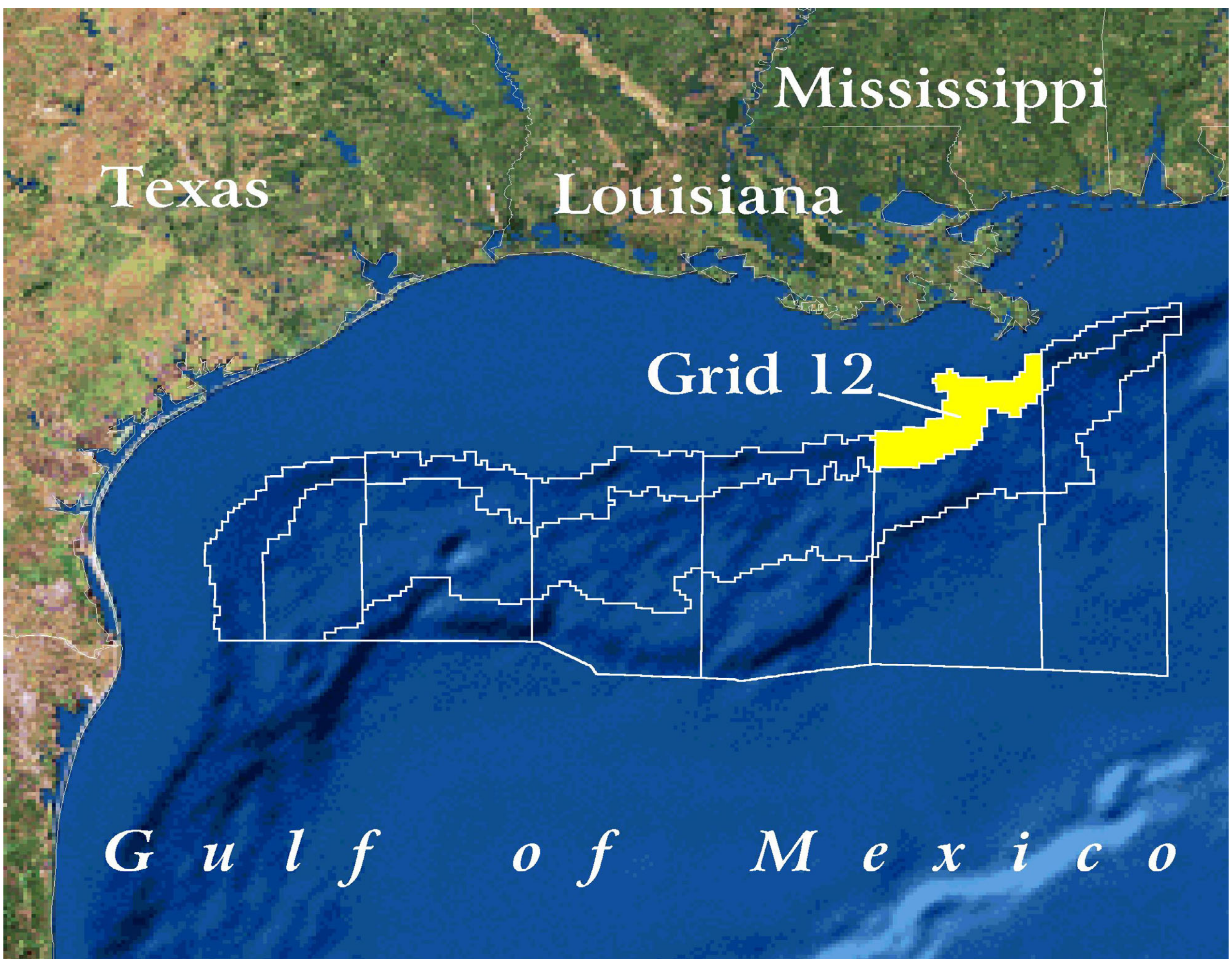
OCS EIS/EA
MMS 2002-041

Programmatic Environmental Assessment for Grid 12

Evaluation for Murphy Exploration and Production Company's Initial Development Operations Coordination Document, N-7269

Medusa Project
Mississippi Canyon Blocks 538 and 582



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

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Medusa Project
Mississippi Canyon Blocks 538 and 582

Prepared by

Minerals Management Service
Gulf of Mexico OCS Region

Published by

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Minerals Management Service
Gulf of Mexico OCS Region

New Orleans
July 2002

PROGRAMMATIC ENVIRONMENTAL ASSESSMENT FOR GRID 12 DETERMINATION

FINDING OF NO SIGNIFICANT IMPACT

Murphy Exploration and Production Company's Initial Development Operations Coordination Document (DOCD), supplement, and amendments propose to complete six wells, install a truss SPAR production platform with eight dry tree risers, and commence production from Mississippi Canyon, Blocks 538 and 582 (OCS-G 16614 and 16623) have been reviewed. Our programmatic environmental assessment (PEA) on the subject action (N-7269 and S-5886) 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. In your plan, you have stated that your proposed activities are in the vicinity of areas that could support high-density chemosynthetic communities. Therefore, please be reminded that you will use state-of-the-art positioning system (e.g., differential global positioning system) on your anchor handling vessel to ensure that any sea floor disturbance resulting from your use of anchors (including that caused by the anchors, anchor chains, and wire ropes) does not occur within 250-ft of such areas (see the enclosed map which depicts the areas). Additionally, you will submit plats, at a scale of 1 inch=1,000-ft with DGPS accuracy, to this office within 60 days after completion of operations which depict the "as-placed" location of all anchors, anchor chains, and wire ropes and demonstrate that the features were not physically impacted by these anchoring activities. (5.1)

2. 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)

3. In accordance with NTL 2001-G04, the MMS has determined that you will need to conduct the ROV surveys you proposed in your plan for the facility location approved under this plan. Submit your pre- and post-installation survey reports within 60 days after the facility installation is completed. (19.2)

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

7/18/02
Date

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

7/18/02
Date

7/18/02

Joe Christopher
Chief, Environmental Assessment Section
Leasing and Environment, GOM OCS Region

7/18/02
Date

For J. Hammond Eve
Regional Supervisor, Leasing and Environment
GOM OCS Region

7/18/2002
Date

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ABBREVIATIONS AND ACRONYMS

AC	Alaminos Canyon
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 Benthic Ecology
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	Texas-Louisiana 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
NGMCS	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
SIC	Standard Industrial Classification
SOP	suspension of production
TA	temporarily abandoned
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). An in-depth discussion of this strategy can be found 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, the 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 12.

This PEA will characterize the environment of Grid 12 and also examine the effects that may result from Murphy Exploration and Production Company's (Murphy) Initial Development Operations Coordination Document (DOCD) (N-7269) and its Supplement (S-5886) for the Medusa Project.

Figure 1 shows the relationship of Grid 12 to the Gulf's coastline and to the other 16 grids. Figure 2 depicts the protraction diagrams and blocks that are contained in Grid 12. Mississippi Canyon (MC) Blocks 538 and 582, which are highlighted, encompass the proposed location for the Medusa Project.

Current Status of Grid 12

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 12. See Appendix F for additional information and supportive data.

Grid 12 includes portions of the Atwater Valley, Ewing Bank, Green Canyon, and MC Outer Continental Shelf (OCS) protraction diagrams. Table 1 provides information on the protraction diagrams, blocks, leases, and acreage in Grid 12.

Table 1

Protraction Diagrams, Blocks, Leases, and Acreage in Grid 12

Protraction Diagrams	No. of Grid Blocks	Approximate Acreage in Grid	No. of Grid Blocks Leased	Percentage of Grid Blocks Leased
Atwater Valley	17	97,920	7	41.2
Ewing Bank	39	224,640	36	92.3
Green Canyon	68	391,680	41	60.3
Mississippi Canyon	202	1,163,520	138	68.3
Grid Totals	326	1,877,760	222	68.1

MC constitutes approximately 62 percent of the total number of blocks in the grid. It also contains about 62 percent of the total number of leases in the grid. Green Canyon is the second largest component of the grid. It contains approximately 21 percent of the total number of blocks in the grid and has slightly over 18 percent of the total leases. Ewing Bank and Atwater Valley contribute approximately 12 and 2 percent of total number of blocks and approximately 16 and 3 percent of total number of leases, respectively.

Figure 3 depicts the bathymetry of Grid 12 in 10-m contour intervals.

Military Warning Area (MWA) W-228A is located within Grid 12. Figure 4 depicts the boundary of this MWA. All leased blocks within the grid that are contained within the MWA will have stipulations included within their leases regarding specific Department of Defense mitigative measures, i.e., hold and save harmless, electromagnetic emissions, and operational considerations. For additional information regarding these stipulations, see the Final Environmental Impact Statement (EIS) for Central Planning Area Sales 169, 172, 175, 178, and 182 (USDOI, MMS, 1997).

Figure 4 shows that an ordnance disposal area is located in the northeastern part of Grid 12. Though this disposal area is inactive, it may contain unexploded munitions and other ordnance. Pipeline routes from the grid may require the operator to deviate their courses to avoid this area. 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."

Figure 4 also depicts Mississippi Canyon Block 194, which is located on the northern part of the Grid 12 and which has known concentrations of hydrogen sulfide (H_2S). Any oil and gas development activities within this block will require special precautions and plans from the operator. See the MMS's Operating Regulations (30 CFR 250) for specific H_2S requirements based on operational considerations (e.g., Subparts D, E, F, and H).

Grid 12 contains a total of 326 blocks. Of these blocks, 222 blocks (68.1%) are leased as of June 2002.

At present, there are 30 operators with leases in Grid 12. These operators include the following:

AEDC	Agip	Amerada Hess
Anadarko	BHP	BP
Chevron-Texaco	Devon	Dominion
EEX	El Paso	Encana
Exxon Mobil	Hunt	Kerr-McGee
Marathon	Mariner Energy	McMoRan
Murphy	Nexen	Ocean Energy
RME	Samedan	Shell
Spinnaker	TotalFinaElf	Union
W & T Offshore	Walter Oil & Gas	Westport Oil & Gas

Figure 5 geographically depicts the leasehold position of these operators within Grid 12.

The grid's active lease status and plans submitted data are portrayed in Figure 6. No other DOCD's have been submitted besides Murphy's Medusa 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 7 shows the locations of publicly announced prospects and fields within Grid 12. Drilled well locations within the grid and its surrounding area are also shown in Figure 7.

Figure 8 depicts the number and percentage of wells drilled, sidetracked, completed, temporarily abandoned, and/or permanently abandoned within Grid 12.

There are eight existing platform structures in the grid at this time. Murphy's spar is the first spar proposed in the grid. Detailed information on these structures is included in Appendix F.

There are active and proposed right-of-way pipeline routes contained within the grid. There are 99 active pipeline segments and 49 proposed pipeline segments in Grid 12. Figure 9 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 12. In the current proposal, Murphy has chosen Port Fourchon, Louisiana, as its onshore base to support the proposed operations. Figure 10 shows the relationship of Grid 12 to this shore base. The distance in miles from the grid to the shore base is also depicted on Figure 10.

