraging areas and nesting beaches can be extensive, with some populations regularly conducting transoceanic migrations (USDOC, NMFS and USDOI, FWS, 1991a; Ernst et al., 1994; Hirth, 1997).

Hawksbill Sea Turtle

The hawksbill (*Eretmochelys imbricata*) is a small- to medium-sized sea turtle that occurs in tropical to subtropical waters of the Atlantic, Pacific, and Indian Oceans. The species is widely distributed in the Caribbean Sea and western Atlantic Ocean. In the continental U.S., the hawksbill has been recorded in coastal waters of each of the Gulf States and along the Atlantic Coast from Florida to Massachusetts (USDOC, NMFS and USDOI, FWS, 1993), although sightings north of Florida are rare (Hildebrand, 1982). They are considered to be the most tropical of all sea turtle species and the least commonly reported sea turtle species occurring in the Gulf (Márquez-M., 1990; Hildebrand, 1995).

Coral reefs are generally recognized as the resident foraging habitat for both juveniles and adults. Adult hawksbills feed primarily on sponges (Carr and Stancyk, 1975; Meylan, 1988) and demonstrate a high degree of selectivity, feeding on a relatively limited number of sponge species, primarily demosponges (Ernst et al., 1994). Texas and Florida are the only states in the U.S. where hawksbills are sighted with any regularity (USDOC, NMFS and USDOI, FWS, 1993). Stranded hawksbills have been reported in Texas (Hildebrand, 1982; Amos, 1989) and in Louisiana (Koike, 1996); these tend to be either hatchlings or yearlings. A hawksbill was captured accidentally in a purse seine net just offshore Louisiana (Rester and Condrey, 1996).

Kemp's Ridley Sea Turtle

The Kemp's ridley (*Lepidochelys kempi*) is the smallest sea turtle species and occurs chiefly in the GOM. It may also be found along the northwestern Atlantic Coast of North America as far north as Newfoundland. It is the most imperiled of the world's sea turtles.

In the northern Gulf, Kemp's ridleys are most abundant in coastal waters from Texas to west Florida (Ogren, 1989; Márquez-M., 1990 and 1994; Rudloe et al., 1991). Kemp's ridleys display strong seasonal fidelity to tidal passes and adjacent beachfront environs of the northern Gulf (Landry and Costa, 1999). There is little prolonged utilization of waters seaward of the 50-m isobath by this species (Renaud, 2001). Adult Kemp's ridley turtles usually occur only in the Gulf, but juvenile and immature individuals sometimes range between tropical and temperate coastal areas of the northwestern Atlantic and Gulf (Márquez-M., 1990). Within the Gulf, juvenile and immature Kemp's ridleys have been documented along the Texas and Louisiana coasts, at the mouth of the Mississippi River, and along the west coast of Florida, as quoted in stranding reports (Ogren, 1989; Márquez-M., 1990).

Loggerhead Sea Turtle

The loggerhead (*Caretta caretta*) is a large sea turtle that inhabits temperate and tropical marine waters of the Atlantic, Pacific, and Indian Oceans. This species is wide-ranging throughout its range and is capable of living in varied habitat types for a relatively long time (Márquez-M., 1990; USDOC, NMFS and USDOI, FWS, 1991b; Ernst et al., 1994). Loggerheads feed primarily on benthic invertebrates but are capable of feeding on a wide range of food items (Ernst et al., 1994). Juvenile and subadult loggerheads are omnivorous, foraging on pelagic crabs, molluscs, jellyfish, and vegetation captured at or near the surface (Dodd, 1988; Plotkin et al., 1993). Adult loggerheads forage on benthic invertebrates (Dodd, 1988). The loggerhead is the most abundant species of sea turtle occurring in U.S. waters of the Atlantic, from Florida to Cape Cod, Massachusetts. The loggerhead is probably the most common sea turtle species in the northern Gulf (e.g., Fritts et al., 1983b; Fuller and Tappan, 1986; Rosman et al., 1987; Lohoefener et al., 1990) and is currently listed as a threatened species.

Aerial surveys indicate that loggerheads are largely abundant in water depths less than 100 m (Shoop et al., 1981; Fritts et al., 1983b). During the GulfCet aerial surveys, loggerheads were sighted throughout the northern Gulf continental shelf waters near the 100-m isobath (Davis et al., 2000). Loggerheads were also sighted over very deep waters (>1,000 m). Sightings indicate that loggerhead distribution is not as coastal-associated as that of Kemp's ridley and green sea turtles (Landry and Costa, 1999). Loggerheads have also been sighted seaward of the shelf break in the northeast U.S. (Shoop and Kenney, 1992). Loggerhead abundance in continental slope waters of the eastern Gulf increased appreciably during winter (Davis et al., 2000).

Leatherback Sea Turtle (Family Dermochelyidae)

Leatherback Sea Turtle

The leatherback (*Dermochelys coriacea*) is the largest and most distinctive sea turtle. This species possesses a unique skeletal morphology, most evident in its flexible, ridged carapace, and in cold water maintains a core body temperature several degrees above ambient. They also have unique deep-diving abilities (Eckert et al., 1986). This species is the most wide-ranging sea turtle, undertaking extensive migrations from the tropics to boreal (cold-temperate regions of the northern latitudes) waters (Morreale et al., 1996; Hughes et al., 1998). Though considered oceanic, leatherbacks will occasionally enter bays and estuaries (Hoffman and Fritts, 1982; Knowlton and Weigle, 1989; Shoop and Kenney, 1992). Leatherbacks feed primarily on gelatinous zooplankton such as jellyfish, siphonophores, and salps (Brongersma, 1972), although they may ingest some algae and vertebrates (Ernst et al., 1994). Leatherbacks' stomach contents have been analyzed and data suggest that they may feed at the surface, at depth within deep scattering layers, or on the benthos. Florida is the only site in the continental U.S. where leatherbacks regularly nest (USDOC, NMFS and USDOI, FWS, 1992; Ernst et al., 1994; Meylan et al., 1995). The leatherback is currently listed as an endangered species.

Sightings of leatherbacks are common in oceanic waters of the northern GOM (Leary, 1957; Fritts et al., 1983b; Lohoefener et al., 1988 and 1990; Collard, 1990; Davis et al., 2000). Based on a summary of several studies, Davis and Fargion (1996) concluded that the primary habitat of the leatherback in the northwestern Gulf is oceanic waters (>200 m). It has been suggested that the region from Mississippi Canyon east to DeSoto Canyon appears to be an important habitat area for leatherbacks (Davis and Fargion, 1996). Most sightings of leatherbacks made during the GulfCet surveys occurred slightly north of DeSoto Canyon (Davis and Fargion, 1996; Davis et al., 2000). The nearly disjunct summer and winter distributions of leatherback sightings over the continental slope in the Eastern Gulf during GulfCet II indicate that specific areas may be important to this species either seasonally or for short periods of time. These specific locations are most probably correlated with oceanographic conditions and resulting concentrations of prey. Other clustered sightings of leatherbacks have been reported for the northern Gulf: 8 leatherbacks were sighted one day in DeSoto Canyon (Davis and Fargion, 1996), 11 during one day just south of the Mississippi River Delta (Lohoefener et al., 1990), and 14 during another day in DeSoto Canyon (Lohoefener et al., 1990).

3.2.5. Birds

Most species of marine birds listed as either threatened or endangered inhabit nearshore waters along the coast and the continental shelf of the GOM and rarely occur in deepwater areas (USDOI, MMS, 2001a). Forty-three species of seabird representing four ecological categories have been documented from deepwater areas of the Gulf: summer migrants (e.g., shearwaters, storm-petrels, boobies), summer residents that breed in the Gulf (e.g., sooty, least, and sandwich terns), winter residents (e.g., gannets, gulls, and jaegers), and permanent resident species (e.g., laughing gull, royal, and bridled terns) (Hess and Ribic, 2000; USDOI, MMS, 2001a). The most abundant species typically found in deepwater areas include terns, storm-petrels, and gulls (Hess and Ribic, 2000).

Seabirds' presence in the Gulf changes seasonally with species diversity and overall abundance being highest in the spring and summer and lowest in fall and winter. Seabirds also tend to associate with various oceanic conditions including specific sea-surface temperatures and salinities (e.g., laughing gull, black and sooty terns), areas of high plankton productivity (e.g., laughing gulls, pomarine jaeger, Audubon's shearwater, band-rumped storm-petrel, bridled tern), and particular currents (pomarine jaeger) (Hess and Ribic, 2000). Various birds (especially passerines) that seasonally migrate over the Gulf may use offshore oil and gas platforms and merchant, cruise, and Naval ships as artificial islands for rest and shelter during inclement weather.

Shorebirds

Shorebirds are those members of the Order Charadriiformes generally restricted to coastline margins (beaches, mudflats, etc.). The GOM shorebirds comprise five taxonomic families — Jacanidae (jacanas), Haematopodidae (oystercatchers), Recurvirostridae (stilts and avocets), Charadriidae (plovers), and Scolopacidae (sandpipers, snipes, and allies) (Hayman et al., 1986). An important characteristic of almost all shorebird species is their strongly developed migratory behavior, with some shorebirds migrating from nesting places in the far north to the southern part of South America (Terres, 1991). Both spring and fall migrations take place in a series of "hops" to staging areas where birds spend time feeding heavily to store up fat for the sustained flight to the next staging area; many coastal habitats along the GOM are critical for such purposes. Along the Gulf Coast, 44 species of shorebirds have been recorded; only 6 species nest in the area. The remaining species are wintering residents and/or "staging" transients (Pashley, 1991). Although variations occur between species, most shorebirds begin breeding at 1-2 years of age and generally lay 3-4 eggs per year. They feed on a variety of marine and freshwater invertebrates and fish, and small amounts of plant life.

Marsh and Wading Birds

The following families of mostly wading birds have some representatives in the northern Gulf: Ardeidae (herons, egrets, and bitterns), Ciconiidae (storks), Threskiornithidae (ibises and spoonbills), and Gruidae (cranes). They have long legs that allow them to forage by wading into shallow water, while their long bills and usually long necks are used to probe under water or to make long swift strokes to seize fish, frogs, aquatic insects, crustaceans, and other prey (Terres, 1991). Seventeen species of wading birds in the Order Ciconiiformes are currently known to nest in the U.S., and all except the wood stork nest in the northern Gulf coastal region (Martin, 1991). Within the Gulf Coast region, Louisiana supports the majority of nesting wading birds. Great egrets are the most widespread nesting species in the Gulf region (Martin, 1991).

Along the GOM, most members of the family Rallidae have compact bodies; therefore, they are not labeled wading birds. They are also elusive and rarely seen within the low vegetation of fresh and saline marshes, swamps, and rice fields (Bent, 1926; National Geographic Society, 1983; Ripley and Beehler, 1985).

Waterfowl

Waterfowl belong to the taxonomic Order Anseriformes and include swans, geese, and ducks. A total of 36 species are regularly reported along the north-central and western Gulf Coast; they include 1 swan, 5 geese, 11 surface-feeding (dabbling) ducks and teal, 5 diving ducks (pochards), and 14 others (including the wood duck, whistling ducks, sea ducks, the ruddy duck, and mergansers) (Clapp et al., 1982; National

Geographic Society, 1983; Madge and Burn, 1988). Many species usually migrate from wintering grounds along the Gulf Coast to summer nesting grounds in the north. Waterfowl migration pathways have traditionally been divided into four parallel north-south paths, or "flyways," across the North American continent. The Gulf Coast serves as the southern terminus of the Mississippi (Louisiana, Mississippi, and Alabama) flyway. Waterfowl are highly social and possess a diverse array of feeding adaptations related to their habitat (Johnsgard, 1975).

3.2.5.1. Threatened and Endangered

The following coastal and marine birds species that inhabit or frequent the northern GOM coastal areas are recognized by FWS as either endangered or threatened: piping plover, southeastern snowy plover, bald eagle, and brown pelican. The southeastern snowy plover is a species of concern to the State of Florida.

Piping Plover

The piping plover (*Charadrius melodus*) is a migratory shorebird that is endemic to North America. The piping plover breeds on the northern Great Plains, in the Great Lakes, and along the Atlantic Coast (Newfoundland to North Carolina); and winters on the Atlantic and Gulf Coasts from North Carolina to Mexico and in the Bahamas and West Indies. Hypothetically, plovers may have a preferred prey base and/or the substrate coloration provides protection from aerial predators due to camouflage from chromatic matching in specific wintering habitat. Such areas include coastal sand flats and mud flats in proximity to large inlets or passes, which may attract the largest concentrations of piping plovers (Nicholls and Baldassarre, 1990). Similarly, nesting habitat in the north includes open flats along the Missouri River and the Great Lakes. This species remains in a precarious state given its low population numbers, sparse distribution, and continued threats to habitat throughout its range.

Southeastern Snowy Plover

The following account of the southeastern snowy plover (*Charadrius alexandrius tenuirostris*) is taken from Gore and Chase (1989). The species nests on coastal sand beaches and interior alkali flats. Observed nest sites in the Florida Panhandle ranged from the Florida-Alabama border eastward beyond Little St. George. At some locations more than 1.5 breeding pairs/km were counted. Most nests are near the front dune and close to vegetation. Vehicles and humans may cause nest failure. Human activity is absent near the beaches of Eglin West and Eglin East because Eglin Air Force Base has restricted areas. This may account for a high nest count in part of this area.

Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*) is the only species of sea eagle that regularly occurs on the North American continent (USDOI, FWS, 1984). Its range extends from central Alaska and Canada to northern Mexico. The bulk of the bald eagle's diet is fish, though it will opportunistically take birds, reptiles, and mammals (USDOI, FWS, 1984). The general tendency is for winter breeding in the south with a progressive shift toward spring breeding in northern locations. In the southeast, nesting activities generally begin in early September; egg laying begins as early as late October and peaks in late December. The historical nesting range of the bald eagle within the southeastern United States included the entire coastal plain and shores of major rivers and lakes. There are certain general elements that seem to be consistent among nest site selection. These include (1) the proximity of water (usually within ½ mi) and a clear flight path to a close point on the water, (2) the largest living tree in a span, and (3) an open view of the surrounding area. The proximity of good perching trees may also be a factor in site selection. An otherwise suitable site may not be used if there is excessive human activity in the area. The current range is limited, with most breeding pairs occurring in peninsular Florida and Louisiana, and some in South Carolina, Alabama, and east Texas. Sporadic breeding takes place in the rest of the southeastern states and in the Florida Panhandle. One hundred twenty nests have been found in Louisiana; only 3 nests occurred within 5 mi of the coast (Patrick, personal communication, 1997). The bald eagle was listed as endangered in 1967 in response to the declines due to DDT and other organochlorines that affected the species' reproduction (USDOI, FWS, 1984). In July 1995, the FWS reclassified the bald eagle from endangered to threatened in the lower 48 states (*Federal Register*, 1995).

Brown Pelican

The brown pelican (*Pelicanus occidentalis*) is one of two pelican species in North America. It feeds entirely upon fish captured by plunge diving in coastal waters. Organochlorine pesticide pollution apparently contributed to the endangerment of the brown pelican. In recent years, there has been a marked increase in brown pelican populations along its entire former range. The population of brown pelicans and their habitat in Alabama, Florida, Georgia, North and South Carolina, and point's northward along the Atlantic Coast were removed from the endangered species list in 1985. Within the remainder of the range, which includes coastal areas of Mississippi, where populations are not secure, the brown pelican remains listed as endangered (*Federal Register*, 1985). The brown pelican is not federally listed in Florida, but it is listed by the three other states (Louisiana, Mississippi, and Alabama).

3.2.6. Essential Fish Habitat and Fish Resources

3.2.6.1. Essential Fish Habitat

The Fishery Conservation and Management Act of 1976 (Magnuson Act) established national standards for the conservation and management of exploited fish and shellfish stocks in U.S. Federal waters. The Fishery Conservation and Management Act was superceded by the Magnuson-Stevens Fishery Conservation and Management Act of 1996, which required that FMP's further include the identification and description of Essential Fish Habitat (EFH). Essential fish habitat includes those waters and substrate necessary for the successful spawning, breeding, feeding, or growth to maturity of targeted species. The Act also requires that management councils consult with Federal agencies regarding any activities that may adversely affect essential fish habitat designated in specific FMP's. An adverse effect is any activity that reduces the quality of essential fish habitat whether it is direct (physical disruption) or indirect (loss of prey). Federal agencies are also required to assess actions that could conserve and enhance essential fish habitat.

In the Central and Western Gulf, EFH has been identified for 32 managed species of fish and shellfish (Gulf of Mexico Fisheries Management Council, 1998; USDOC, NMFS, 1999a and b). Of these, 21 species inhabit nearshore waters less than 200 m (656 ft) in depth. (See USDOI, MMS, 2001a, for further information on the distribution and habitat of these species.) The remaining 11 "offshore" species include the silky shark, longfin mako shark, dolphin, swordfish, skipjack tuna, yellowfin tuna, bluefin tuna, greater amberjack, king mackerel, tilefish, and red snapper. Although these species spawn in deepwater areas of the GOM, little is known about the life history and fate of pelagic larvae and fry. Bluefin larvae have been found associated with the Loop Current boundary and the Mississippi River plume (Richards et al., 1989). Juvenile and adult red snapper aggregate around hard-bottom relief but seldom occur at depths >300 m (985 ft).

3.2.6.2. Fish Resources

The GOM supports a great diversity of fish resources. The distribution and abundance of these resources are not random and are governed by a variety of ecological factors such as temperature, salinity, primary productivity, bottom types, and many other physical and biological factors. There are considerable inshore and offshore differences in fish resources. The majority of the GOM fisheries are dependent upon wetland, estuarine, and nearshore habitats (USDOI, MMS, 2001b).

Fish can be classified as demersal (bottom-dwelling), oceanic pelagic, or mesopelagic (midwater). Demersal (or benthic) fish have been addressed above under the megafauna descriptions (Chapter 3.2.2.3.1). There are no commercial fisheries directed at demersal species in the vicinity of the Magnolia Project. Oceanic pelagic and mesopelagic fishes are discussed briefly below. Additional life history information on important commercial invertebrate fish resources of the GOM is contained in USDOI, MMS (2000 and 2001a).

3.2.6.2.1. Oceanic Pelagics (including highly migratory species)

Common oceanic pelagic species include the large predatory tunas, marlins, sailfish, swordfish, dolphins, wahoo, and mako sharks. Other pelagics include halfbeaks, flyingfishes, and driftfishes (Stromateidae). Lesser known oceanic pelagics include opah, snake mackerels (Gempylidae), ribbonfishes (Trachipteridae), and escolar.

Oceanic pelagic species occur throughout the GOM, especially at or beyond the shelf edge. Oceanic pelagics are reportedly associated with mesoscale hydrographic features such as fronts, eddies, and discontinuities. Fishermen contend that yellowfin tuna aggregate near sea-surface temperature boundaries or frontal zones; however, Power and May (1991) found no correlation between longline catches of yellowfin tuna and sea-surface temperature (defined from satellite imagery) in the GOM. Many of the oceanic fishes associate with drifting sargassum seaweed, which provides feeding and/or nursery habitat.

3.2.6.2.2. Mesopelagics (midwater fishes)

Mesopelagic fish assemblages in GOM collections are numerically dominated by myctophids (lanternfishes), with gonostomatids (bristlemouths) and sternoptychids (hatchet fishes) common but less abundant. These fishes make extensive vertical migrations during the night from mesopelagic depths (200-1,000 m; 656-3,280 ft) to feed in upper, more productive layers of the water column (Hopkins and Baird, 1985). Mesopelagic fishes are important ecologically because they transfer substantial amounts of energy between mesopelagic and epipelagic zones.

The GOM appears to be a distinct zoogeographic province based upon analysis of lanternfish distribution (Bakus et al., 1977). The GOM lanternfish assemblage was characterized by species with tropical and subtropical affinities. This was particularly true for the Eastern GOM where Loop Current effects on species distributions were most pronounced. Gartner et al. (1987) collected 17 genera and 49 species of lanternfish in trawls fished at discrete depths from stations in the Western, Central, and Eastern Gulf. The most abundant species in decreasing order of importance were *Ceratoscopleus warmingii, Notolychus valdiviae, Lepidophanes guentheri, Lampanyctus alatus, Daiphus dumerili, Benthosema suborbitale*, and *Myctophum affine*. Ichthyoplankton collections from oceanic waters yielded high numbers of mesopelagic larvae as compared with larvae of other groups (Richards et al., 1989). Lanternfishes generally spawn year-round, with peak activity in spring and summer (Gartner, 1993).

3.2.7. Gulf Sturgeon

The Gulf sturgeon (*Acipenser oxyrhynchus desotoii*) is the only listed threatened fish species in the GOM. A subspecies of the Atlantic sturgeon, Gulf sturgeon are classified as anadromous, with immature and mature fish participating in freshwater migrations. Gill netting and biotelemetry have shown that subadults and adults spend 8-9 months each year in rivers and 3-4 of the coolest months in estuaries or Gulf waters. Sturgeon less than about two years old remain in riverine habitats and estuaries throughout the year (Clugston, 1991). According to Wooley and Crateau (1985), Gulf sturgeon occurred in most major riverine and estuarine systems from the Mississippi River to the Suwannee River, Florida, and marine waters of the Central and Eastern GOM south to Florida Bay. Important waters west-to-east and north-to-south are Biloxi Bay, Pascagoula Bay, Mobile Bay, Choctawhatchee Bay, the Apalachicola River, the Ochlockounee River, and the Suwannee River. It is not possible, at present, to estimate the size of Gulf sturgeon populations throughout the range of the species, but extant occurrences in 1996 include the Mississippi River and Lake Pontchartrain, Louisiana, to Charlotte Harbor, Florida (Patrick, personal communication, 1996). Eggs have now been discovered in six locations within the Choctawhatchee River system in Florida and Alabama (Fox and Hightower, 1998). During the riverine stage, adults cease feeding, undergo gonadal maturation, and migrate upstream to spawn. Spawning occurs over coarse substrate in deep holes. The decline of the Gulf sturgeon is believed to be due to overfishing, the damming of coastal rivers, and the degradation of water quality (Barkuloo, 1988).

3.2.8. Beach Mouse

Hall (1981) recognizes 16 subspecies of field mouse (*Peromyscus polionotus*), 8 of which are collectively known as beach mice. Of Gulf Coast subspecies, the Alabama, Perdido Key, Choctawhatchee, and St. Andrew beach mice occupy restricted habitats in the mature coastal dunes of

Florida and Alabama and are listed as endangered (USDOI, FWS, 1987). Populations have fallen to levels approaching extinction. For example, in the late 1980's, estimates of total remaining beach mice were less than 900 for the Alabama beach mouse, about 80 for the Perdido Key beach mouse, and about 500 for the Choctawhatchee beach mouse. All four mice are listed as endangered: the Alabama subspecies in Alabama, the Perdido Key subspecies in both Alabama and Florida, and the St. Andrew and Choctawhatchee subspecies in Florida. The Alabama, Perdido Key, and Choctawhatchee beach mice were listed as endangered in the 1980's. The St. Andrew beach mouse was not listed as endangered until 1998 and is the only listed subspecies without designated critical habitat. Continued monitoring of populations of all subspecies along the Gulf Coast between 1985 and the present indicates that approximately 52 km (32.3 mi) of coastal dune habitat are now occupied by the four listed subspecies (1/3 of historic range). The Santa Rosa beach mouse occupies Santa Rosa Island of the Gulf Island National Seashore (GINS). It is not listed as threatened or endangered and is not analyzed in this EA.

The *Federal Register* (1985) cites habitat loss as the primary cause for declines in populations of beach mice. The reduced distribution and numbers of the beach mouse subspecies have continued because of multiple habitat threats over their entire range (coastal real estate development and associated human activities, military activities, coastal erosion, severe storms, and catastrophic effects of hurricanes). Destruction of Gulf Coast sand dune ecosystems for commercial and residential development has destroyed about 60 percent of original beach mouse habitat.

The inland extent of the habitat may vary depending on the configuration of the sand dune system and the vegetation present. There are commonly several rows of dunes paralleling the shoreline, and within these rows there are generally three types of microhabitat. First, the frontal dunes are sparsely vegetated with widely scattered coarse grasses including sea oats (*Uniola paniculata*), bunch grass (*Andropogon maritimus*), and beach grass (*Panicum amarum* and *P. repens*), and with seaside rosemary (*Ceratiola ericoides*), beach morning glory (*Ipomoea stolonifera*), and railroad vine (*I. Pes-caprae*). Secondly, frontal dune grasses appear as a lesser component on the higher rear scrub dunes that support the growth of slash pine (*Pinus elliotti*), sand pine (*P. clausa*), and scrubby shrubs and oaks, including yaupon (*Ilex vomitoria*), marsh elder (*Iva sp*.), scrub oak (*Quercus myrtifolia*), and sand-live oak (*Q. virginiana* var. *maritima*). Thirdly, the interdunal areas contain sedges (*Cyperus sp*.), rushes (*Juncus scirpoides*), and salt grass (*Distichlis spicata).* Beach mice are restricted to the coastal barrier sand dunes along the Gulf. Optimal overall beach mouse habitat is currently thought to be comprised of a heterogeneous mix of interconnected habitats including primary dunes, secondary dunes, scrub dunes, and interdunal areas. Beach mice dig burrows mainly in the primary, secondary, and interior scrub dunes where the vegetation provides suitable cover. Most beach mouse surveys conducted prior to the mid-1990's were in primary and secondary dunes because investors assumed they are the preferred habitat of beach mice. A limited number of surveys in scrub dunes and other interior habitat resulted in less knowledge of the distribution and relative abundance there. In coastal environments, the terms "scrub" and "scrub dune" refer to habitat or vegetation communities adjacent to and landward of primary and secondary dune types where scrub oaks are visually dominant. Interior habitat can include vegetation types such as grass-like forbs (forbs are the herbs other than grasses). There is substantial variation in scrub oak density and cover within and among scrub dunes throughout ranges of beach mice. The variation, an ecological gradient, is represented by scrub oak woodland with a relatively closed canopy at one end of a continuum. At the other extreme of the gradient, scrub dunes are relatively open with patchy scrub ridges and intervening swales or interdunal flats dominated by herbaceous plants. For the three subspecies discussed above that have critical habitat areas (Alabama, Perdido Key, and Choctawhatchee beach mice), the major constituent elements that are known to require special management considerations or protection are dunes and interdunal areas and associated grasses and shrubs that provide food and cover (USDOI, FWS, 1985a and b).

For the most part, beach mice feed nocturnally in the dunes and remain in burrows during the day. Their diets vary seasonally but consist mainly of seeds, fruits, and insects (Ehrhart, 1978; Moyers, 1996). Changes in availability of foods result in changes in diets between seasons and account for variability of seasonal diets between years. Autumn diets of beach mice consist primarily of seeds and/or fruits of sea oats, evening primrose (*Oenothera humifusa*), bluestem (*Schizachyrium maritimum*), and dune spurge (*Chamaesyce ammannioides*). Sea oats and beach pea (Galactia sp.) dominate winter diets. Spring diets primarily consist of dune toadflax (*Linaria floridana*), yaupon holly (*Ilex vomitoria)*, seashore elder (*Iva imbricata*), and greenbrier (*Smilax sp.*). Summer diets are dominated by evening primrose, insects, dune toadflax, and ground cherry (*Physalis augustifolia*) (Moyers, 1996). Management practices designed to promote the recovery of dune habitat, increase food sources, and enhance habitat heterogeneity may aid in recovery of beach mouse populations.

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

Hurricanes are a natural environmental phenomenon affecting the Gulf Coast, and beach mice have evolved and persisted in coastal dune habitats since the Pleistocene. Hurricanes are part of a repeated cycle of destruction, alteration, and recovery of dune habitat. The extensive amount of predevelopment coastal dune habitat along the Gulf Coast allowed beach mice to survive even the most severe hurricane events to repopulate the habitat as it recovered. Beach mice are affected by the passage of hurricanes along the northwest Florida and Alabama Gulf Coast. Since records on hurricane intensity began in 1885, 32 hurricanes have struck northwest Florida within the historic ranges of the four Gulf Coast beach mouse subspecies (Williams and Duedall, 1997; Doehring et al., 1994; Neumann et al., 1993). In addition, since 1899, 11 hurricanes have hit the coast of Alabama.

Hurricanes generally produce damaging winds, storm tides and surges, and rain that erode barrier island, peninsular, and mainland beaches and dunes. Following hurricanes, the dune system begins a slow natural repair process that may take 3-20 years depending on the magnitude of dune loss (Salmon et al., 1982). During this period, sea oats and pioneer dune vegetation become established, collecting sand and building dunes. As the dunes grow and become stable, other successional dune vegetation colonizes the area (Gibson and Looney, 1994), and beach mouse food sources and habitats are reestablished.

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

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

3.3. OTHER RELEVANT ACTIVITIES AND RESOURCES

3.3.1. Socioeconomic Conditions and Other Concerns

3.3.1.1 Economic and Demographic Conditions

3.3.1.1.1. Socioeconomic Impact Area

The MMS defines the GOM impact area for population, labor, and employment as that portion of the GOM coastal zone whose social and economic well-being (population, labor, and employment) is directly or indirectly affected by the OCS oil and gas industry. For this analysis, the coastal impact area consists of 80 counties and parishes along the U.S. portion of the GOM. This area includes 24 counties in Texas, 26 parishes in Louisiana, 4 counties in Mississippi, 2 counties in Alabama, and 24 counties in the Panhandle of Florida. Inland counties and parishes are included where offshore oil and gas activities are known to exist, where offshore-related petroleum industries are established, and where one or more counties or parishes within a Metropolitan Statistical Area (MSA) are on the coast; all counties and parishes within the MSA are included.

Please also note that activity in Grid 7 as proposed is expected to have economic consequences throughout all 10 of the coastal subareas as well as global impacts. Most of the probable changes in population, labor, and employment resulting from the proposed activity would occur in the 24 counties in Texas and the 26 parishes in Louisiana because the oil and gas industry is best established in this region. Some of the likely changes in population, labor, and employment resulting from the proposed activity would occur to a lesser extent in the six Alabama and Mississippi counties due to having an established oil and gas industry and its proximity to the offshore location. Changes in economic factors (in minor service and support industries) from the proposed activity would occur, to a much lesser extent, in the 24 counties of the Florida Panhandle because of its geographic location from the proposed activity area.

For analysis purposes, MMS has divided the impact area (defined geographically in the first paragraph of this section) into the subareas listed below. This impact area is based on the results of a recent MMS socioeconomic study, "Cost Profiles and Cost Functions for GOM Oil and Gas Development Phases for Input-Output Modeling." One of the objectives of this study was to allocate expenditures from the offshore oil and gas industry to the representative onshore subarea where the dollars were spent. Table E-1 (Appendix E) presents these findings in percentage terms. In the table, the IMPLAN number is the code given to the industry (sector) by the input-output software (IMPLAN) used to calculate impacts in Chapter 4. It is analogous to the standardized industry code (SIC). As shown in Table E-1, very little has been spent in the Florida subareas. This is to be expected given the lack of offshore leasing in this area and Florida's attitude towards oil and gas development off their beaches. The same table also makes clear the reason for including all of the GOM subareas in the economic impact area. Expenditures in Texas to several sectors are either exclusively found there or make up a very large percentage of the total. In addition, a significant percentage of total sector expenditures is allocated to each Louisiana subarea. The following subareas (which include the counties/parishes as listed below) are considered as the economic impact area for the proposed activity:

<u>LA-1</u>

Acadia, LA
Calcasieu, LA
Cameron, LA
Iberia, LA
Lafayette, LA
St. Landry, LA
St. Martin, LA
Vermilion, LA

<u>LA-2</u>

Ascension, LA
Assumption, LA
East Baton Rouge, LA
Iberville, LA
Lafourche, LA
Livingston, LA
St. Mary, LA
Tangipahoa, LA
Terrebonne, LA
West Baton Rouge, LA

<u>LA-3</u>

Jefferson, LA
Orleans, LA
Plaquemines, LA
St. Bernard, LA
St. Charles, LA
St. James, LA
St. John the Baptist,
St. Tammany, LA

<u>MA-1</u>

Baldwin, AL
Hancock, MS
Harrison, MS
Jackson, MS
Mobile, AL
Stone, MS

<u>TX-1</u>

Aransas, TX
Calhoun, TX
Cameron, TX
Jackson, TX
Kenedy, TX
Kleberg, TX
Nueces, TX
Refugio, TX
San Patricio, TX
Victoria, TX
Willacy, TX

<u>TX-2</u>

Brazoria, TX
Chambers, TX
Fort Bend, TX
Galveston, TX
Hardin, TX
Harris, TX
Jefferson, TX
Liberty, TX
Matagorda, TX
Montgomery, TX
Orange, TX
Waller, TX
Wharton, TX

<u>FL-1</u>

Bay, FL
Escambia, FL
Okaloosa, FL
Santa Rosa, FL
Walton, FL

<u>FL-2</u>

Dixie, FL
Franklin, FL
Gulf, FL
Jefferson, FL
Levy, FL
Taylor, FL
Wakulla, FL

<u>FL-3</u>

Charlotte, FL
Citrus, FL
Collier, FL
Hernando, FL
Hillsborough, FL
Lee, FL
Manatee, FL
Pasco, FL
Pinellas, FL
Sarasota, FL

<u>FL-4</u>

Miami-Dade, FL
Monroe, FL

3.3.1.1.2. Population and Education

Table E-2 (Appendix E) depicts baseline population projections for the potential impact area. Baseline projections are for the impact area in the absence of the proposed activity. The analysis area consists of highly populated metropolitan areas (such as the Houston MSA, which predominates Subarea TX-2) and sparsely populated rural areas (as is much of Subarea TX-1). Some communities in the analysis area experienced extensive growth during the late 1970's and early 1980's when OCS activity was booming. Following the drop in oil prices, many of these same areas experienced a loss in population (Gramling, 1984; Laska et al., 1993). All subarea populations are expected to grow at a higher rate than the United States' average annual population growth rate over the life of the proposed actions, reflecting the region migration pattern of favoring the south and west over the northeast and Midwest (USDOC, Bureau of the Census, 2001). This is a continuation of historic trends. Average annual population growth projected over the life of the proposed actions range from a low of 0.45 percent for Subarea LA-3 (dominated by the Orleans MSA) to a high of 3.27 percent for Subarea FL-3 in the lower panhandle of Florida. Over the same time period, the population for the United States is expected to grow at about 1.36 percent per year.

At present, the 2000 U.S. Census data for education at the county/parish level have not been released. The last available data at this level is the 1990 Census data. Therefore, this analysis uses the 2000 U.S. Census Supplementary Survey Profile educational attainment data for States. For people 25 years and over, 75.2 percent of the population in the U.S. has graduated from high school, while 20.3 percent has received a bachelor's degree. Texas' educational attainment percentages are higher than the national average for both categories: 76.8 and 23.5 percent, respectively. Louisiana, while higher than the national average for high school graduates, 767 percent, is lower for college degrees, 19.5 percent. Mississippi's educational attainments are lower than the Nation's for both categories—74.3 and 18.6 percent, respectively. Alabama, like Louisiana, has a higher than national high school graduation rate (76.0%), but a lower rate for bachelor's degree (20.2%). Florida mirrors Texas; its educational attainments are higher than the national rates—81.9 and 23.2 percent, respectively.

3.3.1.1.3. Infrastructure and Land Use

The GOM OCS Region has one of the highest concentrations of oil and gas activity in the world. The offshore oil and gas industry has experienced dramatic changes over recent years, particularly since 1981. Historically, most of the activity has been concentrated on the continental shelf off the coasts of Texas and Louisiana. Future activity is expected to extend into progressively deeper waters and into the Eastern Planning Area (EPA). To date, only exploration activities have taken place off the shores of the State of Florida. The high level of offshore oil and gas activity in the GOM is accompanied by an extensive development of onshore service and support facilities. The major types of onshore infrastructure include gas processing plants, navigation channels, oil refineries, pipelines and pipeline landfalls, pipecoating and storage yards, platform fabrication yards, separation facilities, service bases, terminals, and other industry-related installations such as landfills and disposal sites for drilling and production wastes.

Land use in the impact area varies from state to state. The coasts of Florida and Texas are a mixture of urban, industrial, recreational beaches, wetlands, forests, and agricultural areas. Alabama's coastal impact area is predominantly recreational beaches, and small residential and fishing communities. Mississippi's coast consists of barrier islands, some wetlands, recreational beaches, and urban areas. Louisiana's coast impact area is mostly vast areas of wetlands; some small communities and industrial areas extend inward from the wetlands.

3.3.1.1.4. Navigation and Port Usage

A service base is a community of businesses that load, store, and supply equipment, supplies, and personnel needed at offshore work sites. Although a service base may primarily serve the OCS planning area and subarea in which it is located, it may also provide significant services for the other OCS planning areas and subareas. As OCS operations have progressively moved into deeper waters, larger vessels with deeper drafts have been phased into service, mainly for their greater range of travel, greater speed of travel, and larger carrying capacity. Service bases with the greatest appeal for deepwater activity have several common characteristics: strong and reliable transportation system; adequate depth and width of navigation channels; adequate port facilities; existing petroleum industry support infrastructure; location central to OCS deepwater activities; adequate worker population within commuting distance; and insightful strong leadership. Typically, deeper draft service vessels require channels with depths of 6-8 m. The proposed activity is expected to impact Port Fourchon, Louisiana, the designated service base for the proposed action. Helicopter traffic is expected to originate from Amelia, Louisiana. Historically, Terrebonne and Lafourche Parishes have been the primary staging and support area for offshore oil and gas exploration and development. The Port of Fourchon, at the mouth of Bayou Lafourche on the GOM, is a major onshore staging area for OCS oil and gas activities in the CPA and WPA and the headquarters of LOOP. Chapter 3.3.3.2 in the Multisale EIS for the CPA and WPA discusses the Port Fourchon area in detail.

3.3.1.1.5. Employment

Table E-3 (Appendix E) depicts baseline employment projections for the potential impact area. Baseline projections are for the impact area in the absence of the proposed activity. Average annual employment growth projected over the life of the proposed actions range from a low of 1.19 percent for Subarea LA-3 (predominated by the Orleans MSA) to a high of 5.43 percent for Subarea FL-3 in the lower panhandle of Florida. Over the same time period, employment for the United States is expected to grow at about 2.25 percent per year, while the GOM analysis area is expected to grow at about 2.06 percent per year. As stated above, this represents growth in general employment for the subareas. Continuation of existing trends, both in OCS activity and other industries in the area, are included in the projections.

The industrial composition for the subareas in the WPA and that in the CPA are similar. With the exception of Subareas LA-2, LA-3, and FL-4, the top four ranking sectors in terms of employment in the analysis area are the service, manufacturing, retail trade, and State and local government sectors. In Subareas LA-2 and LA-3, construction replaces manufacturing as one of the top four industries on the basis of employment, In Subarea FL-4, transportation, communication, and public utilities replaces manufacturing as one of the top four industries on the basis of employment. The service industry employs more people in all subareas. The service industry is also the fastest growing industry.

3.3.1.1.6. Current Economic Baseline Data

Oil and natural gas prices are used to evaluate the oil and gas industry's ability to economically develop resources. Since the beginning of 2002, oil prices have surged more than 35 percent, but drilling for oil has declined by 3 percent. Over the same period, natural gas prices also have risen by nearly 30 percent, while drilling for natural gas has dropped nearly 15 percent. Though the reasons behind the drilling decline are different for oil than natural gas. An overhang in the capacity to produce oil, i.e., political uncertainty and OPEC production restraints have pushed world oil prices upward, although excess capacity is about 10 percent of world oil consumption, is restraining oil drilling. However, a continued adjustment to previous declines in natural gas prices is driving down natural gas drilling. Natural gas drilling was greatly stimulated by the strong rise in natural gas prices that occurred in 1999 and 2000. Natural gas drilling still is adjusting to the sharp decline in natural gas prices that occurred in 2001 despite recent gains in natural gas prices. Also, relatively high inventory levels of natural gas in storage raise the possibility of slippage in natural gas prices.

As of August 16, 2002, Henry Hub Natural Gas closed at $3.10 per million BTU (an increase of 5.62% or $0.16 from a year ago) (Oilnergy, 2002). During September 2001, natural gas futures plummeted below $2 per thousand cubic feet for the first time since April 1999 amid concerns that the U.S. economy may slip into a recession. Natural gas demand from manufacturers, which accounts for about a quarter of U.S. consumption, was down and a turnaround in the economy was not expected in the short term (Houston Chronicle On-line, 2001). The U.S. natural gas consumption varies by 40 percent of Gross Domestic Production. As the economy strengthens, drilling for oil and natural gas is likely to pick up.

With world oil markets on edge over rising tensions between the United States and Iraq and uncertainty over OPEC's plans for production, September 2002 crude oil futures closed at $29.06 on August 14, 2002, on the New York Mercantile Exchange. Crude has been on the rise much of August because of concerns over Iraq. The rally in crude oil futures were spurred by unexpected high declines in U.S. crude inventories as reported by the American Petroleum Institute and Energy Information Administration (EIA). The EIA also reported that Japan's largest oil company, Nippon Oil, had increased its crude stockpiles by 2.45 million barrels since June to cushion potential cuts in supplies from the Persian Gulf.

Exploration and production (E&P) expenditures are another indicator of the energy industry's strength. Lehman Brothers' mid-year update of its original E&P spending survey of 279 companies indicates that 2002 U.S. E&P expenditures are expected to fall by 20.2 percent. This compares with a 17.9 percent decline cited in the company's December 2001 survey. The survey did reveal, however, that 58 percent of the companies surveyed expect to increase E&P budgets in 2003.

In addition to E&P spending, drilling rig use is employed by the industry as a barometer of economic activity. Drilling rig usage hovered around 90 percent or better for most of 2000 through May 2001 before declining in June 2001 to a low around 50 percent in November 2001 before rebounding from November 2001 to April 2002 to around 70 percent where it hovered throughout the summer of 2002. As of August 16, 2002, the fleet utilization rate for all marketed mobile rigs in the GOM was 65.0 percent (One Offshore, 2002). This breaks down as a 66.2 percent fleet utilization rate for jackups (average day rates of \$16,200-\$75,000); 57.5 percent for semisubmersibles (average day rates of \$30,000-\$125,000); 87.5 percent for drillships (average day rates are not available); and 57.1 percent for submersibles (average day rates of \$21,000-\$22,500). Platform rigs in the Gulf recorded a 37.8 percent fleet utilization rate, while inland barges had a 48.3 percent utilization rate. Offshore drilling rig day rates continue to decline for some rig markets but have improved in the GOM jackup and floating rig day rates. In the GOM, 250-ft to 300-ft rated jackup drilling units continued their slow improvement. Utilization among this group of rigs has been boosted by the departure of some units from the region and continued strong demand for higher-specification rigs at the top end of the fleet. Deepwater Floating Rig day rates spiked up in August 2002, mostly due to the strength of two contracts signed in late July. Day rates for mid-water depth semisubmersible drilling rigs continue to seesaw along with demand for rigs of this class. Since utilization of semisubmersible rigs has increased for two consecutive months, so have day rates for these rigs (One Offshore, 2002).

As rig utilization rates have fallen and the market has become much softer, drilling contractors are no longer lamenting the lack of skilled crews to run their rigs. While some contractors are recruiting full speed ahead, some are only recruiting for deepwater vessels, while others are not recruiting at all or only at the entry level. With some operators still stinging from laying off too many crews during the last downturn, it appears that many companies are more careful about laying off crews this time in response to a slowing market. If companies begin laying off personnel, when the market turns up again, drilling contractors may once again be left out in the cold when it comes to recruiting skilled personnel (One Offshore, 2001).

The still depressed GOM rig market continues to hit offshore service vessel (OSV) operators hard, with the smaller vessel owners hit the hardest. The most significant barometer of rig activity is what the energy companies are thinking, even if commodity prices are high enough to make money. The June 2002 utilization rates for supply boats and crewboats used by the offshore oil and gas industry decreased from the June 2001 figures and, for the most part, average day rates for these vessels followed suit. However, anchor-handling tug/supply vessels (AHTS) utilization and average day rates increased over the same time period. Average day rates for AHTS vessels ranged from \$12,500 for under 6,000-hp vessels (up \$2,000 or 19% from last year's rate) to \$15,500 for over 6,000-hp vessels (up \$3,000 or 24% from last year's rate); utilization rates were 100 percent for both. Supply boat average day rates ranged from \$5,390 for boats up to 200 ft (down \$3,010 or 36% from a year ago) and \$10,725 for boats 200 ft and over (up \$125 or 1% from a year ago); utilization was 61 percent and 96 percent, respectively. Crewboat average day rates ranged from \$2,100 for boats under 125 ft to \$3,000 for boats 125 ft and over (both down about 22% from last year's average rates); utilization was 71 percent and 82 percent, respectively (Greenberg, 2002).

Commencing with Central GOM Lease Sale 178 Part 1 in March 2001, new royalty relief provisions for both oil and gas production in the GOM's deep and shallow waters were enacted. These rules will govern the next three years of lease sales. Central Gulf Lease Sale 178 Part 1 resulted in 534 leases (an increase of 59.88% or 200 blocks from Central Gulf Lease Sale 175 in March 2000). Of these 534 leases, 348 were in shallow water (0-400 m). This increase of 67.30 percent from the last Central Gulf lease sale largely reflects the intensified interest in natural gas due to higher prices over the last year and the new royalty relief provisions. The 186 blocks receiving bids in deep water (greater than 400 m) reflect an increase of 47.62 percent or 60 blocks. Again, this dramatic increase in leasing could be a result of the recently issued royalty relief provisions. Western GOM Lease Sale 180 and Central GOM Lease Sale 178 Part 2, offering the newly available United States' blocks beyond the U.S. Exclusive Economic Zone, were held on August 22, 2001. No bids were received for blocks offered in Central Gulf Lease Sale 178 Part 2. Of the 4,114 blocks offered in Western Gulf Lease Sale 180, 320 received bids. About 55 percent of blocks receiving bids (177 blocks) in Western Gulf Lease Sale 180 are in deep water, and 175 of these deepwater blocks were leased. In Sale 181 in the Eastern GOM held on December 5, 2001, all 95 deepwater blocks receiving bids were leased. In Central GOM Sale 182, held March 20, 2002, 307 shallow-water blocks and 199 deepwater blocks received bids. In Western GOM Sale 184, held August 21, 2002, 164 shallow-water blocks and 159 deepwater blocks received bids.

3.3.1.1.7. Environmental Justice

On February 11, 1994, President Clinton issued an executive order to address questions of equity in the environmental and health conditions of impoverished communities. The most effective way of assuring that environmental endangerment is not concentrated in minority or low-income neighborhoods is to locate and identify these neighborhoods from the outset of a proposed project. While low incomes tend to coincide with concentrations of minority populations — black, Hispanic, Native American, and/or Asian — people living on low-incomes also include fishermen and timber harvesters. Minority populations within the impact region include African-American and Hispanic persons residing in all of the Gulf Coastal States, Native American tribal members scattered throughout coastal Louisiana, and Asian-Americans in Louisiana, Mississippi, and Alabama.

The Native American Data Center lists tribes that are located in the impact area (www.indiandata.com/eastern.htm) including the Chitimacha, Tunica-Biloxi, Coushatta, Houma, and Jena Band of Choctaws. In the early 1970's, only the Coushatta tribe was federally recognized. Today, four of the five tribes have Federal status, with the United Houma Nation still awaiting a finding on its petition. And because members of the Houma Nation live principally in Lafourche Parish and close to Port Fourchon, they could be directly affected by increases in oil and gas activity from the proposed action.

3.3.2. Commercial Fisheries

More than 26 percent (40% excluding Alaska) of commercial fish landings in the continental U.S. occur in the GOM. In 1999, the GOM placed second in total landed weight (almost 1 million tons) and third in value ($776 million) considering all U.S. regions (USDOC, NMFS, 2001). The most important species, such as menhaden, shrimps, oyster, crabs, and drums, are all species that depend heavily on estuarine habitats and the fisheries are restricted to the continental shelf. Menhaden was the most valuable finfish landed in 1999, accounting for $78.5 million in total value. The GOM shrimp fishery, however, is the most valuable fishery in the U.S., and the Gulf fishery accounts for 71.5 percent of total domestic production.

Commercial fishing in deeper waters (i.e., >200 m [656 ft]) of the GOM is characterized by fewer species and by lower landed weights and values than the inshore fisheries. Historically, the deepwater offshore fishery contributes less than 1 percent to the regional total weight and value (USDOI, MMS, 2001a). Target species can be classified into three groups: (1) epipelagic fishes, (2) reef fishes, and (3) invertebrates. In general, the Magnolia development is beyond the normal depth range of commercial reef fishes and invertebrates. While it is possible that new species of demersal fish or invertebrates may be pursued in the future if other fisheries fail, it appears unlikely at present because of the high cost and risk of fishing at extreme water depths. In addition, considerable time, effort, and finances would have to be expended to develop new markets for new species. Epipelagic commercial fishes include dolphin, sharks (spinner, silky, and sandbar), snake mackerels (escolar and oilfish), swordfish, tunas (bigeye, blackfin, bluefin, and yellowfin), and wahoo (USDOI, MMS, 2001a). These species are widespread in the Gulf and probably occur in Grid 7. The distribution and abundance of epipelagic species is influenced by several interrelated variables: water temperature, thickness of water layers of the same temperature, circulation patterns, and biological productivity. Pelagic longlining is likely occurring throughout the Grid 7 area and near the Magnolia Project area.

3.3.3. Recreational Resources and Beach Use

Over the past 20 years, the northern GOM coastal zone has become increasingly domesticated with residential and recreational land use predominating. The satellite photograph below shows the distribution of the population throughout the United States. Lights indicate population centers. One notices immediately that nearly all of the Gulf Coast is a concentrated band of light. But in addition to homes, condominiums and some industry, that same coastline is one of the major recreational regions of the United States, particularly for marine fishing and beach activities, both of which are viewed as public assets, belonging to no one individual or company. There is a diversity of natural and developed landscapes and seascapes, including coastal beaches, barrier islands, estuarine bays and sounds, river deltas, and tidal marshes. Other recreational resources are publicly owned and administered, such as national and state seashores, parks, beaches, and wildlife lands, as well as designated preservation areas, such as historic and natural sites and landmarks, wilderness areas, wildlife sanctuaries, research reserves and scenic rivers. Gulf Coast residents and tourists from throughout the nation, as well as from foreign countries, use these resources extensively and intensively for recreational activity. Commercial and private recreational facilities and establishments, such as resorts, marinas, amusement parks, and ornamental gardens, also serve as primary-interest areas. Locating, identifying, and observing coastal and marine birds is a recreational activity of growing interest and importance all along the Gulf Coast.

Source: National Aeronautics and Space Administration, Astronomy Picture of the Day, November 27, 2000.

More than 25 years ago Congress set aside outstanding examples of Gulf coastal beach and barrier island ecosystems to be managed by the National Park Service for the preservation, enjoyment, and understanding of their inherent value. State and county legislation added to this preservation program so that today there is a lengthy list of reserves, refuges, and public parks. That list, though much abbreviated, is as follows:

The U.S. coastline potentially affected by the installation of this proposed pipeline runs from Lafourche Parish in Louisiana to Gulf Shores, Alabama. It encompasses the confluence with the sea of the Mississippi and Mobile Rivers, which have two of the largest delta systems in the United States (Alabama State Docks Department, 2001). In this section, the MMS analyst divided the coastline into segments according to topography, discrete human and other biological populations, barrier island formations, and special preservation areas. This gives the reader the chance to put in geographical context the textual descriptions. Likewise, the reader will note that most of these counties host a plethora of ecological characteristics which humans use for recreation, research, conservation, and mineral extraction.

Beaches

Louisiana

The three parishes of Cameron, Lafourche, and Jefferson comprise this segment. Spanning part of this coastline is the Barataria-Terrebonne National Estuary Program, the Atchafalaya National Wildlife Refuge, and the Jean Lafitte National Historic Park and Reserve.

Mississippi and Alabama

Gulf Islands National Seashore in this part of the Gulf stretches some 40 mi from Hancock, Harrison, and Jackson Counties in Mississippi to neighboring Mobile County and Dauphin Island and over to Florida's Panhandle. It accommodates over 1 million recreational visits a year. In addition to beaches, the Seashore harbors historic forts, shipwrecks, wetlands, lagoons and estuaries, seagrass, fish and wildlife, and archeological sites. In 1978, Congress designated approximately 1,800 ac on Horn and Petit Bois Islands, part of the Gulf Islands National Seashore in Mississippi, as components of the National Wilderness System. There is also a national estuarine research reserve at Grand Bay (Weeks Bay Reserve Foundation, 1999).

Alabama

Gulf Shores, Alabama, lies at the southernmost part of Baldwin County, which is also known as Pleasure Island. It was not an island but a peninsula until the U.S. Army Corps of Engineers built the intracoastal waterways and cut the land ties to the mainland. Mobile Bay is part of the national estuary program and Weeks Bay, at the southeastern end of the bay, is also part of the national estuarine research reserve system (Weeks Bay Reserve Foundation, 1999).

The U.S. coastline potentially affected by the proposed action runs from Lafourche Parish in Louisiana, to Gulf Shores, Alabama. It encompasses the confluence with the sea of the Mississippi and Mobile Rivers, which have two of the largest delta systems in the United States (Alabama State Docks Department, 2001). In this section, the MMS analyst divided the coastline into segments according to topography, discrete human and other biological populations, barriers island formations, and special preservation areas. This gives the reader the chance to put in geographical context the textual descriptions. Likewise, the reader will note that most of these counties host a plethora of ecological characteristics that humans use for recreation, research, conservation, and mineral extraction.

Land Use

Use of the shorefront directly associated with this proposal is diverse. It consists of national seashores, traditional beachfront cities such as Padre Island, State parks, marshland, casino-dotted beaches eroding with misuse of rip-rap and jetties to Gulf Islands, the migratory bird habitats of Fort Morgan, and the sugar white sands of Gulf Shores, Alabama. Eco-tourism in national estuarine research reserves and beach recreation are interspersed with condominiums, hotels, planned communities, and private residences. Tourists and travelers are also attracted to the sites, sounds, shopping, and dining associated with developed marine areas.

Recreational Land Use

Although there is recreational use of the central Gulf Coast year-round, the primary seasons are the spring and summer. Kelley and Wade (1999) documented major increases in sales and lodging tax revenues in both Baldwin and Mobile Counties from 1979 to 1995, indicating the critical importance and effect of tourism on coastal Alabama (Kelly and Wade, 1999). Other coastal trends charted by Kelly and Wade (1999), such as population growth and the increase in pleasure-boat registrations, also indicate a corresponding growth in resident recreational demand.

3.3.4. Archaeological Resources

Archaeological resources are any material remains of human life or activities that are at least 50 years of age and that are of archaeological interest (30 CFR 250.2). The Archaeological Resources Regulation

(30 CFR 250.196) provides specific authority to each MMS Regional Director to require archaeological resource surveys, analyses, and reports. Surveys are required prior to any exploration or development activities on leases within the high-probability areas (NTL 2002-G01, effective in March 2002).

3.3.4.1. Prehistoric

Available geologic evidence suggests that sea level in the northern GOM was at least 90 m, and possibly as much as 130 m, lower than present sea level, and that the low sea-stand occurred during the period 20,000-17,000 years Before Present (B.P.) (Nelson and Bray, 1970). Sea level in the northern Gulf reached its present stand around 3,500 years B.P. (Coastal Environments, Inc., 1986).

During periods that the continental shelf was exposed above sea level, the area was open to habitation by prehistoric peoples. The advent of early man into the GOM region is currently accepted to be around 12,000 years B.P. (Aten, 1983). According to the sea-level curve for the northern GOM proposed by Coastal Environments, Inc. (CEI), sea level at 12,000 B.P. would have been approximately 45 m below the present still stand (CEI, 1977 and 1982). On this basis, the continental shelf shoreward of the 45-m to 60-m bathymetric contours has potential for prehistoric sites dating after 12,000 B.P. Because of inherent uncertainties in both the depth of sea level and the entry date of prehistoric man into North America, MMS adopted the 12,000 years B.P. and the 60-m water depth as the seaward extant of the prehistoric archaeological high-probability area.

The water depth of Garden Banks Blocks 783 and 784 (Magnolia Project) at the proposed well site is 4,674 ft (1,424 m). Based on the current acceptable seaward extant of the prehistoric archaeological, high-probability area, the extreme depth precludes the existence of any prehistoric archaeological resources within the Grid 7 area.

3.3.4.2. Historic

With the exception of the Ship Shoal Lighthouse structure, historic archaeological resources on the OCS consist of historic shipwrecks. A historic shipwreck is defined as a submerged or buried vessel, at least 50 years old, that has foundered, stranded, or wrecked and is presently lying on or embedded in the seafloor. This includes vessels (except abandoned hulks) that exist intact or as scattered components on or in the seafloor. A 1977 MMS archaeological resources baseline study for the northern GOM concluded that two-thirds of the total number of shipwrecks in the northern Gulf lie within 1.5 km of shore and most of the remainder lie between 1.5 and 10 km of the coast (CEI, 1977). A subsequent MMS study published in 1989 found that changes in the late 19th and early 20th century sailing routes increased the frequency of shipwrecks in the open sea in the Eastern Gulf to nearly double that of the Western and Central Gulf (Garrison et al., 1989). The highest observed frequency of shipwrecks occurred within areas of intense marine traffic, such as the approaches and entrances to seaports and the mouths of navigable rivers and straits.

Review of Garrison et al. (1989) and the most recent MMS shipwreck database lists one possible shipwreck or barge that falls within the Grid 7 area in Garden Banks Block 602. The two listed by MMS archaeologists are also unknown but have been located on the seafloor through side-scan-sonar surveys for those blocks. This wreck is listed in Chapter 4, Table 4-1. The Garrison et al. and MMS shipwreck databases should not be considered exhaustive lists of shipwrecks. Regular reporting of shipwrecks did not occur until late in the 19th century, and losses of several classes of vessels, such as small coastal fishing boats, were largely unreported in official records.

Wrecks occurring in deeper water would have a moderate to high preservation potential, as can be seen by the copper-sheathed wreck recently found in Mississippi Canyon Block 74. In the deep water, temperature at the seafloor is extremely cold, which slows the oxidation of ferrous metals and helps to preserve wood features. The cold water would also eliminate the wood-eating shipworm *Terredo navalis* (Anuskiewicz, 1989).

Aside from acts of war, hurricanes cause the greatest number of wrecks in the Gulf. The wreckage of the 19th century steamer *New York*, which was destroyed in a hurricane in 1846, lies in 16 m of water and has been documented by MMS (Irion and Anuskiewicz, 1999) as scattered over the ocean floor in a swath over 1,500 ft long. Shipwrecks occurring in shallow water nearer to shore are more likely to have been reworked and scattered by subsequent storms than those wrecks occurring at greater depths on the OCS. Historic research indicates that shipwrecks occur less frequently in Federal waters. However, these wrecks are likely to be better preserved, less disturbed, and, therefore, more likely to be eligible for nomination to the National Register of Historic Places than are wrecks in shallower State waters.

3.3.5. Artificial Reef and Rigs-to-Reefs Development

Artificial reefs have been used along the coastline of the U.S. since the early 19th century. Stone (1974) documented that the use of obsolete materials to create artificial reefs has provided valuable habitat for numerous species of fish in areas devoid of natural bottom. Stone et al. (1979) found reefs in marine waters not only attract fish, but in some instances enhance the production of fish as well.

The long-standing debate as to whether artificial reefs contribute to biological production or merely attract the associated marine resources still remains within the artificial reef scientific arena. While no unified answer to this dichotomy persist among the artificial reef researchers, the generally accepted conclusion is that artificial reefs both attract and produce fish. This conclusion depends on a variety of factors, such as associated species, limiting environmental factors, fishing pressure, and type of materials used. The degree to which any of the above factors can be controlled will dictate whether any particular artificial reef is a producer or an attractor. In reality many artificial reefs probably do both at the same time.

In 1985, the National Marine Fisheries Service wrote and completed the National Artificial Reef Plan (NARP). This was the first effort at the Federal or State level to establish guidelines to assist individuals and/or organizations in the development and management of artificial reefs. The NARP states that properly designed, constructed, and located artificial reefs can enhance the habitat and diversity of fishery resources; enhance United States recreational and commercial fishing opportunities; increase the energy efficiency of recreational and commercial fisheries; and contribute to the United States coastal economies.

The NARP provides general criteria for selection of materials for artificial reef application. These criteria include (1) function, which is related to how well a material functions as reef habitat; (2) compatibility, which is related to how compatible a material is with the environment; (3) durability, which is related to how long a material will last in the environment; (4) stability, which is related to how stable a material will be when subject to storms, tides, currents, and other external forces, and (5) availability, which is related to how available a material is to an artificial reef program.

In response to the National Fishing Enhancement Act (NFEA), the Louisiana Artificial Reef Initiative (LARI) combined the talents of university, state, Federal, and industry representatives to develop and artificial reef program for the State. As a result the Louisiana Fishing Enhancement Act (Act 100) became law in 1986. Subsequently, the Louisiana Artificial Reef Plan was written and contains the rationale and guidelines for implementation and maintenance of a state artificial reef program. The State plan is implemented under the leadership of the Louisiana Department of Wildlife and Fisheries. Materials for use as artificial reefs are accepted and placed within reef planning areas. Artificial reef complexes are established within reef planning areas on the basis of the best available information regarding bottom type, currents, bathymetry, and other factors affecting performance and productivity of the reefs. The LARI approved nine artificial reef-planning areas where artificial reefs can be sited (Kasprzak and Perret, 1996).

Rigs-to-Reefs Development

Rigs-to-Reefs (RTR) is a catchy term for converting obsolete, nonproductive, offshore oil and gas platforms to designated artificial reefs (Reggio, 1987). Offshore oil and gas platforms began functioning as artificial reefs in 1947 when Kerr-McGee completed the world's first commercially successful oil well in 5.6 m of water, 70 km south of Morgan City, Louisiana. Today, approximately 4,000 offshore oil and gas platforms exist on the OCS; these platforms also form one of the world's most extensive defacto artificial reef systems. However, MMS regulations require that these platforms be removed within one year after termination of the lease and disposed onshore. Disposal of obsolete offshore oil and gas platforms is not only a financial liability for the oil and gas industry but can be a loss of productive marine habitat (Kasprzak and Perret, 1996).

The use of obsolete oil and gas platforms for reefs has proven to be highly successful. Their availability, design profile, durability, and stability provide a number of advantages over the use of traditional artificial reef materials. To capture this recyclable and valuable fish habitat, the States of

Louisiana, Texas, and Mississippi in 1986, 1989, and 1999, respectively, passed enabling legislation and signed into State law RTR plans for their respective state. Alabama and Florida have no RTR legislation.

The State law set up a mechanism to transfer ownership and liability of the platform from oil and gas companies to the State when the platform ceases production and the lease is terminated. The company (donor) saves money by donating a platform to the State (recipient) for a reef rather than scrapping the platform onshore. The industry then donates 50 percent of the savings to the State to operate and manage the State's artificial reef program. Since the inception of the RTR plans, 151 retired platforms have been donated and used for reefs offshore Gulf Coast States.

Placed with the primary intent of oil and/or gas production for meeting the U.S. need for energy, offshore platforms provide artificial habitat on the Gulf's OCS, where natural hard-bottom habitat is at a minimum. Stanley (personal communications, 1998) calculated that the entire submerged portion of oil and gas platforms in the GOM provides some 12 km^2 of hard substrate. These platform reefs have created the most extensive de facto artificial reef systems in the world, providing some of the best habitat for reef associated species.

Louisiana Rigs-to-Reefs

Louisiana passed enabling State legislation (i.e., the Louisiana Fishing Enhancement Act) in 1986. The Act mandated preparation of the Louisiana Artificial Reef Plan. The Plan contains the rationale and guidelines for implementation and maintenance of the State's artificial reef program. The Louisiana Artificial Reef Council approved initially seven artificial reef-planning areas. Subsequently, two additional planning areas were added. These planning areas are strategically located across the Louisiana coast in various depth and distance from shore for receipt of platform reefs and other artificial reef materials.

Over 90 percent of the nearly 4,000 GOM OCS platforms are located offshore Louisiana. Consequently, the State is the leader in the transfer and capture of platforms for reef. Louisiana has some 100 of the 167 platforms that have to date been permanently converted to artificial reefs.

4. POTENTIAL ENVIRONMENTAL EFFECTS

4.1. PHYSICAL ELEMENTS OF THE ENVIRONMENT

4.1.1. Impacts on Water Quality

4.1.1.1. Coastal

The proposed Magnolia Project in Garden Banks Blocks 783 and 784 is located approximately 150 mi (240 km) from the Louisiana coastline. The proposed project is 180 mi (290 km) from the onshore base at Port Fourchon, Louisiana. All discharges to water are regulated by the USEPA. Conoco has obtained permit coverage under NPDES General Permit No. GMG290000.

Conoco proposed to drill, sidetrack, and complete wells and to commence production. Offshore activities that have a potential to change water quality include discharges of drilling fluids and cuttings; discharge of well treatment, workover, or completion fluids; and operational routine discharges of wastewater during drilling, completion, and production activities. Accidental spills could also alter water quality. Water quality could be affected by sediment disturbance during emplacement of the mooring system for the TLP. If the drill rig is anchored rather than dynamically positioned, as stated in the DOCD, additional sediment disturbances would result.

Discharged drilling fluids and cuttings and resuspended solids are not expected to impact coastal water quality. They would settle through the water column onto the seafloor. Produced-water discharges, the primary wastewater to be discharged, and other operational routine discharges are expected to be diluted to background levels prior to reaching coastal waters (Avanti Corporation, 1998). Accidental spills are addressed in Appendix A.

Coastal waters could be degraded by onshore support operations such as use of onshore support bases and associated navigation channels, dredging and sediment disturbance associated with construction or modification of onshore bases, and pipeline emplacement to bring oil and gas to shore. Conoco plans to use existing onshore support bases at Port Fourchon, Terrebonne Parish, Louisiana. No expansion of these onshore facilities is expected to result from the proposed activities. No increase in maintenance dredging of access canals is expected. Although the Magnolia Project will require two right-of-way pipelines to carry product from the platform to existing pipeline infrastructure at Garden Banks Block 128, no new nearshore or onshore pipelines are proposed for the project. No sediment disturbance from pipeline emplacement in coastal waters would occur.

Waste waters would be discharged from the onshore bases as well as support vessels. State regulations are in place to control contaminants associated with these waste discharges. Minor, transient changes in localized water quality would be intermittent, resulting from such waste discharges.

Conclusion

The proposed action would use existing onshore support facilities. These facilities are not expected to expand their operations to support the proposed activity and no new coastal pipeline or channels are proposed. As a result, only discharges from the support facilities and vessel traffic associated with the proposed action would result in a negative impact to coastal waters. The level of this impact is expected to be very minor and transient, negligibly affecting water quality. Offshore activities associated with the project are not expected to adversely affect coastal water quality because of the water depth and the 150-mi distance of the project from the coast.

4.1.1.2. Offshore

As indicated in the previous section on coastal water quality, offshore activities that have the potential to change water quality include sediment disturbance and discharge of wastes. Sediment disturbance would occur during both drilling and emplacement of the mooring system for the proposed TLP. The installation of anchor systems, pipelines, and other subsea infrastructure during emplacement operations would result in some sediment disturbances.

Discharged wastes include drilling fluids and cuttings, discharges of well treatment, completion, or workover fluids, operational routine discharges of wastewater during drilling, completion and production activities, and accidental spills. Routine production activities that would affect water quality include the discharge of produced water and sanitary and domestic waste discharges. Decommissioning effects would presumably be similar in scope and magnitude with offshore construction and installation operations. All discharges would adhere to existing regulatory discharge criteria designed to mitigate environmental effects.

Sediment disturbance and increased turbidity would create little impact on the water quality because the inputs would be limited in amount and the discharges would be spread out over time. Light limitation, one of the effects of high turbidity, is not an issue in deepwater areas. Surface sediments in the deepwater GOM are relatively pristine so that any turbidity created by bottom disturbances would not decrease water quality other than for the expected total suspended solids (TSS) increase. In conclusion, any effects from elevated turbidity would be short term, localized, and reversible.

Both water-based fluids (WBF's) and synthetic-based fluids (SBF's) are proposed for use. Water-based drilling fluids, which meet discharge permit requirements, would be intermittently discharged to the GOM at a rate of up to 250 bbl/day when discharged. The total discharge volume of WBF and cuttings estimated for each well are 43,000 bbl/well WBF and 2,100 bbl/well cuttings, respectively. The WBF's disperse within the water column at the point of discharge and the solids settle to the bottom (Neff, 1997). The effects of WBF's and cuttings discharge have been extensively studied. The primary concerns are the increased turbidity in the water column, alteration of sediment characteristics because of coarse material in the cuttings, and trace metals. The greatest effects to the benthos are within 100-200 m due to coarsening of the sediment by cuttings. Metals associated with drilling fluids return to background levels within 1,000-3,000 m downcurrent from the discharge (USDOI, MMS, 1998).

Discharge of SBF is not permitted. The SBF would be recovered from the cuttings and reused. The USEPA Region 6 NPDES general permit specifies the percentage of SBF that may be adhered to cuttings when cuttings are discharged into the water. Drill cuttings are representative of the geological formations below the seafloor, and would be discharged at a rate of 100 bbl/day. Conoco anticipates that up to 3,700 bbl/well of SBF-wetted cuttings would be discharged. Cuttings wetted with SBF tend to clump together in seawater and would accumulate near the drill location. The SBF-wetted cuttings could initially physically bury and smother benthic organisms. In time, the adhered SBF's would biodegrade, resulting in a decrease in sediment oxygen concentrations during the period of biological activity. The SBF's adhered to discharged cuttings should degrade within 2-3 years, impacting the local area for only a brief period (Neff et al., 2000). These effects, although adverse, would be confined to a limited area in the immediate vicinity of the drill site.

Mercury and other trace metals are naturally occurring impurities in barite, a component of WBF's and SBF's. Mercury is of particular concern because it can be bioaccumulated in aquatic organisms. Since 1993, USEPA has required concentrations of mercury to be less than or equal to 1 part per million (ppm) in the barite used to make drilling fluids. This reduces the addition of mercury to values similar to the concentration of naturally occurring mercury found in marine sediments throughout the Gulf of Mexico (Avanti Corporation, 1993a and b; USEPA, 1993a and b). Barite is nearly insoluble in seawater, thus trapping mercury and other trace metals in the barite grains (Trefrey, 1998). Therefore, unless the mercuric sulfide in the barite can be microbially methylated, this source of mercury is relatively unavailable for uptake into the marine food web.

Well treatment, completion, or workover fluids are primarily salt or acid solutions (Boehm et al., 2001). They are filtered and reused when feasible. Some inert particulate materials may also be used. The NPDES permit requirements restrict the discharge of priority pollutants and oil. Spent fluids would be discharged intermittently at a rate of 300 bbl/day. The discharge of approximately 3,000 bbl/well of completion fluids is anticipated. Treatment, completion, or workover fluids could alter the pH or dissolved solids in the receiving water. Negligible impacts to water quality would result because of the limitations imposed by the NPDES requirements and the volume and rate of discharge.

Approximately 20,000 bbl of produced-water per day would be discharged over the life of the project. Contaminants in the produced-water discharge stream may contain elevated levels of hydrocarbons and metals, and produced water would be discharged more or less continuously from a surface outlet throughout the production phase (Neff, 1997). Any produced water that has been treated and discharged is expected to disperse rapidly into the open oceanic environment. Because of the water depth, elevated concentrations of hydrocarbons or metals are not expected in bottom sediments. Produced-water discharges in Grid 7 would disperse in the water column before they reach the bottom and thus are not expected to concentrate in the benthic environment.

Sanitary and domestic waste discharges from personnel on-site (50 gallons/day/person) are expected to increase nutrient input and biological oxygen demand (BOD) slightly, but this is not normally a concern in open oceanic waters. Other minor discharges from development activities such as deck drainage, excess cement, other well fluids, and cooling water would affect water quality (e.g., TSS, nutrients, chlorine, BOD) within tens of meters of the discharge.

Accidental spills are examined in Appendix A. Oil from a spill would weather dependent upon a number of factors, particularly the characteristics of the released oil and oceanographic conditions. Some of the subsurface oil may disperse within the water column, as in the case of the *Ixtoc I* seafloor blowout. Evidence from a recent experiment in the North Sea indicated that oil released during a deepwater blowout (844-m water depth) would quickly rise to the surface and form a slick (Johansen et al., 2001). Once the oil enters the ocean, a variety of physical, chemical, and biological processes act to disperse the oil slick. These include spreading, evaporation of the more volatile constituents, dissolution into the water column, emulsification of small droplets, agglomeration sinking, microbial modification, photochemical modification, and biological ingestion and excretion. Some oil from the slick would be mixed into the water and dispersed by wind and waves. The quality of marine waters would be temporarily affected by the dissolved components and small, dispersed oil droplets that do not rise to the surface are mixed down by surface turbulence. Dispersion by currents and microbial degradation remove the oil from the water column or dilute the constituents to background levels.

Conclusion

Near-bottom water quality would be affected by the discharge of drilling fluids and cuttings and by sediments disturbed during the period of installation of subsea infrastructure, including the moorings and anchors and the pipelines which would transport the oil and gas off lease from Magnolia field. Any effects from the elevated turbidity would be short term, localized, and reversible. Oxygen levels in sediments in the immediate area would be temporarily affected as SBF's adhered to cuttings degrade. Trace amounts of mercury would remain within the granular barite. Any produced water, well treatment, completion or workover fluids that have been treated and discharged are expected to affect a relatively small area of oceanic water, would be rapidly diluted, and would disperse rapidly into the open oceanic environment. Produced-water discharges would disperse in the water column before they reach the bottom and thus would not influence sediments or interact with the benthic environment. Routine operational wastes and other minor discharges that have been treated and discharged are expected to affect only the immediate area, would be rapidly diluted, and would disperse rapidly into the open oceanic

Offshore effects from an accidental spill of oil would affect water quality immediately under the slick (top few meters of the water column). Operator-initiated activities to contain and clean up an oil spill would begin as soon as possible after an event. However, the remaining portion of the discharged oil would weather, disperse, and biodegrade within a short period of time so that no significant long-term effects on offshore water quality are expected to occur.

4.1.2. Impacts on Air Quality

The oil and gas activities proposed for the Magnolia Project would generate air pollutants due to emissions from operations of diesel and turbine equipment such as generators, compressors, crew and supply vessels, barges, tugs, and drilling rigs. These emissions would only affect the immediate vicinity of the proposed actions. Air pollutant emissions are readily dispersed by typical over-water atmospheric turbulence, so onshore impacts are expected to be insignificant. Impacts from oxides of nitrogen (NO_x) would be highest during the third year when drilling and construction are taking place. SO_x emissions would be highest during the days when flaring occurs.

Under normal operations, a minor amount of volatile organic compounds (VOC's) would be emitted directly into the atmosphere from various facilities and equipment, such as pipe-fittings, storage tanks, pumps, glycol dehydrators, and turbines. Highly volatile, low molecular weight hydrocarbons would be released to the atmosphere from the formation. The VOC's in the released hydrocarbons are precursors to photochemically produced ozone. A spike in VOC's could contribute to a corresponding spike in ozone, especially if the release was to occur on a hot sunny day in a NO_2 rich environment. The nearby onshore areas are all currently in attainment for ozone. Methane, the primary component of the gas stream, is a greenhouse gas. If a fire occurs, particulate and combustible emissions would be released in addition to the VOC's.

Conclusion

The proposed action is expected to increase air emissions, but these emissions would be below the MMS exemption levels. No significant impacts to air quality are expected.

4.2. Biological Resources

4.2.1. Impacts on Sensitive Coastal Environments

4.2.1.1. Coastal Barrier Beaches and Associated Dunes

The following section describes potential impacts to coastal barrier beaches and associated dunes from oil spills that might occur as a result of proposed activities in Grid 7. Appendix A describes the probability of an oil spill and the estimated dispersal characteristics should a spill occur. Spill response and effectiveness is also discussed in Appendix A.

Contact between an oil slick and a beach primarily depends upon environmental conditions and the nature of the oil spilled. It is not very likely that severe adverse impacts would occur to dunes from a spill within Grid 7. For storm tides to carry oil from a spill across and over the dunes, strong southerly or easterly winds must persist for an extended period of time, prior to or immediately after the spill. The strong winds that would be required to raise the water level sufficiently to contact dunes would also result in oil slick dispersal, thereby reducing impact severity at a landfall site. In addition, a study in Texas showed that oil on vegetated sand dunes had no deleterious effects on the existing vegetation or on the recolonization of the oiled sand by plants (Webb, 1988).

The cleanup operations associated with large oil spills can affect the stability of barrier beaches more than the spill itself. If large quantities of sand were removed during spill cleanup operations, a new beach profile and sand configuration would be established in response to the reduced sand supply and volume. The net result of these changes could be accelerated rates of shoreline erosion at the contact site and down drift of that site. This situation would be accentuated in sand-starved or eroding barrier beaches, such as those found on the Louisiana coast. State governments around the Gulf have recognized these problems and have established policies to limit sand removal by cleanup operations.

Conclusion

The proposed action is not expected to adversely alter barrier beach or dune configurations significantly as a result of a related oil spill, should one occur.

4.2.1.2. Wetlands

A description of a hypothetical oil spill associated with the proposed action is provided in Appendix A. The information below regarding potential impacts of oil spills on wetlands is based on analyses in the Final EIS for Western Gulf of Mexico Lease Sales 171, 174, 177, and 180 (USDOI, MMS, 1998) and more recently in the Final EIS for the Western Gulf of Mexico Lease Sales 185, 190, 194, 198, and 201 (USDOI, MMS, 2002).

Data in Appendix A indicate that a very low probability exists for an oil spill to occur from the Magnolia development. As discussed in USDOI, MMS (1998a and 2002), distant offshore spills have even a further diminished probability of impacting inland wetland shorelines and seagrasses, largely due to the sheltered locations of these habitats.

An inland fuel-oil spill may occur at a shore base or as a result of a vessel collision. The probability of an inland, fuel-oil spill occurring in association with the proposed action is very small. However, should a spill occur inshore or in nearshore waters, it presents a much greater potential for adversely impacting wetlands and seagrasses than an offshore spill, due simply to their proximity to the spill. Oil could accumulate in sheens and thick layers in the marsh and in protected pools and embayments.

The works of several investigators (Webb et al., 1981 and 1985; Alexander and Webb, 1983, 1985, and 1987; Lytle, 1975; Delaune et al., 1979; Fischel et al., 1989) were used to evaluate impacts of potential spills to area wetlands. For wetlands along the central Louisiana area, the critical oil concentration is assumed to be 1.0 l/m^2 of marsh. Concentrations above this would result in longer-term impacts to wetland vegetation, including some plant mortality and loss of land. Concentrations less than this may cause diebacks for one growing season or less, depending upon the concentration and the season during which contact occurs.

Conclusion

It is highly unlikely that significant adverse impacts to wetlands would result from a spill associated with the proposed project. If a spill does occurs at the offshore site, oceanographic and meteorological conditions are very unlikely to move oil far enough in a short enough time to cause oil contacts with wetlands. If an unlikely, project-related, fuel-oil spill occurs inshore, some wetlands in the spill vicinity may be adversely impacted.

4.2.1.3. Seagrasses

Seagrasses have generally experienced little or no damage from oil spills (Chan, 1977; Zieman et al., 1984). The relatively low susceptibility of seagrasses in the northern GOM to oil-spill impacts is partly the result of their location, which is subtidal, generally landward of barrier islands and in a region with a small tidal range. Furthermore, it should be noted that seagrasses are much less common in Louisiana, the most likely landfall for a spill, than elsewhere in the Gulf.

The lack of low-tide exposure protects seagrasses from direct contact with oil. The degree of impact depends on water depth, the nature of the oil, and the tidal and weather events in the affected area during the presence of the floating oil. Another reason for the low susceptibility of seagrass to oil spills is that a large percentage of their biomass is found in the buried root and rhizome, from which the leaves generate. An oil spill that moves over a seagrass area would not be expected to directly cause anything but slight damage to the vegetation. Some seagrass dieback for one growing season might occur, largely depending upon water currents and weather. No permanent loss of seagrass habitat is expected to result from such spills.

During extremely low water conditions such as wind-driven tidal events, seagrass beds might be exposed to the air and could potentially be impacted directly by an oil slick. Even then, their roots and rhizomes remain buried in the water bottom. Given the geography of the coastal area discussed, a strong wind that could lower the water that much generally would be a northerly or westerly wind, which would push water out of bays and estuaries and drive a slick away from the coast. In this situation, oil that was already in the bay or sound would be driven against the southern or eastern shores. Any seagrass beds that may be exposed there might be contacted.

The greatest oil-spill effect to seagrass communities has been to the diversity and populations of the epifaunal community found in the grass bed. Should water turbulence and turbidity increase sufficiently, some oil on the water surface may be emulsified. Suspended particles in the water column will adsorb oil from a sheen as well as from emulsified droplets, causing some particulates to clump together and decrease their suspendability. Typically, submerged vegetation reduces water velocity among the vegetation as well as for a short distance above it. Reduced flow velocity or turbulence further enhances sedimentation.

Minute oil droplets, whether emulsified or bound to suspended particulates, may adhere to vegetation or other marine life; they may be ingested by animals, particularly by filter and sedimentation feeders; or they may settle onto bottom sediments in or around a bed. In these situations, oil has a limited life because it will be degraded chemically and biologically (Zieman et al., 1984).

The potential danger to a seagrass community from an oil-spill event is a reduction for up to two years of the diversity or population of epifauna and benthic fauna found in grass beds. The degree of impact further depends on the time of year, water depth, currents, and weather in the affected area during the presence of a slick, as well as oil density, solubility, ability to emulsify, and toxicity.

A more damaging scenario would involve the secondary impacts of a slick that remains, for a period of time, over a submerged bed of vegetation in a protected embayment during typical fair-weather conditions. This would reduce light levels in the bed. If light reduction continues for several days, chlorophyll content in the leaves will be reduced (Wolfe et al., 1988), causing the grasses to yellow, reducing their productivity. By itself, shading from an oil slick should not last long enough to cause mortality. This depends upon the slick thickness, currents, weather, efforts to clean up the slick, and the nature of the embayment.

Also, a slick that remains over a submerged vegetation bed in an embayment will reduce or eliminate oxygen exchange between the air and the water of the embayment. Currents may not flush adequately oxygenated water from the larger waterbody to the shallow embayment. Seagrasses and related epifauna might be stressed and perhaps suffocated if the biochemical oxygen demand is high, as would be expected for a shallow waterbody that contains submerged vegetation, with its usual detritus load, and an additional burden of spilled oil (Wolfe et al., 1988).

The clean up of slicks that come to rest in shallow or protected waters [0-1.5 m (0-5 ft) deep] may be performed using “john” boats, booms, anchors, and skimmers mounted on boats or shore vehicles. Personnel assisting in oil-spill cleanup in water shallower than about 1 m (3-4 ft) may readily wade through the water to complete their tasks. Foot traffic and equipment can easily damage the seagrass beds. Oil can also be worked more deeply into their sediments by these activities.

As described for wetlands, oil that penetrates or is buried into the water bottom is less available for dissolution, oxidation, or microbial degradation. Oil may then be detectable in the sediments for five years or more, depending upon circumstances.

Navigational vessels that vary their route from established navigation channels can directly scar shallow beds of submerged vegetation with their props, keels (or flat bottoms), and anchors (Durako et al., 1992).

Conclusion

It is highly unlikely that significant adverse impacts to seagrasses would result from a spill associated with the proposed project. If a spill does occur at the offshore site, oceanographic and meteorological conditions are very unlikely to move oil far enough in a short enough time to cause oil contacts with seagrasses. If an unlikely, project-related, fuel-oil spill occurs inshore, some wetlands in the spill vicinity may be adversely impacted; however, seagrasses are unlikely to be impacted directly.