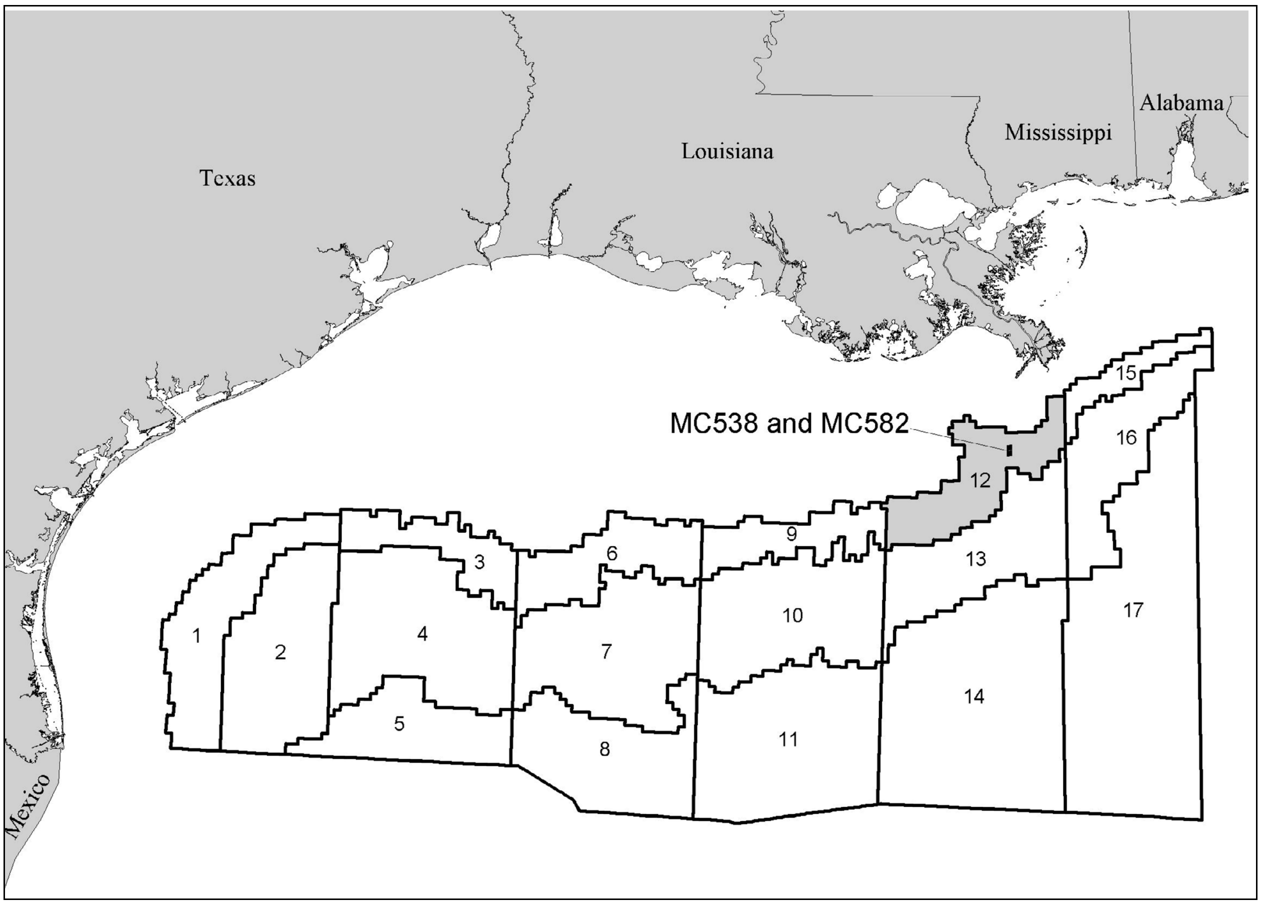


Figure 1. Grid 12 in Relationship to the Gulf Coastline and to Other Grids.

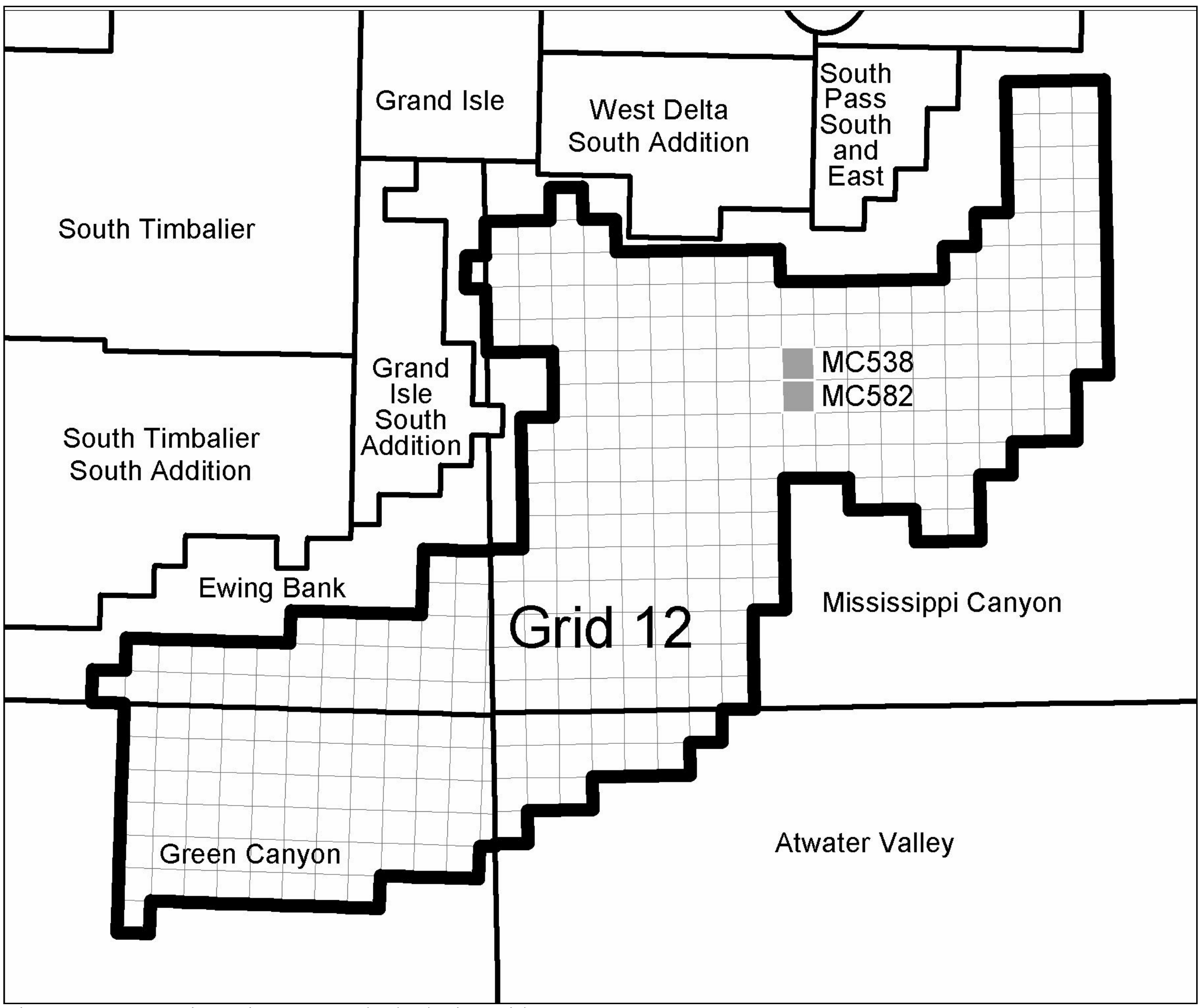


Figure 2. Protraction Diagrams and Blocks in Grid 12.

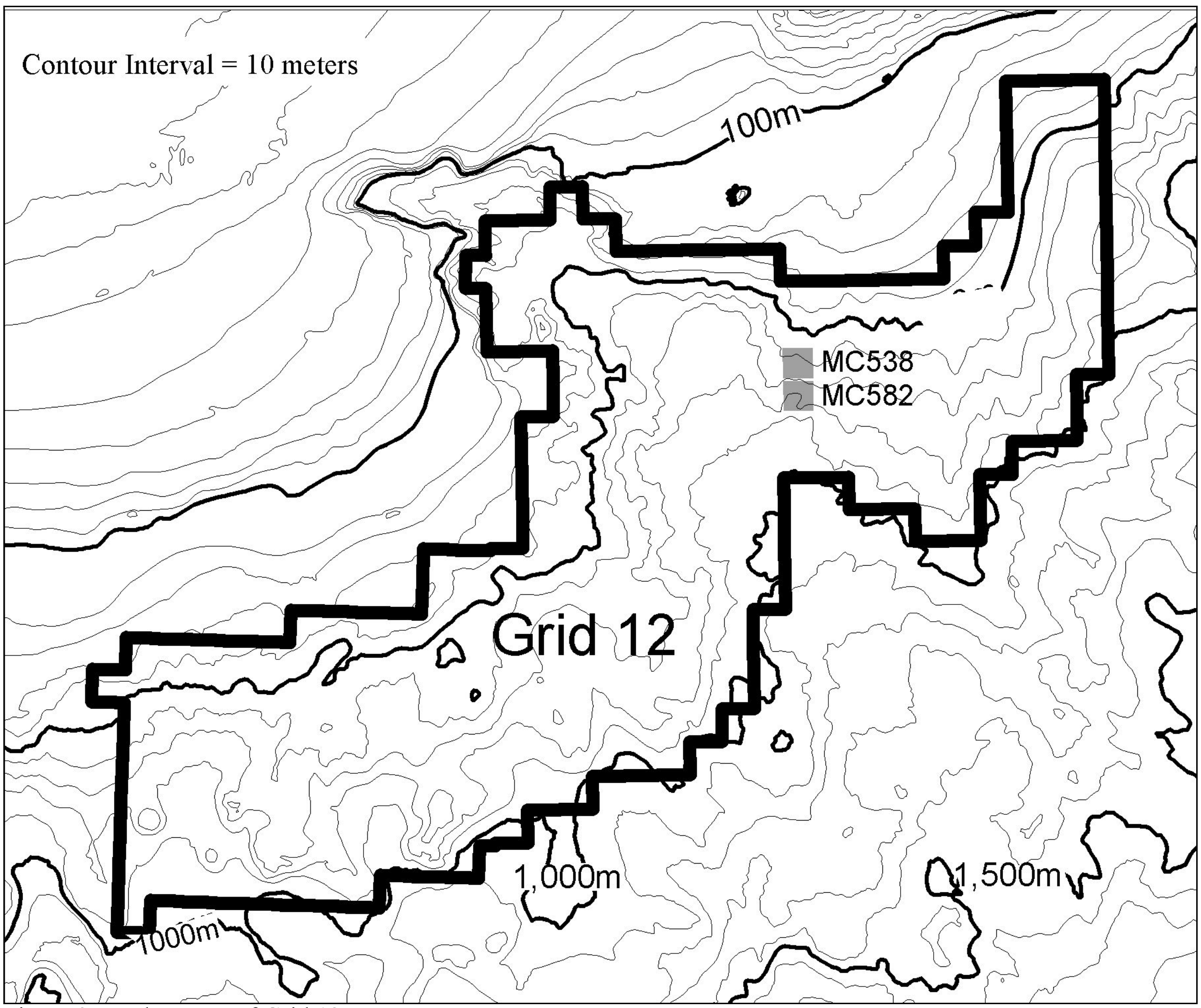


Figure 3. Bathymetry of Grid 12.