4.2.2. Impacts on Deepwater Benthic Communities/Organisms

4.2.2.1. Chemosynthetic Communities

A biological review for the potential occurrence of chemosynthetic communities was performed. No areas for potential chemosynthetic communities were identified in the area, including the 457-m (1500-ft) avoidance distance from the discharging structure, required by NTL 2000-G20. No other potential chemosynthetic community areas were identified within 152 m (500 ft) of all anchor locations or anchor chain/cable impacting areas. The closest known chemosynthetic community is located in Garden Banks Block 520, more than 22 nmi to the southwest.

Conclusion

The proposed Magnolia Project would not have an impact on known chemosynthetic communities, and no potential communities are located in the vicinity of the impacting activities, as indicated by geophysical characteristics.

4.2.2.2. Coral Reefs

Coral reefs in the GOM are typically associated with topographic features. There are no known topographic features in Grid 7. High-density deepwater coral reefs are considered rare in the GOM, and there are no documented areas of high-density, deepwater corals in Grid 7. However, the potential does exist for unknown, deepwater coral habitats to be present in Grid 7.

Conclusion

The proposed action would have no impact on any known coral reef.

4.2.2.3. Deepwater Benthos and Sediment Communities

The deepwater benthos in the immediate vicinity of the proposed project would be impacted by the discharge of drilling mud and cuttings, placement of mooring lines and anchors, and well site locations. The most common adverse impact would be physical smothering by sediments. Invertebrates, many with some degree of mobility, typically dominate the megafaunal benthic communities at the project depth of 1,425 m. The macrofauna is dominated by deposit-feeding polychaete worms with varying degrees of mobility and tolerance to disturbance. The meiofauna, primarily composed of small nematode worms, is more abundant than macrofauna, and their numbers decline with depth. Little is known of the microbiota in deep water, but it probably includes hydrocarbon-degrading forms. None of the benthic communities found in Garden Banks Block 783 are unique to the area and appear to be widespread throughout the Gulf, where depths, substrates, and other environmental factors are similar.

The effects of drilling muds and cuttings on the deepwater benthos would be limited for the following reasons:

- *Low Toxicity*. The synthetic-based fluids (SBF's) are expensive and are recycled. Any unusable portion is sent to approved disposal/recycling sites onshore. The SBF cuttings would be treated to conform to regulatory guidelines. The SBF's are essentially nontoxic, and the composite formulation of the discharged fluid adhering to the cuttings has a very low toxicity to aquatic organisms. Most of the SBF's in current use can easily pass the USEPA's 96-hour, LC_{50} criteria of 30,000 ppm (McKelvie and Ayers, 1999). Test results with four types of SBF's on algae, mysids, copepods, mussels, and amphipods range from 277 to 1,000,000 ppm (McKelvie and Ayers, 1999). Dose response studies on fish by Payne et al. (2001a and b) demonstrated that sediments contaminated with Hibernia (Grand Banks, Newfoundland) source cuttings containing an aliphatic hydrocarbon-based synthetic drilling fluid had a very low toxicity potential. Acute toxicity was not observed in juvenile flounder exposed for up to two months to sediment containing approximately 6,000 ppm of diesel-range (aliphatic) hydrocarbons.

- *Limited Biological Effects*. The only direct biological effect reported for SBF's and associated cuttings in the field environment has been smothering of benthic animals by physical and/or anoxic conditions. Anoxia is caused by the rapid biodegradation of the SBF's. Organic enrichment due to the introduction of carbon into a carbon-poor environment has also been noted (Gallaway and Beaubien, 1997).
- *Limited Affected Area*. Cuttings from wells drilled with SBF's tend to clump together and are transported to the bottom relatively quickly. Thus, the affected area would be relatively small. The vast majority of historical literature [based on the more toxic oil-based mud (OBM's) or water-based mud (WBM's), which tend to disperse farther] indicates biological effects generally do not occur beyond 500 m (1,640 ft) from the source, although several papers have noted subtle effects beyond that range. Most relevant is the recent research in the North Sea (Jensen et al., 1999) that studied a number of platforms that used only SBF's. That study found no benthic effects (i.e., benthic effects as measured by subtle community changes) beyond 250 m (820 ft) in most cases, 500 m (1,640 ft) in a few cases. However, one must note that the North Sea is a shallower environment than the deepwater GOM.

The anchor system for the TLP and mooring lines should have minimal effects on the benthos. Installation of the anchors and activities at the proposed well sites would physically disturb the benthos in the immediate area. The benthos would also be affected in the unlikely event of a subsea blowout that caused disturbance and slumping of the surrounding seabed.

Conclusion

Structure emplacement (including anchor installations and moorings), well drilling, and completion operations would disturb benthic communities by smothering and displacing them from patches within limited distances of the well site locations and within a small area of the anchors and chains or cables that contact the bottom. Partial recovery of the community would occur within weeks or months of the disturbance probably followed by a more or less full recovery within 1-2 years. This would not result in a significant impact on the benthic communities because the duration and area extent of the proposed activities would be limited.

Routine production activities would not significantly impact the benthos. A subsea blowout would physically disturb the benthos within a small radius of the blowout, but most of the released fluids are expected to go to the surface and not interact with deepwater benthos.

4.2.3. Impacts on Marine Mammals

The major impact-producing factors affecting marine mammals as a result of routine OCS activities within Grid 7 and associated with the Magnolia Project include the noise generated by helicopters, vessels, and operating facilities; vessel traffic; structure removals; jetsam and flotsam from associated support vessels and rig/TLP facilities; physical impacts with tendons, risers, pipelines, and other underwater structures; degradation of water quality from operational discharges; accidental chemical/waste spills or releases; and spill response actions.

Some effluents are routinely discharged into offshore marine waters. It is expected that cetaceans may have some interaction with these discharges. Direct effects to cetaceans are expected to be sublethal. However, any toxins in the effluent could poison and kill or debilitate marine mammals and adversely affect the food chains and other key elements of the Gulf ecosystem (Tucker & Associates, Inc., 1990). Because OCS discharges are diluted and dispersed in the offshore environment, impacts to cetaceans are expected to be negligible relative to the contaminants introduced into the Gulf from national and international watersheds.

Helicopter activity projections include eight round trips per week during installation, seven round trips during drilling and completion, and a minimum of one round trip flight per week during production. Flights are expected to originate from Amelia, Louisiana. The FAA Advisory Circular 91-36C encourages pilots to maintain higher than minimum altitudes (noted below) over noise-sensitive areas. Guidelines and regulations promulgated by NOAA Fisheries under the authority of the Marine Mammal Protection Act include provisions specifying that helicopter pilots maintain an altitude of 1,000 ft within

100 yd (91 m) of marine mammals. It is unlikely that cetaceans would be affected by routine OCS helicopter traffic operating at these altitudes, provided pilots do not alter their flight patterns to more closely observe or photograph marine mammals that they see. Routine overflights may elicit a startle response from, and interrupt cetaceans nearby (depending on the activity of the animals) (Richardson et al., 1995). Occasional overflights probably have no long-term consequences on cetaceans; however, frequent overflights could have long-term consequences if they repeatedly disrupt necessary activities, such as feeding and breeding. Although helicopter activity would be relatively low for the Magnolia Project, the helicopter activity is expected to increase as more blocks are developed within Grid 7. Temporary disturbance to cetaceans may occur on occasion as helicopter approaches or departs an OCS facility if animals are near the facility. Such disturbance is believed negligible relative to other sources of noise (e.g., vessel traffic).

Well development activities associated with the Magnolia Project could produce sounds at intensities and frequencies that could be heard by cetaceans. It is expected that noise from drilling and completion activities would be somewhat constant and last approximately 24 months. Although development activities would be relatively limited for the Magnolia Project, the drilling, completion, and production activities and associated noise is expected to increase as more blocks are developed within Grid 7. Odontocetes echolocate and communicate at higher frequencies than the dominant sounds generated by drilling platforms. Sound levels in this range are not expected to be generated by drilling operations (Gales, 1982). Bottlenose dolphins, one of the few species in which low-frequency sound detection has been studied, have been found to have poor sensitivity levels at the level where most industrial noise energy is concentrated. Potential effects on GOM marine mammals include disturbance (subtle changes in behavior, interruption of previous activities, or short- or long-term displacement); masking of calls from conspecifics, reverberations from own calls, and other natural sounds (e.g., surf, predators); stress (physiological); and hearing impairment (permanent or temporary) by explosions and strong nonexplosive sounds.

Conoco estimates that there would be multiple support-vessel trips per week during installation, drilling and completion phases of the Magnolia Project (lasting approximately 12 months). Subsequent support-vessel trips during production would involve approximately one round-trip vessel trip per week. Vessel traffic is anticipated to travel directly from/to Fourchon, Louisiana, in most cases. Although vessel activity would be relatively limited for the Magnolia Project, the vessel activity is expected to increase as more blocks are developed within Grid 7. Noise from support-vessel traffic may elicit a startle and/or avoidance reaction from cetaceans or mask their sound reception. There is the possibility of short-term disruption of movement patterns and behavior, but such disruptions are unlikely to affect survival or productivity. Long-term displacement of animals from an area is also a consideration. Toothed whales exposed to recurring vessel disturbance could be stressed or otherwise affected in a negative but inconspicuous way. Increased vessel traffic increases the probability of collisions between vessels and marine mammals, which may result in injury or death to some animals. Smaller delphinids may approach vessels that are in transit to bow-ride. Limited observations on an NMFS cruise off the mouth of the Mississippi River in the summer of 2000 indicated that sperm whales appeared to avoid passing service vessels. However, marine mammalogists conducting surveys in the CPA during the summer of 2001 documented an adult killer whale that bore conspicuous and aged scarring across its back that were indubitably the result of a collision with a motor vessel. A manatee was unintentionally hit and killed by a boat off Louisiana (Schiro et al., 1998). Another manatee was killed by vessel traffic (type of vessel unknown) in Corpus Christi Bay in October 2001 (Beaver, personal communication, 2001). It appears that there is limited threat posed to smaller, coastal delphinids where the majority of OCS vessel traffic occurs. Support vessel activity in Grid 7 or adjacent waters would increase the risk of vessel strike to sperm whales and other deep-diving cetaceans (e.g., *Kogia* and beaked whales). Deep-diving whales are more vulnerable to vessel strikes because of the extended surface period required to recover from extended deep dives. Grid 7 is known as preferred sperm whale habitat; whales use the area as foraging, nursery, and possibly mating habitat. Sperm whales are known to socialize at the sea surface in groups. Socializing whales may be distracted by conspecifics, hence making the group more likely to be struck by any approaching vessels. Manatees are rare in the northwestern Gulf; consequently, there is little risk posed by OCS vessel traffic in Grid 7.

Another factor of concern is the ability that cetaceans (more specifically, sperm whales) possess for detecting and avoiding the various pipelines, risers, and tendons lines associated with the Magnolia TLP. Sperm whales are known to get entangled in deep-sea cables (USDOI, MMS, 2001a).

Many types of materials, including plastics, are used during drilling and production operations. Some of this material is accidentally lost overboard where cetaceans can consume it. The result of ingesting some materials lost overboard can be lethal, and the probabilities of occurrence, ingestion, and lethal effect are unknown.

Appendix F provides information regarding accidental oil spills associated with the proposed action. The worst case scenario is for a spill of 29,883 bbl. Such a spill is highly unlikely; however, it could negatively impact sperm whales and other oceanic marine mammal species. The expected impacts would involve the oiling of animals and prey and probable temporary displacement from the impacted area. Sperm whales use this area as foraging, nursery, and possibly mating habitat. Spill-response activities could also disrupt normal behavioral activities of marine mammals in the area.

Conclusion

Small numbers of marine mammals could be killed or injured by chance collision with support vessels and by eating indigestible debris, particularly plastic items lost from support vessels, drilling rigs, and fixed and floating platforms. The likelihood of such "take" is greater within this grid than many other grids because surveys indicate there to be sperm whales inhabit and forage within Grid 7. Also, sperm whales may collide with or become entangled in various catenaries, pipelines, risers, and tendons lines associated with the Magnolia Project. Nonetheless, such cases of "take" are expected to be rare. Conclusive evidence is lacking as to whether anthropogenic noise has or has not caused long-term displacements of, or reductions in, marine mammal populations. Contaminants in waste discharges and drilling muds might indirectly affect marine mammals through food-chain biomagnification. Hydrocarbon spills in the area could impact marine mammals; their magnitude and fate would determine the species and numbers of animals impacted. Spills and spill response activities in Grid 7 may temporarily displace marine mammals such as the endangered sperm whale from important foraging, nursery, and/or mating habitat.

The routine activities associated with the Magnolia Project are not expected to have long-term adverse effects on the size and productivity of any marine mammal species or population stock endemic to the northern GOM. Accidental events (e.g., collisions with vessels, oil spills) are expected to be rare and MMS has regulations in place to greatly restrict their possibility.

4.2.4. Impacts on Sea Turtles

Multiple vessel trips per week are expected during installation, drilling and completion phases of the Magnolia Project, lasting approximately 24 months. There would be one weekly support vessel after the facility begins production activities. Transportation corridors would be through areas where Kemp's ridley, green, loggerhead, and leatherback sea turtles have been sighted. Multiple helicopter trips per week are expected, lasting approximately 24 months. Production operations would be supported by an estimated two flights per week. Noise from support-vessel traffic and helicopter overflights may elicit a startle reaction from sea turtles and there is the possibility of short-term disruption of activity patterns. Sounds from approaching aircraft are detectable in the air far earlier than in water. There are no systematic studies published concerning the reactions of sea turtles to aircraft overflights, and anecdotal reports are scarce. It is assumed that aircraft noise could be heard by a sea turtle at or near the surface and cause it to alter its activity (Advanced Research Projects Agency, 1995). In the wild, most sea turtles spend at least 3-6 percent of their time at the surface. Despite the brevity of their respiratory phases, sea turtles sometimes spend as much as 19-26 percent of their time at the surface engaged in surface basking, feeding, orientation, and mating (Lutcavage et al., 1997). Sea turtles located in shallower waters have shorter surface intervals, whereas turtles occurring in deeper waters have longer surface intervals. Sea turtles exposed to recurring vessel disturbance could be stressed or otherwise affected in a negative but inconspicuous way. As other blocks in Grid 7 are developed, the increased vessel traffic would elevate the probability of collisions between vessels and turtles, potentially resulting in injury or death to some animals.

Activities associated with the Magnolia Project could generate sounds at intensities and frequencies that could be heard by turtles. There is evidence suggesting that turtles may be receptive to low-frequency sounds, which is at the level where most industrial noise energy is concentrated. Potential effects on turtles include disturbance (subtle changes in behavior and interruption of activity), masking of other sounds (e.g., surf, predators, vessels), and stress (physiological). Such noise is expected to have sublethal effects on sea turtles.

Many types of materials, including plastics, are used during exploration and production operations. Some of this material is accidentally lost overboard where sea turtles can consume it. The result of ingesting materials lost overboard could be lethal. Leatherback turtles (a species known to inhabit Grid 7) do mistake plastics for jellyfish and may be more vulnerable to gastrointestinal blockage than other sea turtle species. Sea turtles could also become entangled in debris lost by vessels or platforms associated with the Magnolia Project. As more blocks are developed in the Grid 7 area, the probability of OCS-related flotsam in the area would increase. More flotsam increases the risks to sea turtles.

Some effluents would be discharged into offshore marine waters as a result of Magnolia Project and would be regulated by USEPA NPDES permit. Turtles may have some interaction with these discharges. Very little information exists on the impact of drilling muds on Gulf sea turtles (Tucker and Associates, Inc., 1990). Exposure to these discharges could result in sublethal effects to subadult and adult sea turtles. However, hatchling and young juveniles exposed to concentrations of these discharges may suffer sublethal and/ or lethal effects.

Little or no damage is expected to the physical integrity, species diversity, or biological productivity of live-bottom habitat used by sea turtles as a result of a proposed action unless a spill occurs that impacts these areas. Since sea turtle habitat in the Gulf includes inshore, neritic, and oceanic waters, as well as numerous beaches in the region, sea turtles could be impacted by accidental spills resulting from operations associated with the proposed action.

A spill as explained in the previous section (impacts on marine mammals), should it occur, could negatively impact any of the five sea turtle species inhabiting the Gulf. The expected impacts would involve the oiling of animals and prey, and probable displacement from the impacted area.

A spill of this magnitude offshore in oceanic waters would also likely prove lethal to any hatchling or juvenile sea turtles that it contacts. All neonate sea turtles undertake a passive voyage via oceanic waters following nest evacuation. Depending on the species and population, their voyage in oceanic waters may last 10 or more years. Beaches of the Caribbean Sea and GOM are used as nesting habitat, and hatchlings evacuating these nesting beaches emigrate to oceanic waters seaward of their nesting sites. Surface drifter card data (Lugo-Fernandez et al., 2001) indicate that circulation patterns in the Caribbean Sea and southern GOM may transport neonate and young juvenile sea turtles from these areas to oceanic waters off the coasts of Texas and Louisiana. Moreover, these journeys begin as pulsed events, with many hatchlings emerging and emigrating offshore at the same times. Consequently, oil spills occurring in Grid 7 could impact multiple turtles, particularly neonate or young juvenile sea turtles associating with oceanic fronts or refuging in sargassum mats where oil slicks, decomposing residues, and tarballs are likely to accumulate. Oceanic waters of the GOM (including those of Grid 7) are also inhabited by subadult and adult leatherback and loggerhead sea turtles; however, adults of any endemic sea turtle species may be found offshore. Sea turtles (and most notably hatchlings and juveniles) coming into contact with the spill could suffer lethal or sublethal leading to lethal (over time) exposure. Aggregations of sea turtles may be exposed in one spill event. Prey species may be negatively impacted, thereby impacting sea turtles that would otherwise feed on them. Turtles may be temporarily displaced from the impacted areas. The magnitude of impacts to sea turtles would depend upon the oils that they are exposed to, their concentrations, and the period of exposure.

Spill-response activities could also disrupt normal behavioral activities of sea turtles in the area and cause animals to temporarily vacate the spill response area.

Conclusion

Routine activities resulting from the Magnolia Project have the potential to harm sea turtles or temporarily displace them from important habitat areas. These animals could be impacted by the degradation of water quality resulting from operational discharges; noise generated by helicopter and vessel traffic, platforms, and drillships; brightly-lit platforms; vessel collisions; and jetsam and flotsam generated by service vessels and OCS facilities. Lethal effects are most likely to be from chance collisions with OCS service vessels and ingestion of plastic materials. Most Magnolia Project impacts are expected to have sublethal effects. Contaminants in waste discharges and drilling muds might indirectly affect sea turtles through food-chain biomagnification. Routine activities associated with the Magnolia

Project are unlikely to have significant adverse effects on the size and recovery of any sea turtle species or population in the GOM.

Oil spills are accidental events. Populations of sea turtles in the northern Gulf may be exposed to residuals of oil spilled and attributed to the proposed action during their lifetimes. Chronic or acute exposure may debilitate or kill sea turtles. In most foreseeable cases, exposure to spilled hydrocarbons persisting in the sea following the dispersal of an oil slick would result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity; and increased vulnerability to disease) to sea turtles. Sea turtle hatchlings exposed to and becoming fouled by spilled oil or consuming associated tarballs persisting in the sea following the dispersal of an oil slick could be killed.

4.2.5. Impacts on Coastal and Marine Birds

4.2.5.1. Nonthreatened and Nonendangered Birds

This section discusses the possible effects of the proposed action on coastal and marine birds of the GOM and its contiguous waters and wetlands. Air emissions, water quality degradation resulting from discharges, helicopter and service-vessel traffic and noise, light attraction, and discarded trash and debris from service vessels and platforms could impact coastal and marine birds. Associated spill-response activities may also impact coastal and marine birds. Any effects would be especially critical for intensively managed populations such as endangered and threatened species that need to maintain a viable reproductive population size or that depend upon a few key habitats. Emissions of pollutants into the atmosphere from activities associated with the proposed action are expected to have minimal effects on offshore air quality because of the prevailing atmospheric conditions, emission heights, and pollutant concentrations. Such emissions are expected to have negligible effects on onshore air quality because of the atmospheric regime, emission rates, and distance of these emissions from the coastline. These judgments are based on average steady state conditions; however, there will be days of low mixing heights and low wind speeds that could further decrease air quality. These conditions are characterized by fog formation, which in the Gulf occurs mostly during winter. Impacts from offshore sources are reduced in winter because the frequency of significant onshore winds decreases (25%) and the removal of pollutants by rain increases. The summer is more conducive to air quality effects as onshore winds occur more frequently, approximately 50 percent of the time. Helicopter and service-vessel traffic related to the proposed action could sporadically disturb feeding, resting, or nesting behavior of birds or cause abandonment of preferred habitat. These impact-producing factors could contribute to indirect population loss through reproductive failure resulting from nest abandonment. The FAA (Advisory Circular 91-36C) and corporate helicopter policy state that, when flying over land, the specified minimum altitude is 610 m (2,000 ft) over populated areas and biologically sensitive areas such as wildlife refuges and national parks. However, pilots traditionally have taken great pride in not disturbing birds. It is expected that approximately 10 percent of helicopter trips would occur at altitudes somewhat below the minimums listed above as a result of inclement weather. Although these incidents are only seconds in duration and sporadic in frequency, they can disrupt coastal bird behavior and, at worst, possibly result in habitat or nest abandonment.

Service vessels would use selected nearshore and coastal (inland) navigation waterways, or corridors, and adhere to protocol established by the USCG for reduced vessel speeds within these inland areas. Routine presence and low speeds of service vessels within these waterways would diminish the effects of disturbance from service vessels on nearshore and inland populations of coastal and marine birds. The effects of routine service-vessel traffic on birds offshore therefore would be negligible.

Seabirds (e.g., laughing gulls and petrels) may be attracted by lights and/or structures and may remain and feed in the vicinity of the spar platform. Operational discharges or runoff in the offshore environment could affect these individuals. Impacts may be both direct and indirect.

Coastal and marine birds are commonly observed entangled and snared in discarded trash and debris. In addition, many species ingest small plastic debris, either intentionally or incidentally. Such interactions can lead to serious injury and death. The MMS prohibits the disposal of equipment, containers, and other materials into offshore waters by lessees (30 CFR 250.300). Thus, it is expected that coastal and marine birds would seldom become entangled in or ingest OCS-related trash and debris. MARPOL (Annex V, Public Law 100-220; 101 Statute 1458; effective January 1989) prohibits the disposal of any plastics at sea or in coastal waters. Thus, due to the low potential for interaction between coastal and marine birds and project-related debris, any effects would be negligible.

A spill ≥1,000 bbl at the site of the proposed action would have a spill risk for contacting the shoreline of 0.5 percent or greater only for Plaquemines Parish, Louisiana, where the risk is 1 percent, and various birds along the coast could experience mortality and reproductive losses. Recovery would depend on subsequent influxes of birds from nearby feeding, roosting, and nesting habitats.

Oil-spill cleanup methods often require heavy traffic on beaches and wetland areas, application of oil dispersants and bioremediation chemicals, and the distribution and collection of oil containment booms and absorbent material. The presence of humans, along with boats, aircraft, and equipment, could also disturb coastal birds after a spill. Investigations have shown that oil dispersant mixtures pose a threat to bird reproduction similar to that of oil (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; however, successful dispersal of a spill would generally reduce the probability of exposure of coastal and marine birds to oil (Butler et al., 1988). It is possible that changes in the size of a breeding population may also be a result of disturbance from increased human activity related to cleanup, monitoring, and research efforts (Maccarone and Brzorad, 1994). A growing number of studies indicate that current rehabilitation techniques are not effective in returning healthy birds to the wild (Anderson et al., 1996; Boersma, 1995; Sharp, 1995 and 1996). Deterrent or preventative methods, such as scaring birds from the path of an approaching oil slick or the use of booms to protect sensitive colonies, have extremely limited applicability.

4.2.5.2. Threatened and Endangered Birds

Piping Plover

The impacts on shorebirds not listed as endangered or threatened discussed above also apply to the piping plover. A spill of ≥1,000 bbl at the site of the proposed action would have a spill risk for contacting the shoreline of 0.5 percent or greater only for Plaquemines Parish, Louisiana, where the risk is 1 percent. Birds along the coast could experience mortality and reproductive losses. Recovery would depend on subsequent influxes of birds from nearby feeding and roosting habitats.

Bald Eagle

The bald eagle feeds on fish, waterfowl, shorebirds, and carrion near water. This bird may come in contact with an oil spill by eating contaminated dead and dying prey. Bald eagles have narrow preferences for nesting habitat. Any oiling of aquatic feeding habitat resulting in nest site abandonment could lead to relocation of a nest to less preferred habitat. This event in turn would reduce population growth for this already threatened species. However, the bald eagle has high mobility and, when an oil slick enters the feeding habitat, may relocate feeding to unpolluted parts of the waterbodies. When relocating feeding far from the nest, the eagle would successfully home to its nest after feeding because it prefers to build its nest in a highly visible place over the forest canopy with a clear short path from the water.

Brown Pelican

The brown pelican is a species of special concern in Louisiana and Mississippi although it is no longer listed as endangered or threatened in Florida or Alabama (USDOI, FWS, 1998). It is known to nest on Guillard Island, Alabama, a dredged material disposal island in Mobile Bay. There have been no reported nesting sites in Mississippi. Impacts to individual brown pelicans would be similar to those identified for the nonendangered and nonthreatened species discussed in preceding sections.

It is expected that the majority of effects from the major impact-producing factors on coastal and marine birds would be sublethal (behavioral effects and nonfatal intakes of discarded debris), causing temporary disturbance and displacement of localized groups, mostly inshore. However, chronic stress such as digestive upset, partial digestive occlusion, sublethal ingestion, and behavioral changes are often difficult to detect. Such stresses can weaken individuals and make them more susceptible to infection and disease as well as making migratory species less fit for migration. A spill of ≥1,000 bbl at the well site would have a spill risk for contacting the shoreline of 0.5 percent or greater only for Plaquemines Parish, Louisiana, where the risk is 1 percent. Birds along the coast could experience mortality and reproductive losses. Recovery would depend on subsequent influxes of birds from nearby feeding, roosting, and nesting habitats.

However, the amount of shoreline affected would be relatively small compared to the extensive shoreline habitat available in the northern GOM. Associated spill response can cause mortality to a number of bird species, including ones of special concern. Although their rarity would make them less likely to be impacted, any reductions in numbers could threaten their existence as a population.

Conclusion

Coastal and marine birds may encounter periodic disturbance and temporary displacement of localized groups and individuals from the routine activities associated with the proposed action. A spill ≥1,000 bbl at the well site would have a spill risk for contacting the shoreline of 0.5 percent or greater only for Plaquemines Parish, Louisiana, where the risk is 1 percent. Various birds along the coast could experience mortality and reproductive losses. Recovery would depend on subsequent influxes of birds from nearby feeding, roosting, and nesting habitats. Species experiencing the loss of individuals could require a generation to recover.

4.2.6. Impacts on Essential Fish Habitat and Fish Resources

Development activities that have potential to affect fish and EFH include discharge of mud and cuttings, and construction effects on water quality. Production activities that may affect fish are those primarily associated with the "artificial reef effect" and the discharge of produced water.

Drill cuttings with mud adhering to them would be discharged to the water column at the well sites and may contain some contaminant metals. However, contaminant levels would reach background levels about 1,000 m (3,281 ft) from the discharge area and would be undetectable beyond 3,000 m (9,843 ft) from the site (USDOI, MMS, 2000). The SBF's are virtually nontoxic, and cuttings with adherent SBF's are expected to reach the seabed quickly in the form of clumps. Biological effects on the benthos are not expected beyond 500 m (1,640) (Jensen et al., 1999). Numerous studies have demonstrated that mercury impurities associated with drilling mud barite are virtually not capable of being taken up by marine organisms that might come in contact with discharged drilling fluid solids (Neff et al., 1989).

The well risers and platform itself can be expected to attract fish seeking cover and food. Produced-water discharges may affect fish in the immediate area of discharge, but the plume should reach non-impact levels within a few tens of meters. Likewise, concentrations sufficient to cause sublethal effects should cover a small area.

Accidental oil spills or blowouts also have the potential to affect fish resources. Adult fish will, for the most part, avoid the oil (Malins et al., 1982; NRC, 1985; Baker et al., 1991; USDOI, MMS, 2000). Farr et al. (1995) reported the behavioral avoidance of dissolved concentrations of a PAH as low as 147 □g/l by a species of minnow. Furthermore, adult fish must become exposed to crude oil for some time, probably on the order of several months for doses and types of oil to be encountered in the field, to suffer serious biological damage (Payne et al., 1988). Adult fish also possess some capability for metabolizing oil (Spies et al., 1982).

On the other hand, invertebrate and fish eggs and larvae are known to be very sensitive to oil in water (Linden et al., 1979; Longwell, 1977; Baker et al., 1991). However, most fish species produce very large numbers of eggs and larvae spread over wide areas. In order for an oil spill to affect fish resources at the population level, it would have to be very large and cover a very large area that corresponded to an area of highly concentrated eggs and larvae. In addition, the oil would have to disperse deep enough into the water column at levels high enough to cause toxic effects. None of these events would seem likely, even in the low-risk, large-spill scenario. However, it should be noted that the use of dispersants, while potentially beneficial for surface-using birds, turtles, and mammals, could increase the effects on water column organisms including ichthyoplankton. A worst case, in terms of location, would be a spill of fresh oil in a shallow, enclosed bay that contained eggs and larvae of important inshore species such as menhaden, shrimp, or blue crabs. Oil from the hypothetical offshore blowout would be well weathered before it hit shore, if in fact it did so. In addition, spawning areas of most species of marine fish are widespread enough to avoid catastrophic effects at the population level.

The spill risk (the probability of a spill ≥1,000 bbl occurring and contacting specific areas) is less than 0.5 percent for all Gulf Coast areas with one exception; Plaquemines Parish, Louisiana, has a spill risk of 1 percent (Table C-5).

Conclusion

The structures would attract a variety of fish species. Produced water would influence water quality and hence, could potentially produce sublethal effects in fish over a limited area. Any effects would be local and not significant.

Impacts on demersal fish from drilling activities would be negligible. There are no commercially-valuable demersal fish species in the area and effects on bottom fish habitat from cuttings and adherent SBF's would likely be limited to within 500 m (1,640 ft) of the discharge.

Specific effects from oil spills would depend on several factors including timing, location, volume and type of oil, environmental conditions, countermeasures used. The areas affected by the potential spill or blowout scenario would be avoided by adult fish. Fish eggs and larvae of some species of invertebrates and fish would be affected by a spill and some would suffer mortality in areas where their numbers are concentrated in the upper few meters of water and where oil concentrations under the slick are high enough. However, oil and fish concentrations, exposure times, and the area affected would not be great enough to cause significant impacts to northern GOM fish populations.

In summary, it is expected that marine environmental degradation from the proposed action would have little effect on fish resources or EFH. The level of marine environmental degradation from the Magnolia development is expected to cause a small, undetectable decrease in fish populations and EFH.

4.2.7. Impacts on Gulf Sturgeon

Existing occurrences of Gulf sturgeon in 1996 extended from the Mississippi River to Charlotte Harbor in western Florida (Patrick, personal communication, 1996). Spawning has been documented in most of the major river systems of the fish's range. A Gulfwide genetic assessment of Gulf sturgeon was completed in 1995. The results indicate there are four and possibly five geographically distinct units of Gulf sturgeon possessing different genetic material.

Oil spills are the OCS-related factor most likely to impact the Gulf sturgeon. Gulf sturgeon can take up oil by direct ingestion, ingestion of oiled prey, or the absorption of dissolved petroleum products across gill mucus and gill epithelium. 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). 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) notes that early life stages of fish are very sensitive to the toxic effects of hydrocarbons. In adult Gulf sturgeon, contact with or ingestion/absorption of spilled oil could result in death or nonfatal physiological irritation, especially of gill epithelium and the liver.

The subsurface ecosystem with prey and feeding habitat for Gulf sturgeon would have little contact with a slick floating overhead, even in shallow water, but may contact emulsified, chemically dispersed oil.

Conclusion

The Gulf sturgeon could be impacted by oil spills resulting from the proposed action. The impact of the proposed action on the Gulf sturgeon could cause nonfatal irritation of gill epithelium or the liver in a few adults.

4.2.8. Impacts on Beach Mice

The Alabama, Perdido Key, Choctawhatchee, and St. Andrew beach mice are designated as protected species under the Endangered Species Act of 1973. The mice occupy restricted habitat behind coastal foredunes of Florida and Alabama (Ehrhart, 1978; USDOI, FWS, 1987). Portions of these areas have been designated as critical habitat.

The major impact-producing factors associated with the proposed action that may affect the mice include (1) beach trash and debris, (2) a spill at the proposed well site, and (3) spill-response activities.

Beach mice may entangle themselves in trash and debris or may mistakenly consume it. The MMS prohibits both accidental and deliberate disposal of equipment, containers, and other materials into offshore waters by lessees (30 CFR 250.300). Thus, it is expected that beach mice would seldom entangle themselves in OCS-related trash and debris or ingest it. MARPOL (Annex V, Public Law 100-220; 101 Statute 1458; effective January 1989) prohibits the disposal of any plastics at sea or in coastal waters. Thus, due to the low potential for interaction between beach mice and project-related debris, any effects would be negligible.

Direct contact with spilled oil can cause skin and eye irritation. Other direct toxic effects come from asphyxiation from inhalation of fumes, oil ingestion, and food contamination. Indirect oil impacts include food reduction. Vehicular traffic and activity associated with oil-spill cleanup activities can degrade preferred habitat and cause displacement.

The proposed action is expected to contribute negligible marine debris or disruption to beach mice areas. The effects of oil that contacts a beach mouse are mentioned above. A slick cannot wash over the foredunes into beach mouse habitat unless carried by a heavy storm swell.

A spill ≥1,000 bbl at the well site would have a spill risk of <0.5 percent for contacting shoreline beach mouse habitat. In the unlikely event of crude oil contact, spill cleanup activities are not expected to disturb beach mice or their habitats. The home range of the beach mice is designated habitat that receives particular consideration during spill cleanup, as directed by the Oil Pollution Act of 1990. Because of the critical designation and general status of protected species habitats, spill contingency plans include requirements to minimize adverse effects from vehicular traffic during cleanup activities and to maximize protection efforts to prevent spilled petroleum with beach mouse habitat.

Conclusion

An impact from the proposed action on the Alabama, Choctawhatchee, St. Andrew, and Perdido Key beach mice is possible but unlikely as a result of beach trash and debris, oil spills, and spill-response activities because of the prohibition of trash and debris discard; the low probability of spill occurrence and contact; and the protected species and habitat requirements for cleanup included in the Oil Pollution Act. The proposed action is not expected to harm the Alabama, Choctawhatchee, St. Andrew, and Perdido Key beach mice or their habitats.

4.3. OTHER RELEVANT ACTIVITIES AND RESOURCES

4.3.1. Impacts on Socioeconomic Conditions and Other Concerns

4.3.1.1. Economic and Demographic Conditions

4.3.1.1.1. Socioeconomic Impact Area

In Chapter 3.3.1.1., MMS defined the potential impact region as that portion of the GOM coastal zone whose social and economic well-being (population, labor, and employment) is directly or indirectly affected by the OCS oil and gas industry. In this section, MMS projects how and where future changes will occur and whether they correlate with the proposed action.

4.3.1.1.2. Population and Education

The impact region's population will continue to grow, but at a slower rate. Minimal effects on population are projected from activities associated with the proposed action. While some of the labor force is expected to be local to the Port Fourchon and Amelia, Louisiana, areas, most of the additional employees associated with the proposed action are not expected to require local housing. Activities related to the proposed activity are not expected to significantly affect the region's educational level.

Conclusion

Activities related to the proposed activity are not expected to significantly affect the region's population and educational level.

4.3.1.1.3. Infrastructure and Land Use

While OCS-related servicing should increase in Port Fourchon, Louisiana, no expansion of these physical facilities is expected to result from the proposed activity. Changes in land use throughout the region as a result of the proposed activity are expected to be contained and minimal. While land use in the impact area will change over time, the majority of this change is estimated as general regional growth. Increased OCS deepwater activity is expected to impact Port Fourchon and other OCS ports with deepwater capability. The proposed activity is not expected to cause expansion to the Port Fourchon support base that Conoco plans to use.

Conclusion

The proposed action is not expected to significantly affect the region's infrastructure and land use.

4.3.1.1.4. Navigation and Port Usage

The proposed action would use the existing onshore support bases located in Port Fourchon Louisiana, for completion, facility installation, commissioning, and production activities. During TLP installation activities, seven round-trip vessel trips per week are planned. During drilling and completion activities, four round-trip vessel trips per week are expected. During production operations, one round-trip vessel trip per week is anticipated. The vessels to be used are workboats. Conoco would use onshore facilities located in Port Fourchon, Louisiana, as a port of debarkation for supplies and equipment. Port Fourchon is capable of providing the services necessary for the proposed activities; therefore, no onshore expansion or construction is anticipated with respect to the proposed action.

Conoco plans to use helicopters out of the PHI base located in Amelia, Louisiana. During installation activities, eight round-trip helicopter trips per week are expected. During drilling and completion activities, seven round-trip helicopter trips per week are anticipated. During production operations, one round-trip helicopter trip is planned. The base in Amelia, Louisiana, is capable of providing the services needed for the proposed activities with no onshore expansion or construction.

Conclusion

No impacts to navigation and port usage are expected as result of this proposed action.

4.3.1.1.5. Employment

The importance of the oil and gas industry to the coastal communities of the GOM is significant, particularly in Louisiana, eastern Texas, and coastal Alabama. Dramatic changes in the level of OCS oil and gas activity over recent years have resulted in similar fluctuations in population, labor, and employment in the GOM region. This economic analysis focuses on the potential direct, indirect, and induced impacts of the OCS oil and gas industry on the population and employment of the counties and parishes in the impact region.

To improve regional economic impact assessments and to make them more consistent with each other, MMS recently developed a methodology for estimating changes to employment and other economic factors. The methodology developed to quantify these impacts on population and employment takes into account changes in OCS-related employment, along with population impacts resulting from these employment changes within each individual coastal subarea.

The model for the GOM region has two steps. Because there are no publicly available models that estimate the expenditures resulting from offshore oil and gas activities, the first step in the model estimates the expenditures resulting from Conoco's Initial DOCD that proposes the fabrication/installation of a manned TLP platform, the drilling of six development wells and sidetracking of three development wells), and the completion of nine development wells. The model assigns these expenditures to industrial sectors in the 10 MMS coastal subareas defined in Chapter 3.3.1.1.1. The commercial software package, Field Plan, was used to determine expenditures; a contracted effort, "Modeling the Economic Impacts of Offshore Oil and Gas Activities in the Gulf of Mexico: Methods and Applications," was used to assign expenditures to industrial sectors and allocate those expenditures onshore. The second step in the model uses multipliers from the commercial input-output model

IMPLAN (using 1999 data, the latest available data) to translate these expenditures into direct, indirect, and induced employment and other economic factors. Direct employment results from the first round of industry spending. It is the employment that results from the initial dollars spent by Conoco on the platform and development wells from their fabrication/installation or completion through their productive lives. Indirect employment results as the initial spending reverberates through the economy. First, the suppliers of the goods and services for the platform and wells spend the initial direct dollars from the industry. Then, these dollars are re-spent by other suppliers until the initial dollars have trickled throughout the economy. Labor income produces induced spending by the households receiving that income.

Both the level (the amount spent) and the sectoral (the industry in which it is spent) allocations of expenditures can vary considerably. Because local economies vary, a separate set of IMPLAN multipliers is used for each MMS coastal subarea to which expenditures are assigned. Each set of multipliers is based on the actual historical patterns of economic transactions in the area. Model results for employment are presented in number of jobs per year, where one job is defined as a year of employment. This does not necessarily mean only one person occupies the position throughout the year. One job may be equal to two part-time positions occupied over the year or one person occupying a position for 6 months, while another person occupies it for the other 6 months.

Table E-4 (Appendix E) shows total employment projections for activities resulting from the proposed action for the peak year of 2004. The projections are expressed as absolute numbers and as a percentage of the employment levels expected if no development occurs. The baseline projections of employment used in this analysis are described in Chapter 3 and shown on Table E-5 in Appendix E. 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 Program activities. Based on model results, peak year (year 2004) direct employment associated with the proposed action is estimated at about 850 jobs. Indirect employment for the peak year is projected at about 315 jobs, while induced employment is calculated to be 380 jobs. Although the majority of employment is expected to occur in coastal Subarea TX-2, employment is not expected to exceed 1 percent of the total employment in any given subarea. Direct, indirect, and induced employment through the productive life of the proposal (that associated with operation and maintenance and workover activities) are expected at about 30 jobs per year throughout all subareas and expected to be be less than 1 percent of total employment in any subarea.

The resource costs of cleaning up an oil spill, both onshore and offshore, were not included in the above analysis for two reasons. First, oil-spill cleanup activities reflect the spill's opportunity cost. In other words, some of the resources involved in the cleanup of an oil spill, in the absence of that spill, would have produced other goods and services (e.g., tourism activities). Secondly, the occurrence of a spill is not a certainty. Spills are random accidental events. Given that the platform is fabricated and installed and the development wells are completed as described in the initial DOCD, the timing, numbers, sizes, offshore locations of occurrence, and onshore locations of contact of potential spills occurring over the drilling life of the plan are all unknown variables. Appendix A discusses oil spills in general, and the expected sizes, number, and probability of a spill from the proposed action. Additionally, the cost involved in any given cleanup effort is influenced by a variety of factors: whether or not the oil comes ashore; the type of coastal environment contacted by the spill; weather conditions at the time of the incident; the type and quantity of oil spilled; and the extent and duration of the oiling. Nevertheless, the same two-step model used above to project employment for the proposed action was applied to project the opportunity cost employment associated with cleaning up an oil spill. In this case, the first step considered estimates of the expenditures resulting from oil-spill cleanup activities should a worst case blowout scenario spill occur. The second step incorporated the IMPLAN regional model multipliers to translate those expenditures into direct, indirect, and induced employment associated with oil-spill cleanup activities. The size of a scenario spill (on which model results are based) is assumed to be as much as 27,525 bbl a day for 4 days for an uncontrolled blowout. Based on model results, should such a spill occur, it is projected to cost about 3,700-8,700 person-years of employment for cleanup and remediation, depending on whether some of the oil contacts land. Table E-5 (Appendix E) summarizes the direct, indirect, and induced opportunity cost employment (by subarea and planning area) for an oil-spill cleanup should such a spill occur. Employment impacts form the blowout scenario are expected to be minimal (less than 1% of total employment in any subarea even if combined with the employment projected with the proposed activities), should a spill of such magnitude occur. Employment associated with oil spill cleanup is expected to be of short duration (less than 6 months) aside from employment associated with the legal aspects of a spill.

Conclusion

No impacts to employment, including those that could result from a blowout and related spill cleanup scenario, are expected as a result of this proposed action.

4.3.1.1.6. Environmental Justice

Federal agencies are directed by Executive Order 12898 to assess whether their actions will have a disproportionate and negative effect on the environment and health of people of ethnic or racial minorities or those with low income. Since sufficient onshore facilities are available to support offshore activities in Grid 7, effects on minorities or people with low incomes in the Gulf counties and parishes are expected to be similar to other economic actions.

Conclusion

No impacts to minorities or people with low incomes are expected as result of this proposed action.

4.3.2. Impacts on Commercial Fisheries

Little or no impact is expected on commercial fishers from routine project activities. Offshore operators do not normally require a large exclusion area, although the USCG could enforce an area of 500 m (1,640 ft) from structures, if requested or required. Only seven deepwater structures to date have established official safety zones. Also, these safety zones do not restrict vessels less than 100 ft in length.

In the event of a spill, commercial fishermen would actively avoid the area of a spill and the area where there are ongoing activities to control a blowout. Even if fish resources successfully avoid spills, tainting (oily-tasting fish), public perception of tainting, or the potential of tainting commercial catches from oil or dispersants would prevent fishermen (either voluntarily or imposed by regulation) from initiating activities in the spill area. This in turn could decrease landings and/or value of catches for several months. However, GOM species can be found in many adjacent locations; Gulf commercial fishermen do not fish in one locale and have responded to past petroleum spills without discernible loss of catch or income by moving elsewhere for a few months.

There are few new potential fisheries that could occur in the Magnolia area. The most likely target species would be epipelagic species that are highly mobile and have the ability to avoid disturbed areas. This fishery is traditionally pursued using a highly mobile longliner fleet. This type of fishery is less vulnerable to disturbance or loss of fishing space than others such as trap or bottom trawling fisheries. Desirable pelagic fish species may be also be attracted to the Magnolia TLP structure and could potentially improve commercial catches using fishing techniques other than longlining.

Conclusion

There would be some unavoidable loss of fishing space due to the physical presence of the development that could otherwise have been used for pelagic fishing such as longlining. This impact is not considered to be significant because the overall footprint of the development is not large compared to the total space available in the Gulf. A large oil spill might have commercial implications, but for the most part, the Gulf fishing fleets are highly mobile and cover a wide area. In addition, there are no commercially important demersal species at the water depth of this proposed action.

4.3.3. Impacts on Recreational Resources and Beach Use

Millions of annual visitors attracted to the coast are responsible for thousands of local jobs and billions of dollars in regional economic activity. They also are responsible in large part for the trash and debris that litter coastal lands, leaving behind nearly 75 tons of trash per week (Center for Marine Conservation, 2001). Other sources of coastal trash are debris and small leaks from staffed structures in State and Federal waters where hydrocarbons are exploited, commercial shrimping and fishing, runoff from storm drains, antiquated storm and sewage systems in older cities, and commercial and recreational fisher folk who discard plastics. In 1996, the U.S. National Park Service finished a study on the origins of marine debris on South Padre Island in Texas. They tentatively identified about 13 percent of the 63,000+ items collected could be identified with the offshore oil and gas industry (Miller and Echols, 1996).

In September 2001, the USEPA published its comprehensive National Coastal Condition Report. For 5 years, USEPA scientists sampled, collected, and analyzed data on the health of coastal habitats, especially estuaries. They found that the overall condition of the GOM is poor according to the rankings of water clarity (fair), dissolved oxygen (good), and coastal wetland loss, eutrophic condition, sedimentation, benthos, and fish tissue — all of which ranked poor (USEPA, 2001).

The exact sources of all the debris and degradation along the Gulf coastline are not known. Annual "beach sweeps" and the resulting cleanup totals include all coastal beaches — river, lake, and sea — and adjacent waters. The deltas and basins of the Mississippi-Atchafalaya and Mobile Rivers drain at least 50 percent of the land area of the central and eastern U.S. Given this lack of knowledge, we cannot predict that an additional pipeline will have beneficial, detrimental, or neutral effects on human use of coastal lands.

Conclusion

The risk of a large oil spill occurring due to the proposed development operations in Grid 7 is very small. In the event such a spill did occur, according to trajectory analysis from the OSRA model, there is a negligible chance that the spill would contact land within 30 days of a spill. Project aircraft will normally be flying high enough to avoid disturbance to beachgoers.

Conoco has an established waste management plan for all of their offshore operations. While some accidental loss of solid wastes may occur from time to time, it is expected to have a negligible impact on recreational resources.

4.3.4. Impacts on Archaeological Resources

4.3.4.1. Prehistoric

Garden Banks Blocks 783 and 784 are not specifically located within either of MMS's designated high-probability areas for the occurrence of prehistoric or historic archaeological resources. Lease blocks with a high probability for prehistoric archaeological resources may only be found landward of a line that roughly follows the 60-m (200-ft) bathymetric contour. The MMS recognizes the 12,000 B.P. date and 60-m (200 ft) water depth as the seaward extant of prehistoric archaeological potential on the OCS. The water depth of the Garden Banks Block 783 area is approximately 1,424-m (4,672-ft). Based on the extreme water depth of these blocks, there is no potential for prehistoric archaeological resources. Therefore, any oil and gas development directly associated with the Magnolia Project could not possibly impact prehistoric archaeological resources in these blocks.

Proposed Action Analysis

The proposed action includes the emplacement of a tension leg production platform facility in Garden Banks Block 783 and the impacts of associated anchors on the seafloor. The proposed offshore development as described in this plan cannot result in an impact to an inundated prehistoric archaeological site.

The MMS recognizes both the 12,000 B.P. date and 60-m (200 ft) water depth as the seaward extant of prehistoric potential on the OCS. The water depth in the area is greater than 1,424 m. Therefore, the water depth is approximately 1,364-m deeper than the earliest known prehistoric archaeological sites in the GOM area.

Conclusion

Based on the extreme water depth of Garden Banks Blocks 783 and 784, the proposed oil or gas development will not impact any prehistoric archaeological resources.

4.3.4.2. Historic

There are areas of the northern GOM that are considered to have a high probability for historic period shipwrecks as defined by an MMS-funded study and shipwreck model (Garrison et al., 1989). The study expanded the shipwreck database in the GOM from 1,500 to more than 4,000 wrecks. Statistical analysis of shipwreck location data identified two specific types of high-probability areas — the first within 10 km (6 mi) of the shoreline and the second proximal to historic ports, barrier islands, and other shipwreck loss traps (Anuskiewicz, 1989). High-probability search polygons associated with individual shipwrecks were created to afford protection to wrecks located outside the two aforementioned high-probability areas.

An Archaeological Resources Stipulation was included in all GOM lease sales from 1974 through 1994. The stipulation was incorporated into MMS's Operational Regulations on November 21, 1994. The language of the stipulation was incorporated into the operational regulations under 30 CFR 250.26 with few changes, and all protective measures offered in the stipulation have been adopted by the regulation.

NTL 2002-G01, signed by the Regional Director on December 15, 2001, supersedes all other archaeological NTL's and LTL's. This new NTL makes minor technical amendments, updates cited regulatory authorities, and continues to mandate a 50-m (164-ft) remote-sensing survey linespacing density for historic shipwreck surveys in water depths of 60 m (200 ft) or less. The NTL also requires submission of an increased amount of magnetometer data to facilitate MMS analyses. Survey and report requirements for prehistoric sites have not been changed.

Several OCS-related, impact-producing factors may cause adverse impacts to unknown historic archaeological resources. Offshore development could result in a portable semisubmersible drilling rig, production platform, pipeline, or anchoring associated with tension leg platform installation, semisubmersible and derrick barges impacting an historic shipwreck. Direct physical contact with a shipwreck 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 emplacement of anchors associated with a derrick barge and with the anchors from the TLP has the potential to cause physical impact to historic archaeological resources on the seafloor. Based on the plan submitted by the applicant, the manned TLP will be permanently anchored with a taut-leg catenary mooring system consisting of conventional wire and chain and anchor piles. Placing these permanent piles into the seafloor and allowing for wire rope and chain catenary to contact the seafloor would directly disturb approximately an area of 2.1 ha per 3-pile pattern. The derrick barge with its anchoring system would directly disturb approximately 1.9 ha of the seafloor at each anchor point. Pile driving associated with the structure emplacement may also cause sediment liquefaction an unknown distance from the piling, disrupting stratigraphy in the area of liquefaction.

Pipeline installation also has the potential to cause a physical impact to historic archaeological resources. In a recent pipeline installation in March 2001, an 8-in pipeline was accidentally laid across a historic shipwreck in a water depth of approximately 808 m (2,650 ft). Therefore, any future pipelines constructed in association with the production facilities could impact a historic shipwreck.

Petroleum spills have the potential to affect historic archaeological resources. Impacts to historic resources would be limited to visual impacts and, possibly, to physical impacts associated with spill cleanup operations. The OCS operations may also generate tons of ferromagnetic structures and debris, which will tend to mask magnetic signatures of significant historic archaeological resources during magnetometer surveys. The task of locating historic resources via an archaeological survey is, therefore, made more difficult as a result of operational activities.

Proposed Action Analysis

The specific locations of archaeological site areas cannot be identified without first conducting a remote-sensing survey of the seabed and near-surface sediments. The MMS, by virtue of its operational regulations under 30 CFR 250.196, requires that an archaeological survey be conducted prior to development of leases within the high-probability zones for historic and prehistoric archaeological resources. There is only one block within Grid 7, Garden Banks Block 602, that contains a possible shipwreck. In addition, a review of the geophysical report submitted by the applicant indicated that no seafloor features suggestive of historic shipwrecks were recorded during the lease block's side-scan sonar survey. Therefore, the aforementioned survey requirement reduces the potential for an impact to occur by an estimated 90 percent.

The proposed action includes installation of the following major components of the TLP: hull, deck, tendons, risers, quarters, and production facilities. The TLP will be moored by eight steel tendons and is designed to accommodate nine top-tensioned production risers and two export pipeline risers. Ferromagnetic debris associated with exploration and production activities has the potential to mask the magnetic signatures of historic shipwrecks. It is expected that most ferromagnetic debris associated with the proposed action would be removed from the seafloor during the required postlease site clearance and verification procedures. Site clearance, however, takes place after the useful life of the structure is complete. Therefore, there remains the potential for masking the signatures of historic shipwrecks as a result of ferromagnetic debris from OCS oil and natural gas activities.

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 National 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 in support of the proposed action, such as construction of new onshore facilities or pipelines, could result in the direct physical impact to previously unidentified historic sites. This direct physical contact with a historic site could cause physical damage to, or complete destruction of, information on the history of the region and the Nation. Each facility constructed must receive approval from the pertinent Federal, State, county/parish, and/or community involved. Protection of archaeological resources in these cases is expected to be achieved through the various State and Federal agency approval processes involved. There is, therefore, no expected impact to onshore historic sites from any onshore development in support of the proposed action.

Should an oil spill occur and contact a coastal historic site, such as a fort or a lighthouse, the major impact would be visual from petroleum contamination of the site and its environment. Impacts to coastal historic sites are expected to be temporary and reversible.

The greatest potential impact to a historic shipwreck as a result of the proposed action would result from the emplacement of a derrick barge and its associated anchors and this vessel's support to the installation of the TLP facility. The remote-sensing survey and archaeological clearance of sites required prior to an operator beginning oil and gas activities on a lease are estimated to be 90 percent effective at identifying possible historic shipwreck sites. Since the survey and clearance provide a significant reduction in the potential for a damaging interaction between an impact-producing factor and a historic shipwreck, there is a very small possibility of the proposed OCS activities impacting a historic site.

According to Garrison et al. (1989) and the MMS shipwreck database list, only one possible shipwreck or barge falls within Grid 7, Garden Banks Block 602. This potential shipwreck/barge could be eligible for listing in the National Register of Historic Places. No other lease blocks within Grid 7 fall within the MMS's GOM Region's high-probability area for the occurrence of historic shipwrecks.

Most other activities associated with the proposed action are not expected to impact historic archaeological resources. Ferromagnetic debris has the potential to mask the magnetic signatures of historic shipwrecks. It is expected that onshore archaeological resources would be protected through the review and approval processes of the various Federal, State, and local agencies involved in permitting onshore activities. There is a small chance of contact from an oil spill associated with the proposed action. Furthermore, the major impact from a spill contact on an historic coastal site, such as a fort or lighthouse, would be visual contamination. These impacts would be temporary and reversible.

Conclusion

Oil and gas activities associated with proposed development within Garden Banks Blocks 783 and 784 could impact 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.

4.3.5. Artificial Reef and Rigs-to-Reefs Development

Garden Banks Blocks 783 and 784 and the Magnolia Project Area are located south and outside of Louisiana's Artificial Reef Planning and Permit Areas. Therefore, potential environmental effects and conflict use between development in Garden Banks Blocks 783 and 784 and the Magnolia Project Area, and artificial reef and rigs-to-reefs development are not anticipated.

Close coordination between MMS and the Louisiana artificial reef program offices is done to preclude potential conflict between oil and gas development and existing reef materials. All proposed RTR projects and COE permit notices for reef are coordinated and reviewed by the MMS for potential conflict with oil and gas infrastructure (i.e., platforms and pipelines) and development.

Conclusion

Potential environmental effects and conflict use between development in Garden Banks Blocks 783 and 784 and artificial reef and Rigs-to-Reefs (RTR) development is not expected.

4.4. CUMULATIVE EFFECTS

The MMS addressed the cumulative effects of OCS- and non-OCS-related activities for the Western Planning Area and the Gulf Coast region for the years 1998 through 2036 as part of the NEPA documentation completed for proposed multisale lease activities. The most recent final EIS applicable to Grid 7 was prepared for Western GOM Lease Sales 171, 174, 177, and 180 (USDOI, MMS, 1998). The Final EIS for Western GOM Lease Sales 187, 192, 196, and 200 (USDOI, MMS, 2002) provides additional updated information applicable to cumulative effects. Specific OCS-related effects from the proposed activities in Grid 7 and related to the Magnolia Project are addressed in Chapters 4.1-4.3.

The following provides a summary of cumulative effects for potentially affected resources in the Western Planning Area of the GOM. For all of the resources discussed below, the incremental contribution of the Magnolia Project to cumulative impacts would be negligible.

4.4.1. Water Quality

4.4.1.1. Coastal

The rivers that drain over two-thirds of the contiguous U.S. and enter the Gulf are the predominant source of contaminant inputs to coastal waters bordering the GOM.

Numerous industries and activities contribute to the contamination of Gulf coastal waters. These include the petrochemical industry (inclusive of oil and gas development and processing), agriculture, urban expansion, municipal and camp sewerage , marinas, commercial fishing, maritime shipping, hydromodification activities, recreational boating, livestock farming, manufacturing industry activities, forestry, and pulp and paper mills. Runoff, wastewater discharge, accidental spills, and atmospheric deposition from these sources will cause water quality changes that result in nonattainment of Federal water quality standards by a significant percentage of coastal waters. The onshore service industry supporting the OCS oil and gas industry will contribute to a minor extent (less than 10%) to cumulative water quality degradation. Spill events from OCS support operations constitute about 10 percent of the total spill events estimated to occur, resulting in degradation of water quality. Vessel traffic will degrade coastal water quality through routine releases of bilge and ballast waters, fuel and tank spills, trash, and domestic and sanitary discharges. The greatest impacts from vessel traffic will occur along navigation channels within highly populated, confined harbors and anchorages, and boat yards due to increased biological oxygen demand (BOD) and pathogens from sanitary waste discharges and the presence of other compounds used in boat servicing such as tributyltin in marine paints.

Dredging of coastal areas to support coastal development, access for oil and gas wells in State waters, and pipeline emplacements will continue to increase each year. Increased turbidity from dredging operation and dumping of sediments into the coastal water would affect the water quality of the coastal area.

Degradation of water quality conditions due to these inputs is expected to continue. The Gulf Coast has been heavily used and signs of environmental stress are evident. Large areas experience nutrient overenrichment, low-dissolved oxygen, toxin and pesticide contamination, shellfish ground closures, and wetland loss.

4.4.1.2. Offshore

Contaminant inputs to GOM marine waters include offshore, coastal, and land-based sources. Numerous studies have identified the Mississippi River, which drains two-thirds of the U.S., as the major source of contamination for Gulf waters (e.g., Bedinger, 1981; Brooks and Giammona, 1988). Other land-based sources include those industries and activities described in the preceding section on coastal waters. Contaminants released to coastal waters can be transported to offshore marine waters. Offshore sources of contaminants besides OCS oil and gas operations include marine transportation, commercial fishing, and natural hydrocarbon seeps.

Spills of oil and other substances may occur from vessels transporting crude oil and petroleum products, from vessels transporting other products through Gulf waters between U.S. ports, from OCS oil and gas production operations, and from vessels associated with other offshore activity (marine transportation, recreational ships, etc.). Bottom area disturbances resulting from vessel anchoring and facility and pipeline emplacement would increase water-column turbidity in the overlying offshore waters. The extent of anchoring by the maritime industry is not known, but in lightering areas, large supertankers daily anchor while offloading their cargo. Besides turbidity, sediment disturbance can result in the resuspension of any accumulated pollutants, such as trace metals, chlorinated hydrocarbons, and excess nutrients. Bottom disturbances resulting from platform installation on the OCS have produced short-lived impacts on water quality conditions in the immediate vicinity of the emplacement operation (Arthur D. Little, Inc., 1985). Should operations occur frequently and in proximity of each other, there would be increased risk of water quality degradation. Individual operations would result in short-lived and local impacts on water quality.

Blowouts can disturb the bottom and increase turbidity. Blowout events are expected to result in localized, short-term changes in water quality that may affect the uses of the waters disturbed, but would not be of consequence to regional water quality.

Daily operational discharges to offshore waters occur from vessels moving through Gulf waters and from most oil and gas operations. Vessel traffic associated with the extensive maritime industry, oil and gas support operations, and recreational and commercial fishing operations routinely discharge domestic and sanitary wastes and bilge and ballast waters into offshore waters. Bilge waters and ballast waters can contain petroleum and metallic compounds leaked from machinery. Diluted and discharged slowly over large areas, vessel wastes are assumed to contribute in a very small way to the long-term, regional degradation of water quality.

The discharge of drilling fluids and cuttings and produced waters accounts for the bulk of effluent discharge volumes from oil and gas development and production facilities. Major contaminants in oil-field wastes can include high salinity, low pH, high BOD and chemical oxygen demand (COD), suspended solids, heavy metals, crude oil compounds, organic acids, priority pollutants, hazardous wastes, and radionuclides. The discharge of treated sanitary and domestic wastes from rigs and platforms may increase suspended solids, nutrients that exert a high BOD, and chlorine, in a small area near the point of discharge. Deck drainage from OCS structures and support vessels can be contaminated. Numerous studies have examined the water quality impacts of OCS discharges (Avanti Corporation, 1993b; CSA, 1997a and b; Kennicutt, 1995; Neff, 1997). The studies concluded that contaminants in produced water and drilling discharges should be undetectable in the water column by 1,000 m from the discharge point. Sediment contamination is dependent on the water depth and current speed. Retention within the sediments of contaminants in OCS discharges is likely to occur from several hundred to several thousand meters from the discharge point. Despite any possible sediment accumulation, biological responses to contaminant levels retained by the sediments are not expected to be detectable beyond a couple hundred meters, and toxic effects to the benthos are expected to be very localized, limited to within 100 m from the discharge, and of a relatively small magnitude. Toxic effects beyond 100 m should be controlled through the NPDES permit requirements.

Some information is available on the volumes of petroleum hydrocarbon compounds entering Gulf waters from various sources (USDOI, MMS, 1998). Based on the analysis of inputs from various sources, the OCS oil and gas industry contributes about 4 percent of the Gulf's regional, long-term contamination by petroleum hydrocarbons. Natural seepage accounts for 27 percent of the total input.

Although the Gulf comprises one of the world's most prolific offshore oil-producing provinces, onshore sources of hydrocarbons to Gulf waters far outweigh the contributions from offshore domestic production of oil; coastal sources contribute an order of magnitude more petroleum hydrocarbons to Gulf waters than offshore anthropogenic sources.

Contaminants and high levels of nutrients found in land-based effluents and runoff have been identified as potential causes of hypoxia and, possibly, more frequent red tide outbreaks. It is believed that hypoxia occurring in bottom waters in some areas of the open Gulf is caused by nutrient loading coming from the Mississippi River, combined with high summer temperatures and/or phytoplankton blooms in surface waters (Rabalais, 1992).

Information on elevated levels of contaminants of environmental concern measured in northern Gulf offshore waters was summarized by Kennicutt et al. (1988). Large areas of the Gulf appear to be relatively pristine (off Florida and southern Texas) and other areas show significant contamination (northern Texas coast, Louisiana, and Alabama). Volatile organic compounds (VOC's) were generally present in the highest levels in coastal and nearshore waters, were highest near known onshore point-source discharges, and generally decreased with distance from shore. Chlorinated VOC's were generally restricted to nearshore waters, whereas petroleum-related VOC's were detected at offshore locations. The highest levels of petroleum hydrocarbons were measured near point sources in coastal environments and near natural seeps. Trace organochlorine residues appear to exist in many marine species. Higher concentrations of pollutants were generally found in organisms from the Mississippi Delta in comparison to offshore biota (Kennicutt et al., 1988).

Gulf Coast States sample the edible tissue of estuarine and marine fish for total mercury. As a result of the elevated mercury levels, all Gulf Coast States have published fish consumption advisories for large king mackerel (Ache et al., 2000). Advisories for largemouth bass exist on many freshwater rivers that enter Gulf estuaries. Atmospheric deposition is considered the main source of mercury, while mercury in barite has been suggested as a secondary mercury source in the Gulf. Properties of barite and the accompanying trace metals make it unlikely that mercury would become available for methylation and food chain uptake. Drilling fluid discharges are not expected to add to the mercury burden in biota. Nevertheless, in comparison to WBF's, the use of SBF's is likely to reduce the amount of barite per well discharged to water.

The Mississippi River will continue to be the major source of contamination of the Gulf. Over time, continuing coastal water quality contamination will degrade offshore water quality. As the assimilative capacity of coastal waters is exceeded, there will be a subsequent, gradual movement of the area of degraded waters farther offshore over time. This degradation will cause short-term loss of the designated uses of large areas of shallow offshore waters due to hypoxic and red tide impacts.

4.4.2. Air Quality

Effects on air quality within the project area will come primarily from industrial, power generation, and urban emissions. The coastal areas nearest the project area are currently designed as "attainment" for all the National Ambient Air Quality Standards (NAAQS) regulated pollutants. The USEPA has designated several areas along the Gulf Coast as "nonattainment" for ground-level ozone—Houston-Galveston-Brazoria and Beaumont-Port Arthur areas in Texas and Lafourche Parish in Louisiana (USEPA, 2002). The impacts are not expected to significantly affect onshore air quality.

4.4.3. Biological Resources

4.4.3.1. Sensitive Coastal Environments

4.4.3.1.1. Coastal Barrier Beaches and Associated Dunes

Coastal barrier beaches have experienced severe erosion and landward retreat because of human activities and natural processes. These adverse effects on barrier and dunes have come from changes to the natural dynamics of water and sediment flow along the coast. Examples of these activities include pipeline canals, channel stabilization structures, beach stabilization structures, recreational use of vehicles on dunes and beaches, recreational and commercial development, and removal of coastal vegetation. Human activities cause direct impacts as well as accelerate natural processes that deteriorate coastal barrier features. Natural processes that contribute to most effects include storms, subsidence, and sea-level rise acting upon shorelines with inadequate sand content and supply.

Deterioration of Gulf barrier beaches is expected to continue in the future. Federal, State, county, and parish governments have made efforts over the last 10 years to slow beach erosion.

4.4.3.1.2. Wetlands

Wetland loss in the Deltaic Plain of the coastal Louisiana is primarily due to subsidence, erosion, and reduced sediment input from the Mississippi River. The conversion of wetlands to agricultural, residential, and commercial uses has also been a major cause of wetland loss. Commercial uses include dredging for both waterfront developments and coastal oil and gas activities. Wetland loss is projected to continue around the Gulf.

4.4.3.1.3. Seagrasses

Seagrasses are adversely affected by several human activities. These activities include changes to water quality resulting from riverine input, stream channelization, urban runoff, and industrial discharges; physical removal of plants by various forms of dredging, anchoring, and grounding of vessels; and severe storms. These impacts and the general decline of seagrasses are expected to continue into the near future. Various local, State, and Federal programs are focused upon reversing this trend.

4.4.3.2. Deepwater Benthic Communities/Organisms

4.4.3.2.1. Chemosynthetic Communities

No impacts to chemosynthetic communities from non-OCS-related activities are expected. Normal fishing practices should not disturb these areas. Other bottom-disturbing activities such as trawling and anchoring are virtually nonexistent at water depths greater than 400 m.

The most serious impact-producing factor that may affect deepwater benthos and sediment communities is the physical disturbance of the sea bottom. Within anchoring depths, marine transportation vessels may affect localized areas. Hypoxic conditions at the seafloor may affect the deepwater benthos and associated communities.

4.4.3.2.2 Coral Reefs

All of the recognized topographic features in the WPA and CPA are protected by “no activity zones” and other operational zones to minimize effects on associated coral reefs. Uncontrolled anchoring remains a threat to these areas. Increasing pressure is being exerted on these features from both commercial and recreational sources.

4.4.3.2.3. Deepwater Benthos and Sediment Communities

The most serious impact-producing factor that may affect deepwater benthos and sediment communities is the physical disturbance of the sea bottom. Within anchoring depths, marine transportation vessels may affect localized areas; however, the project area is too deep for practical anchoring. Hypoxic conditions at the seafloor may affect the deepwater benthos and associated communities.

4.4.3.3. Marine Mammals

Cumulative impacts to GOM marine mammals include the degradation of water quality resulting from operational discharges; vessel traffic; noise generated by platforms, drillships, helicopters and vessels; seismic surveys; explosive structure removals; oil spills; oil-spill response activities; loss of debris from service vessels and OCS structures; commercial fishing; capture and removal; and pathogens. Cumulative impacts on marine mammals are expected to result in a number of chronic and sporadic sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that may stress and/or weaken individuals of a local group or population and predispose them to infection from natural or anthropogenic sources. Few deaths are expected from oil spills, chance collisions with OCS service vessels, ingestion of plastic material, commercial fishing, and pathogens. Oil spills and slicks of any size are expected to be erratic events that could periodically contact marine mammals. Deaths as a result of structure removals are not expected due to ESA Section 7 consultations. Disturbance (noise from vessel traffic and drilling operations, etc.) and/or exposure to sublethal levels of toxins and anthropogenic contaminants may stress animals, weaken their immune systems, and make them more vulnerable to parasites and diseases that normally would not be fatal. The net result of any disturbance would be dependent upon the size and percentage of the population likely to be affected; ecological importance of the disturbed area; environmental and biological parameters that influence an animal's sensitivity to disturbance and stress; or the accommodation time in response to prolonged disturbance (Geraci and St. Aubin, 1980). Collisions between cetaceans and ships, though expected to be rare events, could cause serious injury or mortality.

4.4.3.4. Sea Turtles

Cumulative impact-producing factors that may harm sea turtles and their habitats include structure installation, dredging, water quality and habitat degradation, OCS-related trash and flotsam, vessel traffic, seismic surveys, explosive structure removals, oil spills, oil-spill response activities, natural catastrophes, pollution, dredge operations, vessel collisions, commercial and recreational fishing, human consumption, beach lighting, and power plant entrainment. Sea turtles could be killed or injured by chance collision with service vessels or eating marine debris, particularly plastic items, lost from OCS structures and service vessels. It is expected that deaths due to structure removals would rarely occur due to mitigation measures established by ESA Section 7 consultations. The presence of and the noise produced by, service vessels and by the construction, operation, and removal of drill rigs may cause physiological stress and make animals more susceptible to disease or predation, as well as disrupt normal activities. Contaminants in waste discharges and drilling muds might indirectly affect sea turtles through food-chain biomagnfication; there is uncertainty concerning the possible effect. Oil spills and oil-spill response activities are potential threats that may be expected to cause turtle deaths. Contact with, and consumption of oil and oil-contaminated prey, may seriously impact turtles. Sea turtles have been seriously harmed by oil spills in the past. The majority of OCS activities are estimated to be sublethal (behavioral effects and nonfatal exposure to intake of OCS-related contaminants or debris). Chronic sublethal effects (e.g., stress) resulting in persistent physiological or behavioral changes and/or avoidance of impacted areas could cause declines in survival or productivity, resulting in either acute or gradual population declines.

4.4.3.5. Coastal and Marine Birds

Possible impacts to coastal and marine birds can come from air emissions, water quality degradation, habitat loss and modification resulting from coastal construction and development, collisions with aircraft or vessels, noise from aircraft and vessels, trash and debris, and lighting. Any effects could be especially critical to endangered or threatened species that must maintain a viable reproductive population size or that are dependent on a few key habitat factors. Aircraft or vessel traffic could sporadically disturb feeding, resting, or nesting behavior of birds or cause abandonment of preferred habitat. Birds could become entangled and snared in trash and debris. In addition, they may ingest small plastic debris that could lead to injury or death.

Cumulative activities could 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 contaminants or discarded debris) and will usually cause temporary disturbances and displacement of localized groups inshore. 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 coastal oil spills and associated spill-response activities in wetlands 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. Most birds can potentially produce two or more eggs in one breeding season and have them survive to maturity. Populations would increase and recover if the average reproductive rate were greater than two offspring successfully surviving to maturity per pair of parents, but the time period for recovery would depend on the average reproductive rate. Therefore, recruitment of birds through successful reproduction is expected to take a year or more, 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 navigation waterways will alter species composition and reduce the overall carrying capacity of disturbed area(s) in general.

The incremental contribution of the proposed action to the cumulative impact would be negligible because the effects of the most probable impacts, such as OCS-related operational discharges and helicopters and service-vessel noise and traffic, are expected to be sublethal, although some displacement of local individuals or groups may occur. It is expected that there will be little interaction between OCS-related oil spills and coastal and marine birds.

The cumulative effect on coastal and marine birds is expected to result in a discernible decline in the numbers of birds that form localized groups or populations, with associated change in species composition and distribution. Some of these changes are expected to be permanent, as exemplified in historic census data, and to stem from a net decrease in preferred and/or critical habitat.

4.4.3.6. Essential Fish Habitat and Fish Resources

Degradation of water quality, loss of essential habitat (including wetland loss), pathogens, trash and debris, riverine influences, and overfishing could affect fish resources. Eggs and larvae are more susceptible than adults to environmental contaminants. Portions of the Gulf experience hypoxia during portions of the year (Murray, 1998). However, areas of hypoxia typically occur only on the continental shelf.

4.4.3.7. Gulf Sturgeon

The Gulf sturgeon can be impacted by cumulative activities such as oil spills, alteration and destruction of habitat, and commercial fishing. The effects from contact with spilled oil are expected to be nonfatal and last for less than one month. 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 population sizes and a displacement from their current distribution that will last more than one generation. Deaths of adult sturgeon are expected to occur from commercial fishing. The incremental contribution of the proposed action to the cumulative impact would be negligible because the effect of contact between oil spills from the proposed action and Gulf sturgeon is expected to be nonfatal and last less than one month.

4.4.3.8. Beach Mice

Cumulative activities have a potential to harm or reduce the numbers of Alabama, Choctawhatchee, St. Andrew, and Perdido Key beach mice. Those activities include oil spills, oil-spill response activities, alteration and reduction of habitat, predation and competition, and beach trash and debris. The majority of OCS-related activities and events, as well as oil spills stemming from import tankering and prior and future lease sales, are not expected to contact beach mice or their habitats. The expected incremental contribution of the proposed action to the cumulative impact level would be negligible. Non-OCS activities or natural catastrophes could potentially deplete some beach mice populations to unsustainable levels, especially if reintroduction could not occur.

4.4.4. Other Relevant Activities

4.4.4.1. Socioeconomic Conditions and Other Concerns

4.4.4.1.1. Economic and Demographic Conditions

The economic and demographic conditions evaluated in this PEA are limited to that portion of the GOM's coastal zone whose social and economic well-being (population, labor, and employment) is directly or indirectly affected by the OCS oil and gas industry. The energy industry has become increasingly more global. While the OCS Program, in general, has played a significant role in the GOM region's economy and demography, the activities in Grid 7 are expected to have minimal economic and demographic consequences to the region.

4.4.4.1.2. Population and Education

The impact area's population is expected to grow at an average annual rate of 1.0 to 1.5 percent over the next 40 years, with that growth slowing over time. This population growth is based on the continuation of existing conditions, including OCS energy development. Activities in Grid 7 are not expected to affect the population's growth rate. Education levels are expected to remain unchanged by activities within Grid 7.

4.4.4.1.3. Infrastructure and Land Use

Sufficient infrastructure is in place to support activities within Grid 7. Sufficient land is designated in commercial and industrial parks and adjacent to the existing ports to minimize potential disruption to current residential and business use patterns. Land use in the area will change over time; however, the majority of this change is expected to be general regional growth.

4.4.4.1.4. Navigation and Port Usage

There are approximately 50 shore bases that are traditionally used by the oil and gas industry to support activities on the Federal OCS. Certain companies favor some of these bases for their offshore operations. No new expansion or construction is expected at these existing shore bases to support offshore activities within Grid 7.

4.4.4.1.5. Employment

The oil and gas industry is very important to many of the coastal communities of the central and western GOM. Changes in OCS oil and gas activities have significant employment implications to these communities, particularly in industries directly and indirectly related to oil and gas development. However, the energy industry has global markets (both for the supply of goods and services needed to produce energy and demand for energy products). While mergers, relocations, and consolidation of oil and gas companies' assets have affected employment in the GOM region in recent years, employment changes to the coastal communities as a result of activities in Grid 7 are expected to be negligible.

4.4.4.1.6. Environmental Justice

This proposed project, in combination with existing extraction activities on the OCS, mayprove beneficial to minority peoples and those with low incomes. Benefits would be derived from direct employment in the oil/gas industry, in a supporting service, or in another part of the economy positively affected by financial multipliers. This is contingent, of course, on the persons' willingness to seek employment in a highly volatile industry. It is also contingent on these individuals having the job skills and experience needed to meet the labor requirements of the various companies. It also depends on the companies' willingness to hire individuals of various ethnic and racial backgrounds and/or persons of low economic status.

4.4.4.2. Commercial Fisheries

Federal and State fishery management agencies will control the "take" of commercial fishes. The agencies' primary responsibility is to manage effectively the fishery stock to perpetuate commercially important species. Various management plans aimed at selected species have been and will continue to be prepared. The GOM will remain one of the Nation's most important commercial fisheries areas.

4.4.4.3. Recreational Resources and Beach Use

Factors such as land development, civil works projects, and natural phenomena have affected, and will continue to affect, beach stabilization, which ultimately affects the recreational use of beaches. Also, pressure on the natural resources within the coastal zone is expected to continue or possibly increase.

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 area that would have been effected as a result of the proposed action. 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.

Although trash from onshore sources will continue to adversely affect the ambience of recreational beaches, the level of chronic pollution should decline. Beach use at the regional level is unlikely to change.

4.4.4.4. Archaeological Resources

4.4.4.4.1. Prehistoric

The applicant proposes to install a TLP that will be moored by eight steel tendons and is designed to accommodate nine top-tensioned production risers and two export pipeline risers. The water depth of these two blocks is approximately of 1,424 m. Analysis by MMS indicates there is simply no potential for the occurrence of prehistoric archaeological sites in water depths greater than 60 m on the OCS. The aforementioned statement is based on the current acceptable seaward extant of the prehistoric archaeological high-probability area in the Gulf of Mexico. Therefore, there will be no impact to prehistoric, archaeological resources as a result of exploration and development of a drilling rig and associated platform emplacement.

However, future installation of associated pipelines and onshore support facilities could cause impact to prehistoric archaeological resources when these associated actions take place in water depth less than 60 m. Marine and terrestrial archaeological surveys are assumed to reduce the potential for an interaction between an impact-producing activity and a prehistoric resource by 90 percent. Marine archaeological surveys were first required for Lease Sale 32 held in December 1973; therefore, it is assumed that the major impacts to prehistoric resources resulted from oil and gas development prior to this time. The potential of an interaction between pipeline emplacement and an onshore support facility and a prehistoric site is diminished by these surveys, but they still exist. Such an interaction would result in the loss of or damage to significant or unique prehistoric information.

The setting of anchors for pipeline lay barges and anchoring associated with oil and gas service-vessel trips to the OCS have the potential to impact shallowly buried prehistoric sites. Archaeological surveys minimize the chance of impacting these sites; however, these surveys are not seen as infallible and the chance of an impact from future activities exists. Impacts from anchoring on a prehistoric site may have occurred. Such an interaction could result in the loss of significant or unique archaeological information.

The combined probabilities for offshore oil spills ≥1,000 bbl occurring from the OCS Program in the cumulative activity area and contacting the U.S. shoreline are presented in Appendix A. Oil spills have the potential to impact coastal prehistoric sites directly or indirectly by physical impacts caused by oil-spill cleanup operations. It is assumed that the majority of the spills will occur around terminals and will be contained in the vicinity of the spill. There is a small possibility of these spills contacting a prehistoric site. The impacts caused by oil spills to coastal prehistoric archaeological resources can severely distort information relating to the age of the site. Contamination of the organic materials by hydrocarbons can render dating by radiocarbon dating (e.g., C-14) methods useless. Using artifact seriation or other relative dating techniques might ameliorate this loss. Coastal prehistoric sites might also suffer direct impact from oil-spill cleanup operations as well as looting resulting from interactions between persons involved in cleanup operations and unrecorded prehistoric sites. Interaction between oil-spill cleanup equipment or personnel and a site could destroy fragile artifacts or disturb site context, possibly resulting in the loss of information on the prehistory of North America and the Gulf Coast region. Some coastal sites may contain significant or unique information.

Most channel dredging occurs in relatively shallow water 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 GOM. 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 would only affect the uppermost portion of the sediment column (Garrison et al., 1989). This zone would already be disturbed by natural factors, and site context to this depth would presumably be disturbed. Therefore, no effect of trawling on prehistoric sites is assumed. Investigations prior to construction can determine whether prehistoric archaeological resources occur at these sites.

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 U.S. Army 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 and onshore associated facilities should be mitigated under the requirements of the NHPA.

Prior to 1989, explosives (dynamite) were used on the OCS to generate seismic pulses. Explosives have been replaced by piston-type acoustic sources that generate superior acoustic signals and that do not cause the damaging environmental impacts associated with explosives. Rapid rise time (high velocity), high peak pressure, and rapid energy decrease characterize acoustical energy from explosives. Seismic air guns are considered non-explosive and have long rise times to peak pressure (low velocity). It is assumed that no explosives will be used in future OCS seismic surveys.

About half of the coast along the northern Gulf was hit with 16-20 tropical cyclones between the years 1901 and 1955 (DeWald, 1982). Prehistoric sites in shallow waters and on coastal beaches are exposed to the destructive effects of wave action and scouring currents. Under such conditions, it is highly likely that artifacts would be dispersed and the site context disturbed. Some of the original information contained in the site would be lost in this process. Overall, a significant loss of data from prehistoric sites has probably occurred, and will continue to occur, in the northeastern Gulf from the effects of tropical storms.

Conclusion

Several impact-producing factors may threaten prehistoric archaeological resources of the GOM. 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 required archaeological surveys and archaeological report analysis and clearance that are required prior to an operator beginning oil and gas activities in a lease are estimated to be 90 percent effective at identifying possible prehistoric sites. The OCS development prior to requiring archaeological surveys has possibly impacted sites containing significant or unique prehistoric information.

The effects of the various impact-producing factors discussed in this analysis have likely resulted in the loss of significant or unique prehistoric archaeological information. In the case of factors related to OCS Program activities in the cumulative activity area, it is reasonable to assume that most impacts would have occurred prior to 1973 (the date of initial archaeological survey and clearance requirements). Therefore, the proposed installation of a TLP moored with eight steel tendons located in Garden Banks Blocks 783 and 784 is expected to be very small. This potential small impact is due to the efficacy of the required terrestrial and marine remote-sensing surveys and concomitant archaeological report and clearance.

4.4.4.4.2. Historic

The Magnolia Project, Garden Banks Blocks 783 and 784, is located in approximately 1,424 m of water. Deepwater archaeological surveys are assumed to reduce the potential for an interaction between an impact-producing activity and a historic resource by approximately 95 percent in those areas that have a thin Holocene sediment veneer because any historic resource is likely to be detected by side-scan sonar. Within Grid 7, archaeological surveys are estimated to be 90 percent effective in those areas that have a thick blanket of unconsolidated Holocene sediments. This is the water depth where the majority of lease blocks with a high probability for historic shipwrecks occur. The potential of an interaction between rig or platform emplacement and a historic shipwreck is greatly diminished by requisite site surveys, but it still exists. Such an interaction could result in the loss of or damage to significant or unique historic information.