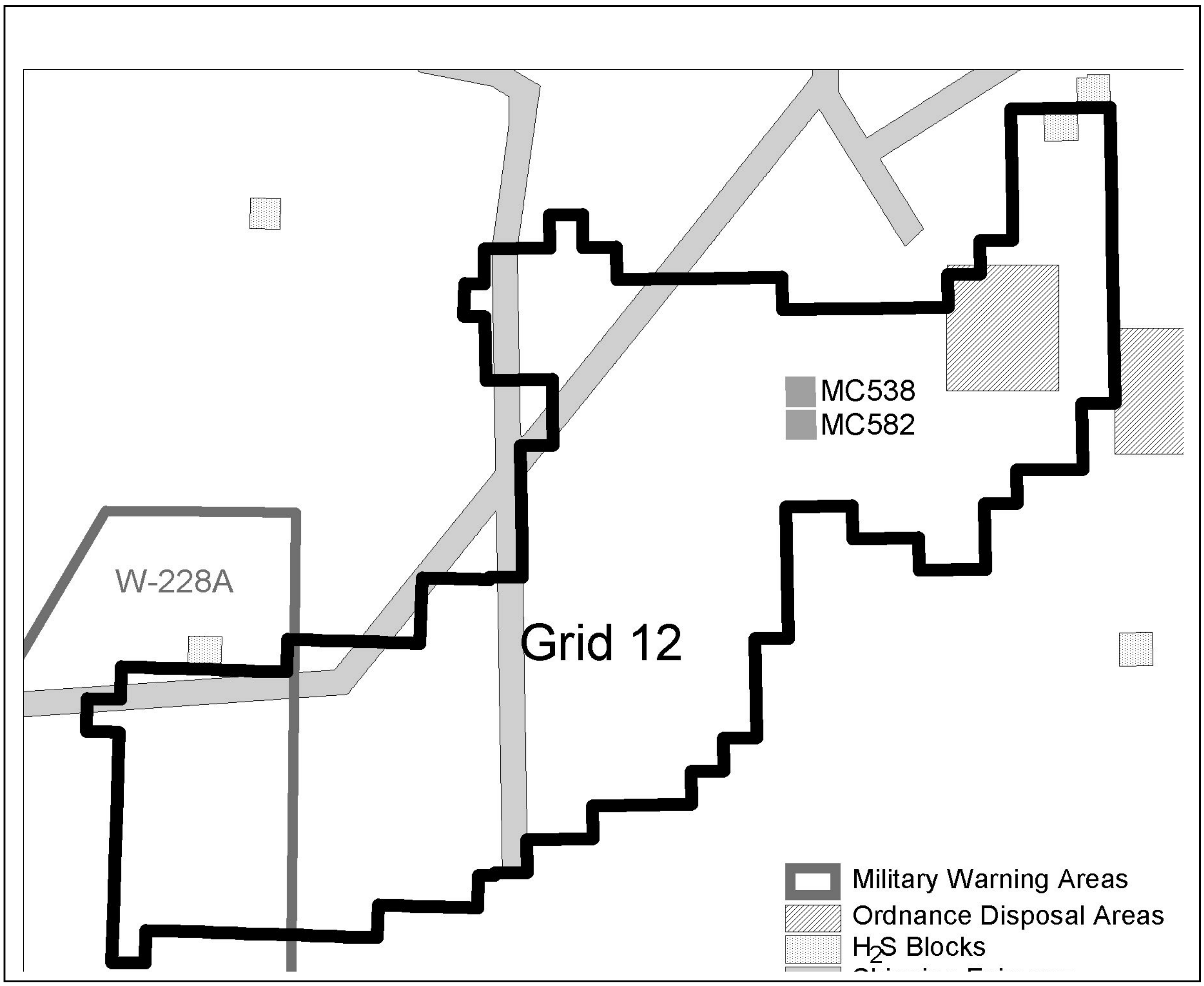
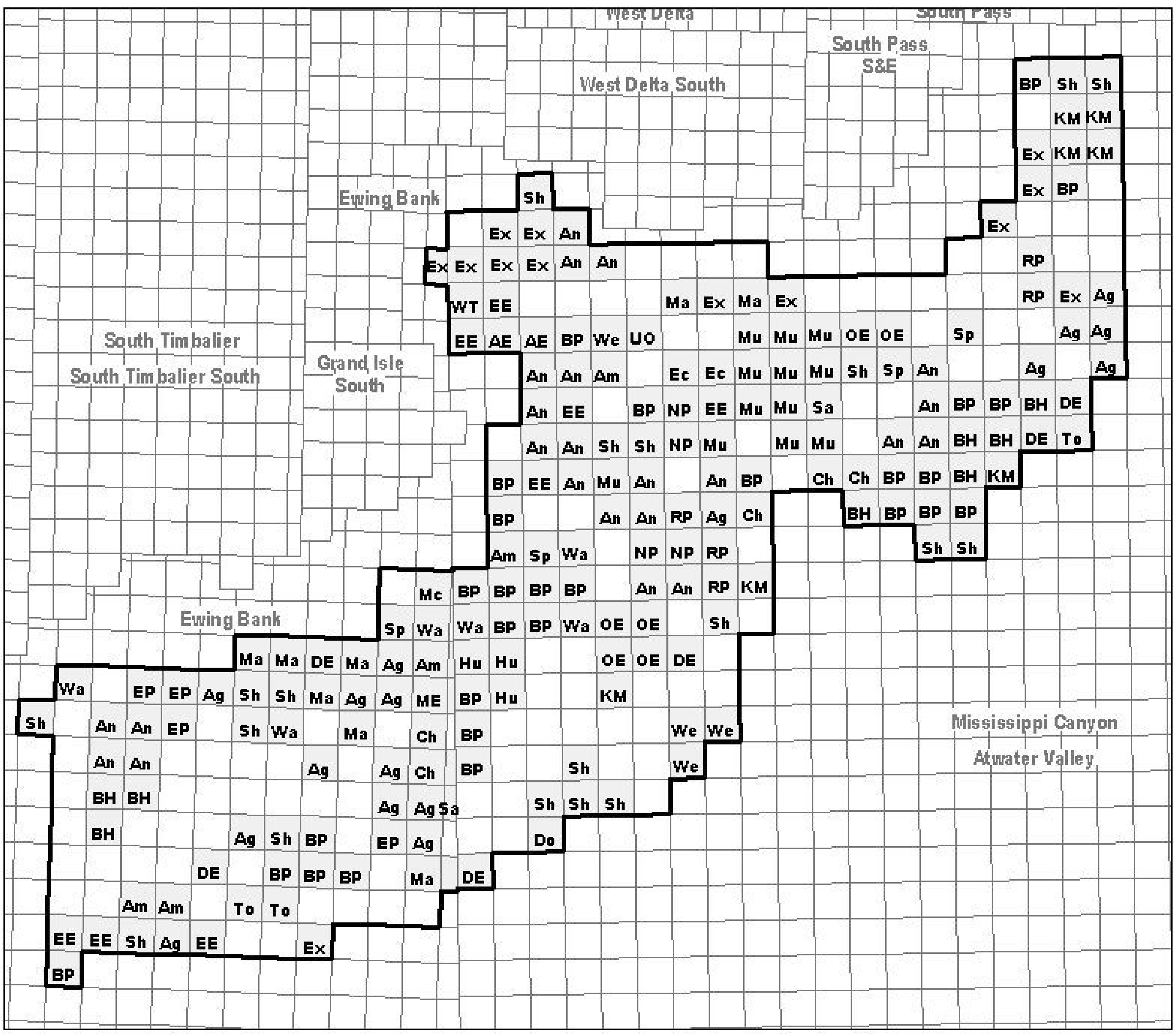


Figure 4 Military Warning Areas, H_2S Block, and Ordnance Disposal Area.



ACTIVE LEASE OPERATORS

— Grid Boundary

AE	AEDC USA INC	**EP**	EL PASO	**OE**	OCEAN ENERGY
Ag	AGIP PETROLEUM	**Ec**	ENCANA	**RP**	RME PETRO CO
Am	AMERADA HESS	**Ex**	EXXONMOBIL	**Sa**	SAMEDAN OIL CORP
An	ANADARKO	**Hu**	HUNT OIL CO	**Sh**	SHELL
BH	BHP	**KM**	KERR-MCGEE	**Sp**	SPINNAKER EXPL CO
BP	BP	**ME**	MARINER ENERGY INC	**To**	TOTALFINAELF E&P
Ch	CHEVRONTEXACO	**Ma**	MARATHON	**UO**	UNION OIL CO OF CA
DE	DEVON ENERGY	**Mc**	MCMORAN OIL & GAS	**WT**	W & T OFFSHORE
Do	DOMINION	**Mu**	MURPHY	**Wa**	WALTER OIL & GAS
EE	EEX CORP	**NP**	NEXEN PETROLEUM	**We**	WESTPORT

Figure 5. Leasehold Position of Operators within Grid 12.

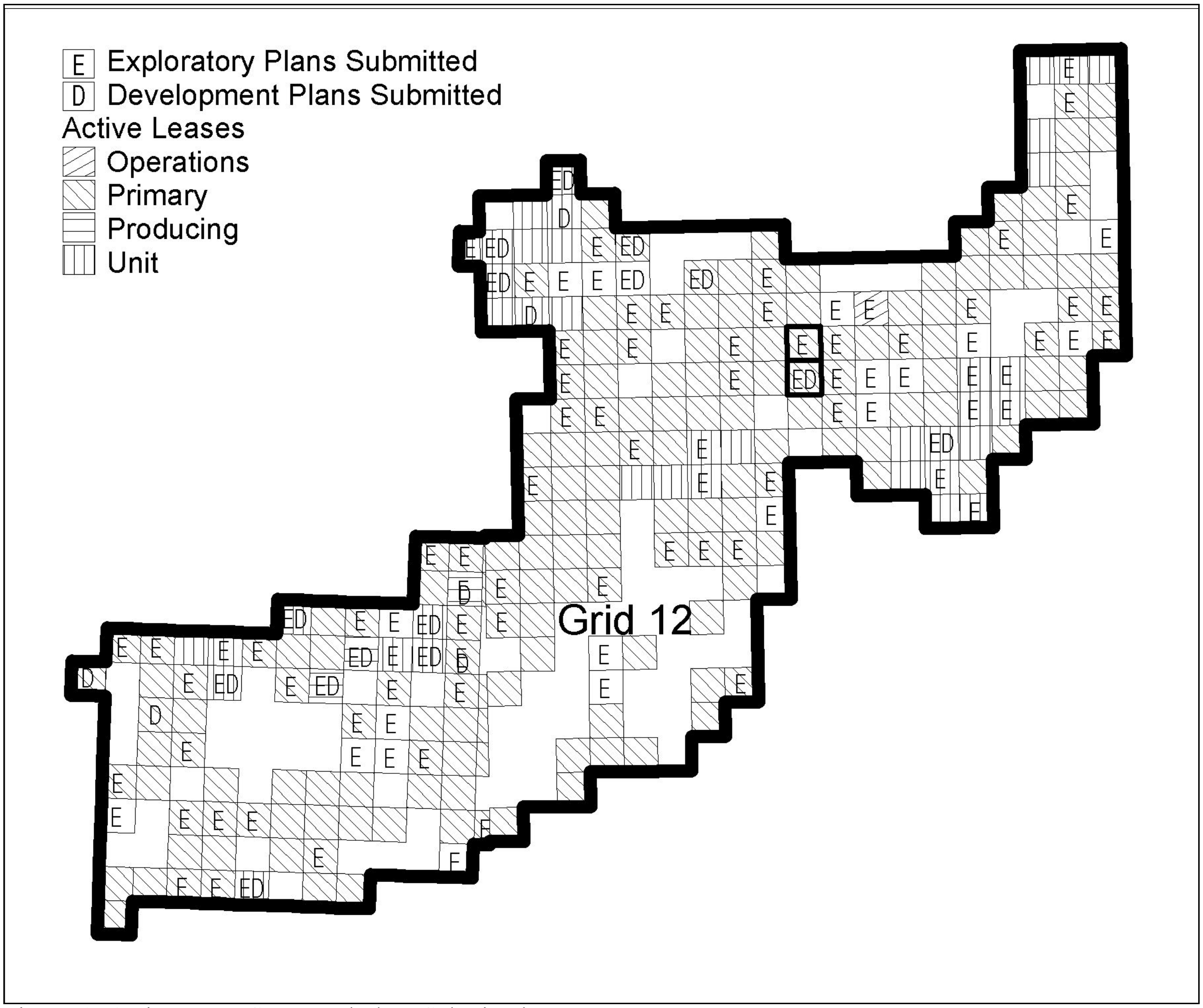


Figure 6. Active Lease Status and Plans Submitted.

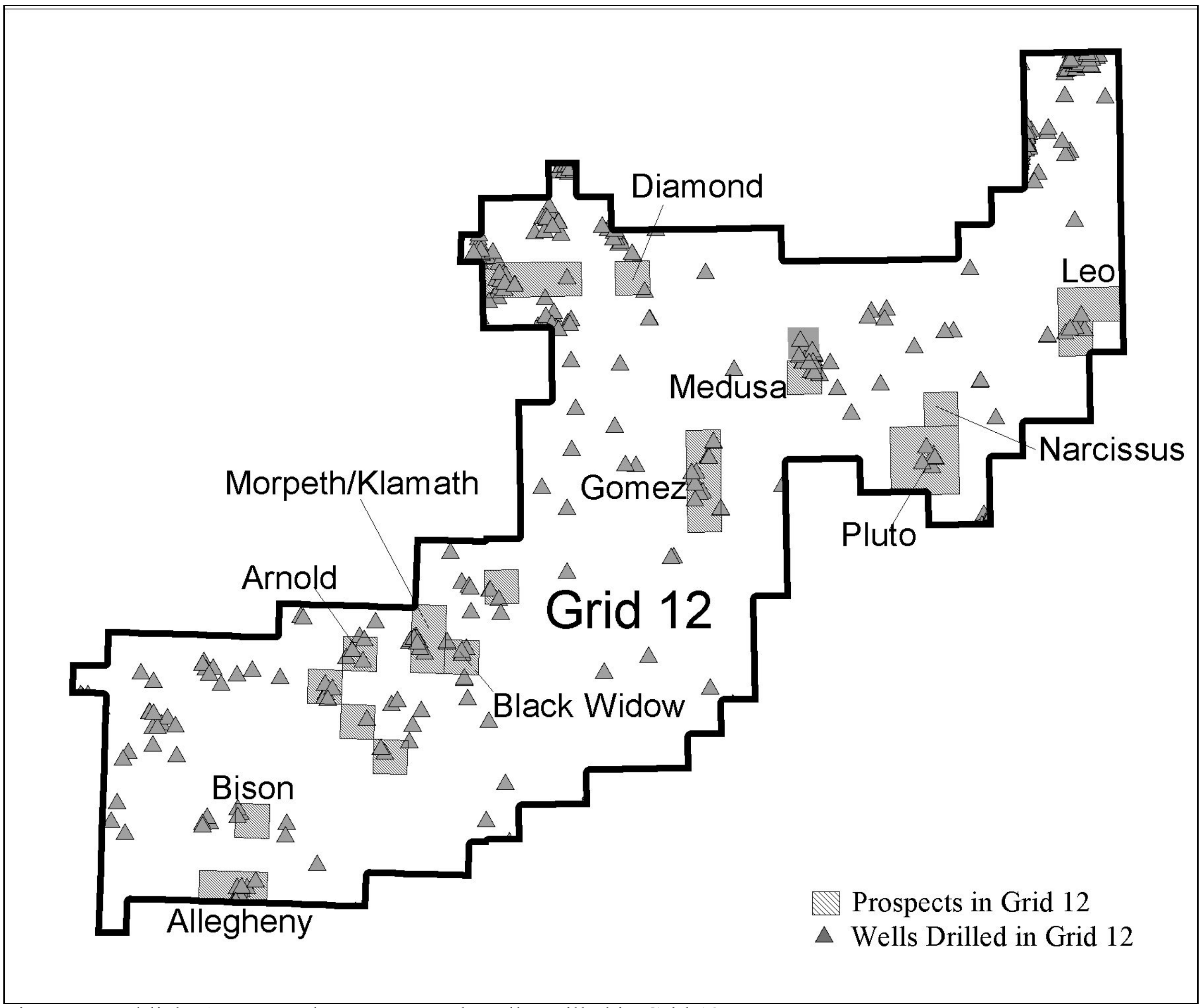


Figure 7. Publicly Announced Prospects and Wells Drilled in Grid 12.