While an archaeological survey minimizes the chances of impacting a historic shipwreck, there remains a possibility that a wreck could be impacted by pipeline emplacement, as was the case of the late 18^{th} century copper-sheathed, wood wreck in Mississippi Canyon Block 74. An 8-in pipeline was accidentally laid across this wreck in March 2002. As a result of this interaction, the historic archaeological resource was impacted by pipeline construction. To mitigate for the loss of or damage to this significant and unique historic archaeological resource, a data recovery program was instituted.

The setting of anchors for drilling rigs, platforms, and pipeline lay barges and anchoring associated with oil and gas service-vessel trips to the OCS have the potential to impact historic wrecks. Archaeological surveys serve to minimize the chance of impacting historic wrecks; however, these surveys are not infallible and the chance of an impact from future activities does exist. Impacts from anchoring on a historic shipwreck may have occurred. There is also a potential for future impacts from anchoring on a historic shipwreck. Such an interaction could result in the loss of or damage to significant or unique scientific information.

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 issues permits associated with pipelines in State waters, are responsible for the protection of archaeological resources under the NHPA. Therefore, the impacts that might occur to archaeological resources by OCS-related pipeline construction within State waters should be mitigated under the requirements of the NHPA.

Conclusion

Several impact-producing factors may threaten historic archaeological resources. 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 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 are estimated to be 90 percent effective at identifying possible historic shipwrecks. They would be most effective in areas with a high probability and a thick blanket of unconsolidated sediments. The OCS development prior to requiring archaeological surveys has possibly impacted wrecks containing significant or unique historic information.

The loss or discard of ferromagnetic debris associated with oil and gas exploration and development and trawling activities could result in the masking of historic shipwrecks.

Loss of significant or unique historic archaeological information from commercial fisheries (trawling) is not expected. It is expected that dredging, sport diving, commercial treasure hunting, and tropical storms have impacted and will continue to impact historic period shipwrecks. Additionally, it is possible that explosive seismic surveys on the OCS and within State waters, prior to 1989, could have impacted historic shipwrecks.

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 in the cumulative activity area, it is reasonable to assume that most impacts would have occurred prior to 1973 (the date of initial archaeological survey and clearance requirements). Therefore, the proposed drilling of installation of a tension leg platform moored by eight steel tendons and designed to accommodate nine top-tensioned risers and two export pipeline risers in Garden Banks Block 783 is expected to be very small due to the efficacy of the required remote-sensing survey and archaeological review of these data. However, there is a possibility of an interaction between bottom-disturbing activity (rig emplacement, pipeline trenching, and anchoring) and a historic shipwreck.

Table 4-1

Possible Shipwreck or Barge Listed within the Garden Banks (Grid 7) Area

Vessel Name	Year It Sank	Area and Block
*Unknown	Unknown	Garden Banks 602

* Discovered during a side-scan sonar survey.

4.4.4.5. Artificial Reefs and Rig-to-Reefs Development

Because the proposed project is located outside State Artificial Reef and Permit Areas, no potential cumulative environmental effects or use conflicts are expected. Non-OCS activities, including anchoring and trawling, have the potential to impact artificial reef areas.

5. CONSULTATION AND COORDINATION

A notice was published in the *The Times-Picayune* on September 12, 2002, announcing preparation of an environmental assessment on the Magnolia Project. The notice provided the public with a 30-day comment period to provide comments on issues that should be addressed in the EA. No comments were received.

The State of Louisiana has an approved Coastal Zone Management (CZM) Program. Therefore, a Certificate of Coastal Zone Consistency from the State of Louisiana is required for the proposed activities. The MMS mailed the plan and other required and necessary information to the Louisiana Department of Natural Resources (LDNR), the State's appropriate CZM agency on August 1, 2002. In a letter dated August 21, 2002, the LDNR indicated that the plan is consistent with the Louisiana Coastal Resources Program as required by Section 307(c)(3)(B) of the Coastal Zone Management Act of 1972, as amended.

6. BIBLIOGRAPHY

Ache, B.W., Boyle, J.D, and Morse, C.E. 2000. A survey of the occurrence of mercury in the fishery resources of the Gulf of Mexico. Prepared by Battelle for the USEPA Gulf of Mexico Program, Stennis Space Center, MS. January.

Advanced Research Projects Agency. 1995. Final environmental impact statement/environmental impact report (EIS/EIR) for the California Acoustic Thermometry of Ocean Climate (ATOC) Project and its associated Marine Mammal Research Program (MMRP) (Scientific Research Permit Application [P557A]), Vol. 1.

Alabama State Docks Department. 2001. Of men and ships: The revenue cutter *Alabama*. Alabama Seaport, April. p. 25.

Albers, P.H. 1979. Effects of Corexit 9527 on the hatchability of mallard eggs. Bull. Environ. Contam. and Toxicol. 23:661-668.

Albers, P.H. and M.L. Gay. 1982. Effects of a chemical dispersant and crude oil on breeding ducks. Bull. Environ. Contam. and Toxicol. 9:138-139.

Alexander, S.K. and J.W. Webb. 1983. Effects of oil on growth and decomposition of *Spartina alterniflora*. In: Proceedings, 1983 Oil Spill Conference . . . February 28-March 3, 1983, San Antonio, TX. Washington, DC: American Petroleum Institute. Pp. 529-532.

Alexander, S.K. and J.W. Webb. 1985. Seasonal response of *Spartina alterniflora* to oil. In: Proceedings, 1985 Oil Spill Conference . . . February 25-28, 1985, Los Angeles, CA. Washington, DC: American Petroleum Institute. Pp. 355-357.

Alexander, S.K. and J.W. Webb. 1987. Relationship of *Spartina alterniflora* growth to sediment oil content following an oil spill. In: Proceedings, 1987 Oil Spill Conference . . . April 6-9, 1988, Baltimore, MD. Washington, DC: American Petroleum Institute. Pp. 445-450.

Amos, A.F. 1989. The occurrence of hawksbills (*Eretmochelys imbricata*) along the Texas coast. In: Proceedings of the Ninth Annual Workshop on Sea Turtles Conservation and Biology, February 7-11, 1989, Jekyll Island, GA. NOAA-TM-NMFS-SEFC-232. Miami, FL.

Anderson, D.W., F. Gress, and D.M. Fry. 1996. Survival and dispersal of oiled brown pelicans after rehabilitation and release. Mar. Poll. Bull. 32:711-718.

Anuskiewicz, R.J. 1989. A study of maritime and nautical sites associated with St. Catherines Island, Georgia. Ph.D. Dissertation presented to the University of Tennessee, Knoxville, TN. 90 pp.

Arthur D. Little, Inc. 1985. Union Oil Project/Exxon Project. Shamrock and Central Santa Maria Basin Area Study, draft environmental impact statement/environmental report. June 24, 1985.

Aten, L.E. 1983. Indians of the upper Texas coast. New York, NY: Academic Press.

Avanti Corporation. 1993a. Ocean discharge criteria evaluation for the NPDES general permit for the Western Gulf of Mexico OCS. Prepared for the U.S. Environmental Protection Agency, Water Management Division, Region VI. USEPA contract no. 68-C9-0009.

Avanti Corporation. 1993b. Environmental analysis of the final effluent guideline, offshore subcategory, oil and gas industry. Volume II: Case impacts. Prepared for the U.S. Environmental Protection Agency, Water Management Division, Region VI. USEPA contract no. 68-C9-0009.

Avanti Corporation. 1998. Ocean discharge criteria evaluation for the NPDES general permit for the Western Gulf of Mexico OCS. Prepared for the U.S. Environmental Protection Agency, Water Management Division, Region VI. EPA Contract No. 68-C9-0009.

Baker, J.M., R.B. Clark, and P.F. Kingston. 1991. Two years after the spill: Environmental recovery in Prince William Sound and the Gulf of Alaska. Institute of Offshore Engineering, Heriot-Watt University, Edinburgh, EH14 4AS, Scotland. 31 pp.

Bakus, R.H., J.E. Craddock, R.L. Haedrich, and B.H. Robison. 1977. Atlantic mesopelagic zoogeography. In: Gibbs, R.H., Jr., ed. Fishes of the Western North Atlantic. Pp. 266-287.

Barkuloo, J.M. 1988. Report on the conservation status of the Gulf of Mexico sturgeon, *Acipenser oxyrhunchus desotoi*. U.S. Dept. of the Interior, Fish and Wildlife Service, Panama City, FL.

Barron, G.L. and T.A. Jefferson. 1993. First records of the melon-headed whale (*Peponicephala electra*) from the Gulf of Mexico. Southw. Natural. 38:82-85.

Baumgartner, M.F. 1995. The distribution of select species of cetaceans in the northern Gulf of Mexico in relation to observed environmental variables. M.Sc. Thesis, University of Southern Mississippi.

Baumgartner, M.F. 1997. The distribution of Risso's dolphin (*Grampus griseus*) with respect to the physiography of the northern Gulf of Mexico. Mar. Mamm. Sci. 13:614-638.

Bea, R.G., N.W. Lai, A.W. Niedoroda, and G.H. Moore. 1983. Gulf of Mexico shallow-water wave heights and forces. In: Proceedings of the Offshore Technical Conference, Houston, TX, May 1983. OTC 4586. Pp. 49-62.

Beaver, C. 2001. Personal communication. Texas A&M University at Corpus Christi, Center for Coastal Studies, Corpus Christi, TX.

Bedinger, C.A., ed. 1981. Ecological investigations of petroleum production platforms in the Central Gulf of Mexico. Volume 1: Pollutant fate and effects studies. Prepared by the Southwest Research Institute for the Bureau of Land Management under contract no. AA551-CT8-17. San Antonio, TX.

Bent, A.C. 1926. Life histories of North American marsh birds. New York, NY: Dover Publications.

Bernard, H.J. and S.B. Reilly. 1999. Pilot whales *Globicephala* (Lesson, 1828). In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals, Vol. 6: Second book of dolphins. San Diego, CA: Academic Press. Pp. 245-279.

Boehm, P., D. Turton, A. Raval, D. Caudle, D. French, N. Rabalais, R. Spies, and J. Johnson. 2001. Deepwater program: Literature review, environmental risks of chemical products used in the Gulf of Mexico deepwater oil and gas operations; Volume I: Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-011. 326 pp.

Boersma, P.D. 1995. Prevention is more important than rehabilitation: Oil and penguins don't mix. In: Proceedings, The Effects of Oil on Wilidlife, 4th International Conference, April, Seattle, WA.

Boland, G.S. 2000. Personal observations. Observations of two new chemosynthetic communities (Blocks GB 535 and GC 354) from the Johnson Sea Link submersible as part of an MMS funded Coastal Marine Institute Study with Louisiana State University; Harry Roberts, Project Manager, Contract no. 17801.

Boyd, R. and S. Penland, eds. 1988. A geomorphologic model for Mississippi Delta evolution. In: Transactions — Gulf Coast Association of Geological Societies, Volume XXXVIII.

Brongersma, L. 1972. European Atlantic turtles. Zool. Verh. Mus., Leiden. 121:1-3.

Brooks, J.M. and C.P. Giammona, eds. 1988. Mississippi-Alabama marine ecosystem study, annual report, year 2. Volume 1: Technical narrative. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 89-0095. 348 pp.

Brooks, J.M., M.C. Kennicutt II, and R.R. Bidigare. 1986. Final cruise report for Offshore Operators Committee study of chemosynthetic marine ecosystems in the Gulf of Mexico. Geophysical and Environmental Research Group, Department of Oceanography, Texas A&M University, College Station, TX. 102 pp.

Brown, Jr., L.F., J.H. McGowen, T.J. Evans, C.S. Groat, and W.L. Fisher. 1977. Environmentatl geological atlas of the Texas coastlal zone: Kingsville area. The University of Texas at Austin, Bureau of Economc Geology, Austin, TX.

Butler, R.G., A. Harfenist, F.A. Leighton, and D.B. Peakall. 1988. Impact of sublethal oil and emulsion exposure on the reproductive success of Leach's storm-petrels: short- and long-term effects. Journal of Applied Ecology 25:125-143.

Byrnes, M.R. and R.A. McBride. 1995. Preliminary assessment of beach response to a segmented breakwater system: Constance Beach and vicinity, 1990-1994. Prepared in cooperation with the Louisiana Dept. of Natural Resources, Coastal Restoration Division.

Caldwell, D.K. and M.C. Caldwell. 1989. Pygmy sperm whale *Kogia breviceps* (de Blainville, 1838): dwarf sperm whale *Kogia simus* (Owen, 1866). In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 4: River dolphins and the larger toothed whales. London: Academic Press. Pp. 235-260.

Carney, R.S., R.L. Haedrich, and G. T. Rowe. 1983. Zonation of fauna in the deep sea. In: Rowe, G.T., ed. Deep Sea Biology. New York, NY: John Wiley & Sons. Pp. 371-398.

Carr, A. and D.K. Caldwell. 1956. The ecology and migration of sea turtles. I. Results of field work in Florida, 1955. Amer. Mus. Novit. 1793:1-23.

Carr, A. and S. Stancyk. 1975. Observations on the ecology and survival outlook of the hawksbill turtle. Biol. Conserv. 8:161-172.

Center for Marine Conservation. 2001. Cleaning North America's beaches: 1995-1998 beach cleanup results. Washington, DC: Center for Marine Conservation.

Chan, E.I. 1977. Oil pollution and tropical littoral communities: biological effects at Florida Keys oil spill. In: Proceedings, 1977 Oil Spill Conference . . . March 8-10, 1977, New Orleans, LA. Washington, DC: American Petroleum Institute. Pp. 539-542.

Childs, S. 2002. Personal observation. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Clapp, R.B., R.C. Banks, D. Morgan-Jacobs, and W.A. Hoffman. 1982. Marine birds of the southeastern United States and Gulf of Mexico. U.S. Dept. of the Interior, Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-82/01. 3 vols.

Clugston, J.P. 1991. Gulf sturgeon in Florida prey on soft-bodied macroinvertebrates. U.S. Dept. of the Interior, Fish and Wildlife Service. Research Information Bulletin No. 90-31. 2 pp.

Coastal Environments, Inc. (CEI). 1977. Cultural resources evaluation of the Northern Gulf of Mexico Continental Shelf. Prepared for U.S. Dept. of the Interior, National Park Service, Office of Archaeology and Historic Preservation, Interagency Archaeological Services. Baton Rouge, LA.

Coastal Environments, Inc. (CEI). 1982. Sedimentary studies of prehistoric archaeological sites. Prepared for the U.S. Dept. of the Interior, National Park Service, Division of State Plans and Grants. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Coastal Environments, Inc. (CEI). 1986. Prehistoric site evaluation on the Northern Gulf of Mexico Outer Continental Shelf: Ground truth testing of the predictive model. Prepared for the U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Collard, S.B. 1990. Leatherback turtles feeding near a warmwater mass boundary in the eastern Gulf of Mexico. Marine Turtle Newsletter 50:12-14.

Conoco Inc. 2002. Development Operations Coordination Document: Magnolia Project; Garden Banks 783 Unit; MMS Contract no. 754399007. Garden Banks Block 783, OCS-G 11573: Garden Banks Block 784, OCS-G 11574. July 2002.

Continental Shelf Associates, Inc. (CSA). 1997a. Characterization and trends of recreational and commercial fishing from the Florida panhandle. U.S. Dept. of the Interior, Geological Survey, Biological Resources Division, USGS/BRD/CR-1997-0001 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 97-0020. 333 pp.

Continental Shelf Associates, Inc. (CSA). 1997b. Gulf of Mexico produced water bioaccumulation study: Definitive component technical report. Prepared for Offshore Operators Committee. 258 pp.

Continental Shelf Associates, Inc. (CSA). 2000. Deepwater Gulf of Mexico environmental and socioeconomic data search and literature synthesis. Volume I: Narrative report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-049. 340 pp.

Corliss, J.B., J. Dymond, L.I. Gordon, J.M. Edmond, R.P. von Herzen, R.D. Ballard, K. Green, D. Williams, A. Bainbridge, K. Crane, and T.H. van Andel. 1979. Submarine thermal springs on the Galapagos Rift. Science 203:1073-1083.

Cruz-Kaegi, M. 1998. Latitudinal variations in biomass and metabolism of benthic infaunal communities: College Station, TX, Texas A&M University, Ph.D. dissertation.

Cummings, W.C. 1985. Bryde's whale — *Balaenoptera edeni*. In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 3: The Sirenians and baleen whales. San Diego, CA: Academic Press, Inc. Pp. 137-154.

Curry, B.E. and J. Smith. 1997. Phylogeographic structure of the bottlenose dolphin (*Tursiops truncatus*): stock identification and implications for management. In: Dizon, D.E., S.J. Chivers, and W.F. Perrin, eds. Molecular genetics of marine mammals. Society for Marine Mammalogy, Special Publication 3. Pp. 227-247.

Dahlheim, M.E. and J.E. Heyning. 1999. Killer whale *Orcinus orca* (Linnaeus, 1758). In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 6: Second book of dolphins. San Diego, CA: Academic Press. Pp. 281-322.

Davis, R.W. and G.S. Fargion, eds. 1996. Distribution and abundance of cetaceans in the north-central and western Gulf of Mexico; final report. Volume II: Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 96-0027. 357 pp.

Davis, R.W., G.A.J. Worthy, B. Würsig, S.K. Lynn, and F.I. Townsend. 1996. Diving behaviour and at-seamovement of an Atlantic spotted dolphin in the Gulf ofMexico. Mar. Mamm. Sci. 12:569-581.

Davis, R.W., G.S. Fargion, N. May, T.D. Leming, M. Baumgartner, W.E. Evans, L.J. Hansen, and K. Mullin. 1998. Physical habitat of cetaceans along the continental slope in the north-central and western Gulf of Mexico. Mar. Mamm. Sci. 14:490-507.

Davis, R.W., W.E. Evans, and B. Würsig. 2000. Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. U.S. Dept. of the Interior, Geological Survey, Biological Resources Division, USGS/BRD/CR-1999-0006 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-003. 346 pp.

Delaune, R.D., W.H. Patrick, and R.J. Bureh. 1979. Effect of crude oil on a Louisiana *Spartina alterniflora* salt marsh. Environ. Poll. 20:21-31.

Deming, J. and J. Baross. 1993. The early diagenesis of organic matter: Bacterial activity. In: Engel, M. and S. Macko, eds. Organic Geochemistry. New York, NY: Plenum. Pp. 119-144.

DeWald, O. 1982. Severe storms and hurricane impacts along the Gulf and lower Atlantic coasts. In: U.S. Dept. of the Interior, Bureau of Land Management. Environmental information on hurricanes, deepwater technology, and Mississippi Delta mudslides in the Gulf of Mexico, Section III. New Orleans, LA. BLM Open File Report 80-02. 10 pp.

Dodd, C.K., Jr. 1988. Synopsis of the biological data on the loggerhead sea turtle *Caretta caretta* (Linnaeus 1758). U.S. Dept. of the Interior, Fish and Wildlife Service. Biological Report 88(14). Gainesville, FL: National Ecology Research Center. 119 pp. Available from NTIS: PB89-109565.

Doering, F., I.W. Duedall, and J.M. Williams. 1994. Florida hurricanes and tropical storms 1871-1993: An historical survey. Florida Institute of Technology, Division of Marine and Environmental Systems, Florida Sea Grant Program, Gainesville, FL. Tech. Paper 71. 118 pp.

Durako, M.J., M.O. Hall, F. Sargent, and S. Peck. 1992. Propeller scars in sea grass beds: An assessment and experimental study of recolonization in Weedon Island State Preserve, Florida. In: Web, F., ed. Proceedings, 19th Annual Conference of Wetland Restoration and Creation. Hillsborough Community College, Tampa, FL. Pp. 42-53.

Eckert, S.A., D.W. Nellis, K.L. Eckert, and G.L. Kooyman. 1986. Diving patterns of two leatherback sea turtles (*Dermochelys coriacea*) during internesting intervals at Sandy Point, St. Croix, U.S. Virgin Islands. Herpetologica 42:381-388.

Ehrhart, L.M. 1978. Choctawhatchee beach mouse. In: Layne, J.N., ed. Rare and endangered biota of Florida. Volume I: Mammals. Gainesville: University Presses of Florida. Pp. 18-19.

Ernst, C.H., R.W. Barbour, and J.E. Lovich. 1994. Turtles of the United States and Canada. Washington, DC: Smithsonian Institution Press. 578 pp.

Farr, A.J., C.C. Chabot, and D.H. Taylor. 1995. Behavioral avoidance of flurothene by flathead minnows (*Pimephales promelas*). Neurotoxicology and Teratology 17(3):265-271.

Federal Register. 1985. Endangered and threatened wildlife and plants; removal of the brown pelican in the southeastern United States from the list of endangered and threatened wildlife. 50 FR 23.

Federal Register. 1995. Endangered and threatened wildlife and plants; final rule to reclassify the bald eagle from endangered to threatened in all of the lower 48. 60 FR 133, pp. 36,000-36,010.

Fischel, M., W. Grip, and I.A. Mendelssohn. 1989. Study to determine the recovery of a Louisiana marsh from an oil spill. In: Proceedings, 1989 Oil Spill Conference . . . February 13-16, 1989, San Antonio, TX. Washington, DC: American Petroleum Institute.

Fisher, C.R. 1990. Chemoautotrophic and methanotrophic symbioses in marine invertebrates: Reviews in Aquatic Sciences 2:399-436.

Fisher, W.L., J.H. McGowen, L.F. Brown, Jr., and C.G. Groat. 1972. Environmental geologic atlas of the Texas coastal zone: Galveston-Houston area. The University of Texas at Austin, Bureau of Economic Geology, Austin, TX.

Fisher, W.L., L.F. Brown, Jr., J.H. McGowen, and C.G. Groat. 1973. Environmental geologic atlas of the Texas coastal zone: Beaumont-Port Arthur area. The University of Texas at Austin, Bureau of Economic Geology, Austin, TX.

Fox, D.A. and J.E. Hightower. 1998. Identification of Gulf sturgeon spawning habitat in the Choctawhatchee River System, Alabama. Final report to North Carolina Cooperative Fish and Wildlife Research Unit, Raleigh, NC. 51 pp.

Fritts, T.H., A.B. Irvine, R.D. Jennings, L.A. Collum, W. Hoffman, and M.A. McGehee. 1983a. Turtles, birds, and mammals in the northern Gulf of Mexico and nearby Atlantic waters. U.S. Dept. of the Interior, Fish and Wildlife Service, Division of Biological Services, Washington, DC: FWS/OBS82/65. 455 pp.

Fritts, T.H., W. Hoffman, and M.A. McGehee. 1983b. The distribution and abundance of marine turtles in the Gulf of Mexico and nearby Atlantic waters. Journal of Herpetology 17:327-344.

Fuller, D.A. and A.M. Tappan. 1986. The occurrence of sea turtles in Louisiana coastal waters. Baton Rouge, LA: Louisiana State University, Center for Wetland Resources. LSU-CFI-86-28.

Gales, R.S. 1982. Effects of noise of offshore oil and gas operations on marine mammals — an introductory assessment. Technical Report 844. Naval Ocean Systems Center, San Diego, CA.

Gallaway, B.J., ed. 1988a. Northern Gulf of Mexico continental slope study: Year 4; final report. Vol. I: Executive summary. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 88-0052. 69 pp.

Gallaway, B.J., ed. 1988b. Northern Gulf of Mexico continental slope study: Year 4; final report. Vol. II: Synthesis report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 88-0053. 701 pp.

Gallaway, B.J., ed. 1988c. Northern Gulf of Mexico continental slope study: Year 4; final report. Vol. III: Appendices. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 88-0054. 378 pp.

Gallaway, B.J. and D.K. Beaubien. 1997. Initial monitoring at a synthetic drilling fluid discharge site on the continental slope of the northern Gulf of Mexico: The Pompano Development. In: McKay, M. and J. Nides, eds. Proceedings, Seventeenth Annual Gulf of Mexico Information Transfer Meeting, December 1997. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 99-0042.

Gallaway, B.J., L.R. Martin, and R.L. Howard, eds. 1988. Northern Gulf of Mexico continental slope study: Annual report, year 3. Volume I: Executive summary. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 87-0059. 154 pp.

Gallaway, B.J., J.G. Cole, and L.R. Martin. 2001. The deep sea Gulf of Mexico: An overview and guide.U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-065. 28 pp + CD.

Gallaway, B.J., J. G. Cole, and R. G. Fechhelm. In preparation. Selected aspects of the ecology of the continental slope fauna of the Gulf of Mexico: A synopsis of the northern Gulf of Mexico Continental Slope Study, 1983-1988. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans. 37 pp.+ app.

Gambell, R. 1985. Sei whale — *Balaenoptera borealis*. In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 3: The sirenians and baleen whales. San Diego, CA: Academic Press. Pp. 155-170.

Garrison, E.G., C.P. Giammona, F.J. Kelly, A.R. Tripp, and G.A. Wolf. 1989. Historic shipwrecks and magnetic anomalies of the northern Gulf of Mexico: Reevaluation of archaeological resource management zone 1. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 89-0024. 241 pp.

Gartner, J.V., Jr. 1993. Patterns of reproduction on the dominant lanternfish species (Pisces: Myctophidae) of the eastern Gulf of Mexico, with a review of reproduction among tropical-subtropical Myctophidae. Bull. Mar. Sci. 52(2):721-750.

Gartner, J.V., Jr., T.L. Hopkins, R.C. Baird, and D.M. Milliken. 1987. The lanternfishes of the eastern Gulf of Mexico. Fish. Bull. 85(1):81-98.

Geraci, J.R. and D.J. St. Aubin. 1980. Offshore petroleum resource development and marine mammals: a review and research recommendations. Marine Fisheries Review 42:1-12.

Gibson, D.J. and P.B. Looney. 1994. Vegetation colonization of dredge spoil on Perdido Key, Florida. Journal of Coastal Research 10:133-134.

Gore, J.A. and C.A. Chase III. 1989. Snowy plover breeding distribution. Final performance report from Nongame Wildlife Section, Division of Wildlife, Florida Game and Freshwater Fish Commission, Tallahassee, FL.

Gramling, R. 1984. Housing in the coastal zone parishes. In: Gramling, R.B. and S. Brabant, eds. The role of outer continental shelf oil and gas activities in the growth and modification of Louisiana's coastal zone. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration; Louisiana Dept. of Natural Resources, Layfayette, LA. Interagency Agreement NA-83-AA-D-CZ025;21920-84-02. Pp.127-134.

Greenberg, J. 2002. OSV day rates: Will the offshore sector improve in'03? Workboat 59(12):16.

Griffin, R.B. 1999. Sperm whale distributions and community ecology associated with a warm-core ring off Georges Bank. Mar. Mamm. Sci. 15:33-51.

Griffin, R.B. and N.J. Griffin. 1999. Distribution and habitat differentiation of *Stenella frontalis* and *Tursiops truncatus* on the eastern Gulf of Mexico continental shelf. Abstracts, 13th Biennial Conference on the Biology of Marine Mammals, Wailea, Maui, 28 November - 3 December.

Gulf of Mexico Fishery Management Council (GMFMC). 1998. Generic amendment for addressing essential fish habitat requirements. Gulf of Mexico Fishery Management Council, Tampa, FL. NOAA Award No. NA87FC0003. 238 pp. + apps. May 8, 1999.

Hall, E.R. 1981. The mammals of North America: Volume II. New York, NY: John Wiley and Sons. Pp. 667-670.

Handley, L.R. 1995. Seagrass distribution in the northern Gulf of Mexico. In: LaRoe, E.T., G.S. Farris, C.E. Puckett, P.D. Doran, and M.J. Mac, eds. Our Living Resources: A Report to the Nation on the Distribution, Abundance, and Health of U.S. Plants, Animals, and Ecosystems. U.S. Dept. of the Interior, National Biological Service, Washington, DC. Pp. 273-275.

Hartman, D.S. 1979. Ecology and behavior of the manatee (*Trichechus manatus*) in Florida. American Society of Mammalogists, Special Publication 5. St. Lawrence, KS. 153 pp.

Hayman, P., J. Marchant, and T. Prater. 1986. Shorebirds: An identification guide to the waders of the world. Boston, MA: Houghton Mifflin Co. 412 pp.

Hendrickson, J.R. 1980. The ecological strategies of sea turtles. Amer. Zool. 20:597-608.

Hersh, S.L. and D.A. Duffield. 1990. Distinction between northwest Atlantic offshore and coastal bottlenose dolphins based on hemoglobin profile and morphometry. In: Leatherwood, S. and R.R. Reeves, eds. The bottlenose dolphin. San Diego, CA: Academic Press. Pp. 129-139.

Hersh, S.L. and D.K. Odell. 1986. Mass stranding of Fraser's dolphin, *Lagenodelphis hosei*, in the western North Atlantic. Mar. Mamm. Sci. 2:73-76.

Hess, N.A. and C.A. Ribic 2000. Seabird ecology. Chapter 8. In: Davis, R.W., W.E. Evans, and B. Wursig, eds. Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. U.S. Dept. of the Interior, Geological Survey, Biological Resources Division, USGS/BRD/CR-1999-0006 and the Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-003.

Heyning, J.E. 1989. Cuvier's beaked whale — *Ziphius cavirostris* (G. Cuvier, 1823). In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 4: River dolphins and the larger toothed whales. London: Academic Press. Pp. 289-308.

Hildebrand, H.H. 1995. A historical review of the status of sea turtle populations in the western Gulf of Mexico. In: Bjorndal, K.A., ed. Biology and conservation of sea turtles, second edition, Washington, DC: Smithsonian Institution Press. Pp. 447-453.

Hildebrand, H.H. 1982. A historical review of the status of sea turtle populations in the western Gulf of Mexico. In: Bjorndal, K.A., ed. Biology and conservation of sea turtles. Washington, DC: Smithsonian Institution Press. Pp. 447-453.

Hirth, H.F. 1997. Synopsis of the biological data on the green turtle *Chelonia mydas* (Linnaeus 1758). U.S. Dept. of the Interior, Fish and Wildlife Service. Biological Report 97(1).

Hoffman, W. and T.H. Fritts. 1982. Sea turtle distribution along the boundary of the Gulf Stream current off eastern Florida. Herpetologica 39:405-409.

Holder, Jr., S.W. and A. Lugo-Fernandez. 1993. Relationships between the Barataria Basin tidal prism and the basin's barrier islands. In: Clipp, A., ed. Louisiana shoreline erosion: Emphasis on Grand Isle. Proceedings of a Symposium held at Grand Isle, LA, March 3-5, 1993. Pp. 31-42.

Hopkins, T.L. and R.C. Baird. 1985. Feeding ecology of four hatchetfishes (Sternoptychidae) in the eastern Gulf of Mexico. Bull. Mar. Sci. 36(2):260-277.

Houston Chronicle On-line. 2001. Gas contracts below $2; curtailing output discussed. Internet website: http://www.chron.com/content/chronicle/business/index.html. September 24.

Hughes, G.R., P. Luschi, R. Mencacci, and F. Papi. 1998. The 7000-km oceanic journey of a leatherback tracked by satellite. J. Ecper. Mar. Bio. Ecol. 229:209-217.

Irion, J.B. and R.J. Anuskiewicz. 1999. MMS seafloor monitoring project: The first annual technical report, 1997 field season. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico Region, New Orleans, LA. OCS Report MMS 99-0014. 63 pp.

Jefferson, T.A. and A.J. Schiro. 1997. Distribution of cetaceans in the offshore Gulf of Mexico. Mammal Review 27:27-50.

Jefferson, T.A., S. Leatherwood, L.K.M. Shoda, and R.L. Pitman. 1992. Marine mammals of the Gulf of Mexico: A field guide for aerial and shipboard observers. College Station, TX: Texas A&M University Printing Center. 92 pp.

Jefferson, T.A., S. Leatherwood, and M.A. Webber. 1993. FAO species identification guide. Marine Mammals of the World. Food and Agriculture Organization, Rome. 320 pp.

Jensen, T., R. Palerud, F. Olsgard, and S.M. Bakke. 1999. Dispersion and effects of synthetic drilling fluids on the environment. Norwegian Ministry of Oil and Energy Technical Report No. 99-3507. Prepared by Olsgård Consulting, Akvaplan-niva, and Det Norske Veritas. 66 pp.

Johansen, O., H. Rye, and C. Cooper. 2001. DeepSpill JIP — Field study of simulated oil and gas blowouts in deep water. In: Proceedings from the Fifth International Marine Environment Modeling Seminar, October 9-11, 2001, New Orleans, LA. 377 pp.

Johnsgard, P.A. 1975. Waterfowl of North America. Bloomington and London: Indiana University Press.

Johnston, J.B., M.C. Watzin, J.A. Barras, and L.R. Handley. 1995. Gulf of Mexico coastal wetlands: Case studies of loss trends. In: LaRoe, E.T., G.S. Farris, C.E. Puckett, P.D. Doran, and M.J. Mac, eds. Our Living Resources.A Report to the Nation on the Distribution, Abundance, and Health of U.S. Plants, Animals, and Ecosystems. U.S. Dept. of the Interior, National Biological Service, Washington, DC. Pp. 269-272.

Kasprzak, R.A. and W.S. Perret. 1996. Use of oil and gas platforms as habitat in Louisiana's Artificial Reef Program. Louisiana Department of Wildlife and Fisheries.

Kelley, J.Q. and W.W. Wade. 1998. Social and economic consequences of onshore OCS-related activities in coastal Alabama: Final baseline report. Economic baseline of the Alabama coastal region. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 98-0046. 102 pp.

Kennicutt II, M.C., ed. 1995. Gulf of Mexico offshore operations monitoring experiment, Phase I: Sublethal responses to contaminant exposure; final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 95-0045. 709 pp.

Kennicutt M.C., J.M. Brooks, R.R. Bidigare, R.R. Fay, T.L. Wade, and T.J. McDonald. 1985. Vent-type taxa in a hydrocarbon seep region on the Louisiana slope. Nature 317:351-353.

Kennicutt, M.C., J. Sericano, T. Wade, F. Alcazar, and J.M. Rooks. 1987. High-molecular weight hydrocarbons in the Gulf of Mexico continental slope sediment: Deep-Sea Research.

Kennicutt, M.C., J.M Brooks, E.L. Atlas, and C.S.Giam. 1988. Organic compounds of environmental concern in the Gulf of Mexico: A review. Aquatic Toxicology 11:191-212.

Knowlton, A.R. and B. Weigle. 1989. A note on the distribution of leatherback turtles (*Dermochelys coriacea*) along the Florida coast in February 1988. Proceedings, 9th Annual Workshop on Sea Turtle Conservation and Biology. NOAA Tech. Memo. NMFS-SEFSC-232.

Koike, B.G. 1996. News from the bayous — Louisiana Sea Turtle Stranding and Salvage Network. Proceedings, 15th Annual Workshop on Sea Turtle Conservation and Biology. NOAA Tech. Memo. NMFS-SEFSC-387.

Kruse, S., D.K. Caldwell, and M.C. Caldwell. 1999. Risso's dolphin *Grampus griseus* (G. Cuvier, 1812). In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 6: Second book of dolphins. San Diego, CA: Academic Press. Pp. 183-212.

Landry, Jr., A.M. and D. Costa. 1999. Status of sea turtle stocks in the Gulf of Mexico with emphasis on the Kemp's ridley. In: Kumpf, H., K. Steidinger, and K. Sherman, eds. The Gulf of Mexico Large Marine Ecosystem: Assessment, Sustainability, and Management. Blackwell Science. Pp. 248-268.

Lang, W. 2001. Personal communication. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Laska, S.B., V.K. Baxter, R. Seydlitz, R.E. Thayler, S. Brabant, and C.J. Forsyth, eds. 1993. Impact of offshore oil exploration and production on the social institutions of coastal Louisiana. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 93-0007. 246 pp.

Leary, T.R. 1957. A schooling of leatherback turtles, *Dermochelys coriacea coriacea*, on the Texas coast. Copeia 1957:232.

Leatherwood, S. and R.R. Reeves. 1983. Abundance of bottlenose dolphins in Corpus Christi Bay and coastal southern Texas. Contributions in Marine Science 26:179-199.

Leatherwood, S., T.A. Jefferson, J.C. Norris, W.E. Stevens, L.J. Hansen, and K.D. Mullin. 1993. Occurrence and sounds of Fraser's dolphins (*Lagenodelphis hosei*) in the Gulf of Mexico. Tex. Journal of Science. 45:349-354.

Linden, O., J.R. Sharp, R. Laughlin, Jr., and J.M. Neff. 1979. Interactive effects of salinity, temperature, and chronic exposure to oil on the survival and development rate of embryos of the estuarine killfish Fundulus heteroclitus. Mar. Biol. 51:101-109.

Lohoefener, R.R., W. Hoggard, C.L. Roden, K.D. Mullin, and C.M. Rogers. 1988. Distribution and relative abundance of surfaced sea turtles in the north-central Gulf of Mexico: Spring and fall 1987. Proceedings, 8th Annual Workshop on Sea Turtle Conservation and Biology. NOAA Tech. Memo. NMFS-SEFSC-214.

Lohoefener, R., W. Hoggard, K. Mullin, C. Roden, and C. Rogers. 1990. Association of sea turtles with petroleum platforms in the north-central Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 90-0025. 90 pp.

Longwell, A.C. 1977. A genetic look at fish eggs and oil. Oceanus 20(4):46-58.

Lowery, G.H. 1974. The mammals of Louisiana and its adjacent waters. Baton Rouge, LA: Louisiana State University. 565 pp.

Lugo-Fernandez, A., M.V. Morin, C.C. Ebesmeyer, and C.F. Marshall. 2001. Gulf of Mexico historic (1995-1987) surface drifter data analysis. J. Coastal Research 17:1-16.

Lutcavage, M.E., P. Plotkin, B. Witherington, and P.L. Lutz. 1997. Human impacts on sea turtle survival. In: Lutz, P.L. and J.A. Musick, eds. The biology of sea turtles. Boca Raton, FL: CRC Press. Pp. 387-409.

Lytle, J.S. 1975. Fate and effects of crude oil on an estuarine pond. In: Proceedings, Conference on Prevention and Control of Oil Pollution, San Francisco, CA. Pp. 595-600.

Maccarone, A.D. and J.N. Brzorad. 1994. Gulf and waterfowl populations in the Arthur Kill. In: Burger, J., ed. Before and after an oil spill: The Arthur Kill. New Brunswick, NJ: Rutgers University Press. Pp. 595-600.

MacDonald, I.R., ed. 1992. Chemosynthetic ecosystems study literature review and data synthesis: Volumes I-III. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 92-0033 through 92-0035.

MacDonald, I.R., N.L. Guinasso, Jr., J.F. Reilly, J.M. Brooks, W.R. Callender, and S.G. Gabrielle. 1990. Gulf of Mexico hydrocarbon seep communities: VI. Patterns in community structure and habitat. Geo-Marine Letters 10:244-252.

Madge, S. and H. Burn. 1988. Waterfowl: An identification guide to the ducks, geese, and swans of the world. Boston, MA: Houghton Mifflin. 298 pp.

Malins, D.C., S. Chan, H.O. Hodgins, U. Varanasi, D.D. Weber, and D.W. Brown. 1982. The nature and biological effects of weathered petroleum. Environmental Conservation Division, Northwest and Alaska Fisheries Center, National Marine Fisheries Service, Seattle, WA. 43 pp.

Mann, D.W. and G.G. Thompson. 2001. Holly Beach, Louisiana, breakwater enhancement and sand management plan. Contracted proposal by Coastal Planning and Engineering, Inc. of Boca Raton, FL, to the Louisiana Dept. of Natural Resources, Coastal Restoration Division.

Márquez-M., R. 1990. FAO Species Catalogue. Volume 11: Sea turtles of the world. An annotated and illustrated catalogue of sea turtle species known to date. FAO Fisheries Synopsis. FAO, Rome.

Márquez-M., R. 1994. Synopsis of biological data on the Kemp's ridley turtle, *Lepidochelys kempi*, (Garman, 1880). U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 94-0023. 91 pp.

Martin, R.P. 1991. Regional overview of wading birds in Louisiana, Mississippi, and Alabama. In: Proceedings of the Coastal Nongame Workshop. U.S. Dept. of the Interior, Fish and Wildlife Service, Region 4 and the Florida Game and Fresh Water Fish Commission. Pp. 22-33.

McKelvie, S. and R.C. Ayers, Jr. 1999. Environmental effects of cuttings from synthetic based drilling fluids. A literature review. Draft Report by Robert Ayers & Associates Inc. and Rudall Blanchard Associates for the American Petroleum Institute. 33 pp.

Mead, J.G. 1989. Beaked whales of the genus — Mesoplodon. In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 4: River dolphins and the larger toothed whales. London: Academic Press. Pp. 349-430.

Mead, J.G. and C.W. Potter. 1990. Natural history of bottlenose dolphins along the Central Atlantic coast of the United States. In: Leatherwood, S. and R.R. Reeves, eds. The bottlenose dolphin. San Diego, CA: Academic Press. Pp. 165-195.

Menzies, R., R. George, and G. Rowe. 1973. Abyssal environment and ecology of the world oceans. New York, NY: John Wiley and Sons.

Meylan, A. 1988. Spongivory in hawksbill turtles: A diet of glass. Science 239:393-395.

Meylan, A., B. Schroeder, and A. Mosier. 1995. Sea turtle nesting activity in the State of Florida 1979-1992. Florida Marine Research Publications, Florida Marine Research Institute, No. 52.

Miller, J.E. and D.L. Echols. 1996. Marine debris point source investigation: Padre Island National Seashore, March 1994-September 1995. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 96-0023. 35 pp.

Mills, L.R. and K.R. Rademacher. 1996. Atlantic spotted dolphins (*Stenella frontalis*) in the Gulf of Mexico. Gulf Mex. Sci. 1996:114-120.

Miyazaki, N. and W.F. Perrin. 1994. Rough-toothed dolphin — *Steno bredanensis* (Lesson, 1828). In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 5: First book of dolphins. San Diego, CA: Academic Press. Pp. 1-21.

Moore, D.R. and H.R. Bullis, Jr. 1960. A deep-water coral reef in the Gulf of Mexico. Bull. Mar. Sci. 10(1):125-128.