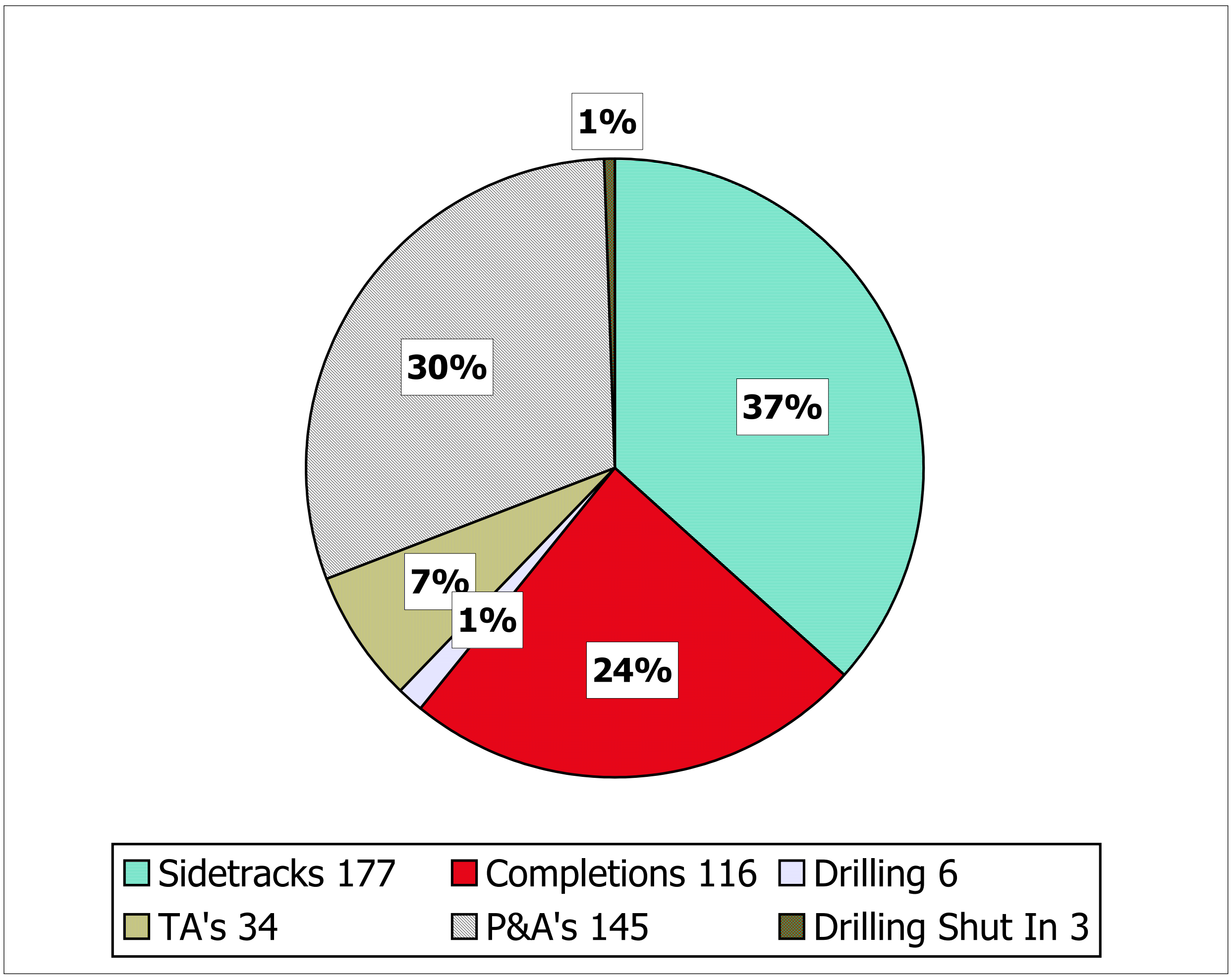


Figure 8. Exploration and Development Drilling Activities Conducted in Grid 12.

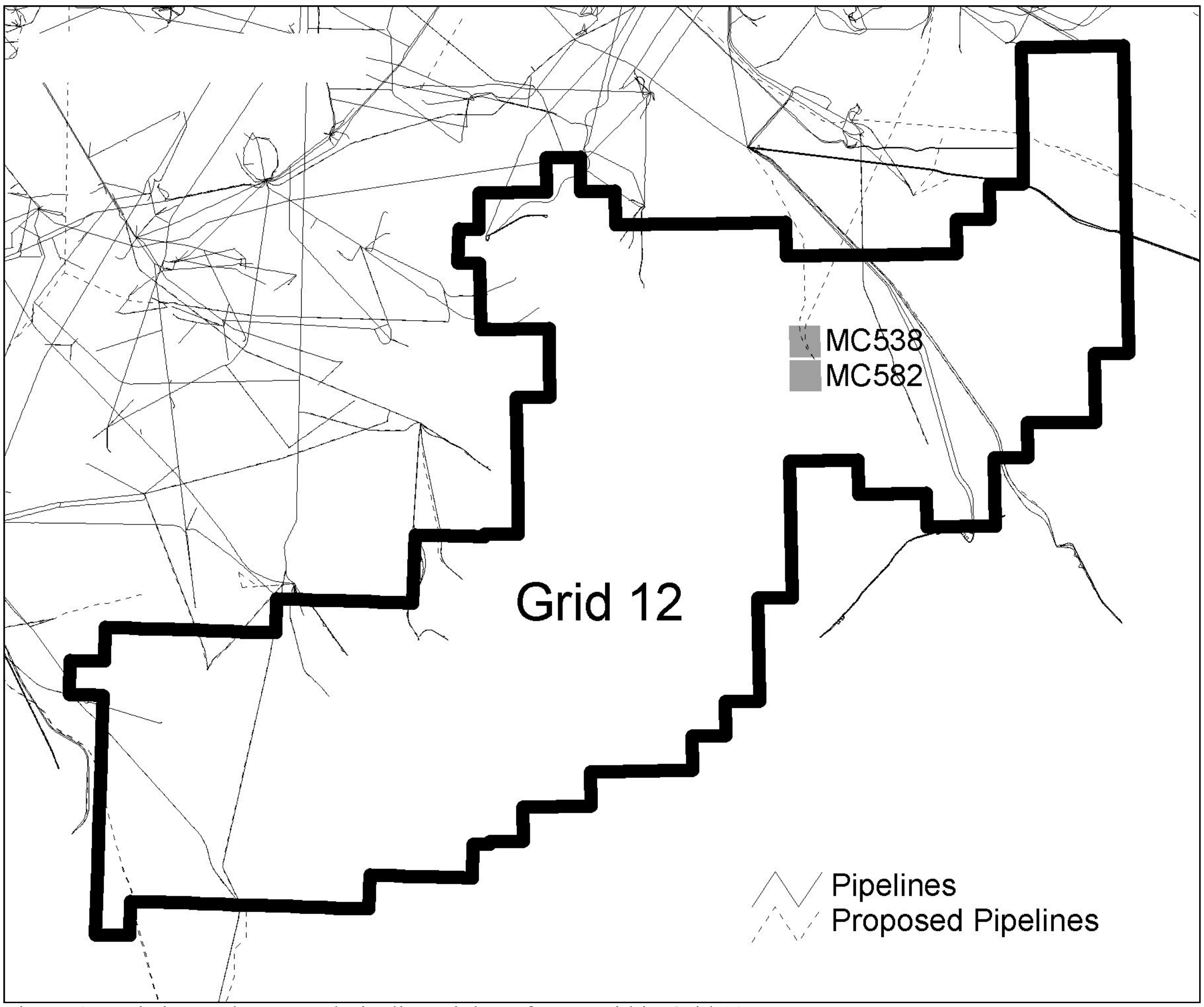


Figure 9. Existing and Proposed Pipeline Rights-of-Way within Grid 12.

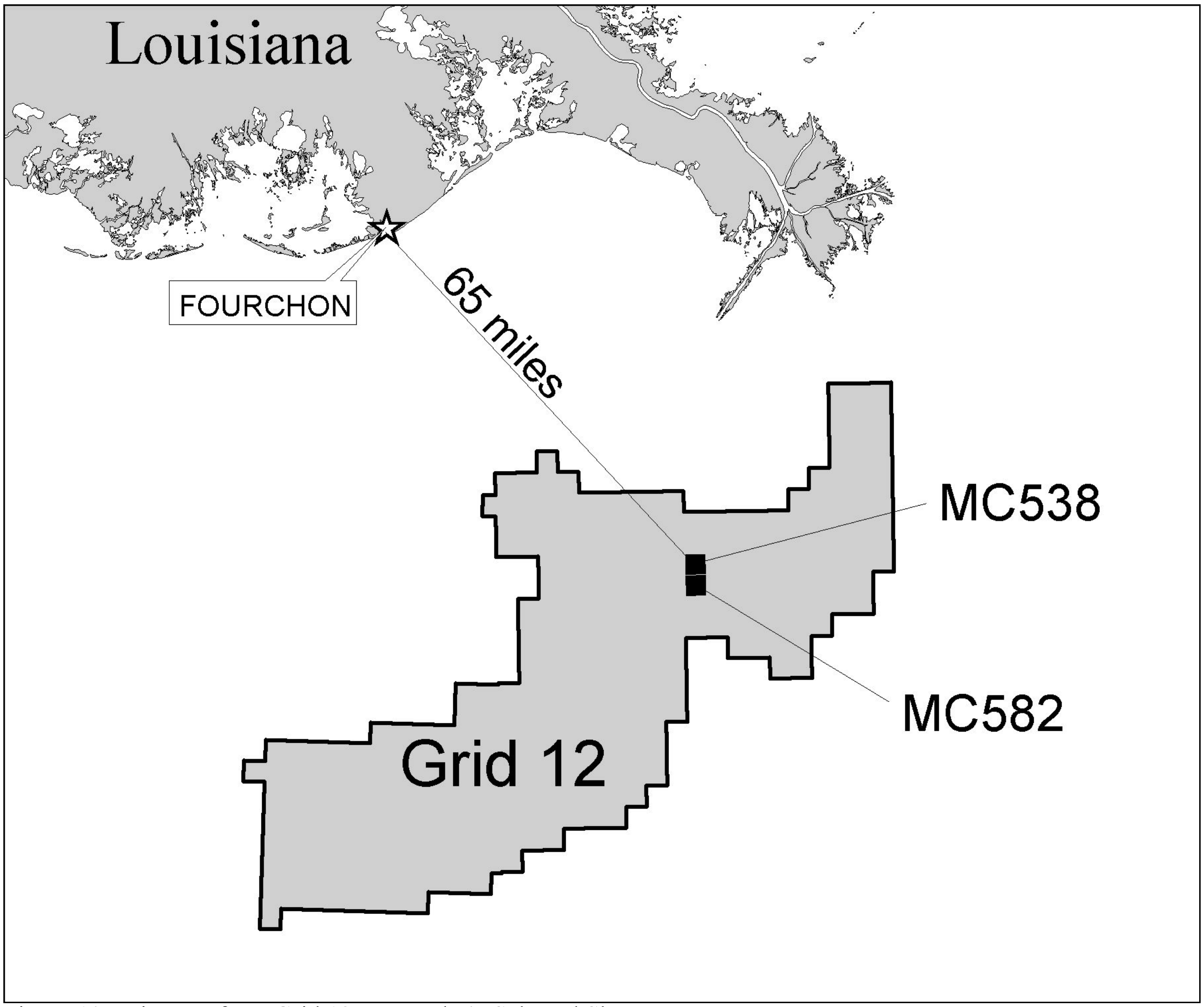


Figure 10. Distance from Grid 12 to Murphy's Selected Shore Base.

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.

Murphy Exploration and Production Company's (Murphy) Initial Development Operations Coordination Document (DOCD) and its supplement represent 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 Central Planning Area Sales 169, 172, 1754, 178, and 182 (USDOI, MMS, 1997), 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 12. 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 focused on selected key issues. The grid area was determined by 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, Murphy 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 GOM Region, Office of Field Operations, received an Initial DOCD from Murphy. The DOCD proposes to install a truss spar production platform (Platform "A") with eight dry tree risers (five of which will be installed initially) and complete, tie back, and produce five wells (wells #A1 through #A5) to the spar production platform on MC Block 582, Lease Number OCS-G 16623. On March 29, 2002, Murphy submitted a supplemental DOCD to install a riser and complete, tie back, and produce a sixth well (well #A6). The planned wells will share a common surface location in MC Block 582 (Murphy Exploration and Production Company, 2001). This proposal is also known as the Medusa Project. Previous projects on these leases include S-5763, R-3709, and R-3664. Also received via separate covers from the Viosca Knoll Gathering Company and Murphy were right-of-way (ROW) applications to construct, maintain, and operate a gas export pipeline and an oil export pipeline. The oil and gas ROW applications were previously approved via a separate NEPA review, but they are also discussed in this PEA. Table 1-1 depicts the spar's proposed location.

Table 1-1

Proposed Location of the Medusa Truss Spar in Mississippi Canyon Block 582

Surface Location	Distance from Lease Lines	Lambert X-Y Coordinates	Latitude/Longitude
Medusa Truss Spar	FNL 285 ft FEL 3,685 ft	X = 851,677 Y = 10,311,554	Lat. 28° 23' 33.3" Long. 89° 27′12.9"

Note: FNL is from the north line of the lease.
FEL is from the east line of the lease.

The Medusa spar would be a manned, floating production facility that will be anchored with a spread mooring system composed of conventional steel spiral strand wire, chain, and anchor (suction) piles over the existing wells utilizing surface trees to the extent possible. A workover/completion rig would be used for the initial completion operations and for performing any well re-completion, workover, or sidetrack operations if necessary. No additional onshore facilities would be built as a result of this proposed action. A 14-member crew will man the spar.

Table 1-2 shows the activity schedule proposed by Murphy for their Medusa Project.

Table 1-2

Proposed Activity Schedule for the Medusa Project

Activity	Start Date	End Date
Pipeline installation	05/01/02	05/21/02
Platform installation	07/15/02	08/31/02
Set rig	09/01/02	09/10/02
Complete 1st well	09/11/02	10/19/02
Initial Production	10/20/02	
Complete additional 2 wells	10/21/02	12/31/02
Complete additional 2 wells	01/01/03	04/10/03
Tieback and complete 6th well	04/11/03	05/15/03

The water depth at the spar location is approximately 2,223 ft (678 m). The deepwater development is located approximately 36.8 mi (58.9 km) from the nearest Louisiana shoreline. The project will use existing onshore support bases in Port Fourchon, Louisiana, to support the proposed activities, which is approximately 65 mi (105 km) from the proposed spar location.

Crude oil, condensate, and natural gas produced at the Medusa field would be transported off lease by two ROW pipelines. The 12.75-in natural gas ROW pipeline would originate at the proposed spar, run approximately 35 mi, and would terminate at South Pass Block 55. The 12-in crude oil ROW pipeline would also originate at the proposed spar, run approximately 20 mi, and would terminate at West Delta Block 143. The environmental effects from these transportation operations were evaluated in a previous NEPA analysis, but they are also considered and discussed in this PEA as previously-approved related activities. Tables 1-3 and 1-4 provide information on the ROW pipelines.

Table 1-3

Proposed Medusa Bulk Natural Gas ROW Pipeline

Applicants	Viosca Knoll Gathering Company
Control Number	Right-of-Way Grant OCS-G 23438, Pipeline Segment No. P-13688
Pipeline Size (O.D.) and Type	12.75-in, bulk natural gas
Area and Blocks Involved	MC Blocks 582, 538, 494, 451, 407, 383, 364, and 320 South Pass Blocks 96, 92, 90, 85, 84, 82, 75, 75, and 55
Approximate Length	35 miles
Start Point and Water Depth	Medusa spar (Platform A) in MC Block 582; WD = 2,223 ft
End Point and Water Depth	Tennessee Platform A in South Pass Block 55; WD = 260 ft
Overall Estimated Completion Time	42 days

Table 1-4

Proposed Medusa Bulk Oil ROW Pipeline

Applicants	Murphy Exploration and Production Company
Control Number	Right-of-Way Grant; OCS-G 23724, Pipeline Segment No., P-13776
Pipeline Size (O.D.) and Type	12-in, bulk natural oil
Area and Blocks Involved	MC Blocks 582, 538, 494, 450, 406, 362, 361, and 317 West Delta Area Blocks 147,148, and 143
Approximate Length	20 miles
Start Point and Water Depth	Medusa spar (Platform A) in MC Block 582; WD = 2,223ft
End Point and Water Depth	Shell Platform B in West Delta Block 143; WD = 369 ft
Overall Estimated Completion Time	106 days

2. ALTERNATIVES TO THE PROPOSED ACTION

2.1. NONAPPROVAL OF THE PROPOSAL

Murphy would not be allowed to drill, complete, and produce the six wells proposed in its Initial and Supplemental DOCD's. 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 Murphy 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 EIS for Central Planning Area Sales 169, 172, 175, 178, and 182 (USDOI, MMS, 1997). 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 Murphy 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 Central Planning Area Sales 169, 172, 175, 178, and 182 (USDOI, MMS, 1997). Approval of the proposal with existing and additional mitigation is the selected alternative. The following additional mitigation has been identified.

Mitigation 5.1 (Advisory) - Anchor Positioning (GPS)

In your plan, you have stated that your proposed activities are in the vicinity of areas that could support high-density chemosynthetic communities. Therefore, please be reminded that you will use state-of-the-art positioning system (e.g., differential global positioning system) on your anchor handling vessel to ensure that any sea floor disturbance resulting from your use of anchors (including that caused by the anchors, anchor chains, and wire ropes) does not occur within 250-ft of such areas (see the enclosed map which depicts the areas). Additionally, you will submit plats, at a scale of 1 inch=1,000-ft with DGPS accuracy, to this office within 60 days after completion of operations which depict the "as-placed" location of all anchors, anchor chains, and wire ropes and demonstrate that the features were not physically impacted by these anchoring activities.

Mitigation 8.3 - (Advisory) H_2S Absent

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 19.2 - (Advisory) ROV Survey Required

In accordance with NTL 2001-G04, the MMS has determined that you will need to conduct the ROV surveys you proposed in your plan for the facility location approved under this plan. Submit your pre- and post-installation survey reports within 60 days after the facility installation is completed.

3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1. PHYSICAL ELEMENTS OF THE ENVIRONMENT

3.1.1. Water Quality

3.1.1.1. Coastal Water Quality

Nearshore water quality along the Gulf north-central coast is addressed because the Medusa Project is located off the mouth of the Mississippi River, offshore the Louisiana coast, and because accidental spills could make landfall in this region. 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.

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, fishes, 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 then adult stages. The quality of coastal waters is, therefore, an important issue.

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 ppt during fall and winter but fall to 20 ppt during spring and summer due to increased runoff (USDOI, MMS, 1997). 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, recreational and commercial fisheries, and so forth (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, 1997) with municipalities, refineries and petrochemical plants accounting for the majority of these point sources. Most of the industrial sources are in Texas and Louisiana with much lesser numbers in the remaining Gulf States. 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, increased turbidity, release of contaminants, and so forth. 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, 1997). 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, 1997).

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, 1997). 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 and Beliaeff, 1995). At least some contaminants are bioavailable, as evidenced by the 1986-1999 Mussel Watch Program (USDOI, MMS, 2001a).

3.1.1.2. Offshore Water Quality

Offshore marine waters in the GOM are characterized by higher salinity (36.0-36.5 ppt) than inshore waters (USDOI, MMS, 1997). 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) from the river delta to Freeport, Texas, and is probably exacerbated by human inputs (USDOI, MMS, 1997). 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, 1997).

Offshore areas, particularly over deep water, could be considered almost pristine compared to the coastal waters, particularly off southern Texas and Florida (USDOI, MMS, 1997). 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 (USDOI, MMS, 1997). Similarly, trace metal concentrations are low relative to coastal waters (Boyle et al., 1984 in USDOI, MMS, 1997).

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, 1997). 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, 1997). 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., 2002; USDOI, MMS, 1997). 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., 2002), 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., 2002; USDOI, MMS, 1997).

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., 2002). 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

The proposed operations would occur west of 87.5° W. longitude and hence fall under MMS's jurisdiction for enforcement of the Clean Air Act. The air over the OCS water is not classified, but it is presumed to be better than the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants. The blocks involved, MC Blocks 538 and 582, are in OCS waters, south of the Mississippi River Delta. These blocks are located between 100 and 200 km of the Breton National Wilderness Area (BNWA) Prevention of Significant Deterioration (PSD) Class I Area. Although, the closest onshore areas are within 60 km and are located in Plaquemines Parish, Louisiana, this area is in attainment of the NAAQS (USEPA, 2001), and for PSD purposes is classified as Class II.

The influence to onshore air quality is dependent upon meteorological conditions and air pollution emitted from the proposed action. The pertinent meteorological conditions are the wind speed and direction, the atmospheric stability, and the mixing height, which govern the dispersion and transport of emissions. The typical synoptic wind flow for this area is driven by the clockwise circulation around the Bermuda High, resulting in a prevailing southeasterly to southerly flow, which is conducive to transporting emissions toward shore. However, superimposed upon this synoptic circulation are smaller meso-scale wind flow patterns, such as the land/sea breeze phenomena. In addition, there are other synoptic scale patterns that occur periodically, namely tropical cyclones, and mid-latitude frontal systems. Because of the routine occurrence of these various conditions, the winds blow from all directions in the area of concern (USDOI, MMS, 1988).

The atmospheric stability is typically expressed using the Pasquill-Gifford stability classes. However, not all of the Pasquill-Gifford stability classes are routinely found offshore in the GOM. Specifically, the F stability class is rare. The "F" stability class is characterized by the extremely stable condition (i.e., a strong radiative inversion) that usually develops at night, over land, with rapid radiative cooling of the ground surface and the air directly above it. This type of atmospheric stability strongly limits the vertical dispersion of emitted air pollutants. The large heat capacity of the GOM is simply incapable of loosing enough heat overnight to set up a strong radiative inversion. Likewise, "A" stability class is also rare. Stability is characterized by the extremely unstable condition that develops over land with very rapid warming of the ground surface and the air directly above it and the occurrence of colder air aloft. This type of atmospheric stability strongly enhances the vertical dispersion of air pollutants. Although, once again, the large heat capacity of the GOM does not allow for the ocean surface warming rapidly. Therefore, the most common stability classes over the GOM are slightly unstable to neutral, which are conducive to only a moderate amount of buoyant vertical dispersion.

The mixing height is a measure of the upward extends for the vertical dispersion of emitted air pollutants. Offshore mixing heights are rather shallow, generally less than 1,000 m (3,281 ft), as compared to onshore mixing heights, which are typically greater than 2,000 m (6,362 ft) during the day. Close to shore, the mixing height over the water increases notably from the typical offshore level, due to the water being shallower and the influence of the land, which penetrates out over the water for a short distance. Thus, with a typical southeasterly to southerly wind flow, which is conducive to transporting emissions toward shore, the extent of the vertical dispersion will increase as the shoreline is approached. This has the effect of lowering the resultant air pollutant concentration arising from emissions.

The composite of these meteorological conditions that influence the dispersion and transport of emissions is represented by an exemption level, which can be compared to the projected air pollutant emissions for a proposed action.

3.2. Biological Resources

3.2.1. Sensitive Coastal Environments

3.2.2. Coastal Barrier Beaches and Associated Dunes

General information on types and status of coastal landforms in the Central and Western Gulf is contained in USDOI, MMS (2001a). The brief description below is a summary of that document.