Moore, J.C. and E. Clark. 1963. Discovery of right whales in the Gulf of Mexico. Science 141:269.

Morreale, S.J., E.A. Standora, J.R. Spotila, and F.V. Paladino. 1996. Migration corridor for sea turtles. Nature 384:319-320.

Morton, R.A. 1982. Effects of coastal structures on shoreline stabilization and land loss — the Texas experience. In: Boesch, D.F., ed. Proceedings of the conference on coastal erosion and wetland modification in Louisiana: Causes, consequences, and options. Washington, DC: U.S. Dept. of the Interior, Fish and Wildlife Service, Biological Services Program. FWS/OBS-82/59.

Moyers, J.E. 1996. Food habits of Gulf Coast subspecies of beach mice (*Peromyscus polionotus* spp.). M.S. Thesis, Auburn University, AL. 84 pp.

Mullin, K. 1998. Personal communication. U.S. Dept. of Commerce, National Marine Fisheries Service, Pascagoula, MS.

Mullin, K.D. and L.J. Hansen. 1999. Marine mammals of the northern Gulf of Mexico. In: H. Kumph, K. Steidinger, and K. Sherman, eds. Gulf of Mexico a large marine ecosystem. Blackwell Science. Pp. 269-277.

Mullin, K., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers, and B. Taggart. 1991. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 91-0027. 108pp.

Mullin, K.D., W. Hoggard, C.L. Roden, R.R. Lohoefener, C.M. Rogers, and B. Taggart. 1994a. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. U.S. Fish. Bull. 92:773-786.

Mullin, K.D., L.V. Higgins, T.A. Jefferson, and L.J. Hansen. 1994b. Sightings of the Clymene dolphin (*Stenella clymene*) in the Gulf of Mexico. Mar. Mamm. Sci. 10:464-470.

Mullin, K.D., T.A. Jefferson, L.J. Hansen, and W. Hoggard. 1994c. First sightings of melon-headed whales (*Peponocephala electra*) in the Gulf of Mexico. Mar. Mamm. Sci. 10:342-348.

Murray, S.P. 1998. An observational study of the Mississippi-Atchafalaya coastal plume: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 98-0040. 513 pp.

National Geographic Society. 1983. Field guide to the birds of North America. Washington, DC: The National Geographic Society. 464 pp.

National Research Council (NRC). 1985. Oil in the sea: inputs, fates, and effects. Washington, DC: National Academy Press. 601 pp.

Neff, M.J. 1997. Metals and organic chemicals associated with oil and gas well produced water: Bioaccumulation, fates, and effects in the marine environment. Report prepared for Continental Shelf Associates, Inc., Jupiter, FL, to Offshore Operators Committee, New Orleans, LA. April 14, 1997.

Neff, M.J., R.E. Hillman, and J.J Waugh. 1989. Bioaccumulation of trace metals from drilling mud barite by benthic marine animals. In: Engelhardt, F.R., J.P. Ray, and A.H. Gillam, eds. Drilling Wastes. Elsevier. Pp. 461-479.

Neff, J.M., S. McKelvie, and R.C. Ayers, Jr. 2000. Environmental impacts of synthetic based drilling fluids. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-064. 118 pp.

Nelson, H.F. and E.E. Bray. 1970. Stratigraphy and history of the Holocene sediments in the Sabine-High Island Area, Gulf of Mexico. In: Morgam, J.P., ed. Deltaic Sedimentation; Modern and Ancient. Special Publn. No. 15. Tulsa, OK: SEPM.

Neumann, C.J., B.R. Jarvinen, and J.D. Elms. 1993. Tropical cyclones of the north Atlantic Ocean, 1871-1992. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Ashville, NC. 193 pp.

Nicholls, J.L. and G.A. Baldassarre. 1990. Habitat associations of piping plovers wintering in the United States. Wilson Bulletin 102:581-590.

O'Connor, T.P. 1990. Coastal environmental quality in the United States, 1990: Chemical contamination in sediment and tissues. A Special NOAA 20th Anniversary Report. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Status and Trends Program, Rockville, MD. 34 pp.

O'Connor, T.P. and B. Beliaeff. 1995. Recent trends in coastal environments quality: Results from the mussel watch project (National Status and Trends Program, Marine Environmental Quality). U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Silver Spring, MD. 40 pp.

Odell, D.K. and K.M. McClune. 1999. False killer whale *Pseudorca crassidens* (Owen, 1846). In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 6: Second book of dolphins. San Diego, CA: Academic Press. Pp. 213-243.

Ogren, L.H. 1989. Distribution of juvenile and subadult Kemp's ridley turtles: Preliminary result from the 1984-1987 surveys. In: Proceedings of the First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management, October 1-4, 1985, Galveston, TX. TAMU-SG-89-105. Sea Grant College Program, Texas A&M University. Pp. 116-123.

Oilneregy. 2002. Internet website: http://www.oilnergy.com.April 18, 2002.

One Offshore. 2001. Gulf of Mexico Weekly Rig Locator. December 7, 2001. 15(49).

One Offshore. 2002. Gulf of Mexico Newsletter. Internet website: http://opg.oneoffshore.com/Home?newURL=opg March.

Ortega, J. 1998. Personal communication. Texas A&M University at Galveston, Marine Mammal Research Program, Galveston, TX.

O'Shea, T.J., B.B. Ackerman, and H.F. Percival, eds. 1995. Population biology of the Florida manatee. National Biological Service, Information and Technology Report 1.

O'Sullivan, S. and K.D. Mullin. 1997. Killer whales (*Orcinus orca*) in the northern Gulf of Mexico. Mar. Mamm. Sci. 13:141-147.

Pashley, D.N. 1991. Shorebirds, gulls, and terns: Louisiana, Mississippi, Alabama. In: Proceedings of the coastal nongame workshop. U.S. Dept. of the Interior, Fish and Wildlife Service, Region 4, and Florida Game and Fresh Water Fish Commission. Pp. 79-83.

Patrick, L. 1996. Personal communication. U.S. Dept. of the Interior, Fish and Wildlife Service, Panama City, FL.

Patrick, L. 1997. Personal communication. U.S. Dept. of the Interior, Fish and Wildlife Service, Panama City, FL.

Payne, J.F., J. Kiceniuk, L.L. Fancey, U. Williams, G.L. Fletcher, A. Rahimtula, and B. Fowler. 1988. What is a safe level of polycyclic aromatic hydrocarbons for fish: Subchronic toxicity study on winter flounder (*Pseudopleuronectes americanus*). Can. J. Fish. Aquat. Sci.45:1983-1993.

Payne, J., C. Andrews, S. Whiteway, and K. Lee. 2001a. Definition of sediment toxicity zones around oil development sites: does response relationships for the monitoring surrogates Microtox® and amphipods exposed to Hibernia source cuttings containing a synthetic base oil. Canadian Manuscript Report of Fisheries and Aquatic Sciences No. 2577. 10 pp.

Payne, J., L. Fancey, C. Andrews, J. Meade, F. Power, K. Lee, G. Veinott, and A. Cook. 2001b. Laboratory exposures of invertebrate and vertebrate species to concentrations of IA-35 (Petro-Canada) drill mud fluid, production water, and Hibernia drill mud cuttings. Canadian Manuscript Report of Fisheries and Aquatic Sciences No. 2560. 27 pp.

Pequegnat, W.E. 1983. The ecological communities of the continental slope and adjacent regimes of the northern Gulf of Mexico. Final report to the U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. Contract No. AA851-CT1-12.

Pequegnat, W.E., B.J. Gallaway, and L. Pequegnat. 1990. Aspects of the ecology of the deepwater fauna of the Gulf of Mexico. American Zoologist 30:45-64.

Perrin, W.F. and J.W. Gilpatrick, Jr. 1994. Spinner dolphin — *Stenella longirostris* (Gray, 1828). In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 5: First book of dolphins. London: Academic Press. Pp. 99-128.

Perrin, W.F. and A.A. Hohn. 1994. Pantropical spotted dolphin — *Stenella attenuata*. In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 5: The first book of dolphins. London: Academic Press. Pp. 71-98.

Perrin, W.F. and J.G. Mead. 1994. Clymene dolphin — *Stenella clymene* (Gray, 1846). In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 5: The first book of dolphins. London: Academic Press. Pp. 161-171.

Perrin, W.F., D.K. Caldwell, and M.C. Caldwell. 1994a. Atlantic spotted dolphin — *Stenella frontalis* (G. Cuvier, 1829). In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 5: The first book of dolphins. London: Academic Press. Pp. 173-190.

Perrin, W.F., S. Leatherwood, and A. Collet. 1994b. Fraser's dolphin — *Lagenodelphis hosei* (Fraser, 1956). In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 5: The first book of dolphins. London: Academic Press. Pp. 225-240.

Perrin, W.F., C.E. Wilson, and F.I. Archer II. 1994c. Striped dolphin — *Stenella coeruleoalba* (Meyen, 1833). In: Ridgway, S.H. and R. H arrison, eds. Handbook of marine mammals. Vol. 5: The first book of dolphins. London: Academic Press. Pp. 129-159.

Perryman, W.L., D.W.K. Au, S. Leatherwood, and T.A. Jefferson. 1994. Melon-headed whale — *Peponocephala electra* (Gray, 1846). In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 5: The first book of dolphins. London: Academic Press. Pp. 363-386.

Plön, S. and R. Bernard. 1999. The fast lane revisited: Life history strategies of *Kogia* from southern Africa. Abstracts, 13th Biennial Conference on the Biology of Marine Mammals, Wailea, Maui, 28 November - 3 December.

Plotkin, P.T., M.K. Wicksten, and A.F. Amos. 1993. Feeding ecology of the loggerhead sea turtle *Caretta caretta* in the northwestern Gulf of Mexico. Mar. Biol. 115:1-15.

Powell, J.A. and G.B. Rathbun. 1984. Distribution and abundance of manatees along the northern coast of the Gulf of Mexico. Northeast Gulf Sci. 7:1-28.

Power, J.H. and L.N. May, Jr. 1991. Satellite observed sea-surface temperatures and yellowfin tuna catch and effort in the Gulf of Mexico. Fish. Bull. 89:429-439

Price, W.A. 1958. Sedimentology and quaternary geomorphology of south Texas, supplementary to field trip manual "Sedimentology of South Texas": Corpus Christi Geological Society spring field trip 1958. Gulf Coast Association of Geological Societies Transactions 8(1958):41-75.

Pritchard, P.C.H. 1997. Evolution, phylogeny, and current status. In: Lutz, P.L. and J.A. Musick, eds. The biology of sea turtles. Boca Raton, FL: CRC Press. Pp. 1-28.

Rabalais, N.N. 1992. An updated summary of status and trends in indicators of nutrient enrichment in the Gulf of Mexico: Report to the Gulf of Mexico program, Nutrient Enrichment Subcommittee, U.S. Environmental Protection Agency, Office of Water, Gulf of Mexico Program, Stennis Space Center, MS. EPA/800-R-004. 421 pp.

Rathbun, G.B., J.P. Reid, and G. Carowan. 1990. Distribution and movement patterns of manatees (*Trichechus manatus*) in northwestern peninsular Florida. FL Mar. Res. Publ. No. 48. 33 pp.

Reeves, R.R., B.S. Stewart, and S. Leatherwood. 1992. The Sierra Club handbook of seals and sirenians. San Francisco, CA: Sierra Club Books.

Reggio, C.V., Jr. 1987. Rigs-to-Reefs: The use of obsolete petroleum structures as artificial reefs. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 87-0015. 17 pp.

Renaud, M. 2001. Sea turtles of the Gulf of Mexico. In: McKay, M., J. Nides, W. Lang, and D. Vigil. Gulf of Mexico Marine Protected Species Workshop, June 1999. U.S. Dept of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-039. Pp. 41-47.

Rester, J. and R. Condrey. 1996. The occurrence of the hawksbill turtle, *Eretmochelys imbricata*, along the Louisiana coast. Gulf Mex. Sci. 1996:112-114.

Rhinehart, H.L., C.A. Manire, J.D. Buck, P. Cunningham-Smith, and D.R. Smith. 1999. Observations and rehabilitation of rough-toothed dolphins, *Steno bredanensis*, treated at Mote Marine Laboratory from two separate stranding events. Abstracts, 13th Biennial Conference on the Biology of Marine Mammals, Wailea, Maui, 28 November - 3 December.

Rice, D.W. 1989. Sperm whale — *Physeter macrocephalus* (Linnaeus, 1758). In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 4: River dolphins and the larger toothed whales. London: Academic Press, Inc. Pp. 177-234.

Richards, W.J., T. Leming, M.F. McGowan, J.T. Lamkin, and S. Kelley-Farga. 1989. Distribution of fish larvae in relation to hydrographic features of the Loop Current boundary in the Gulf of Mexico. Rapp. P.-v. Reun. Cons. Int. Explor. Mer. 191:169-176.

Richardson, W.J., C.R. Greene, C.I. Malme, and D.H. Thomson. 1995. Marine mammals and noise. San Diego, CA: Academic Press.

Richie, W. and S. Penland. 1985. Overwash process-response characteristics of landforms along the Caminada-Moreau coast, Louisiana. In: Penland, S. and R. Boyd, eds. Transgressive Depositional Environments of the Mississippi River Delta Plain: A Guide to the Barrier Islands, Beaches and Shoals in Louisiana. Louisiana Geological Survey Guidebook Series, No. 3.

Ripley, S.D. and B.M. Beechler. 1985. Rails of the world, a compilation of new information, 1975-1983, (Aves: Rallidae). Smithsonian Contributions to Zoology, No. 417. Washington, DC: Smithsonian Institute Press.

Roberts, H.H. 2002. Personal communication. Director, Coastal Marine Institute. Louisiana State University, Baton Rouge, LA.

Roberts, H.H., and R.S. Carney. 1997. Evidence of episodic fluid, gas, and sediment venting on the northern Gulf of Mexico continental slope. Economic Geology 92:863-879.

Roberts, H.H., P. Aharon, R. Carney, J. Larkin, and R. Sassen. 1990. Sea floor responses to hydrocarbon seeps, Louisiana continental slope. Geo-Marine Letter 10(4):232-243.

Rosman, I., G.S Boland, L.R. Martin, and C.R. Chandler. 1987. Underwater sightings of sea turtles in the northern Gulf of Mexico. U.S. Dept of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 87-0107. 37 pp.

Ross, G.J.B. and S. Leatherwood. 1994. Pygmy killer whale — *Feresa attenuata* Gray, 1874. In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 5: The first book of dolphins. London: Academic Press. Pp. 387-404.

Rudloe, J., A. Rudloe, and L. Ogren. 1991. Occurrence of immature Kemp's ridley turtles, *Lepidochelys kempi*, in coastal waters of northwest Florida. Short Papers and Notes. Northeast Gulf Sci. 12:49-53.

Salmon, J., D. Henningsen, and McAlpin. 1982. Dune restoration and revegetation manual. Florida Sea Grant College. Report No. 48, September. 49 pp.

Sassen, R., J.M. Brooks, M.C. Kennucutt, II, I.R. MacDonald, and N.L. Guinasso, Jr. 1993. How oil seeps, discoveries relate in deepwater Gulf of Mexico. Oil and Gas Journal 91(16):64-69.

Schales, S. and D. Soileau. 2001. Personal communication with Samuel Holder: Shell Key, Point au Fer and their surrounding shell reefs, June 15. Both gentlemen were employed by the Louisiana Dept. of Wildlife and Fisheries at the time.

Schiro, A.J., D. Fertl, L.P. May, G.T. Regan, and A. Amos. 1998. West Indian manatee (*Trichechus manatus*) occurrence in U.S. waters west of Florida. Presentation, World Marine Mammal Conference, 20-24 January, Monaco.

Schmidly, D.J. 1981. Marine mammals of the southeastern United States coast and the Gulf of Mexico. FWS/OBS-80/41. U.S. Dept. of the Interior, Fish and Wildlife Service, Office of Biological Services, Washington, DC. 163 pp.

Schmidly, D.J., C.O. Martin, and G.F. Collins. 1972. First occurrence of a black right whale (*Balaena glacialis*) along the Texas coast. Southw. Natural. 17:214-215.

Sharp, B.E. 1995. Does the cleaning and treatment of oiled seabirds mean that they are rehabilitated — what about post-release survival? In: Proceedings, The Effects of Oil on Wildlife, 4th International Conference, April 1995, Seattle, WA.

Sharp, B.E. 1996. Post-release survival of oiled, cleaned seabirds in North America. Ibis 138:222-228.

Shoop, C.R. and R.D. Kenney. 1992. Seasonal distributions and abundance of loggerhead and leatherback sea turtles in waters of the northeastern United States. Herpetological Monographs No. 6.

Shoop, C., T. Doty, and N. Bray. 1981. Sea turtles in the region between Cape Hatteras and Nova Scotia in 1979. In: Shoop, C., T. Doty, and N. Bray. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf: Annual report for 1979: Chapter IX. Kingston, RI: University of Rhode Island. Pp. 1-85.

Sparks, T.D., J.C. Norris, R. Benson, and W.E. Evans. 1996. Distributions of sperm whales in the northwestern Gulf of Mexico as determined from an acoustic survey. In: Proceedings of the 11th Biennial Conference on the Biology of Marine Mammals, 14-18 December 1995, Orlando, FL. 108 pp.

Spies, R.B., J.S. Felton, and L. Dillard. 1982. Hepatic mixed-function oxidases in California flatfishes are increased in contaminated environments and by oil and PCB ingestion. Mar. Biol.70:117-127.

Stanley, D. 1998. Personal communication. Coastal Fisheries Institute, Louisiana State University, Baton Rouge, LA.

Stewart, B.S. and S. Leatherwood. 1985. Minke whale — *Balaenoptera acutorostrata*. In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 3: The sirenians and baleen whales. London: Academic Press, Inc. Pp. 91-136.

Stone, R.B. 1974. A brief history of artificial reef activities in the United States. In: Proceedings of a Conference on Artificial Reefs, March 20-22, 1974, Houston, TX. Texas A&M University Sea Grant College Program 74-103. Pp. 24-27.

Stone, R.B., W. Pratt, R.O. Parker, and G. Davis. 1979. A comparison of fish populations on an artificial and natural reef in the Florida Keys. Mar. Fish. Rev. 41(9):1-24.

Terres, J.K. 1991. The Audubon Society encyclopedia of North American birds. New York, NY: Wing Books. 1,109 pp.

Trefrey, J. 1998. Forms of mercury and cadmium in barite and their fate in the marine environment: A review and synthesis. Report Prepared for Exxon Production Research Company. Unpublished.

Tucker & 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. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 90-0009. 211 pp.

U.S. Dept. of Commerce. Bureau of the Census. 2001. Current population survey. Internet website: http://www.census.gov

U.S. Dept. of Commerce. National Marine Fisheries Service. 1990. Recovery plan for U.S. population of Atlantic green turtle (*Chelonia mydas*). U.S. Dept. of Commerce, National Marine Fisheries Service, St. Petersburg, FL.

U.S. Dept. of Commerce. National Marine Fisheries Service. 1998. Recovery plan for the blue whale (*Balaenoptera musculus*). Prepared by Reeves R.R., P.J. Clapham, R.L. Brownell, Jr., and G.K. Silber for the U.S. Dept. of Commerce, National Marine Fisheries Service, Silver Spring, MD. 42 pp.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2001. Information and databases on fisheries landings. Internet site: http://www.st.nmfs.gov/st1/commercial/landings/annual_landings.html.

U.S. Dept. of Commerce, National Marine Fisheries Service and U.S. Dept. of the Interior, Fish and Wildlife Service. 1991a. Recovery plan for U.S. population of Atlantic green turtle. U.S. Dept. of Commerce, National Marine Fisheries Service, Washington, DC. 52 pp.

U.S. Dept. of Commerce, National Marine Fisheries Service and U.S. Dept. of the Interior, Fish and Wildlife Service. 1991b. Recovery plan for U.S. populations of loggerhead turtle. U.S. Dept. of Commerce, National Marine Fisheries Service, Washington, DC. 64 pp.

U.S. Dept. of Commerce, National Marine Fisheries Service and U.S. Dept. of the Interior, Fish and Wildlife Service. 1992. Recovery plan for leatherback turtles in the U.S. Caribbean, Atlantic, and Gulf of Mexico. U.S. Dept. Commerce National Marine Fisheries Service, Washington, DC. 65 pp.

U.S. Dept. of Commerce, National Marine Fisheries Service and U.S. Dept. of the Interior, Fish and Wildlife Service. 1993. Recovery plan for hawksbill turtles in the U.S. Caribbean Sea, Atlantic Ocean, and Gulf of Mexico. U.S. Dept. of Commerce, National Marine Fisheries Service, St. Petersburg, FL. 52 pp.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 1991. Our living oceans. The first annual report on the status of U.S. living marine resources. NOAA Tech. Memo.NMFS-F/SPO-1. 123 pp.

U.S. Dept. of the Interior. Fish and Wildlife Service. 1984. Southeastern states bald eagle recover plan. U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Atlanta, GA.

U.S. Dept. of the Interior. Fish and Wildlife Service. 1985a. Endangered and threatened wildlife and plants; determination of endangered status and critical habitat for three beach mice; final rule. *Federal Register* 50 FR 109, pp. 23872-23889.

U.S. Dept. of the Interior. Fish and Wildlife Service. 1985b. Critical habitat designation Choctawhatchee beach mouse. 50 CFR 1 §17.95.

U.S. Dept. of the Interior. Fish and Wildlife Service. 1987. Recovery plan for the Choctawhatchee, Perdido Key, and Alabama Beach Mouse. U.S. Dept. of the Interior, Fish and Wildlife Service, Atlanta, GA. 45 pp.

U.S. Dept. of the Interior. Fish and Wildlife Service. 1995. Florida manatee recovery plan (second revision). U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Atlanta, GA. 160 pp.

U.S. Dept. of the Interior. Fish and Wildlife Service. 1998. Division of Endangered Species. Species Accounts. Internet site: http://www.fws.gov/r9endspp/i/b/sab2s.html.

U.S. Dept. of the Interior. Fish and Wildlife Service. 2001. Technical Agency Draft, Florida manatee recovery plan (*Trichechus manatus latirostris*), third revision. U.S. Dept. of the Interior, Fish and Wildlife Service, Atlanta, GA. 138 pp.

U.S. Dept. of the Interior Geological Survey. 1988. Report to Congress: Coastal barrier resource system. Recommendations for additions to or deletions from the Coastal Barrier Resource System. Vol. 18, Louisiana.

U.S. Dept. of the Interior. Geological Survey. 1998. Chandeleur Islands, La. — 1992 submerged aquatic vegetation. Geospatial data presentation form: map. Maintained by the U.S. Dept. of the Interior, Geological Survey, National Wetlands Research Center.

U.S. Dept. of the Interior. Minerals Management Service. 1998. Gulf of Mexico OCS oil and gas lease Sales 171, 174, 177, and 180: Western Planning Area, final environmental impact statement. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 98-0008. Available from NTIS, Springfield, VA.

U.S. Dept. of the Interior. Minerals Management Service. 2000. Gulf of Mexico deepwater operations and activities; environmental assessment. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2000-001. 264 pp.

U.S. Dept. of the Interior. Minerals Management Service. 2001a. Proposed use of floating production, storage, and offloading systems on the Gulf of Mexico outer continental shelf; Western and Central

Planning Areas; final environmental impact statement. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2000-090.

U.S. Dept. of the Interior. Minerals Management Service. 2001b. The promise of deep gas in the gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2001-037.

U.S. Dept. of the Interior. Minerals Management Service. 2002. Gulf of Mexico OCS oil and gas lease sales: 2003-2007—Central Planning Area Sales 185, 190, 194, 198, and 201; Western Planning Area Sales 187, 192, 196, and 200 – final environmental impact statement. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2002-052. Available from NTIS, Springfield, VA

U.S. Environmental Protection Agency. 1993a. Development document for effluent limitation guidelines and standards for the offshore subcategory of the oil and gas extraction point source category. EPA 821-R-93-003.

U.S. Environmental Protection Agency. 1993b. Supplemental information for effluent limitation guidelines and new source performance standards for the offshore subcategory of the oil and gas extraction point source category (49 CFR 435); Office of Water, Washington, DC. Also supportive documents produced by the Office of Water Regulations and Standards, Washington, DC. Economic impact analysis of proposed effluent limitation guidelines and standards for the offshore oil and gas industry. Prepared by Eastern Research Group, Inc. EPA 440/2-91-001. Regulation published in the *Federal Register*, Vol. 58, No. 41, pages 12,453-12,512 (March 4, 1993).

U.S. Environmental Protection Agency. 1999a. Effluent limitations guidelines and new source performance standards for synthetic-based and other non-aqueous drilling fluids in the oil and gas extraction point source category; proposed rule. February 3, 1999. 64(22):5,488-5,554.

U.S. Environmental Protection Agency. 1999b. The ecological conditions of estuaries in the Gulf of Mexico, Gulf Breeze, Florida. 71 pp.

U.S. Environmental Protection Agency. 2001. Aerometric information retrieval system (AIRS). Internet website: http://www.epa.gov/airs

U.S. Environmental Protection Agency. 2002. Green book, non-attainment areas for criteria pollutants. Internet website: http://www.epa.gov/oar/oaqps/greenbk/.

Waring, G.T., D.L. Palka, K.D. Mullin, J.H.W. Hain, L.J. Hansen, and K.D. Bisack. 1997. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments — 1996. NOAA Tech. Memo. NMFS-NE-114.

Waring, G.T., D.L. Palka, P.J. Clapham, S. Swartz, M.C. Rossman, T.V.N. Cole, L.J. Hansen, K.D. Bisack, K.D. Mullin, R.S. Wells, D.K. Odell, and N.B. Barros. 1999. U.S. Atlantic marine mammal stock assessments — 1999. U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-NE-153.

Watkins, W.A. and W.E. Schevill. 1976. Right whale feeding and baleen rattle. J. Mammal. 57:58-66.

Webb, J.W. 1988. Establishment of vegetation on oil-contaminated dunes. Shore and Beach, October. Pp. 20-23.

Webb, J.W., G.T. Tanner, and B.H. Koerth. 1981. Oil spill effects on smooth cordgrass in Galveston Bay, Texas. Contributions in Marine Science 24:107-114.

Webb, J.W., S.K. Alexander, and J.K. Winters. 1985. Effects of autumn application of oil on *Spartina alterniflora* in a Texas salt marsh. Environ. Poll., Series A. 38(4):321-337.

Weber, M., R.T. Townsend, and R. Bierce. 1992. Environmental quality in the Gulf of Mexico: A citizen's guide. Center for Marine Conservation. 2nd edition, June 1992. 130 pp.

Weeks Bay Reserve Foundation. 1999. Weeks Bay Reserve Foundation: Introductory brochure. Fairhope, AL. 2 pp.

Weller, D.W., A.J. Schiro, V.G. Cockcroft, and W. Ding. 1996. First account of a humpback whale (*Megaptera novaeangliae*) in Texas waters, with a re-evaluation of historic records from the Gulf of Mexico. Mar. Mamm. Sci. 12:133-137.

Wells, R.S. and M.D. Scott. 1999. Bottlenose dolphin — *Tursiops truncatus* (Montagu, 1821). In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 6: Second book of dolphins. San Diego, CA: Academic Press. Pp. 137-182.

Wells, R., C. Mainire, H. Rhinehart, D. Smith, A. Westgate, F. Townsend, T. Rowles, A. Hohn, and L. Hansen. 1999. Ranging patterns of rehabilitated rough-toothed dolphins, *Steno bredanensis*, released in the northeastern Gulf of Mexico. Abstracts, 13th Biennial Conference on the Biology of Marine Mammals, Wailea, Maui, 28 November - 3 December.

Wetherell, V. 1992. St. Joseph Bay Aquatic Preserve Management Plan: Adopted January 22, 1992. Florida Dept. of Natural Resources and Bureau of Submerged Lands and Preserves Division of State Lands.

White, W.A., T.R.Calnan, R.A. Morton, R.S. Kimble, T.G. Littleton, J.H. McGowen, H.S. Nance, and K.E. Schmedes. 1986. Submerged lands of Texas, Brownsville-Harlingen area. University of Texas at Austin, Bureau of Economic Geology, Austin, TX.

Williams, J.H. and I.W. Duedall. 1997. Florida hurricanes and tropical storms. Revised edition. The university of Florida Press. 146 pp.

Williams, S.J., S. Penland, and A.H. Sallenger, Jr., eds. 1992. Louisiana barrier island study: Atlas of shoreline changes in Louisiana from 1853 to 1989. U.S. Dept. of the Interior, Geological Survey, Miscellaneous Investigations Series I-2150-A.

Winn, H.E. and N.E. Reichley. 1985. Humpback whale — *Megaptera novaeangliae*. In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 3: The sirenians and baleen whales. London: Academic Press, Inc. Pp. 241-274.

Wooley, C.M. and E.J. Crateau. 1985. Movement, microhabitat, exploitation, and management of Gulf of Mexico sturgeon, Apalachicola River, Florida. North American Journal of Fishery Management. Pp. 590-605.

Wolfe, S.H., J.A. Reidenauer, and D.B. Means. 1988. An ecological characterization of the Florida Panhandle. U.S. Dept. of the Interior, Fish and Wildlife Service Biological Report 88(12) and U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA, OCS Study MMS 88-0063. 278 pp.

Würsig, B., T.A. Jefferson, and D.J. Schmidly. 2000. The marine mammals of the Gulf of Mexico. College Station, TX: Texas A&M University Press. 232 pp.

Yochem, P.K. and S. Leatherwood. 1985. Blue whale — *Balaenoptera musculus*. In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 3: The sirenians and baleen whales. London: Academic Press, Inc. Pp. 193-240.

Zieman, J.C., R. Orth, R.C. Phillips, G. Thayer, and A. Thornhaug. 1984. The efffects of oil on seagrass ecosystems. In: Cairns, J. and A. Buikema, eds. Recovery and restoration of marine ecosystems. Stoneham, MA: Butterworth Publications. Pp. 37-64.

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8. APPENDICES

Appendix A. Accidental Hydrocarbon Discharge Analysis
Appendix B. Air Quality/Meteorological Conditions
Appendix C. Geology
Appendix D. Physical Oceanography
Appendix E. Socioeconomic Conditions
Appendix F. Other Information on Grid 7

APPENDIX A

Accidental Hydrocarbon Discharge Analysis

ANALYSIS OF THE POTENTIAL FOR AN ACCIDENTAL OIL SPILL AND POTENTIAL FOR IMPACTS FROM THE MAGNOLIA PROJECT

GARDEN BANKS 783 UNIT
GARDEN BANKS BLOCKS 783 AND 784

Introduction

The National Environmental Policy Act (NEPA) requires Federal agencies to consider potential environmental impacts (direct, indirect, and cumulative) of proposed actions as part of agency planning and decisionmaking. The NEPA analyses address many issues relating to potential impacts, including issues that may have a very low-probability of occurrence, but which the public considers important or for which the environmental consequences could be significant.

The past several decades of spill data show that large accidental oil spills associated with oil and gas exploration and development are low probability events in Federal Outer Continental Shelf (OCS) waters of the Gulf of Mexico (GOM). This appendix summarizes key information about the probability of accidental spills from offshore oil and gas activities in the GOM.

Spill Prevention

The MMS has comprehensive, pollution-prevention requirements that include numerous redundant levels of safety devices, as well as inspection and testing requirements to confirm that these devices work. Many of these requirements have been in place since about 1980. Spill trends analysis for the GOM OCS show that spills from facilities have decreased over time, indicating that MMS engineering and safety requirements have minimized the potential for spill occurrence and associated impacts. Details regarding MMS engineering and safety requirements can be found at 30 CFR 250.800 Subpart H.

OCS Spills in the Past

This summary of past OCS spills presents data for the period 1985-1999. The 1985-1999 time period was chosen to reflect more modern engineering and regulatory requirements and because OCS spill rates are available for this period. For the period 1985-1999, there were no spills ≥1,000 barrels (bbl) from OCS platforms, eight spills ≥1,000 bbl from OCS pipelines, and no spills ≥ 1,000 bbl from OCS drilling activities (Tables A-1 through A-3). It should be noted that past OCS spills (Tables A-1 through A-3), some of which are considerably greater than 1,000 bbl, have not resulted in any documented significant impacts to shorelines or other resources. The most recent Final EIS's for the Central and Western Planning Areas (USDOI, MMS, 2002) in the Western Planning Area and Lease Sale 181 in the Eastern Planning Area (USDOI, MMS, 2001) provide additional information on past OCS spills.

Estimating Future Potential Spills

The MMS estimates the risk of future potential spills by multiplying variables to result in a numerical expression of risk. These variables include the potential of a spill occurring based on historical OCS spill rates and a variable for the potential for a spill to be transported to environmental resources based on trajectory modeling. The following subsections describe the spill occurrence and transport variables used to estimate risk and the risk calculation for the proposed action.

Spill Occurrence Variable (SOV) Representing the Potential for a Spill

The SOV is based on past OCS spill frequency. That is, data from past OCS spills are used to estimate future potential OCS spills. The MMS has estimated spill rates for spills from the following sources: facilities, pipelines, and blowouts.

Spill rates for facilities and pipelines have been developed for several time periods and an analysis of trends for spills is presented in *Update of Comparative Occurrence Rates for Offshore Oil Spills* (Spill

Science & Technology Bulletin, 2000). Spill rates for the most recent period analyzed, 1985-1999, are presented here. Data for this recent period should reflect more modern spill prevention requirements.

Spill rates for facilities and pipelines are based on the number of spills per volume of oil handled. Spill rates for drilling activity are based on the number of spills associated with activities occurring during drilling. These include spills from blowouts, drilling rigs, supply vessels, fuel storage, and other drilling activities. Spill rates for the period 1985-1999 are shown in Table A-4. It should be noted that there were no platform or drilling spills ≥1,000 bbl for the period 1985-1999. Use of "zero" spills would result in a zero spill rate. To provide a nonzero spill rate for conservative future predictions of spill occurrence, the spill period was expanded to include older spill data. The spill data period is expanded to 1980 to include a spill for facilities. The spill data period is expanded to 1971 to include a spill for drilling activities. Spill rates are combined with site-specific data on production or pipeline volumes or number of wells being drilled to result in a site-specific SOV.

Transport Variable (TV) Representing the Potential for a Spill to be Transported to Important Environmental Resources

The TV is derived using an oil-spill trajectory model. This model predicts the direction that winds and currents would transport spills. The model uses an extensive database of observed and theoretically computed ocean currents and fields that represent a statistical estimate of winds and currents that would occur over the life of an oil and gas project, which may span several decades. This model produces the TV that can be combined with other variables, such as the SOV, to estimate the risk of future potential spills and impacts.

Risk Calculation for the Proposed Action

Conoco will develop and produce the Garden Banks Blocks 783 and 784 by completing three previously drilled and abandoned wells and by drilling and completing six additional wells, for a total of nine wells, all from a common surface location in Garden Banks Block 783. At this location (4,674-ft water depth), Conoco will set a tension leg platform and commence production. Oil and gas production will be transported through two right-of-way pipelines to be installed, owned, and operated by subsidiaries of Shell Oil. It is anticipated that the pipelines will terminate at Garden Banks Block 128 where they will enter into existing pipeline infrastructure to shore.

The coastline and associated environmental resources are presented in Table A-5. The final column in Table A-5 presents the result of combining the SOV's and the TV's. The risk of a spill impact from the facility could be considered to be so low as to be near zero.

Given the low risk of resources being exposed to spills as a result of the proposed action, spill-prevention requirements, and spill-response requirements, significant impacts to environmental resources are unlikely. The most recent Final EIS's for Central and Western Lease Sales (USDOI, MMS, 2002), and 180 in the Western Planning Area and Lease Sale 181 in the Eastern Planning Area (USDOI, MMS, 2001), provide additional information on spills and potential impacts. The following section provides additional information regarding the spill-response preparedness requirements of MMS.

Spill Response

The MMS has extensive requirements both for the prevention of spills and preparedness to respond to a spill in the event of an accidental spill. The MMS'S spill-prevention requirements and the low incidence of past OCS spills were addressed earlier in this document. This section presents information on MMS requirements for spill-response preparedness.

MMS Spill Response Program

The MMS Oil Spill Program oversees the review of oil-spill response plans, coordinates inspection of oil-spill response equipment, and conducts unannounced oil-spill drills. This program also supports continuing research to foster improvements in spill prevention and response. Studies funded by MMS address issues such as spill prevention and response, *in-situ* burning, and dispersant use.

In addition, MMS works with the U.S. Coast Guard and other members of the multiagency National Response System to further improve spill-response capability in the GOM. The combined resources of these groups and the resources of commercially contracted oil-spill response organizations result in extensive equipment and trained personnel for spill response in the GOM.

Spill Response for this Project

The subject operator has an oil-spill response plan on file with MMS and has current contracts with offshore oil-spill response organizations.

Potential spill sources for this project include a production spill during the life of the development (14 years), an accidental blowout (27,525 bbl/day), a spill of liquid oil stored on the platform (approximately 2,033 bbl total storage capacity), a spill of liquid oil stored on one of the rigs (approximately 28,617 bbl largest total storage capacity), a spill from the offloading of well test fluids (maximum volume of barge is 24,000 bbl), a spill from the associated oil flowlines (200 bbl), or the export pipelines. The operator has demonstrated spill-response preparedness for accidental releases from these types of potential spills in their oil-spill response plan.

The MMS will continue to verify the operator's capability to respond to oil spills via the MMS Oil Spill Program. The operator is required to keep their oil-spill response plan up to date in accordance with MMS regulations. The operator must also conduct an annual drill to demonstrate the adequacy of their spill preparedness. The MMS also conducts unannounced drills to further verify the adequacy of an operator's spill-response preparedness; such a drill could be conducted for this proposed action.

Table A-1

Historical Record of OCS Spills ≥1,000 Barrels from OCS Facilities, 1985–1999

Spill Date	Area and Block (water depth and distance from shore)	Volume Spilled (barrels)	Cause of Spill

No OCS facility spills ≥1,000 bbl during the period 1985-1999.

Table A-2

Historical Record of OCS Spills ≥1,000 Barrels from OCS Pipelines, 1985–1999

Spill Date	Area and Block(water depth and distance from shore)	Volume Spilled (barrels)	Cause of Spill
February 7, 1988	South Pass 60 (75 ft, 3.4 mi)	15,576	Service vessel's anchor damaged pipeline
January 24, 1990	Ship Shoal 281 (197 ft, 60 mi)	14,423*	Anchor drag, flange and valve broke off
May 6, 1990	Eugene Island 314 (230 ft, 78 mi)	4,569	Trawl drag pulled off valve
August 31, 1992	South Pelto 8 (30 ft, 6 mi)	2,000	Hurricane Andrew, loose drilling rig's anchor drag damaged pipeline
November 22, 1994	Ship Shoal 281 (197 ft, 60 mi)	4,533*	Trawl drag
January 26, 1998	East Cameron 334 (264 ft, 105 mi)	1,211*	Service vessel's anchor drag damaged pipeline during rescue operation
September 29, 1988	South Pass 38 (110 ft, 6 mi)	8,212	Hurricane Georges, mudslide parted pipeline
July 23, 1999	Ship Shoal 241 (133 ft, 50 mi)	3,200	Jack-up barge sat on pipeline

*condensate

Table A-3

Historical Record of OCS Spills ≥1,000 Barrels from OCS Blowouts, 1985–1999

Spill Date	Area and Block (water depth and distance from shore)	Volume Spilled Barrels	Cause of Spill

No OCS blowout spills ≥ 1,000 bbl during the period 1985-1999.

Table A-4

Spill Rates Used to Estimate the Future Potential for Spills

Spill Source	Volume of Oil Handled in Billions of Barrels	Number of Wells Drilled	No. of Spills ≥1,000 Barrels	Risk of Spill from Facilities or Pipelines per Billion Barrels	Risk of Spill from Drilling Blowout per Well
Facilities	7.41 [a]	Not Applicable	1[a]	>0 to <0.13[c]	Not Applicable
Pipelines	5.81	Not Applicable	8	1.38	Not Applicable
Drilling	Not Applicable	14,067	1[b]	Not Applicable	>0 to <0.00007[c]

[a] There were actually zero spills ≥1,000 bbl from facilities during the period 1985-1999. The data shown represent 1980-1999. The spill period for facility spills was expanded to 1980 to include a spill for facilities to result in a nonzero risk.

[b] There have been no spills ≥1,000 bbl from drilling activities during the period 1985-1999. Drilling activities include spills from blowouts, drillrigs, supply vessels, fuel storage, and other drilling activities. The data shown represent 1971-1999. One spill ≥1,000 bbl occurred in this period — a 1,500-bbl diesel spill from a drillrig damaged in a storm.

[c] There were no facility or drilling spills ≥1,000 bbl for the period 1985-1999; however, a nonzero spill rate was calculated by expanding the facility and drilling period to 1980 and 1971. Therefore, the spill rates for these categories are presented as greater than zero but below the rates calculated by expanding the data period.