Barrier landforms include islands, spits, dunes, and beaches. The landforms are usually long and narrow in shape, having been formed by sediment transported by rivers, waves, currents, storm surges, and winds. Barrier landforms are in a state of constant change and they can be classified into two main types:

1. Transgressive—where shoreline is moving inland and marine deposits overlay terrestrial ones. This type is usually rapidly eroding, low profile, sparsely vegetated, with numerous washover channels.
2. Regressive—where shoreline is moving seaward and terrestrial sediments are becoming overlain over the marine ones. Type is higher profile, well-vegetated dunes, with few if any washover channels (USDOI, MMS, 2001b).

Both types are important ecologically. Barrier islands, particularly vegetated ones with fresh- and/or saltwater pools, may serve as habitat for a variety of fairly specialized species, including birds. The islands and spits protect the bays, lagoons, estuaries, salt marshes, seagrass beds, and other wetlands, some of which may contain threatened or endangered species.

3.2.2.1. Wetlands

Wetlands are common along the coast of the GOM, 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, 2001b).

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, 2001b). 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 USDOC, 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).

3.2.2.2. Seagrasses

Seagrass communities are extremely productive, providing essential habitat for wintering waterfowl, as well as spawning and feeding habitat for several commerially and recreationally species of fish and shellfish, and endangered and threatened species of manatee and sea turtles. Seagrass habitat loss in the Gulf have 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).

3.2.3. Deepwater Benthic Communities/Organisms

3.2.3.1. 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., 1986). 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 over 50 sites across the northern GOM continental slope where the presence of chemosynthetic metazoans (dependent on hydrocarbon seepage) have been definitively documented (Gallaway et al., 2000). A number of known chemosynthetic communities are located in Grid 12, but the closest one is more than 39 nmi distant from the Medusa Project. 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 Medusa Project was performed separately from this EA. The conclusion of this analysis, completed on January 3, 2002, determined that all impacting factors related to the Medusa development in MC Blocks 582 and 538 are well removed from any area with potential for the existence of chemosynthetic communities pursuant to the requirements of NTL 2000-G20.

3.2.3.2. 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) (Figure 3-1). None of these are located in the deepwater areas of Grid 12.

Currently, 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).

3.2.3.3. Deepwater Benthos

Marine benthic communities consist of a wide variety of single-celled organisms, plants, bacteria, invertebrates, and to some extent, even 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.

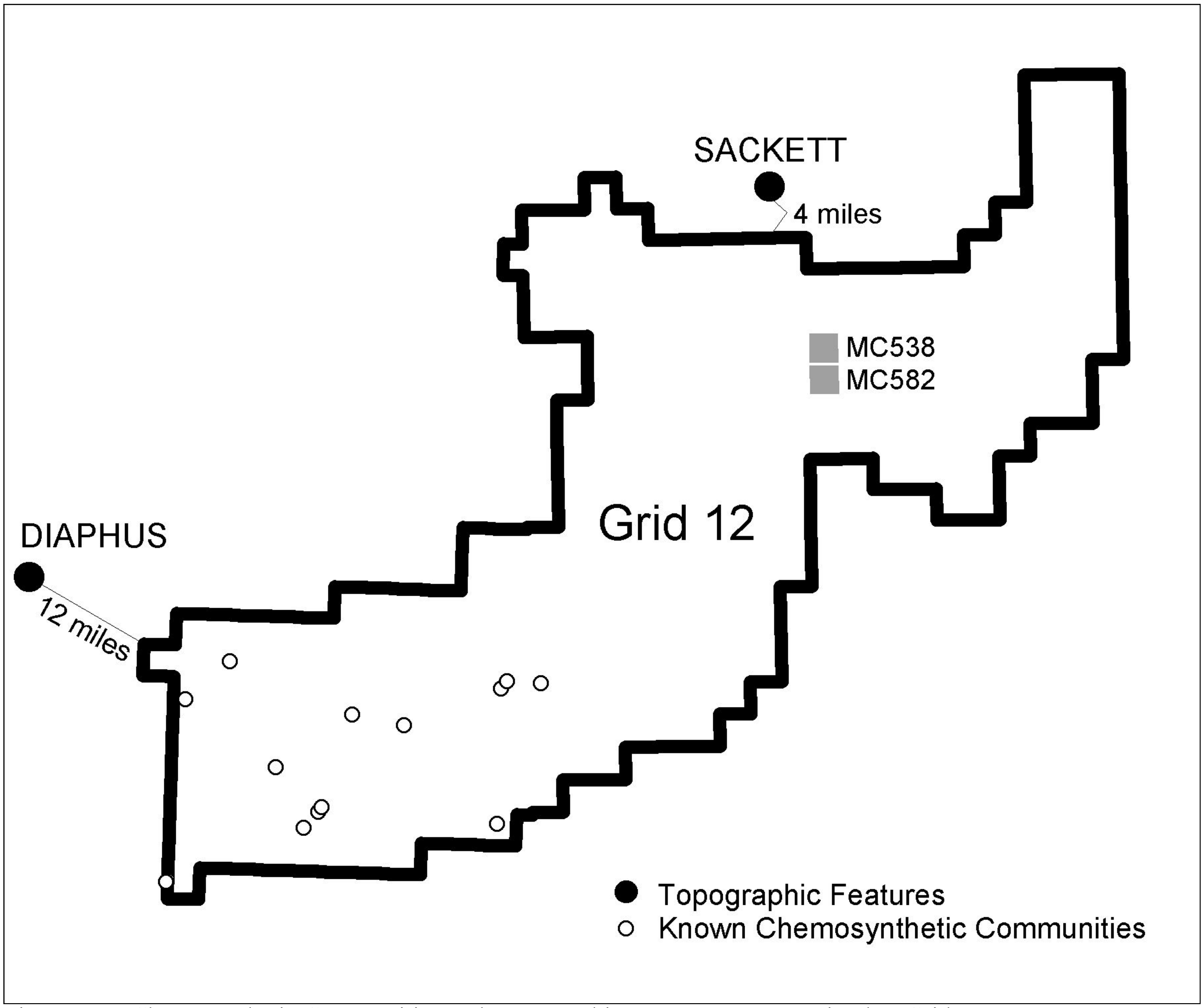


Figure 3-1. Chemosynthetic Communities and Topographic Features In or Proximal to Grid 12.

3.2.3.3.1. 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, 2001b). 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, 2001b). 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; USDOI, MMS, 2001b). These zones include the following:

- Shelf/Slope Transition Zone (100-500 m) — Echinoderms, crustaceans, and several species of abundant fish.
- Archibenthal Zone (Horizon A) (500-775m) — 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 Northern Gulf of Mexico Continental Slope Study (NGMCS) 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. (2002) 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 Medusa development, at a depth of 678 m, lies within the distinct upper slope zone described above.

3.2.3.3.2. Macrofauna

The benthic macrofaunal component of the NGMCS Study (Gallaway et al., 2002) 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 Medusa 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., 2002). 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., 2002). 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., 2002).

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, 2001b). This decline in benthos has been attributed to the relatively low productivity of the Gulf offshore open waters (USDOI, MMS, 2001b). 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. (2002) 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., 2002) and that size of individuals are generally small. Macrofaunal abundance appears to be higher in spring than in fall (Gallaway et al., 2002).

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., 2002).

3.2.3.3.3. 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., 2002; USDOI, MMS, 2001b). 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., 2002). 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., 2002). 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., 2002).

The above conclusions were partially based on the collections from the NGMCS Study stations in adjacent Grid 13 and 14 (the Central Gulf transect) (see also “Macrofauna” above). 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., 2002).

3.2.3.3.4. 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, 2001a) 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 re-pressurized 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.

3.2.4. 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).

3.2.4.1. Nonthreatened and Nonendangered Species

Cetaceans – Mysticetes

Bryde's Whale (Balaenoptera edeni)

The Bryde's whale (*Balaenoptera edeni*) is the second smallest of the balaenopterid whales; 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; 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 (Balaenoptera acutorostrata)

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 were 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 (Stenella frontalis)

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 (Tursiops truncatus)

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 (Stenella clymene)

The Clymene dolphin *(Stenella clymen*e) 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 (Pseudorca crassidens)

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 (Lagenodelphis hosei)

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 (Orcinus orca)

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 (Peponocephala electra)

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., 1994a).

Pantropical Spotted Dolphin (Stenella attenuata)

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 (Feresa attenuata)

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 (Grampus griseus)

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 (Steno bredanensis)

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., 1999). 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 (Globicephala macrorhynchus)

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 (Stenella longirostris)

The spinner dolphin *(Stenella longirostris*) 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 (Stenella coeruleoalba)

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).

3.2.4.2. Threatened and Endangered Species

Cetaceans — Mysticetes

Blue Whale (Balaenoptera musculus)

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 (Balaenoptera physalus)

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 (Megaptera novaeangliae)

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 (Eubalaena glacialis)

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 (Balaenoptera borealis)

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 (Physeter macrocephalus)

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 (Trichechus manatus)

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.

3.2.5. 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 hawksbill, 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 (Chelonia mydas)

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 (Eretmochelys imbricata)

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, 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, 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 (Lepidochelys kempi)

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 (Caretta caretta)

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 (Dermochelys coriacea)

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., 1983a; Lohoefener et al., 1988, 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 MC 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).

3.2.6. 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).

3.2.6.1. Threatened and Endangered Species

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 GOM 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 southeast 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, written 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).

3.2.7. Essential Fish Habitat and Fish Resources

3.2.7.1. 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 Fishery Management Plans (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 EFH whether it is direct (physical disruption) or indirect (loss of prey). Federal agencies are also required to assess actions that could conserve and enhance EFH.

In the Central and Western Gulf, essential fish habitat 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, 2001b, 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).

3.2.7.2. Description of 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, 2001a).

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 Medusa 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 2001b).

3.2.7.2.1. 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.

3.2.7.2.2. 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).

3.2.8. 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).

3.2.9. Beach Mice

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.

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 Gulf of Mexico 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 the table, 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 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:

LA-1

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

LA-2

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

LA-3

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

MA-1

Baldwin, AL
Mobile, AL
Hancock, MS
Harrison, MS
Jackson, MS
St. Landry, LA

TX-1

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

TX-2

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

FL-1

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

FL-2

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

FL-3

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

FL-4

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, 76.7 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 Gulf of Mexico 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. A small amount of vessel and helicopter traffic may originate from bases other than Port Fourchon in order to address changes in weather, market, and operational conditions.

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. Current crude oil and natural gas prices are substantially above the economically viable threshold for drilling in the GOM. As of April 18, 2002, Henry Hub Natural Gas closed at $3.485 per million BTU (an increase of 44% or $1.071 from six months 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, is down and a turnaround in the economy is not expected in the short term (Houston Chronicle On-line, 2001a). Although the Secretary-General of OPEC, Ali Rodriguez, said that the Arab-dominated cartel would ensure world oil supplies and price stability immediately following the September 11, 2001, terrorist attacks on the United States, oil and gold prices surged (COMTEX, 2001). Crude oil prices then dropped, taking their biggest hit in 10 years during September 2001. Fear of a recession that would reduce demand is compounded by the belief that OPEC will not act to maintain prices (Houston Chronicle On-line, 2001b). Oil prices have since moved moderately higher over the last six months with a steeper increase since late February 2002. Light sweet crude averaged $25.71 per barrel on the New York Mercantile Exchange between April 1 and April 18, 2002 (an increase of 4.9% or $1.19 from the March 2002 average).

New rig deliveries and orders are another indicator of the industry. Fifteen new rigs were delivered in 2000, three of which were speculative new builds. All three of these "spec" rigs had contracts waiting for them by the time they were delivered. After taking a hiatus from placing new rig orders in 1999, drilling contractors once again began to open up their pocketbooks in 2000. Orders for six new drilling rigs were placed in 2000. A recent survey by Lehman Brothers asked over 60 'leading experts' how many rig orders would be placed for 2001. The average of all the predictions was 13 (One Offshore, 2001a). However, Tom Marsh, associate publisher with One Offshore Inc., does not believe that 2002 will be particularly strong for offshore constructions (One Offshore, 2002).