Table A-5

Spill Risk Estimate for Facilities

Environmental Resource	Spill Occurrence Variable [1] (%)	Transport Variable [2] within 30 Days (%)	Spill Risk [3] within 30 Days (%)
Counties/Parishes			
Cameron, Tex.	1	1	<0.5
Willacy, Tex.	1	<0.5	<0.5
Kenedy, Tex.	1	2	<0.5
Kleburg, Tex.	1	2	<0.5
Nueces, Tex.	1	1	<0.5
Aransas, Tex.	1	2	<0.5
Calhoun, Tex.	1	3	<0.5
Matagorda, Tex.	1	6	<0.5
Brazoria, Tex.	1	2	<0.5
Galveston, Tex.	1	4	<0.5
Chambers, Tex.	1	<0.5	<0.5
Jefferson, Tex.	1	3	<0.5
Cameron, La.	1	5	<0.5
Vermilion, La.	1	2	<0.5
Iberia, La.	1	1	<0.5
St. Mary, La.	1	<0.5	<0.5
Terrebonne, La.	1	1	<0.5
Lafourche, La.	1	<0.5	<0.5
Jefferson, La.	1	<0.5	<0.5
Plaquemines, La.	1	<0.5	<0.5
St. Bernard, La.	1	<0.5	<0.5
Harrison, Ms.	1	<0.5	<0.5
Jackson, Ms.	1	<0.5	<0.5
Baldwin, Ala.	1	<0.5	<0.5
Mobile, Ala.	1	1	<0.5
Escambia, Fla.	1	<0.5	<0.5
Santa Rosa, Fla.	1	<0.5	<0.5
Okaloosa, Fla.	1	<0.5	<0.5
Walton, Fla.	1	<0.5	<0.5
Bay, Fla.	1	<0.5	<0.5
Gulf, Fla.	1	<0.5	<0.5
Franklin, Fla.	1	<0.5	<0.5
Wakulla, Fla.	1	<0.5	<0.5
Jefferson, Fla.	1	<0.5	<0.5
Taylor, Fla.	1	<0.5	<0.5
Dixie, Fla.	1	<0.5	<0.5
Levy, Fla.	1	<0.5	<0.5
Citrus, Fla.	1	<0.5	<0.5
Hernando, Fla.	1	<0.5	<0.5
Pasco, Fla.	1	<0.5	<0.5
Pinellas, Fla.	1	<0.5	<0.5
Hillsborough, Fla.	1	<0.5	<0.5
Manatee, Fla.	1	<0.5	<0.5
Sarasota, Fla.	1	<0.5	<0.5
Charlotte, Fla.	1	<0.5	<0.5

Table A-5.Spill Risk Estimate for Facilities (contintued).

Environmental Resource	Spill Occurrence Variable (1) (%)	Transport Variable (2) within 30 Days (%)	Spill Risk (3) within 30 Days (%)
Lee, Fla.	1	<0.5	<0.5
Collier, Fla.	1	<0.5	<0.5
Monroe, Fla.	1	<0.5	<0.5
State Offshore Waters			
Texas State Offshore Waters	1	30	<0.5
Louisiana (Western) State Offshore Waters	1	10	<0.5
Louisiana (Eastern) State Offshore Waters	1	<0.5	<0.5
Mississippi State Offshore Waters	1	<0.5	<0.5
Alabama State Offshore Waters	1	<0.5	<0.5
Florida Panhandle State Offshore Waters	1	<0.5	<0.5
Florida Peninsula State Offshore Waters	1	<0.5	<0.5
Major Recreational Beach Areas			
TX Coastal Bend Area Beaches	1	5	<0.5
TX Matagorda Area Beaches	1	7	<0.5
TX Galveston Area Beaches	1	7	<0.5
TX Sea Rim State Park	1	2	<0.5
LA Beaches	1	5	<0.5
AL/MS Gulf Islands	1	<0.5	<0.5
AL Gulf Shores	1	<0.5	<0.5
FL Panhandle Beaches	1	<0.5	<0.5
FL Big Bend Beaches	1	<0.5	<0.5
FL Southwest Beaches	1	<0.5	<0.5
FL Ten Thousand Islands	1	<0.5	<0.5

(1) The percent chance of a spill event occurring from the proposed action.

(2) The percent chance that winds and currents will move a point projected onto the surface of the Gulf beginning within the area of GB 783 or 784 and ending at specified shoreline segments or environmental resources within 30 days. These results are the results of a numerical model that calculates the trajectory of a drifting point projected onto the surface of the water using temporally and spatially varying winds and ocean current fields. These probabilities do not factor in the risk of spill occurrence, consideration of the spill size, any spill response or cleanup actions, or any dispersion and weathering of the slick with time. Model results used are for W4-3 cluster area.

(3) The probability of a spill occurring and contacting identified environmental features represents the weighted risk that accounts for both the risk that a large spill will occur and the risk that it will contact locations where the resources occur, given the assumptions already described in (1) and (2).

(4) <0.5 = less than 0.5%.

REFERENCES

Spill Science & Technology Bulletin. 2000. Update of comparative occurrence rates for offshore oil spills. 6(5/6):303-321.

U.S. Dept. of the Interior. Minerals Management Service. 2001. Gulf of Mexico OCS oil and gas lease sale 181: Eastern Planning Area Sale 181—final environmental impact statement. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2001-056.

U.S. Dept. of the Interior. Minerals Management Service. 2002. Gulf of Mexico OCS oil and gas lease Sales: 2003-2007. Central Planning Area Sales 185, 190, 194, 198, and 201, and Western Planning Area Sales 187, 192, 196, and 200—final environmental impact statement. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. 2 vols. OCS EIS/EA MMS 2002-052.

APPENDIX B

Air Quality/Meteorological Conditions

MAGNOLIA DEVELOPMENT PROJECT
GARDEN BANKS 783 AND 784

MMS CONTROL NUMBER N-7506
OCS-G 11573 AND 11574

DESCRIPTION OF THE ENVIRONMENT

Air Quality

These operations will occur west of 87.5 degrees west longitude and hence falls under MMS's jurisdiction for enforcement of the Clean Air Act. The air over the OCS water is not classified, but is presumed to be better than the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants. The block involved, Garden Banks 783, is offshore, south of Vermilion parish, Louisiana. Vermilion Parish is in attainment of all of the NAAQS.

The primary meteorological influences upon air quality and the dispersion of emissions are the wind speed and direction, the atmospheric stability, and the mixing height.

The general wind flow for this area is driven by the clockwise circulation around the Bermuda High, resulting in a prevailing southeasterly to southerly flow. Superimposed upon this circulation are smaller scale effects such as the sea breeze effect, tropical cyclones and mid-latitude frontal systems. Because of the various factors the winds do blow from all directions in the area of concern.

Not all of the Pasquill-Gifford stability classes are routinely found offshore in the Gulf of Mexico. Specifically, the F stability class is rare. This is the extremely stable condition which usually develops at night over land with rapid radiative cooling; this large body of water is simply incapable of loosing enough heat overnight to set up a strong radiative inversion. Likewise, the A stability class is also rare. It is the extremely unstable condition, which requires a very rapid warming of the lower layer of the atmosphere, along with cold air aloft. This is normally brought about when cold air is advected in aloft and strong insolation rapidly warms the earth's surface, which in turn warms the lowest layer of the atmosphere. Once again, the ocean surface is incapable of warming rapidly and therefore you would not expect to find stability class A over the Gulf of Mexico. For the most part the stability is slightly unstable to neutral.

The mixing heights offshore are quite shallow, generally 900 m or less. The exception to this is close to shore, where the influence of the land penetrates out over the water for a short distance. Transient cold fronts also have an impact on the mixing heights; some of the lowest heights can be expected to occur with frontal passages and on the cold air side of the fronts. This effect is caused by the frontal inversion.

Effects on Air Quality

The projected air emissions, submitted by Conoco, for this project are below the MMS exemption levels. Conoco has estimated the emissions associated with this project. These emission projections are required to represent the worst case. They are summarized below:

Emissions (tons)

	TSP	SOx	NOx	VOC	CO
2002	6.27	2,877.00	215.60	6.47	47.04
2003	37.46	171.90	1,294.26	41.53	299.63
2004	68.46	309.28	2,452.98	133.80	591.90
2005	14.91	54.09	81,075.00	204.46	346.59
2006-2011	6.85	17.13	53,378.00	196.15	286.15
MMS exemption level	4,995.00	4,995.00	4,995.00	4,995.00	95,985.67

Unavoidable Impacts

Air quality will be impacted in the immediate vicinity of the facilities and the vessels. The operations are expected to last 10 years. The impacts are not expected to significantly affect onshore air quality. NO_x impacts will be highest during the years when drilling and construction are taking place. SO_x emissions will be highest during the days when flaring is occurring.

Air quality will be affected if a blowout occurs. Highly volatile, low molecular weight hydrocarbons would be released to the atmosphere from the formation. The VOC's in the released hydrocarbons are precursors to photochemically produced ozone. A spike in VOC's could contribute to a corresponding spike in ozone, especially if the release were to occur on a hot sunny day in a NO_2 rich environment. The nearby onshore areas are all currently in attainment for ozone. Methane, the primary component of the gas stream, is a greenhouse gas.

Mitigation

Mitigation 2.02 (Advisory) — Potential to exceed exemption level, DOCD

A deviation from your DOCD (such as additional drilling time, changes in the drilling schedule, and/or the use of higher horsepower equipment, especially for the drilling rig and construction barges) could potentially cause the annual emissions exemption level for NOx to be exceeded. Therefore, if such a deviation occurs, please be advised that you will immediately prepare a revised DOCD pursuant to 30 CFR 250.204(q)(2) to include the recalculated emission amounts and the air quality modeling required by 30 CFR 250.303(e). You will not proceed with the actions that could cause the potential exceedance until the revised DOCD has been submitted to and approved by this office.

Mitigation 2.06 (Reminder) — Flaring beyond 48 hours

Your plan indicates well test flaring for more than 48 continuous hours. Please be reminded that 30 CFR 250.1105(a)(3) requires you to obtain approval from the Regional Supervisor for Production and Development prior to conducting the proposed flaring activities.

APPENDIX C

Geology

GEOLOGY

GENERAL DESCRIPTION

The present day Gulf of Mexico is a small ocean basin of more than 1.5 million km^2 with its greatest water depth reaching approximately 3,700 m. It is almost completely surrounded by land, opening to the Atlantic Ocean through the Straits of Florida and to the Caribbean Sea through the Yucatan Channel. Underlying the present Gulf of Mexico and the adjacent coast is the larger geologic basin that began forming in Triassic time. Over the last 20 million years, clastic sediments (sands and silts) have poured into the Gulf of Mexico Basin from the north and west. The centers of sediment deposition shifted progressively eastward and southward in response to changes in the source of sediment supply. Sediments more than 15 km in thickness have been deposited. Each sediment layer is different, reflecting the source of the material and the geologic processes occurring during deposition. In places where the Gulf was shallow and intermittently dry, evaporitic deposits such as salt were formed. Where there was gradual subsidence and shallow seas persisted overtime, marine plants and animals created reefs. Where marine life was abundant, the deposition of limestone was dominant.

The physiographic provinces in the Gulf of Mexico—shelf, slope, rise, and abyssal plain—reflect the underlying geology. In the Gulf, the continental shelf extends seaward from the shoreline to about the 200-m water depth and is characterized by a gentle slope of less than one degree. The shelf is wide off Texas, but it is narrower or absent where the Mississippi River delta has extended across the entire shelf. The continental slope extends from the shelf edge to the continental rise, usually at about the 2,000-m water depth. The topography of the slope in the Gulf is uneven and is broken by canyons, troughs, and escarpments. The gradient on the slope is characteristically 3-6 degrees, but may exceed 20 degrees in some places, particularly along escarpments. The continental rise is the apron of sediment accumulated at the base of the slope. It is a gentle incline, with slopes of less than one degree, to the abyssal plain. The abyssal plain is the flat region of the basin floor at the base of the continental rise.

The Western Gulf, which includes both the Western and Central Planning Areas, is a clastic province. Many wells have been drilled in the Western Gulf, and the geology has been studied in detail for the identification and development of natural gas and oil resources.

Sedimentary features, such as deltas, fans, canyons, and sediment flow forms, are formed by the erosion of land and deposition of sediments. Structural features, such as faults, folds, and ridges, are produced by displacement and deformation of rocks. The regional dip of sediments in the Gulf of Mexico is interrupted by salt diapirs, shale diapirs, and growth faults. Deformation has been primarily in response to heavy sediment loading.

The most significant factor controlling the hydrocarbon potential in the northern Gulf of Mexico is the environment of deposition. Sediments deposited on the outer shelf and upper slope have the greatest potential for hydrocarbon accumulation because it is the optimum zone for encountering the three factors necessary for the successful formation and accumulation of oil and gas: source material, reservoir space, and geologic traps. The massive shale beds with high organic content are excellent source beds. The thick sands and sandstones with good porosity (pore space between the sand grains where oil and gas can exist) and permeability (connections between the pore spaces through which oil and gas can flow) provide reservoir space. Impermeable shales, salt dome caprocks, and faults serve as seals, trapping oil and gas in the pore spaces of the reservoir rocks.

The geologic horizons with the greatest potential for hydrocarbon accumulation on the continental shelf of the northern Gulf are Miocene, Pliocene, and Pleistocene in age. Producing horizons become progressively younger in a seaward direction. Recent developments in high-energy, 3D seismic technology has allowed industry to "see" below the regional salt layers and identify potential "subsalt plays" or hydrocarbon traps. Exploration and development in the Gulf of Mexico have resulted in the identification of more than 1,000 fields.

The presence of hydrogen sulfide (H_2S) within formation fluids occurs sporadically throughout the Gulf of Mexico OCS. H_2S-rich oil and gas is called "sour." Approximately 65 operations have encountered H_2S-bearing zones on the Gulf of Mexico OCS to date. Occurrences of H_2S offshore Texas are in Miocene Age rocks and occur principally within a geographically narrow band. There is some debate as to the origin of H_2S in these wells offshore Texas as they were reported mostly from deep, high-temperature drilling wells using a ligno-sulfonate mud component, which is widely believed to break down under high wellbore temperature to generate H_2S. The occurrences of H_2S offshore Louisiana are mostly on or near piercement domes with caprock and are associated with salt and gypsum deposits. The

H_2S from a caprock environment is generally thought to be a reaction product of sulfates and hydrocarbons in the presence of sulfate-reducing microbes. In some areas offshore Louisiana, H_2S-rich hydrocarbons are produced from lower Cretaceous Age limestone deposits not associated with piercement domes. Generally speaking, formations of Lower Cretaceous Age or older (which are deeply buried in the Gulf) are prone to contain H_2S in association with hydrocarbons (cf. Bryan and Lingamallu, 1990). There has also been some evidence that petroleum from deepwater plays contain significant amounts of sulfur (cf. Smith, written communication, 1996; Thorpe, 1996).

The concentrations of H_2S found in conjunction with hydrocarbons vary extensively. Examination of in-house data suggest that H_2S concentrations vary from as low as fractional ppm to as high as 650,000 ppm in one isolated case (the next highest concentrations of H_2S reported are about 55,000 and 19,000 ppm). The concentrations of H_2S found to date are generally greatest in the eastern portion of the CPA.

GEOLOGIC HAZARDS

The major geologic hazards that may affect oil and gas activities within the Gulf of Mexico north of 26°N. latitude can be generally grouped into the following categories: (a) slope instability and mass transport of sediments; (b) gas hydrates; (c) sediment types and characteristics; and (d) tectonics.

Geologic conditions that promote seafloor instability are variable sediment types, steep slopes, high-sedimentation rates, gas hydrates at or near the seafloor, interstitial gas, faulting, areas of lithified and mounded carbonates, salt and shale mobilization, and mudflows. Some features that may indicate a possible unstable condition include step faulting, deformed bedding, detached blocks, detached masses, displaced lithologies, acoustically transparent layers, anomalously thick accumulations of sediment, and shallow faulting and fissures. These features can be identified on seismic survey profiles or through coring samples.

Mass movement of sediments includes landslides, slumps, and creeps. Sediment types, accumulation rates, sediment accumulation over features with seafloor relief, and internal composition and structure of the sedimentary layers are all factors that affect seafloor stability. Rapidly accumulated sediments that have not had the opportunity to dewater properly are underconsolidated. These underconsolidated sediments can be interbedded with normal or overconsolidated sediments and may act as slide zones causing mass movement or collapse. A slope of less than one degree can be sufficient to cause sliding or slumping when high sedimentation rates have resulted in underconsolidation or high pore-pressure conditions in the sediments.

In the deepwater areas of the Gulf, slope stability and soil properties are of great concern in the design of oil and gas operations. Slopes steep enough to create conditions conducive to mass transport are found regionally on the continental slope. Steeper slopes are found locally along the walls of canyons and channels, adjacent to salt structures, and at fault scarps.

Gas hydrates occur in the upper sediments and are of biogenic in origin rather than petrogenic. Methane is the major and often the only component. Gas hydrates are more prevalent in deeper waters than on the shelf because of the lower temperature and high pressures at greater depths. The effect of gas pressure, distribution of gas in pores, solution-dissolution potential, and upward dispersal characteristics are factors considered in the engineering design of production facilities.

Overpressured salt, shale, and mud have a tendency to become plasticized and mobile. Movements of overpressured salts and shales could form mounds and diapirs. Large diapirs formed by the upward movement of shale or salt originates from a greater depth and do not form an environmental geologic hazard by itself. These features have associated faulting and sometimes collapse structures. Their upward movement causes slope steepening and consequently slumping. Movement of overpressured mud could form mud volcanoes. Soft mud diapirs resulting from delta front muds are excellent indicators of an unstable sediment at shallow depths.

Evidence of geologic hazards includes hydrocarbon seeps, deformed bedding, detached blocks or masses, anomalously thick accumulations of sediments, shallow faulting and fissures, diapirs, sediment dikes or mud lumps, displaced lithologies, internal chaotic masses, hummocky topography, en echelon faulting, and horst and graben blocks. Evidence of geologic hazards can be obtained or seen by using core sampling techniques, high-resolution seismic surveying, and side-scan sonar. Geologic hazards pose engineering, structural design, and operational constraints that can usually be effectively mitigated through existing or new technologies and designs.

References

Bryan, F. and S.N. Lingamallu. 1990. Hydrogen sulfide occurrence in Gulf of Mexico outer continental shelf operation. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. 8 pp.

Smith, M. 1996. Written communication. Notes on GRI Offshore Gas Processing Workshop, February 13, 1996, New Orleans, LA.

Thorpe, H. 1996. Oil and water. Texas Monthly 24(2):88-93 and 140-145.

APPENDIX D

Physical Oceanography

PHYSICAL OCEANOGRAPHY

The Gulf of Mexico is a semi-enclosed, subtropical sea with a surface area about 1.6 million km^2 (USDOI, MMS, 2000). The main physiographic regions of the Gulf Basin are the continental shelf (including the Campeche, Mexican, and U.S. shelves), continental slopes and associated canyons, abyssal plains, the Yucatan Channel, and Florida Straits.

The Gulf of Mexico is unique oceanographically with a basin depth of 3,000 m and two shallow entrances of Yucatan Strait (1,600-m depth) and the Straits of Florida (1,000-m) (USDOI, MMS, 2000). These 'shallow' sills prevent the input of cold (2°C) Atlantic bottom water and thus bottom water in the Gulf basin remains relatively warm (about 4°C). The offshore oceanography is dominated by the Loop Current, the main origin of the Gulf Stream, and the inshore oceanography is heavily influenced by major freshwater input from precipitation and numerous river systems, including some extremely large ones such as the Mississippi and Atchafalaya rivers.

There are at least five major identifiable water masses in the Central and Western Gulf of Mexico (USDOI, MMS, 2001):

- Gulf of Mexico water—(0-250 m; 0-820 ft),
- Tropical Atlantic Central Water—(250-400 m; 820-1,312 ft),
- Antarctic Intermediate Water (phosphate maximum)—(500-700 m; 1,641-2,297 ft),
- Antarctic Intermediate Water (salinity maximum)—(600-860 m; 1,969-2,822 ft), and
- Mixed Upper North Atlantic Deep and Caribbean mid water—(1,000-1,100 m; 3,281-3,609 ft).

These watermasses can be identified by their different temperatures and chemical signatures based on salinity, dissolved oxygen, nitrate, phosphate, and silicate concentrations. Below about 1,650 m, temperature, salinity, and oxygen remain fairly constant to the bottom at about 4ºC, 35-36 ppt, 5.0 ml/l, respectively (Gulf Basin Water) (Gallaway et al., 2000).

In addition to the above watermasses, there is an upper mixed isothermal layer that varies in thickness but averages about 75 m in thickness (Pequegnat, 1983). Sea surface (i.e., 0-m depth) temperatures within the relevant area are fairly constant throughout the Gulf in August, about 30°C. In January, surface waters cool considerably in northern coastal areas (14-15°C) and slightly in the center of the Loop Current to 25°C. At 1,000 m depths, the water temperatures are more or less constant at a cool 4.9°C (USDOI, MMS, 2000).

Oceanographic fronts are important features of marine systems because they tend to be productive areas and also concentrate drifting material such as plankton, which attracts fish, birds, turtles, and mammals for feeding purposes. Unfortunately, fronts also may collect debris such as floating plastics or contaminants such as oil slicks or tar balls.

Fronts form along sharp discontinuities in temperature and or salinity; they can be horizontal or vertical and surface or subsurface. In the Gulf semi-permanent fronts form along the interface between the low salinity coastal or riverine water and offshore water and along edges of major currents (e.g., the Loop Current) and eddies.

The Loop Current, a dominant feature of the Gulf, enters through the Yucatan Strait and exits through the Straits of Florida where it becomes the Gulf Stream. The Loop Current flows clockwise around the fairly static water in the center of the Gulf. Its influence can be seen in hydrographic data to depths as deep as 800-1,000 m. It is a highly variable current in geographic extent, width (25- to 50-km), and velocity (normally 100-200 cm/sec but up to 300 cm/sec) (USDOI, MMS, 2000).

On average about once a year and on no regular pattern, the Loop Current will form into a 'warm core eddy' with a diameter of 300-400 km, a depth to 1,000 m, and velocities of 50 to 200 cm/sec. These warm core eddies normally move to the western Gulf at speeds between two and five km per day, out of the study area and have a life span of about one-year. Smaller eddies (both clockwise and counterclockwise) are also created by the Loop Current and by other less known sources. Other currents are also present in the Gulf as ephemeral; semi-permanent and permanent features, primarily wind-driven by prevailing winds and by extreme events such as hurricanes. The mechanisms of some currents are poorly known and are still subject to study (USDOI, MMS, 2001). Short-lived, intense current jets have been reported at mid-depths (to about 200 m; see Figure 3-17 *in* USDOI, MMS, 2001) along the Louisiana-Texas slope but little is known about them (USDOI, MMS, 2000). Loop Current eddies may be found to about 1,500 m and topographic Rossby Wave activity may be encountered below 500 m, with possible intensification below 2,500 m depth (see Figure 3-17 *in* USDOI, MMS, 2001). Warm core Loop Current eddies interacting with the continental slope to the north can result in strong eastward flow and negative offshore temperature gradients to at least 500 m water depth, and cold core Loop Current frontal eddies interacting with the slope can result in westward flow following the slope bathymetry.

Coastal currents, based on historical current meter data, for the northern Gulf of Mexico are described in Dinnel et al. (1997); their predominant directions are alongshore, east or west depending upon location.

High frequency currents in some Northern Gulf of Mexico continental slope regionsare dominated by inertial oscillations, with periods of ~1 day, that are present in deep water throughout the year. At the shelf break, inertial oscillations are present in the summer but not in the winter because of lack of stratification in winter. Hurricanes passing over the slope produce a strong inertial response, which can persist for many days (Hamilton et al., 2000).

Average wave heights for the northern Gulf have been reported at one meter with 94 percent being two meters or less with a maximum height to 9.5-m (Quayle and Fulbright, 1977 *in* USDOI, MMS, 2001). Because the Gulf of Mexico is an enclosed sea, and thus fetch is somewhat limited, long period, large amplitude waves are rare except during extreme events such as hurricanes (McGrail and Carnes, 1983; NDBC, 1990, and others in USDOI, MMS, 2001). The maximum 100-year wave height has been estimated by Ward et al. (1979) as 21 m for water depths of 100 m and greater (USDOI, MMS, 2000).

References

Dinnel, S.P., W.J. Wiseman, Jr., and L.J. Rouse, Jr. 1997. Coastal currents in the northern Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 97-0005. 113 pp.

Gallaway, B.J., J.G. Cole, and L.R. Martin. 2001. The deep sea Gulf of Mexico: An overview and guide. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-065. 27 pp.

Hamilton, P., T. J. Berger, J.J. Singer, E. Waddell, J.H. Churchill, R. Leben, T.N. Lee, and W. Sturges. 2000. DeSoto Canyon eddy intrusion study, final report, Volume II: Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-080. 275 pp.

Pequegnat, W.E. 1983. The ecological communities of the continental slope and adjacent regimes of the northern Gulf of Mexico. Final report to the U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. Contract No. AA851-CT1-12).

U.S. Dept. of the Interior. Minerals Management Service. 2000. Gulf of Mexico deepwater operations and activities; environmental assessment. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2000-001. 264 pp.

U.S. Dept. of the Interior. Minerals Management Service. 2001. Proposed use of floating production, storage, and offshore loading systems on the Gulf of Mexico continental shelf, Western and Central planning areas, draft environmental impact statement. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2000-051.

Ward, E.G., L. Borgman, and V.J. Cardone. 1979. Statistics of hurricane waves in the Gulf of Mexico. J. Petroleum Technology, May 1979. Pp. 632-642.

APPENDIX E

Socioeconomic Conditions

Table E-1

Onshore Allocations

Sector	Sector Definition	TX-1	TX-2	LA-1	LA-2	LA-3	MA-1	FL-1	FL-2	FL-3	FL-4	GULF-OTHER	US-OTHER
38	Oil & Gas Operations	0.00	0.34	0.09	0.06	0.15	0.00	0.00	0.00	0.00	0.00	0.23	0.12
50	New Gas Utility Facilities	0.07	0.38	0.05	0.10	0.10	0.10	0.00	0.00	0.00	0.00	0.11	0.07
53	Misc Natural Resource Facility Construction	0.03	0.21	0.23	0.15	0.30	0.02	0.00	0.00	0.00	0.00	0.01	0.03
56	Maintenance and Repair, Other Facilities	0.06	0.31	0.04	0.08	0.09	0.08	0.00	0.00	0.00	0.00	0.21	0.11
57	Other Oil & Gas Field Services	0.00	0.30	0.26	0.12	0.16	0.00	0.00	0.00	0.00	0.00	0.07	0.05
160	Office Furniture and Equipment	0.15	0.54	0.00	0.00	0.08	0.23	0.00	0.00	0.00	0.00	0.00	0.00
178	Maps and Charts (Msc Publishing)	0.12	0.59	0.02	0.06	0.11	0.10	0.00	0.00	0.00	0.00	0.01	0.00
206	Explosives	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
209	Chemicals, NEC	0.03	0.64	0.04	0.10	0.04	0.04	0.00	0.00	0.00	0.00	0.04	0.04
210	Petroleum Fuels	0.11	0.50	0.09	0.16	0.09	0.05	0.00	0.00	0.00	0.00	0.00	0.00
232	Hydraulic Cement	0.00	0.10	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.50	0.30
258	Steel Pipe and Tubes	0.00	0.50	0.31	0.05	0.07	0.00	0.00	0.00	0.00	0.00	0.08	0.04
284	Fabricated Plate Work	0.04	0.63	0.06	0.09	0.05	0.14	0.00	0.00	0.00	0.00	0.00	0.00
290	Iron and Steel Forgings	0.00	0.81	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.14	0.00
307	Turbines	0.05	0.65	0.00	0.10	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
311	Construction Machinery & Equipment	0.06	0.42	0.00	0.06	0.19	0.11	0.00	0.00	0.00	0.00	0.11	0.06
313	O&G Field Machinery & Equipment	0.03	0.18	0.27	0.18	0.22	0.00	0.00	0.00	0.00	0.00	0.05	0.04
331	Special Industrial Machinery	0.00	0.00	0.00	0.38	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.03
332	Pumps & Compressors	0.04	0.30	0.17	0.22	0.09	0.00	0.00	0.00	0.00	0.00	0.12	0.06
354	Industrial Machines, NEC	0.05	0.66	0.06	0.10	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00
356	Switchgear	0.00	0.63	0.00	0.07	0.11	0.07	0.00	0.00	0.00	0.00	0.11	0.00
374	Communication Equipment, NEC	0.13	0.50	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.13	0.00
392	Shipbuilding and Ship Repair	0.09	0.24	0.05	0.24	0.18	0.19	0.00	0.00	0.00	0.00	0.00	0.00
399	Transportation Equipment, NEC	0.00	0.78	0.06	0.11	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00
401	Lab Equipment	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
403	Instrumentation	0.01	0.13	0.39	0.27	0.08	0.00	0.00	0.00	0.00	0.00	0.08	0.04
435	Demurrage/Warehousing/Motor Freight	0.11	0.37	0.21	0.09	0.09	0.01	0.00	0.00	0.00	0.00	0.07	0.00
436	Water Transport	0.02	0.27	0.10	0.25	0.22	0.04	0.01	0.00	0.01	0.00	0.06	0.00
437	Air Transport	0.03	0.42	0.11	0.11	0.08	0.02	0.00	0.00	0.00	0.01	0.21	0.00

Table E-1. Onshore Allocations (continued).

Sector	Sector Definition	TX-1	TX-2	LA-1	LA-2	LA-3	MA-1	FL-1	FL-2	FL-3	FL-4	GULF-OTHER	US-OTHER
441	Communications	0.09	0.51	0.07	0.11	0.11	0.11	0.00	0.00	0.00	0.00	0.00	0.00
443	Electric Services	0.13	0.36	0.06	0.15	0.12	0.18	0.00	0.00	0.00	0.00	0.00	0.00
444	Gas Production/Distribution	0.10	0.54	0.08	0.07	0.05	0.03	0.00	0.00	0.00	0.00	0.05	0.04
445	Water Supply	0.08	0.43	0.08	0.12	0.05	0.11	0.00	0.00	0.00	0.00	0.01	0.01
446	Waste Treatment/Disposal	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
454	Eating/Drinking	0.00	0.24	0.28	0.08	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00
455	Msc Retail	0.09	0.48	0.06	0.10	0.15	0.11	0.00	0.00	0.00	0.00	0.00	0.00
459	Insurance	0.04	0.47	0.07	0.12	0.09	0.00	0.00	0.00	0.00	0.00	0.17	0.03
462	Real Estate	0.09	0.47	0.04	0.08	0.11	0.08	0.00	0.00	0.00	0.00	0.11	0.01
469	Advertisement	0.06	0.45	0.06	0.08	0.15	0.08	0.00	0.00	0.00	0.00	0.12	0.01
470	Other Business Services	0.00	0.60	0.11	0.09	0.06	0.00	0.00	0.00	0.00	0.00	0.09	0.05
473	Msc. Equipment Rental and Leasing	0.09	0.26	0.22	0.10	0.10	0.01	0.00	0.00	0.00	0.00	0.18	0.03
490	Doctors & Veterinarian Services	0.09	0.53	0.06	0.09	0.14	0.08	0.00	0.00	0.00	0.00	0.00	0.00
494	Legal Services	0.07	0.48	0.07	0.11	0.19	0.08	0.00	0.00	0.00	0.00	0.00	0.00
506	Environmental/Engineering Services	0.06	0.38	0.11	0.08	0.08	0.03	0.01	0.00	0.02	0.00	0.20	0.01
507	Acct/Msc Business Services	0.06	0.46	0.05	0.09	0.13	0.07	0.00	0.00	0.00	0.00	0.11	0.01
508	Management/Consulting Services	0.04	0.54	0.04	0.09	0.11	0.05	0.00	0.00	0.00	0.00	0.11	0.01
509	Testing/Research Facilities	0.00	0.38	0.14	0.14	0.05	0.00	0.00	0.00	0.00	0.00	0.21	0.11

Table E-2

Population Forecast from 2000 to 2041
by Year and by Subarea
(in thousands)

Year	Coastal Subarea													
	LA-1	LA-2	LA-3	MA-1	TX-1	TX-2	FL-1	FL-2	FL-3	FL-4	CGOM	WGOM	EGOM	GOM
2000	667.12	1,009.54	1,337.60	920.12	920.58	5,158.08	774.39	128.07	3,954.32	2,340.67	3,934.36	6,078.66	7,197.46	17,210.48
2001	672.18	1,020.72	1,343.62	930.79	930.98	5,238.54	787.39	129.53	4,022.21	2,362.41	3,967.32	6,169.52	7,301.53	17,438.37
2002	677.35	1,032.14	1,350.07	941.63	941.65	5,320.26	800.68	131.07	4,091.10	2,384.86	4,001.19	6,261.91	7,407.70	17,670.81
2003	682.66	1,043.66	1,356.53	952.61	952.50	5,402.58	813.98	132.59	4,160.29	2,408.00	4,035.47	6,355.07	7,514.87	17,905.41
2004	688.01	1,055.31	1,363.03	963.72	963.47	5,486.16	827.51	134.14	4,230.65	2,431.38	4,070.07	6,449.64	7,623.67	18,143.38
2005	693.29	1,066.73	1,369.47	974.61	974.23	5,567.43	840.64	135.65	4,298.86	2,454.36	4,104.10	6,541.66	7,729.51	18,375.26
2006	698.70	1,078.41	1,376.22	985.73	985.30	5,650.56	854.05	137.23	4,368.60	2,478.49	4,139.06	6,635.87	7,838.37	18,613.29
2007	704.16	1,090.21	1,382.99	996.98	996.51	5,734.94	867.67	138.82	4,439.48	2,502.86	4,174.34	6,731.45	7,948.83	18,854.62
2008	709.66	1,102.14	1,389.80	1,008.35	1,007.84	5,820.57	881.51	140.44	4,511.50	2,527.47	4,209.96	6,828.41	8,060.92	19,099.29
2009	715.20	1,114.20	1,396.65	1,019.86	1,019.30	5,907.49	895.57	142.07	4,584.70	2,552.32	4,245.91	6,926.78	8,174.66	19,347.36
2010	720.38	1,125.14	1,403.21	1,030.25	1,029.64	5,983.33	907.72	143.54	4,647.77	2,575.09	4,278.97	7,012.97	8,274.12	19,566.06
2011	726.20	1,137.43	1,410.76	1,041.94	1,041.44	6,069.85	921.64	145.17	4,720.05	2,601.26	4,316.33	7,111.28	8,388.12	19,815.73
2012	732.08	1,149.85	1,418.35	1,053.77	1,053.36	6,157.62	935.78	146.82	4,793.45	2,627.70	4,354.04	7,210.98	8,503.74	20,068.76
2013	738.00	1,162.40	1,425.99	1,065.73	1,065.43	6,246.66	950.13	148.48	4,868.00	2,654.41	4,392.11	7,312.09	8,621.01	20,325.21
2014	743.97	1,175.09	1,433.66	1,077.82	1,077.63	6,336.99	964.70	150.17	4,943.70	2,681.38	4,430.54	7,414.62	8,739.95	20,585.11
2015	749.53	1,186.60	1,440.99	1,088.74	1,088.63	6,416.17	977.37	151.69	5,009.36	2,706.02	4,465.86	7,504.81	8,844.44	20,815.11
2016	755.65	1,199.33	1,449.10	1,100.87	1,100.92	6,505.30	991.66	153.38	5,083.64	2,733.69	4,504.94	7,606.21	8,962.38	21,073.53
2017	761.83	1,212.18	1,457.25	1,113.13	1,113.34	6,595.66	1,006.17	155.09	5,159.02	2,761.65	4,544.39	7,708.99	9,081.93	21,335.31
2018	768.05	1,225.18	1,465.45	1,125.53	1,125.90	6,687.28	1,020.90	156.81	5,235.52	2,789.89	4,584.21	7,813.17	9,203.11	21,600.50
2019	774.33	1,238.32	1,473.70	1,138.06	1,138.60	6,780.17	1,035.83	158.56	5,313.15	2,818.42	4,624.40	7,918.77	9,325.96	21,869.12
2020	780.19	1,250.28	1,481.58	1,149.44	1,150.11	6,862.28	1,048.94	160.14	5,381.16	2,844.53	4,661.48	8,012.39	9,434.78	22,108.65
2021	786.67	1,263.57	1,490.31	1,162.08	1,162.96	6,954.70	1,063.76	161.94	5,460.95	2,873.84	4,702.62	8,117.67	9,560.49	22,380.77
2022	793.20	1,276.99	1,499.09	1,174.87	1,175.96	7,048.36	1,078.79	163.76	5,538.93	2,903.44	4,744.15	8,224.32	9,684.92	22,653.39
2023	799.79	1,290.56	1,507.92	1,187.80	1,189.10	7,143.29	1,094.04	165.60	5,618.02	2,933.35	4,786.07	8,332.39	9,811.00	22,929.46
2024	806.43	1,304.27	1,516.81	1,200.87	1,202.39	7,239.49	1,109.49	167.46	5,698.24	2,963.56	4,828.38	8,441.88	9,938.75	23,209.01
2025	812.61	1,316.73	1,525.25	1,212.71	1,214.41	7,324.63	1,123.09	169.14	5,765.56	2,991.12	4,867.31	8,539.04	10,048.91	23,455.25
2026	819.36	1,330.72	1,534.24	1,226.06	1,227.98	7,423.27	1,138.95	171.03	5,847.89	3,021.93	4,910.38	8,651.25	10,179.81	23,741.44
2027	826.17	1,344.86	1,543.28	1,239.55	1,241.70	7,523.25	1,155.05	172.95	5,931.39	3,053.06	4,953.86	8,764.95	10,312.46	24,031.26
2028	833.03	1,359.15	1,552.38	1,253.19	1,255.58	7,624.57	1,171.37	174.90	6,016.09	3,084.51	4,997.74	8,880.15	10,446.86	24,324.75

Table E-2. Population Forecast from 2000 to 2041 by Year and by Subarea (in thousands).

Year	Coastal Subarea													
	LA-1	LA-2	LA-3	MA-1	TX-1	TX-2	FL-1	FL-2	FL-3	FL-4	CGOM	WGOM	EGOM	GOM
2029	839.95	1,373.59	1,561.52	1,266.98	1,269.61	7,727.25	1,187.92	176.86	6,101.99	3,116.29	5,042.04	8,996.86	10,583.05	24,621.95
2030	846.93	1,388.18	1,570.73	1,280.92	1,283.80	7,831.32	1,204.70	178.84	6,189.12	3,148.39	5,086.75	9,115.12	10,721.06	24,922.93
2031	853.96	1,402.93	1,579.98	1,295.01	1,298.15	7,936.79	1,221.72	180.85	6,277.50	3,180.82	5,131.89	9,234.93	10,860.89	25,227.71
2032	861.06	1,417.83	1,589.29	1,309.26	1,312.65	8,043.68	1,238.98	182.88	6,367.14	3,213.58	5,177.45	9,356.33	11,002.59	25,536.36
2033	868.21	1,432.90	1,598.66	1,323.67	1,327.32	8,152.01	1,256.49	184.93	6,458.06	3,246.69	5,223.43	9,479.33	11,146.17	25,848.93
2034	875.42	1,448.12	1,608.08	1,338.23	1,342.16	8,261.79	1,274.24	187.01	6,550.27	3,280.13	5,269.86	9,603.95	11,291.65	26,165.46
2035	882.70	1,463.50	1,617.56	1,352.96	1,357.16	8,373.06	1,292.25	189.11	6,643.80	3,313.92	5,316.72	9,730.22	11,439.08	26,486.01
2036	890.03	1,479.05	1,627.09	1,367.85	1,372.32	8,485.82	1,310.50	191.23	6,738.67	3,348.06	5,364.02	9,858.15	11,588.46	26,810.63
2037	897.42	1,494.77	1,636.68	1,382.90	1,387.66	8,600.11	1,329.02	193.38	6,834.90	3,382.54	5,411.76	9,987.77	11,739.84	27,139.37
2038	904.88	1,510.65	1,646.32	1,398.12	1,403.17	8,715.93	1,347.80	195.55	6,932.49	3,417.39	5,459.96	10,119.10	11,893.23	27,472.28
2039	912.39	1,526.69	1,656.02	1,413.50	1,418.85	8,833.31	1,366.84	197.75	7,031.48	3,452.59	5,508.61	10,252.16	12,048.66	27,809.43
2040	919.97	1,542.91	1,665.78	1,429.05	1,434.70	8,952.28	1,386.15	199.96	7,131.89	3,488.16	5,557.72	10,386.98	12,206.16	28,150.86
2041	927.62	1,559.31	1,675.60	1,444.78	1,450.74	9,072.84	1,405.74	202.21	7,233.72	3,524.09	5,607.30	10,523.58	12,365.76	28,496.63

Source: Woods & Poole (2002)

Table E-3

Employment Forecast from 2000 to 2041
by Year and by Subarea
(in thousands)

	Coastal Subareas													
Year	LA-1	LA-2	LA-3	MA-1	TX-1	TX-2	FL-1	FL-2	FL-3	FL-4	CGOM	WGOM	EGOM	GOM
2000	377.47	571.95	781.67	515.20	454.25	3,046.85	427.04	44.99	2,248.28	1,306.73	2,246.29	3,501.10	4,027.03	9,774.42
2001	381.65	580.15	787.95	522.71	460.67	3,095.53	435.03	45.55	2,298.83	1,324.75	2,272.46	3,556.20	4,104.15	9,932.81
2002	386.15	590.66	793.66	529.89	466.67	3,143.66	442.85	46.10	2,347.94	1,341.81	2,300.36	3,610.33	4,178.69	10,089.39
2003	391.13	597.79	799.20	537.22	472.64	3,192.77	450.71	46.63	2,396.65	1,358.41	2,325.34	3,665.41	4,252.40	10,243.15
2004	396.19	605.00	804.77	544.65	478.68	3,242.66	458.72	47.17	2,446.37	1,375.22	2,350.61	3,721.33	4,327.47	10,399.42
2005	401.12	612.06	810.28	551.90	484.58	3,291.14	466.47	47.69	2,494.20	1,391.66	2,375.37	3,775.72	4,400.02	10,551.11
2006	406.59	620.40	816.60	559.63	490.78	3,342.60	474.56	48.24	2,543.53	1,408.55	2,403.22	3,833.38	4,474.86	10,711.47
2007	412.12	628.86	822.98	567.47	497.06	3,394.87	482.78	48.79	2,593.82	1,425.64	2,431.43	3,891.93	4,551.03	10,874.39
2008	417.74	637.43	829.40	575.41	503.42	3,447.96	491.15	49.34	2,645.12	1,442.94	2,459.98	3,951.38	4,628.55	11,039.90
2009	423.43	646.11	835.87	583.47	509.87	3,501.87	499.66	49.92	2,697.43	1,460.44	2,488.88	4,011.74	4,707.45	11,208.07
2010	428.46	653.79	841.92	590.56	515.60	3,548.60	506.92	50.41	2,740.96	1,476.14	2,514.73	4,064.20	4,774.43	11,353.35
2011	434.19	662.57	849.67	598.72	522.23	3,603.53	515.28	50.97	2,791.75	1,494.05	2,545.16	4,125.76	4,852.05	11,522.97
2012	440.01	671.47	857.50	606.99	528.94	3,659.31	523.78	51.53	2,843.48	1,512.18	2,575.96	4,188.25	4,930.98	11,695.20
2013	445.90	680.48	865.39	615.38	535.74	3,715.96	532.42	52.10	2,896.18	1,530.54	2,607.16	4,251.70	5,011.24	11,870.09
2014	451.88	689.62	873.36	623.88	542.62	3,773.49	541.20	52.68	2,949.85	1,549.11	2,638.74	4,316.11	5,092.84	12,047.68
2015	457.17	697.71	880.71	631.38	548.75	3,823.42	548.75	53.20	2,995.06	1,565.76	2,666.96	4,372.16	5,162.78	12,201.90
2016	463.11	706.94	889.98	639.94	555.91	3,882.59	557.39	53.77	3,047.79	1,585.13	2,699.96	4,438.50	5,244.08	12,382.54
2017	469.12	716.29	899.34	648.63	563.16	3,942.68	566.16	54.35	3,101.45	1,604.74	2,733.38	4,505.84	5,326.69	12,565.92
2018	475.22	725.76	908.80	657.43	570.51	4,003.70	575.07	54.93	3,156.06	1,624.59	2,767.22	4,574.21	5,410.64	12,752.07
2019	481.39	735.36	918.37	666.36	577.96	4,065.66	584.12	55.52	3,211.62	1,644.68	2,801.48	4,643.62	5,495.94	12,941.04
2020	486.90	743.91	927.09	674.27	584.60	4,119.61	591.98	56.06	3,259.01	1,662.71	2,832.17	4,704.20	5,569.74	13,106.11
2021	493.05	753.66	937.98	683.29	592.41	4,183.83	600.92	56.64	3,314.18	1,683.95	2,867.98	4,776.24	5,655.69	13,299.91
2022	499.28	763.55	948.98	692.43	600.34	4,249.05	610.00	57.23	3,370.29	1,705.46	2,904.24	4,849.39	5,742.98	13,496.61
2023	505.58	773.56	960.12	701.70	608.37	4,315.29	619.21	57.83	3,427.35	1,727.25	2,940.97	4,923.66	5,831.64	13,696.26
2024	511.97	783.70	971.39	711.09	616.50	4,382.57	628.56	58.43	3,485.38	1,749.31	2,978.16	4,999.07	5,921.69	13,898.91
2025	517.67	792.71	981.53	719.41	623.71	4,440.89	636.71	58.98	3,535.04	1,768.97	3,011.32	5,064.60	5,999.70	14,075.62
2026	524.21	803.11	993.05	729.03	632.05	4,510.12	646.33	59.60	3,594.89	1,791.57	3,049.40	5,142.18	6,092.38	14,283.96
2027	530.83	813.64	1,004.71	738.79	640.50	4,580.44	656.09	60.22	3,655.75	1,814.46	3,087.97	5,220.94	6,186.52	14,495.42

Table E-3. Employment Forecast from 2000 to 2041 by Year and by Subarea (in thousands).

Year	Coastal Subareas													
	LA-1	LA-2	LA-3	MA-1	TX-1	TX-2	FL-1	FL-2	FL-3	FL-4	CGOM	WGOM	EGOM	GOM
2028	537.54	824.31	1,016.50	748.67	649.07	4,651.84	666.01	60.85	3,717.65	1,837.64	3,127.02	5,300.91	6,282.13	14,710.06
2029	544.33	835.12	1,028.43	758.69	657.75	4,724.36	676.07	61.48	3,780.59	1,861.11	3,166.57	5,382.11	6,379.25	14,927.93
2030	551.20	846.08	1,040.50	768.84	666.55	4,798.01	686.28	62.12	3,844.59	1,884.89	3,206.62	5,464.56	6,477.88	15,149.06
2030	558.17	857.17	1,052.17	779.13	675.46	4,872.81	696.55	62.77	3.909.68	1,908.97	3,247.18	5,548.27	6,478.07	15,373
2032	565.22	868.41	1,065.07	789.55	684.50	4,948.77	707.17	63.43	3,975.88	1,933.35	3,288.25	5,633.27	6,679.83	15,601.35
2033	572.36	879.80	1,077.57	800.12	693.65	5,025.92	717.85	64.09	4,043.19	1,958.05	3,329.85	5,719.57	6,783.18	15,832.60
2034	579.59	891.34	1,090.22	810.83	702.93	5,104.27	728.70	64.76	4,111.64	1,983.06	3,371.97	5,807.20	6,888.16	16,067.33
2035	586.91	903.03	1,103.01	821.68	712.33	5,183.85	739.70	65.43	4,181.25	2,008.40	3,414.63	5,896.17	6,994.79	16,305.59
2036	594.32	914.88	1,115.96	832.67	721.86	5,264.66	750.88	66.11	4,252.05	2,034.06	3,457.83	5,986.51	7,103.09	16,547.44
2037	601.83	926.87	1,129.06	843.81	731.51	5,346.73	762.22	66.80	4,324.03	2,060.04	3,501.57	6,078.24	7,213.10	16,792.92
2038	609.43	939.03	1,142.31	855.10	741.29	5,430.08	773.74	67.50	4,397.24	2,086.36	3,545.87	6,171.38	7,324.84	17,042.09
2039	617.13	951.34	1,155.72	866.54	751.21	5,514.74	785.42	68.21	4,471.69	2,113.01	3,590.74	6,265.94	7,438.33	17,295.01
2040	624.93	963.82	1,169.28	878.14	761.25	5,600.71	797.29	68.92	4,547.40	2,140.00	3,636.17	6,361.96	7,553.61	17,551.74
2041	632.82	976.46	1,183.01	889.89	771.44	5,688.02	809.33	69.64	4,624.39	2,167.34	3,682.18	6,459.45	7,670.70	17,812.33

Source: Woods & Poole (2002)

Table E-4

Employment Impacts Projected from Conoco's Initial Development Operations Coordination Document
(peak employment is projected for the year 2004 as shown)

Onshore Subarea	Direct Employment	Indirect Employment	Induced Employment	Total Employment	Baseline Employment	Conoco's Plan as a % of Baseline
FL-1	1.0	0.7	0.5	2.2	458,721	0.00%
FL-2	0.1	0.1	0.0	0.2	47,166	0.00%
FL-3	1.6	1.3	0.9	3.7	2,446,369	0.00%
FL-4	0.5	0.3	0.2	1.0	1,375,217	0.00%
EGOM	3.1	2.4	1.6	7.2	4,327,473	0.00%
LA-1	162.9	33.7	59.7	256.3	396,186	0.06%
LA-2	125.5	44.2	50.6	220.4	605,001	0.04%
LA-3	201.8	58.4	77.6	337.8	804,768	0.04%
MA-1	13.4	4.6	5.0	22.9	544,654	0.00%
CGOM	503.6	140.9	192.8	837.4	2,350,609	0.04%
TX-1	20.5	5.7	7.4	33.7	478,678	0.01%
TX-2	319.5	163.8	177.9	661.2	3,242,655	0.02%
WGOM	340.0	169.5	185.3	694.8	3,721,334	0.02%
Total GOM	846.8	312.8	379.8	1,539	10,399,416	0.01%

Table E-5

Estimated Oil Spill Cleanup and Remediation Employment Impacts
(year 2004)

	Direct		Indirect		Induced		Total Area		Percent of Oil Spill to Total Employment		
OnshoreArea	Low	High	Low	High	Low	High	Low	High	Employment	Low	High
FL-1	4	9	2	5	2	4	7	18	458,721	0.00%	0.00%
FL-2	0	0	0	0	0	0	0	0	47,166	0.00%	0.00%
FL-3	6	15	4	11	3	8	13	34	2,446,369	0.00%	0.00%
FL-4	1	3	1	2	0	1	2	5	1,375,217	0.00%	0.00%
EPA Total	11	27	7	18	5	13	23	58	4,327,473	0.00%	0.00%
LA-1	201	553	45	126	100	244	345	923	396,186	0.09%	0.23%
LA-2	252	649	49	131	118	275	419	1,055	605,001	0.07%	0.17%
LA-3	382	845	80	181	218	464	680	1,491	804,768	0.08%	0.19%
MA-1	164	346	32	69	87	182	284	597	544,654	0.05%	0.11%
CPA Total	999	2,393	206	507	524	1,166	1,728	4,066	2,350,609	0.07%	0.17%
TX-1	180	385	42	92	92	194	314	672	478,678	0.07%	0.14%
TX-2	834	2,020	267	646	541	1,226	1,641	3,892	3,242,655	0.05%	0.12%
WPA Total	1,014	2,406	309	738	633	1,420	1,955	4,564	3,721,334	0.05%	0.12%
Total	3,033	7,246	734	1,787	1,691	3,777	3,706	8,687	10,399,416	0.04%	0.08%

APPENDIX F

Other Information on Grid 7

Table F-1

Grid 7 — Exploration and Development Drilling Activities

Area	Block	Well	Operator	Spud Date	Total Depth Date	Water Depth (ft)	Remarks
GB	515	001	Marathon Oil Company	6/4/99	6/25/99	3,243	PA
GB	515	002	Marathon Oil Company	8/7/01	8/8/01	3,290	PA
GB	515	003	Marathon Oil Company	8/17/01	10/23/01	3,290	ST
GB	515	003	Marathon Oil Company	4/2/02	4/11/02	3,287	ST
GB	515	003	Marathon Oil Company	4/25/02	5/18/02	3,287	ST
GB	515	003	Marathon Oil Company	6/1/02	6/19/02	3,287	TA
GB	559	OR001	Shell Offshore Inc.	2/8/99	3/27/99	3,400	ST
GB	559	OR001	Shell Offshore Inc.	8/27/00	9/1/00	3,400	COM
GB	559	OR002	Shell Offshore Inc.	8/15/00	10/2/00	3,400	ST
GB	559	OR002	Shell Offshore Inc.	10/6/00	10/8/00	3,400	ST
GB	559	OR002	Shell Offshore Inc.	10/19/00	10/24/00	3,400	ST
GB	559	OR002	Shell Offshore Inc.	10/24/00	10/29/00	3,400	COM
GB	559	OR003	Shell Offshore Inc.	5/27/02	7/5/02	3,393	ST
GB	559	OR003	Shell Offshore Inc.	7/22/02		3,393	DRL
GB	600	001	Amerada Hess Corporation	6/24/01	8/13/01	2,934	PA
GB	602	001	Shell Offshore Inc.	9/13/95	9/21/95	3,708	PA
GB	602	003	Shell Offshore Inc.	4/3/96	7/5/96	3,665	ST
GB	602	003	Shell Offshore Inc.	7/15/96	8/7/96	3,665	TA
GB	602	A002	Shell Offshore Inc.	9/25/95	1/21/96	3,693	ST
GB	602	A002	Shell Offshore Inc.	2/25/97	3/24/97	3,708	COM
GB	602	A004	Shell Offshore Inc.	12/10/98	9/27/99	3,708	ST
GB	602	A004	Shell Offshore Inc.	11/29/00	1/3/01	3,708	COM
GB	602	A005	Shell Offshore Inc.	12/11/98	3/7/99	3,693	ST
GB	602	A005	Shell Offshore Inc.	4/26/99	5/29/99	3,693	COM
GB	602	BH001	Shell Offshore Inc.	2/10/96	2/19/96	3,669	PA
GB	782	001	BP Exploration & Production Inc.	3/6/00	4/22/00	4,642	ST
GB	782	001	BP Exploration & Production Inc.	4/29/00	5/9/00	4,690	ST
GB	782	001	BP Exploration & Production Inc.	5/18/00	5/22/00	4,642	ST
GB	782	001	BP Exploration & Production Inc.	5/29/00	5/31/00	4,690	ST
GB	782	001	BP Exploration & Production Inc.	6/2/00	6/4/00	4,690	ST
GB	782	001	BP Exploration & Production Inc.	6/5/00	6/28/00	4,642	TA
GB	782	002	BP Exploration & Production Inc.	7/4/00	7/16/00	4,528	ST
GB	782	002	BP Exploration & Production Inc.	7/17/00	8/6/00	4,528	ST
GB	782	002	BP Exploration & Production Inc.	8/14/00	8/19/00	4,528	TA
GB	783	001	Conoco Inc.	1/30/99	5/3/99	4,668	ST
GB	783	001	Conoco Inc.	5/24/01	6/12/01	4,674	ST
GB	783	001	Conoco Inc.	6/22/01	7/10/01	4,674	TA
GB	783	002	Conoco Inc.	8/20/00	10/15/00	4,674	ST
GB	783	002	Conoco Inc.	10/25/00	11/3/00	4,673	ST
GB	783	002	Conoco Inc.	11/16/00	11/28/00	4,674	TA
GB	783	003	Conoco Inc.			4,668	AST
GB	783	003	Conoco Inc.	3/22/01	5/17/01	4,674	ST
GB	783	003	Conoco Inc.	9/19/01	10/16/01	4,674	TA
GB	785	001	Conoco Inc.	12/17/97	1/10/98	4,640	ST
GB	785	001	Conoco Inc.	2/3/98	2/23/98	4,640	ST
GB	785	001	Conoco Inc.	3/9/98	4/11/98	4,640	PA
GB	941	001	Union Oil Company of California	7/11/99	9/3/99	3,716	TA
KC	199	001	Marathon Oil Company	7/7/00	8/3/00	5,565	PA
KC	511	001	Conoco Inc.			6,115	APD

APD = Application for Permit to Drill
AST = approved sidetrack
COM = completion
DRL = drilling
GB = Garden Banks
KC = Keathley Canyon
PA = plugged and abandoned
ST = sidetrack
TA = temporarily abandoned

Table F-2

Grid 7 — Surface Structures

Area	Block	Control	Plan Type	Operator	Plan Final Action Date	Plan Site Type	Plan Site Name	Water Depth (ft)
GB	783	N-7506	DOCD	Conoco Inc.		TLP	Magnolia	4,674
GB	559	N-6890	DOCD	Shell Deepwater Development Inc.	3/5/01	Structure	OR SLED	3,400

DOCD = Development Operations Coordination Document
GB = Garden Banks
TLP = tension leg platform

Table F-3

Grid 7 — Leases and Operators

Grid	Area	Block	Lease Number	Operator	Lease Status
7	GB	515	G20792	Marathon Oil Company	Primary
7	GB	552	G21399	Kerr-McGee Oil & Gas Corporation	Primary
7	GB	553	G21400	Kerr-McGee Oil & Gas Corporation	Primary
7	GB	557	G22324	Amerada Hess Corporation	Primary
7	GB	558	G11545	Shell Offshore Inc.	Unit
7	GB	559	G11546	Shell Offshore Inc.	Unit
7	GB	597	G23326	Amerada Hess Corporation	Primary
7	GB	600	G22326	Amerada Hess Corporation	Primary
7	GB	601	G22327	Amerada Hess Corporation	Primary
7	GB	602	G11553	Shell Offshore Inc.	Prod
7	GB	606	G17397	Mobil Producing Texas & New Mexico Inc.	Primary
7	GB	607	G14948	Mobil Producing Texas & New Mexico Inc.	Primary
7	GB	608	G14949	Mobil Producing Texas & New Mexico Inc.	Primary
7	GB	611	G15925	Mobil Producing Texas & New Mexico Inc.	Primary
7	GB	640	G17402	Phillips Petroleum Company	Primary
7	GB	641	G23330	Amerada Hess Corporation	Primary
7	GB	647	G17403	Nexen Petroleum U.S.A. Inc.	Primary
7	GB	648	G17404	Nexen Petroleum U.S.A. Inc.	Primary
7	GB	653	G22332	Murphy Exploration & Production Company	Primary
7	GB	654	G15930	Mobil Producing Texas & New Mexico Inc.	Primary
7	GB	683	G23332	Amerada Hess Corporation	Primary
7	GB	684	G17411	Union Oil Company of California	Primary
7	GB	687	G15932	Phillips Petroleum Company	Primary
7	GB	688	G15933	Phillips Petroleum Company	Primary
7	GB	689	G15934	Phillips Petroleum Company	Primary
7	GB	690	G15935	Phillips Petroleum Company	Primary
7	GB	691	G15936	Phillips Petroleum Company	Primary
7	GB	692	G15937	Petrobras America Inc.	Primary
7	GB	693	G15938	Petrobras America Inc.	Primary
7	GB	697	G21402	Murphy Exploration & Production Company	Primary
7	GB	698	G15939	Mobil Producing Texas & New Mexico Inc.	Primary
7	GB	699	G15940	Mobil Producing Texas & New Mexico Inc.	Primary
7	GB	727	G17416	Shell Offshore Inc.	Primary
7	GB	728	G17417	Union Oil Company of California	Primary
7	GB	730	G22335	Amerada Hess Corporation	Primary
7	GB	731	G15941	Phillips Petroleum Company	Primary
7	GB	732	G15942	Phillips Petroleum Company	Primary
7	GB	733	G15943	Phillips Petroleum Company	Primary
7	GB	734	G17418	Phillips Petroleum Company	Primary
7	GB	735	G17419	Phillips Petroleum Company	Primary
7	GB	736	G19164	BP Exploration & Production Inc.	Primary
7	GB	737	G19165	BP Exploration & Production Inc.	Primary
7	GB	738	G22336	BP Exploration & Production Inc.	Primary
7	GB	743	G23333	Kerr-McGee Oil & Gas Corporation	Primary
7	GB	766	G17422	BP Exploration & Production Inc.	Primary
7	GB	771	G17423	Shell Offshore Inc.	Primary
7	GB	772	G22337	Amerada Hess Corporation	Primary
7	GB	773	G19173	BP Exploration & Production Inc.	Primary
7	GB	774	G17424	Amerada Hess Corporation	Primary
7	GB	775	G17425	EEX Corporation	Primary
7	GB	776	G17426	EEX Corporation	Primary
7	GB	777	G19174	Shell Offshore Inc.	Primary
7	GB	778	G19175	Shell Offshore Inc.	Primary

Table F-3. Grid 7 — Leases and Operators (continued).

Grid	Area	Block	Lease Number	Operator	Lease Status
7	GB	780	G19176	Dominion Exploration & Production, Inc.	Primary
7	GB	781	G19177	Dominion Exploration & Production, Inc.	Primary
7	GB	782	G20797	BP Exploration & Production Inc.	Primary
7	GB	783	G11573	Conoco Inc.	Unit
7	GB	784	G11574	Conoco Inc.	Unit
7	GB	785	G21403	BP Exploration & Production Inc.	Primary
7	GB	786	G17427	Conoco Inc.	Primary
7	GB	807	G17432	Kerr-McGee Oil & Gas Corporation	Primary
7	GB	808	G21405	Kerr-McGee Oil & Gas Corporation	Primary
7	GB	810	G17433	Shell Offshore Inc.	Primary
7	GB	811	G17434	Shell Offshore Inc.	Primary
7	GB	812	G17435	Shell Offshore Inc.	Primary
7	GB	813	G17436	Shell Offshore Inc.	Primary
7	GB	814	G17437	Shell Offshore Inc.	Primary
7	GB	816	G17439	Shell Offshore Inc.	Primary
7	GB	817	G17440	Shell Offshore Inc.	Primary
7	GB	818	G19182	Conoco Inc.	Primary
7	GB	819	G17441	Phillips Petroleum Company	Primary
7	GB	820	G15947	Phillips Petroleum Company	Primary
7	GB	821	G15948	Phillips Petroleum Company	Primary
7	GB	823	G15949	Phillips Petroleum Company	Primary
7	GB	825	G19183	Dominion Exploration & Production, Inc.	Primary
7	GB	826	G20798	BP Exploration & Production Inc.	Primary
7	GB	827	G20799	BP Exploration & Production Inc.	Primary
7	GB	828	G23337	Conoco Inc.	Primary
7	GB	829	G19186	BP Exploration & Production Inc.	Primary
7	GB	830	G19187	BP Exploration & Production Inc.	Primary
7	GB	831	G19188	Exxon Mobil Corporation	Primary
7	GB	847	G19194	EnCana GOM Inc.	Primary
7	GB	851	G17444	Kerr-McGee Oil & Gas Corporation	Primary
7	GB	852	G21407	Kerr-McGee Oil & Gas Corporation	Primary
7	GB	855	G17445	Shell Offshore Inc.	Primary
7	GB	856	G17446	Phillips Petroleum Company	Primary
7	GB	857	G17447	Phillips Petroleum Company	Primary
7	GB	858	G17448	Shell Offshore Inc.	Primary
7	GB	859	G19195	BP Exploration & Production Inc.	Primary
7	GB	860	G19196	Conoco Inc.	Primary
7	GB	861	G17449	Conoco Inc.	Primary
7	GB	862	G17450	BP Exploration & Production Inc.	Primary
7	GB	863	G17451	BP Exploration & Production Inc.	Primary
7	GB	864	G19197	BP Exploration & Production Inc.	Primary
7	GB	865	G17452	Phillips Petroleum Company	Primary
7	GB	866	G17453	Phillips Petroleum Company	Primary
7	GB	867	G19198	Union Oil Company of California	Primary
7	GB	869	G22339	Pioneer Natural Resources USA, Inc.	Primary
7	GB	870	G19199	BP Exploration & Production Inc.	Primary
7	GB	871	G17454	BP Exploration & Production Inc.	Primary
7	GB	872	G17455	BP Exploration & Production Inc.	Primary
7	GB	873	G17456	BP Exploration & Production Inc.	Primary
7	GB	874	G17457	Exxon Mobil Corporation	Primary
7	GB	875	G17458	Conoco Inc.	Primary
7	GB	891	G19203	Union Oil Company of California	Primary
7	GB	892	G19204	Union Oil Company of California	Primary
7	GB	893	G19205	Union Oil Company of California	Primary
7	GB	894	G20801	Devon Energy Production Company, L.P.	Primary
7	GB	895	G20802	Devon Energy Production Company, L.P.	Primary
7	GB	897	G20803	BP Exploration & Production Inc.	Primary
7	GB	899	G19206	Kerr-McGee Oil & Gas Corporation	Primary

Table F-3. Grid 7 — Leases and Operators (continued).

Grid	Area	Block	Lease Number	Operator	Lease Status
7	GB	900	G19207	Kerr-McGee Oil & Gas Corporation	Primary
7	GB	901	G17460	Shell Offshore Inc.	Primary
7	GB	904	G19208	Kerr-McGee Oil & Gas Corporation	Primary
7	GB	905	G17461	Conoco Inc.	Primary
7	GB	906	G17462	Conoco Inc.	Primary
7	GB	907	G17463	BP Exploration & Production Inc.	Primary
7	GB	908	G19209	BP Exploration & Production Inc.	Primary
7	GB	909	G15950	Phillips Petroleum Company	Primary
7	GB	910	G17464	Phillips Petroleum Company	Primary
7	GB	911	G19210	Exxon Mobil Corporation	Primary
7	GB	913	G22340	Pioneer Natural Resources USA, Inc.	Primary
7	GB	914	G19211	BP Exploration & Production Inc.	Primary
7	GB	915	G19212	BP Exploration & Production Inc.	Primary
7	GB	918	G17465	Exxon Mobil Corporation	Primary
7	GB	919	G22341	BP Exploration & Production Inc.	Primary
7	GB	935	G17467	BP Exploration & Production Inc.	Primary
7	GB	936	G17468	BP Exploration & Production Inc.	Primary
7	GB	937	G17469	BP Exploration & Production Inc.	Primary
7	GB	939	G22342	Mariner Energy, Inc.	Primary
7	GB	941	G20804	Union Oil Company of California	Primary
7	GB	942	G20805	BP Exploration & Production Inc.	Primary
7	GB	943	G19219	Phillips Petroleum Company	Primary
7	GB	944	G19220	Phillips Petroleum Company	Primary
7	GB	945	G17470	Shell Offshore Inc.	Primary
7	GB	948	G19221	Kerr-McGee Oil & Gas Corporation	Primary
7	GB	949	G19222	Exxon Mobil Corporation	Primary
7	GB	950	G17471	Conoco Inc.	Primary
7	GB	951	G17472	BP Exploration & Production Inc.	Primary
7	GB	952	G17473	BP Exploration & Production Inc.	Primary
7	GB	953	G17474	BP Exploration & Production Inc.	Primary
7	GB	954	G17475	BP Exploration & Production Inc.	Primary
7	GB	955	G19223	Exxon Mobil Corporation	Primary
7	GB	956	G19224	Exxon Mobil Corporation	Primary
7	GB	957	G19225	Exxon Mobil Corporation	Primary
7	GB	958	G19226	Exxon Mobil Corporation	Primary
7	GB	959	G19227	BP Exploration & Production Inc.	Primary
7	GB	962	G23340	Amerada Hess Corporation	Primary
7	GB	963	G23341	Amerada Hess Corporation	Primary
7	GB	979	G17477	BP Exploration & Production Inc.	Primary
7	GB	980	G19232	BP Exploration & Production Inc.	Primary
7	GB	985	G20806	BP Exploration & Production Inc.	Primary
7	GB	986	G20807	Kerr-McGee Oil & Gas Corporation	Primary
7	GB	992	G19234	BP Exploration & Production Inc.	Primary
7	GB	993	G17478	Shell Offshore Inc.	Primary
7	GB	994	G17479	Shell Offshore Inc.	Primary
7	GB	995	G17480	Conoco Inc.	Primary
7	GB	996	G17481	BP Exploration & Production Inc.	Primary
7	GB	997	G19235	BP Exploration & Production Inc.	Primary
7	GB	998	G19236	BP Exploration & Production Inc.	Primary
7	GB	999	G19237	Exxon Mobil Corporation	Primary
7	GB	1000	G19238	Exxon Mobil Corporation	Primary
7	GB	1001	G19239	EEX Corporation	Primary
7	GB	1002	G19240	Exxon Mobil Corporation	Primary
7	GB	1003	G19241	BP Exploration & Production Inc.	Primary
7	KC	17	G20888	Kerr-McGee Oil & Gas Corporation	Primary
7	KC	18	G20889	Kerr-McGee Oil & Gas Corporation	Primary
7	KC	21	G17576	Shell Offshore Inc.	Primary
7	KC	22	G17577	Shell Offshore Inc.	Primary
7	KC	23	G20890	Shell Offshore Inc.	Primary

Table F-3. Grid 7 — Leases and Operators (continued).

Grid	Area	Block	Lease Number	Operator	Lease Status
7	KC	25	G20891	Kerr-McGee Oil & Gas Corporation	Primary
7	KC	26	G20892	Kerr-McGee Oil & Gas Corporation	Primary
7	KC	27	G19454	BP Exploration & Production Inc.	Primary
7	KC	28	G19455	BP Exploration & Production Inc.	Primary
7	KC	29	G19456	Shell Offshore Inc.	Primary
7	KC	30	G19457	BP Exploration & Production Inc.	Primary
7	KC	31	G19458	Exxon Mobil Corporation	Primary
7	KC	32	G19459	Exxon Mobil Corporation	Primary
7	KC	33	G19460	Exxon Mobil Corporation	Primary
7	KC	34	G19461	Exxon Mobil Corporation	Primary
7	KC	35	G19462	BP Exploration & Production Inc.	Primary
7	KC	56	G17578	Chevron U.S.A. Inc.	Primary
7	KC	58	G19468	Chevron U.S.A. Inc.	Primary
7	KC	59	G17579	Chevron U.S.A. Inc.	Primary
7	KC	62	G20893	Kerr-McGee Oil & Gas Corporation	Primary
7	KC	69	G20894	Kerr-McGee Oil & Gas Corporation	Primary
7	KC	71	G19469	BP Exploration & Production Inc.	Primary
7	KC	72	G19470	Shell Offshore Inc.	Primary
7	KC	73	G19471	Shell Offshore Inc.	Primary
7	KC	74	G19472	BP Exploration & Production Inc.	Primary
7	KC	75	G19473	BP Exploration & Production Inc.	Primary
7	KC	76	G20895	EnCana GOM Inc.	Primary
7	KC	77	G20896	EnCana GOM Inc.	Primary
7	KC	78	G17580	Conoco Inc.	Primary
7	KC	79	G17581	Conoco Inc.	Primary
7	KC	80	G19474	BP Exploration & Production Inc.	Primary
7	KC	81	G19475	BP Exploration & Production Inc.	Primary
7	KC	83	G19476	EnCana GOM Inc.	Primary
7	KC	100	G17582	Chevron U.S.A. Inc.	Primary
7	KC	112	G19484	Shell Offshore Inc.	Primary
7	KC	113	G17583	BP Exploration & Production Inc.	Primary
7	KC	114	G17584	BP Exploration & Production Inc.	Primary
7	KC	115	G19485	BP Exploration & Production Inc.	Primary
7	KC	116	G19486	BP Exploration & Production Inc.	Primary
7	KC	118	G19487	Conoco Inc.	Primary
7	KC	119	G19488	Conoco Inc.	Primary
7	KC	120	G19489	EnCana GOM Inc.	Primary
7	KC	121	G19490	EnCana GOM Inc.	Primary
7	KC	122	G17585	Conoco Inc.	Primary
7	KC	124	G17586	Conoco Inc.	Primary
7	KC	125	G19491	BP Exploration & Production Inc.	Primary
7	KC	126	G19492	BP Exploration & Production Inc.	Primary
7	KC	141	G19496	Chevron U.S.A. Inc.	Primary
7	KC	146	G19497	Murphy Exploration & Production Company	Primary
7	KC	147	G17587	Chevron U.S.A. Inc.	Primary
7	KC	153	G19498	Shell Offshore Inc.	Primary
7	KC	154	G19499	BP Exploration & Production Inc.	Primary
7	KC	155	G19500	Marathon Oil Company	Primary
7	KC	156	G19501	BP Exploration & Production Inc.	Primary
7	KC	157	G19502	OXY USA Inc.	Primary
7	KC	162	G19503	Conoco Inc.	Primary
7	KC	163	G19504	Conoco Inc.	Primary
7	KC	164	G19505	BP Exploration & Production Inc.	Primary
7	KC	165	G19506	BP Exploration & Production Inc.	Primary
7	KC	166	G19507	Exxon Mobil Corporation	Primary
7	KC	167	G19508	Union Oil Company of California	Primary
7	KC	168	G17588	Conoco Inc.	Primary
7	KC	169	G19509	BP Exploration & Production Inc.	Primary
7	KC	170	G19510	Murphy Exploration & Production Company	Primary

Table F-3. Grid 7 — Leases and Operators (continued).

Grid	Area	Block	Lease Number	Operator	Lease Status
7	KC	186	G22350	Amerada Hess Corporation	Primary
7	KC	189	G19513	Murphy Exploration & Production Company	Primary
7	KC	190	G19514	Murphy Exploration & Production Company	Primary
7	KC	191	G21424	Conoco Inc.	Primary
7	KC	192	G21425	Conoco Inc.	Primary
7	KC	196	G21426	Kerr-McGee Oil & Gas Corporation	Primary
7	KC	197	G19515	BP Exploration & Production Inc.	Primary
7	KC	198	G19516	BP Exploration & Production Inc.	Primary
7	KC	199	G19517	Marathon Oil Company	Primary
7	KC	200	G19518	BP Exploration & Production Inc.	Primary
7	KC	206	G19519	BP Exploration & Production Inc.	Primary
7	KC	207	G19520	Conoco Inc.	Primary
7	KC	209	G19521	Kerr-McGee Oil & Gas Corporation	Primary
7	KC	210	G19522	Exxon Mobil Corporation	Primary
7	KC	211	G19523	Murphy Exploration & Production Company	Primary
7	KC	213	G17590	Exxon Mobil Corporation	Primary
7	KC	214	G19524	BP Exploration & Production Inc.	Primary
7	KC	230	G22351	Amerada Hess Corporation	Primary
7	KC	235	G23399	Conoco Inc.	Primary
7	KC	236	G21427	Conoco Inc.	Primary
7	KC	237	G23400	Conoco Inc.	Primary
7	KC	241	G19527	Murphy Exploration & Production Company	Primary
7	KC	242	G19528	BP Exploration & Production Inc.	Primary
7	KC	243	G19529	BP Exploration & Production Inc.	Primary
7	KC	244	G19530	BP Exploration & Production Inc.	Primary
7	KC	245	G19531	BP Exploration & Production Inc.	Primary
7	KC	252	G19532	TotalFinaElf E&P USA, Inc.	Primary
7	KC	253	G19533	Exxon Mobil Corporation	Primary
7	KC	254	G19534	Exxon Mobil Corporation	Primary
7	KC	256	G17592	Exxon Mobil Corporation	Primary
7	KC	257	G17593	Exxon Mobil Corporation	Primary
7	KC	258	G19536	BP Exploration & Production Inc.	Primary
7	KC	259	G19537	BP Exploration & Production Inc.	Primary
7	KC	279	G23401	Conoco Inc.	Primary
7	KC	280	G23402	Conoco Inc.	Primary
7	KC	281	G23403	Conoco Inc.	Primary
7	KC	284	G19539	Kerr-McGee Oil & Gas Corporation	Primary
7	KC	285	G19540	Kerr-McGee Oil & Gas Corporation	Primary
7	KC	286	G23404	Kerr-McGee Oil & Gas Corporation	Primary
7	KC	287	G19541	Marathon Oil Company	Primary
7	KC	288	G19542	BP Exploration & Production Inc.	Primary
7	KC	289	G19543	BP Exploration & Production Inc.	Primary
7	KC	290	G19544	BP Exploration & Production Inc.	Primary
7	KC	291	G19545	BP Exploration & Production Inc.	Primary
7	KC	298	G20905	Exxon Asset Holdings LLC	Primary
7	KC	299	G20906	Exxon Asset Holdings LLC	Primary
7	KC	300	G17597	Phillips Petroleum Company	Primary
7	KC	301	G17598	Marathon Oil Company	Primary
7	KC	324	G23405	Conoco Inc.	Primary
7	KC	326	G17600	BP Exploration & Production Inc.	Primary
7	KC	327	G17601	BP Exploration & Production Inc.	Primary
7	KC	328	G19551	Kerr-McGee Oil & Gas Corporation	Primary
7	KC	329	G19552	Kerr-McGee Oil & Gas Corporation	Primary
7	KC	332	G19553	BP Exploration & Production Inc.	Primary
7	KC	333	G19554	BP Exploration & Production Inc.	Primary
7	KC	334	G17602	BP Exploration & Production Inc.	Primary
7	KC	335	G17603	BP Exploration & Production Inc.	Primary
7	KC	336	G19555	BP Exploration & Production Inc.	Primary
7	KC	340	G23406	Conoco Inc.	Primary

Table F-3. Grid 7 — Leases and Operators (continued).

Grid	Area	Block	Lease Number	Operator	Lease Status
7	KC	363	G21428	Union Oil Company of California	Primary
7	KC	364	G21429	Union Oil Company of California	Primary
7	KC	365	G19561	Union Oil Company of California	Primary
7	KC	366	G19562	Union Oil Company of California	Primary
7	KC	369	G21430	Kerr-McGee Oil & Gas Corporation	Primary
7	KC	370	G17606	BP Exploration & Production Inc.	Primary
7	KC	371	G17607	BP Exploration & Production Inc.	Primary
7	KC	372	G21431	Kerr-McGee Oil & Gas Corporation	Primary
7	KC	373	G21432	Kerr-McGee Oil & Gas Corporation	Primary
7	KC	376	G17608	Conoco Inc.	Primary
7	KC	377	G17609	Conoco Inc.	Primary
7	KC	378	G19563	BP Exploration & Production Inc.	Primary
7	KC	379	G17610	BP Exploration & Production Inc.	Primary
7	KC	380	G17611	BP Exploration & Production Inc.	Primary
7	KC	383	G22352	Amerada Hess Corporation	Primary
7	KC	384	G22353	Amerada Hess Corporation	Primary
7	KC	406	G20907	Union Oil Company of California	Primary
7	KC	407	G20908	Union Oil Company of California	Primary
7	KC	408	G21433	Murphy Exploration & Production Company	Primary
7	KC	409	G19567	Union Oil Company of California	Primary
7	KC	412	G17614	Chevron U.S.A. Inc.	Primary
7	KC	413	G17615	Chevron U.S.A. Inc.	Primary
7	KC	420	G17616	Conoco Inc.	Primary
7	KC	421	G17617	Conoco Inc.	Primary
7	KC	422	G17618	Conoco Inc.	Primary
7	KC	424	G22354	Phillips Petroleum Company	Primary
7	KC	425	G22355	Phillips Petroleum Company	Primary
7	KC	426	G22356	Phillips Petroleum Company	Primary
7	KC	427	G22357	Amerada Hess Corporation	Primary
7	KC	428	G22358	Amerada Hess Corporation	Primary
7	KC	450	G20910	Union Oil Company of California	Primary
7	KC	451	G20911	Union Oil Company of California	Primary
7	KC	457	G19571	Chevron U.S.A. Inc.	Primary
7	KC	464	G19572	Shell Offshore Inc.	Primary
7	KC	465	G17622	Conoco Inc.	Primary
7	KC	466	G19573	Conoco Inc.	Primary
7	KC	467	G22359	Conoco Inc.	Primary
7	KC	468	G19574	Shell Offshore Inc.	Primary
7	KC	469	G19575	Shell Offshore Inc.	Primary
7	KC	470	G22360	Phillips Petroleum Company	Primary
7	KC	473	G19576	Murphy Exploration & Production Company	Primary
7	KC	474	G17623	Phillips Petroleum Company	Primary
7	KC	494	G17628	Chevron U.S.A. Inc.	Primary
7	KC	495	G17629	Chevron U.S.A. Inc.	Primary
7	KC	502	G20919	Union Oil Company of California	Primary
7	KC	503	G20920	Union Oil Company of California	Primary
7	KC	504	G21434	Kerr-McGee Oil & Gas Corporation	Primary
7	KC	505	G19583	Kerr-McGee Oil & Gas Corporation	Primary
7	KC	508	G17630	Shell Offshore Inc.	Primary
7	KC	509	G17631	Conoco Inc.	Primary
7	KC	510	G20921	Union Oil Company of California	Primary
7	KC	511	G17632	Conoco Inc.	Primary
7	KC	512	G17633	Conoco Inc.	Primary
7	KC	513	G19584	Shell Offshore Inc.	Primary
7	KC	517	G19585	Murphy Exploration & Production Company	Primary
7	KC	538	G17635	Chevron U.S.A. Inc.	Primary
7	KC	547	G20927	Union Oil Company of California	Primary
7	KC	548	G20928	Union Oil Company of California	Primary
7	KC	549	G19588	Kerr-McGee Oil & Gas Corporation	Primary

Table F-3. Grid 7 — Leases and Operators (continued).

Grid	Area	Block	Lease Number	Operator	Lease Status
7	KC	551	G19589	Ocean Energy, Inc.	Primary
7	KC	552	G19590	Union Oil Company of California	Primary
7	KC	554	G20929	Union Oil Company of California	Primary
7	KC	555	G17638	Conoco Inc.	Primary
7	KC	557	G19591	Murphy Exploration & Production Company	Primary
7	KC	594	G19598	Ocean Energy, Inc.	Primary
7	KC	595	G19599	Ocean Energy, Inc.	Primary
7	KC	596	G19600	Ocean Energy, Inc.	Primary
7	KC	598	G22361	Conoco Inc.	Primary
7	KC	599	G17641	Conoco Inc.	Primary
7	KC	601	G17642	BP Exploration & Production Inc.	Primary
7	KC	603	G17643	BP Exploration & Production Inc.	Primary
7	KC	604	G19601	Murphy Exploration & Production Company	Primary
7	KC	605	G19602	Murphy Exploration & Production Company	Primary
7	KC	606	G19603	BP Exploration & Production Inc.	Primary
7	KC	646	G17646	BP Exploration & Production Inc.	Primary
7	KC	647	G19610	BP Exploration & Production Inc.	Primary
7	KC	648	G19611	Murphy Exploration & Production Company	Primary
7	KC	649	G17647	BP Exploration & Production Inc.	Primary
7	KC	650	G17648	BP Exploration & Production Inc.	Primary
7	KC	651	G17649	BP Exploration & Production Inc.	Primary
7	KC	693	G17653	BP Exploration & Production Inc.	Primary
7	KC	694	G17654	BP Exploration & Production Inc.	Primary
7	KC	695	G17655	Amoco Production Company	Primary

GB = Garden Banks
KC = Keathley Canyon

Table F-4

Grid 7 — Block Listing

Grid	Area	Block
7	GB	507
7	GB	514
7	GB	515
7	GB	551
7	GB	552
7	GB	553
7	GB	554
7	GB	557
7	GB	558
7	GB	559
7	GB	595
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7	GB	903
7	GB	904
7	GB	905
7	GB	906
7	GB	907
7	GB	908
7	GB	909

Table F-4. Grid 7 – Block Listing (continued).

Grid	Area	Block
7	GB	910
7	GB	911
7	GB	912
7	GB	913
7	GB	914
7	GB	915
7	GB	916
7	GB	917
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7	GB	991
7	GB	992
7	GB	993
7	GB	994
7	GB	995

Grid	Area	Block
7	GB	996
7	GB	997
7	GB	998
7	GB	999
7	GB	1000
7	GB	1001
7	GB	1002
7	GB	1003
7	GB	1004
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Grid	Area	Block
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7	KC	153

Table F-4. Grid 7 – Block Listing (continued).

Grid	Area	Block
7	KC	154
7	KC	155
7	KC	156
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7	KC	158
7	KC	159
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Table F-4. Grid 7 – Block Listing (continued).

Grid	Area	Block
7	KC	421
7	KC	422
7	KC	423
7	KC	424
7	KC	425
7	KC	426
7	KC	427
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Grid	Area	Block
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Grid	Area	Block
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GB = Garden Banks
KC = Keathley Canyon

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Minerals Revenue Management** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.