In addition to new rig deliveries and orders, drilling rig use is employed by the industry as a barometer of economic activity. After having 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, the March 2002 utilization rate for all marketed mobile rigs in the GOM was 71.9 percent (One Offshore, 2002). This breaks down as a 72.0 percent utilization rate for jackups (average day rates of $15,500-$32,000); 70.0 percent for semisubmersibles (average day rates of $30,000-$105,000); 87.5 percent for drillships (average day rates are not available); and 50.0 percent for submersibles (average day rates of about $18,000). Platform rigs in the Gulf recorded a 51.7 percent utilization rate, while inland barges had a 42.0 percent utilization rate. Offshore drilling rig day rates remained flat or declined in the major offshore drilling market segments over the last month. In the GOM, 250-ft to 300-ft rated jackup drilling units saw a slight increase in day rates from March to April, but with fleet utilization hovering around 70 percent, too much excess rig capacity exists in the market for rates to increase significantly. Deepwater drilling fleet utilization remains above 90 percent, but the pace of deepwater drilling has slowed, putting downward pressure on day rates. More than a dozen deepwater rigs will reach the end of their current firm contract commitments this year, which may result in continued softness in rates for this rig market segment. Day rates for mid-water depth semisubmersible drilling rigs continue to slip but not as severe as in previous months (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, 2001b).

The still depressed GOM rig market continues to hit offshore service vessel (OSV) operators hard, with the smaller vessel owners hit the hardest. The February 2002 average day rates for all types and categories of vessels used by the offshore oil and gas industry decreased from the February 2001 averages, with the exception of anchor-handling tug/supply vessel (AHTS) under 6,000-horse power (hp) and supply boats 200 ft and over. Average day rates for AHTS vessels ranged from $12,000 for under 6,000-hp vessels (up $1,000 or 9% from last year’s rate) to $14,000 for over 6,000-hp vessels (down $1,750 or 11% from last year’s rate); utilization rates were 100 percent for both. Supply boat average day rates ranged from $5,225 for boats up to 200 ft (down $2,375 or 31% from a year ago) and $11,156 for boats 200 ft and over (up $1,426 or 15% from a year ago); utilization was 95 percent and 100 percent, respectively. Crewboat average day rates ranged from $2,320 for boats under 125 ft to $3,200 for boats 125 ft and over (both down about 12% from last year’s average rates); utilization was 100 percent for both (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 deepwater (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 deepwater, 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.

3.3.1.1.7. Environmental Justice

On February 11, 1994, the President 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 (African American, 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 Coast 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 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, 2001b). Target species can be classified into three groups: (1) epipelagic fishes, (2) reef fishes, and (3) invertebrates. In general, the Medusa 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. Thus, if new fisheries develop in the deepwater Gulf, the most likely target species would be the epipelagic fishes, normally fished using surface longlines.

Epipelagic commercial fishes include dolphin, sharks (mako, silky, and thresher), snake mackerels (escolar and oilfish), swordfish, tunas (bigeye, blackfin, bluefin, and yellowfin), and wahoo (USDOI, MMS, 2001b). These species are widespread in the Gulf and probably occur in Grid 12. Nonetheless, it does not appear likely that significant fisheries for epipelagic fishes will develop in the far offshore waters of the Gulf, including the Medusa Project area, because of the generally low productivity and high costs and risks associated with these waters.

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 (Figure 3-2) 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.

Figure 3-2. A Million Points of Lights: Population Distribution in the U.S. (Year 2000).
(Source: National Aeronautics and Space Administration, Astronomy Picture of the Day, November 27, 2000. http://antwrp.gsfc.nasa/gov/apod/image/0011/eartlights_dmsp_big.jpg)

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:

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 in Alabama 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, wetland, lagoons and estuaries, seagrass, fish and wildlife, and archaeological sites. In 1978, Congress designated approximately 1,800 ac on Horn and Petit Bois Islands, part of Gulf Island 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 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 installation of this 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, 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 that humans use for recreation, research, conservation, and mineral extraction.

Land Use

Use of the shorefront directly associated with this proposed action that could be impacted is diverse. It consists of national seashores, traditional beachfront cities such as Gulfport, State parks, marshland, casino-dotted beaches, 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 is 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. For example, spending for food, beverages, and lodging along Baldwin County beaches was estimated by Alabama's Gulf Coast Convention and Visitors Bureau at approximately $300 million in 1995 (*Mobile Register*, 1996).

Recreational Land Use

Although there is recreational use of the Central Gulf Coast year round, the primary season is the spring and summer. Foster and Associates, Inc. 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 (Kelley and Wade, 1999). Other coastal trends charted by Foster and Associates, Inc. (Kelley 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 in MC Block 582 at the proposed well site is 2,223 ft (678 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 12 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 the Garrison et al. (1989) shipwreck database lists two shipwrecks that fall within the Grid 12 area of MC. In addition, a separate MMS archaeologist's shipwreck database lists two possible additional wrecks in MC Blocks 195 and 497. No other shipwrecks are listed in Grid 12 areas of Green Canyon, Atwater Valley, or Ewing Bank. The two shipwrecks listed by the Garrison et al. (1989) study are known only through the historical record and, to date, have not been located on the ocean floor. The two listed by MMS archaeologists are also unknown but have been located on the seafloor through side-scan-sonar surveys for those blocks. All of these wrecks are listed in Table 3.2. The Garrison et al. (1989) 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 in MC Block 74. In the deep water, temperature at the seafloor is extremely cold, which slows the oxidation of ferrous metals and help to preserve wood features. The cold water would also eliminate woodeating 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 structure.

In 1984, the U.S. Congress, recognizing the social and economic value in developing artificial reefs, passed the National Fishing Enhancement Act (NFEA). The NFEA directed the Secretary of Commerce to develop and publish a long-term National Artificial Reef Plan (NARP) to promote and facilitate responsible and effective artificial reef use based on the best scientific information available. Mississippi's artificial reef efforts began in the 1960's and Louisiana's Artificial Reef Initiative (LARI) started in the 1980's.

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.

The Medusa Project and Murphy Exploration and Production Company's proposal to install a spar production platform in MC Block 582 is located offshore Louisiana, approximately 40 mi south of the nearest (i.e., West Delta Area) Artificial Reef Planning and Permit Area. The proposed pipelines are also located south and far outside of the Louisiana West Delta Artificial Reef Planning and Permit Area.

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 Medusa Project in MC Blocks 538 and 582 is located approximately 37 mi (59 km) from the Louisiana coastline; the closest shoreline is the Mississippi River's active delta area.

Offshore activities that have a potential to change water quality include sediment disturbance during emplacement of the mooring system for the spar, operational routine discharges of wastewater during completion and production activities, and accidental spills. Sediment disturbance is not likely to impact nearby coastal water quality since this area is characterized by turbid, contaminated waters discharged from the Mississippi River into this area. Produced-water discharges, the primary wastewater to be discharged, is 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. Murphy 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. No sediment disturbance from pipeline emplacement in coastal waters would occur. Murphy proposes to use an existing pipeline system in the coastal area.

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 this operation 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 location of the project off the mouth of the Mississippi River.

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 during emplacement of the mooring system for the proposed spar, operational routine discharges of wastewater during completion and production activities, and accidental spills. The installation of anchor systems, pipelines, and other subsea infrastructure during emplacement operations would result in some sediment disturbances. Completion is expected to be accomplished without discharges. 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.

Localized sediment disturbance from oil and gas ROW pipeline emplacement may occur during the projected 148-day effort (Murphy Exploration and Production Company, 2002). 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.

Approximately 2,000 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 12 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 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, and 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 sediments disturbed during the period of installation of subsea infrastructure, including the moorings and anchors and the pipelines that would transport the oil and gas off lease from the Medusa field. Any effects from the elevated turbidity would be short term, localized, and reversible. Any produced water that has been treated and discharged is 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 concentrate in the sediments or interact with the benthic environment.

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 Medusa Project would generate air pollutants due to emissions from the operation 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 first year when drilling, pipelaying, and construction are taking place.

Sulfur oxide (SO_x) emissions would be highest during emergency events when flaring is required. Hydrogen sulfide (H_2S), a minor contaminant (i.e., at a concentration less than 100 ppm) in the gas stream, would only be vented into the atmosphere in the event of a well blowout (assuming no fire). The released large quantities of low concentration H_2S would be entrained in the oil and gas stream, which is under high pressure and likely exiting the well bore at or near sonic speed. This mechanism effectively transports the majority of the H_2S above the mixing height and disperses it in the middle to upper troposphere (USDOI, MMS, 1997).

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. Since this plan stipulates that VOC emissions from the wet oil tank and the glycol dehydrator will be routed to a vapor recovery system, VOC emissions are expected to be even lower than normal. The VOC's are precursors to photochemically produced ozone. A spike in VOC's arising from a malfunction or well blowout could contribute to a corresponding spike in ozone, especially if the release were to occur on a hot sunny day in a NO_x-rich environment. However, the nearby onshore areas are all currently in attainment for ozone (USEPA, 2001), thus such a spike would not contribute to an existing public health problem. If a fire occurs, particulate and combustible emissions will 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 12. 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 12. 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 Central Gulf of Mexico Lease Sales 169, 172, 175, 178, and 182 (USDOI, MMS, 1997) and more recently in the Draft EIS for the Central 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 Medusa development. As discussed in USDOI, MMS (1997 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 shorebase 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 liter/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, particularly in Florida.

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 (1,500-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 MC Block 969, more than 41 nmi to the southwest.

Conclusion

The proposed Medusa 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 12; thus, there are no known shallow-water coral reefs in this area (Figure 3-1). Deepwater coral reefs are considered rare in the GOM, and there are no documented hard substrate areas that might support deepwater corals in Grid 12; however, the potential does exist for unknown deepwater coral habitats to be present in Grid 12.

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 678 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 deepwater, but it probably includes hydrocarbon-degrading forms. None of the benthic communities found in MC Blocks 582 and 538 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) 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 is 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 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 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 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. 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 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] or water-based mud [WBM], 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. 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 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 12 and associated with the proposed action (Medusa Project) include the noise generated by helicopters, vessels, and operating facilities; vessel traffic; explosive structure removals; jetsam and flotsam from associated support vessels and rig/spar facilities; 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 are a minimum of two flights per week during production. The FAA Advisory Circular 91-36C encourages pilots to maintain higher than minimum altitudes (noted below) over noise-sensitive areas. Corporate helicopter policy states that helicopters should maintain a minimum altitude of 700 ft while in transit offshore and 500 ft while working between platforms. In addition, guidelines and regulations promulgated by NMFS under the authority of the Marine Mammal Protection Act do include provisions specifying helicopter pilots to maintain an altitude of 1,000 ft 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 Medusa Project, as more blocks are developed within Grid 12, the helicopter activity is expected to increase. 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 Medusa 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 12 months. Although development activities would be relatively limited for the Medusa Project, as more blocks are developed within the Grid 12, the drilling, completion, and production activities and associated noise is expected to increase. 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.

Murphy estimates that there would be multiple support vessel trips per week during drilling and completion of the Medusa Project and associated pipelines emplacements (lasting approximately 12 months). Subsequent support-vessel trips during production would involve daily vessel activity. Although vessel activity would be relatively limited for the Medusa Project, as more blocks are developed within Grid 12, the vessel activity is expected to increase. 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 ships 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 12 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 12 is known as preferred sperm whale habitat; whales utilize the area as foraging, nursery, and possibly mating habitat. Manatees are rare in the northwestern Gulf; consequently, there is little risk posed by OCS vessel traffic in Grid 12.

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. An estimated blowout rate of the #A1 well could release 20,000 bbl of oil per day for a period of 30 days, for a total estimated discharge of approximately 600,000 bbl. Surface intervention to stop the blowout would in all likelihood not be accomplishable before 30 days. Such a spill is highly unlikely; however, it could result in negative impacts to sperm whales and other oceanic marine mammal species. The expected impacts would involve the oiling of animals and prey and probable 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 increased concentrations of sperm whales within Grid 12. The removal of one sperm whale from the GOM sperm whale stock exceeds the Potential Biological Removal limit and, consequently, may negatively impact their ability to recover. 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 12 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 Medusa 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 and oil spills) are expected to be rare, and the MMS has regulations in place to greatly restrict their possibility.

4.2.4. Impacts on Sea Turtles

Multiple and daily vessel trips per week are expected during completion activities of the Medusa Project, lasting approximately 12 months. There would be daily support vessel activity 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 12 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 12 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 Medusa 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, and 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 12) 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 Medusa Project. As more blocks are developed in the Grid 12 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 the Medusa 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 utilized 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.

Should a spill occur (as explained in the previous section [impacts on marine mammals]) it could result in negative impacts to 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 12 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 12) 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.

Summary and Conclusion

Routine activities resulting from the Medusa Project have the potential to harm sea turtles or temporarily displace them from necessary habitat. 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 Medusa 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 Medusa 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 platform 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 ingests 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 $\geq$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 $\geq$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 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, and 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, 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. 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 discharge area and be undetectable beyond 3,000 m (9,843 ft) from the site (USDOI, MMS, 2000). The SBF are virtually nontoxic, and cuttings with adherent SBF 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 ft) (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 14.7 μg/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 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, and 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 Medusa 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 $\geq$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

In Chapter 3.2.9.1.1. the potential impact region was defined 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. This section projects how and where future changes will occur and whether they correlate with the proposed action.

4.3.1.2. 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 Venice, 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.

4.3.1.3. 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 Murphy plans to use.

Conclusion

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

4.3.1.4. 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. Support vessels and travel frequency during the proposed spar installation and pipeline construction is one ROV support vessel two to three times weekly for each activity. Support vessels and travel frequency during the proposed well completion activities are one supply boat two times weekly, one crew boat once weekly, and one helicopter once weekly. Murphy would use one supply boat daily and one Sikor A76A helicopter and one Bell helicopter a minimum of once weekly for spar operation and maintenance. Murphy would use onshore facilities located in Fourchon 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.

Conclusion

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

4.3.1.5. 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 Murphy's Initial DOCD (for the fabrication/installation of a truss-spar platform, the completion of 6 development wells, and the installation of pipelines from the proposed spar to two existing platforms) and assigns these expenditures to industrial sectors in the 10 MMS coastal subareas defined in Chapter 3.3.1. 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 Murphy on the platform, pipeline, 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) allocation 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 2002. 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 Table E-3 (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 2002) direct employment associated with the proposed action is estimated at 879 jobs. Indirect employment for the peak year is projected at 334 jobs, while induced employment is calculated to be 406 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 through the productive life of the proposal (that associated with operation and maintenance and workover activities) are expected at about 50-60 jobs per year throughout all subareas and 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 20,000 bbl a day for 30 days for an uncontrolled blowout (Appendix A, Section C). Based on model results, should such a spill occur, it is projected to cost about 12,068 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 from 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.

4.3.1.6. Environmental Justice

Federal agencies are directed by Executive Order 12898 to assess whether their actions would 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 12, no effects to minorities or people with low incomes in the Gulf counties and parishes are expected.

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, if any, new potential fisheries that could occur in the Medusa 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.

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

The value of recreation and tourism in the GOM coastal zone from Texas through Florida has been estimated at almost $20 billion annually (USDOI, MMS, 1990). A significant portion of these expenditures is made in coastal counties, where major shoreline beaches are primary recreational attractions.

The primary impact-producing factors associated with offshore oil and gas development, and most widely recognized as major threats to the enjoyment and use of recreational beaches, are oil spills (Appendix A) and trash and debris. Additional factors such as noise from aircraft can adversely affect a beach-related recreational experience. All these factors, either individually or collectively, may adversely affect the number and value of recreational beach visits. The major recreational activity occurring on the OCS is recreational fishing and diving. A substantial recreational fishery, including scuba diving, is directly associated with oil and gas production platforms and stems from the fact that platforms beneficially function as high-profile, artificial reefs that attract fish.

Conclusion

The risk of a large oil spill occurring due to the proposed development operations in Grid 12 is very small. In the event such a spill did occur, according to analysis (Appendix A), there is a negligible chance that the spill would contact land within 30 days of a spill. Project aircraft would normally be flying high enough to avoid disturbance on beach goers.

Murphy 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

MC Blocks 582 and 538 in Grid 12, where the proposed development activities would occur, are not specifically located within either of the 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 extent of prehistoric archaeological potential on the OCS. The water depths in MC Blocks 582 and 538 are greater than 676 m, which is approximately 616 m deeper than the earliest known prehistoric archaeological sites in the GOM. Based on the extreme water depth of the MC Blocks 582 and 538, there is no potential for prehistoric archaeological resources. Therefore, any oil and gas development directly associated with the Medusa Prospect in MC Blocks 582 and 538 could not possibly impact prehistoric archaeological resources in these blocks.

Conclusion

Based on the extreme water depths in Grid 12 and MC Blocks 582 and 538, the proposed action would 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; page 76). High-probability search polygons associated with individual shipwrecks were created to afford protection to wrecks located outside of the two aforementioned high-probability areas.

NTL 2002-G01, signed by the Regional Director on December 15, 2001, supersedes all other archaeological NTL’s and LTL’s from 1974 through 1994. This new NTL makes minor technical amendments, updates cited regulatory authorities, and continues to mandate a 50-m (164-ft) remote-sensing survey line spacing 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 the MMS analyses. Survey and report requirements for prehistoric sites have not been changed.

There are 23 lease blocks within the Grid 12 area that fall within the MMS high-probability shipwreck zone (Garrison et al., 1989). However, MC Blocks 582 and 538 are not located within this high-probability zone. 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.

According to Garrison et al., (1989), the shipwreck database lists four shipwrecks that fall within the Grid 12 area. One additional wreck was discovered when a pipeline was laid across it in March 2001. All four of the wrecks date prior to 1952. If the other two shipwrecks are found they may be eligible for listing in the National Register of Historic Places. Twenty-two of the lease blocks within the Grid 12 area fall within the MMS GOM Region's high-probability area for the occurrence of historic shipwrecks. However, MC Blocks 582 and 583 do not fall within the MMS high-probability zone. As a result, there is a very small possibility that the proposed action would impact a historic shipwreck.

The proposed action may also generate ferromagnetic structures and debris, which would tend to mask magnetic signatures of significant historic archaeological resources during magnetometer surveys. However, most of the ferromagnetic debris associated with the proposed action would be removed from the seafloor after the useful life of the structure is complete. Therefore, no impact to the historic archaeological resources is expected as a result of the proposed action.

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 existing historic properties or previously unidentified historic sites. This direct physical contact with an existing or unknown historic site could cause physical damage to, or complete destruction of, information on the history of the region and the Nation. Murphy indicated that no new facility would be constructed to support the activities related to the proposed action. Therefore, no impacts to onshore historic sites are expected from the proposed action.

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. Should an oil spill 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.

Conclusion

Activities associated with proposed development in MC Blocks 582 and 538 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

The proposed Medusa Project in MC Blocks 538 and 582 is located south and outside of Louisiana's Artificial Reef Planning and Permit Areas. Therefore, potential environmental effects and conflict use between development in MC Blocks 538 and 582 and artificial reef and Rigs-to-Reefs (RTR) development is not anticipated.

The blocks and the blocks between that are subject to be traversed by the construction of the pipelines are also outside of Louisiana's West Delta Artificial Reef Planning and Permit Areas. Therefore, potential environmental effects, and conflict use between pipeline construction and artificial use and RTR development is not expected.

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 RTR are coordinated and reviewed by the MMS for potential conflict with oil and gas infrastructure (i.e., platforms and pipelines) and development.

4.4. CUMULATIVE EFFECTS

The MMS addressed the cumulative effects of OCS- and non-OCS-related activities for the CPA and the Gulf Coast region for the years 1996 through 2036 as part of the NEPA documentation completed for proposed multisale lease activities. The most recent final EIS applicable to Grid 12 was prepared for Central GOM Lease Sales 169, 172, 175, 178, and 182 (USDOI, MMS, 1997). The Draft EIS for Central GOM Lease Sales 185, 190, 194, 198, and 201 (USDOI, MMS, 2002) provides additional updated information applicable to cumulative effects. Specific OCS-related effects from the proposed activities in Grid 12 and related to the Medusa Project are addressed in Chapters 4.1-4.3.

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

4.4.1. Water Quality

4.4.1.1. Coastal

Sources of contaminant inputs to coastal waters bordering the GOM include large volumes of water entering the Gulf from rivers draining over two-thirds of the contiguous U.S., municipal and industrial point- and nonpoint-source discharges, and accidental spill events.

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 treatment processes, marinas, commercial fishing, maritime shipping, hydromodification activities forestry, recreational boating, livestock farming, manufacturing industry activities, nuclear power plant operations, 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 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 and domestic waste discharges and the presence of other compounds used in boat servicing such astributyltin 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 effect 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 presently shows some signs of environmental stress. 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 of wells 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, the oil and gas support operations, and recreational and commercial fishing operations routinely discharge contaminants in domestic and sanitary wastes and in 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, 1993; CSA, 1997a and b; Kennicutt et al., 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, 1997). 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. The results have been combined in a regional database, the Gulfwide Mercury in Tissue Database. All Gulf Coast States have published fish consumption advisories for large king mackerel (Ache et al., 2000).

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 is 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).

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 beaches 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, 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 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

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.

Two pipelines are projected for installation from the Medusa spar leading to other facilities in shallower water. Both of these right-of-way applications were reviewed for potential impacts to sensitive biological features in both deep water and on the continental shelf. No areas for potential chemosynthetic communities were identified along the length of pipeline impacting activities.

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.

4.4.3.3. Coral Reefs

All of the recognized topographic features in the 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.

4.4.3.4. 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. Hypoxic conditions at the seafloor may affect the deepwater benthos and associated communities.

4.4.3.5. 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 Endangered Species Act (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.

4.4.4. 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.

4.4.5. 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.

4.4.6. 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 (LATEX B; Murray, 1998). However, areas of hypoxia typically occur only on the continental shelf.

4.4.6.1. 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.

4.4.7. 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.

4.4.8. Other Relevant Activities

4.4.8.1. Socioeconomic Conditions and Other Concerns

4.4.8.1.1. 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 12 are expected to have minimal economic and demographic consequences to the region.

4.4.8.1.2. Population and Education

The impact area's population is expected to grow at an average annual rate of 1.5 to 1.0 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 12 are not expected to affect the population's growth rate. Education levels are expected to remain unchanged by activities within Grid 12.

4.4.8.1.3. Infrastructure and Land Use

Sufficient infrastructure is in place to support activities within Grid 12. 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.

4.4.8.1.4. 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 12.

4.4.8.1.5. Employment

The oil and gas industry is very important to many of the coastal communities of the Central 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 12 are expected to be negligible.

4.4.8.1.6. Environmental Justice

Federal agencies are directed by Executive Order 12898 to assess whether their actions will have a disproportionate environmental effect on people of ethnic or racial minorities or with low income. Since sufficient onshore facilities are available to support offshore activities in Grid 12, no effects to minorities or people with low incomes in the Gulf counties and parishes are expected.

4.4.9. 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 Central GOM will remain one of the Nation's most important commercial fisheries area.

4.4.10. 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 affected 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.

4.4.11. Archaeological Resources

4.4.11.1. Prehistoric

The MMS's analysis indicates that there simply no potential for the occurrence prehistoric archaeological sites in water depths greater than 60 m. The aforementioned statement is based on the current acceptable seaward extent of the prehistoric archaeological high-probability area in the GOM. The effects of the various impact-producing factors related to OCS and non-OCS activities (pipeline and platform installations, drilling rig emplacement and operation, dredging, and anchoring activities) may have 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 truss spar with eight dry tree risers and tied back with top-tension risers from a single platform located in MC Block 538 and 582 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.

4.4.11.2. Historic

Several impact-producing factors may threaten historic archaeological resources. An impact could result from a contact between an OCS activities (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.

Any potential effects of oil spills on historic coastal resources would be temporary and reversible.

The effects of the various impact-producing factors discussed in this analysis have likely resulted in the loss of significant or unique historic archaeological information. In the case of factors related to OCS Program activities 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 eight wells from a single platform location in MC Block 582 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.

4.4.12. Artificial Reefs and Rig-to-Reefs Development

Because the proposed project is located outside of 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 Times-Picayune* on December 3, 2001, announcing preparation of an environmental assessment on the Medusa 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 October 10, 2001. The plan was received by the LDNR on October 11, 2001. In a letter dated November 20, 2001, 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.

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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 12

Appendix A

Accidental Hydrocarbon Discharge Analysis

Appendix A

Accidental Hydrocarbon Discharge Analysis

Analysis of the Potential for an Accidental Oil Spill and Potential for Impacts from the Medusa Project (Mississippi Canyon Blocks 538 and 582, N-7269 and S-5886)

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 accidental oil spills (≥1,000 bbl) 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 document 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 shows 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 blowouts (Tables A-1 through A-3). The most recent Final EIS's for Lease Sales 169, 172, 175, 178, and 182 in the Central Planning Area and Lease Sale 181 in the Eastern Planning Area 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 derived 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, Vol. 6, No. 5/6, pp. 303-321, 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 blowouts are based on the number of blowouts with a release of oil per number of wells drilled. Spill rates for the period 1985-1999 are shown in Table A-4. It should be noted that there were no platform or blowout spills ≥1,000 bbl for the period 1985-1999. Use of "zero" spills would result in a zero spill rate. To allow for conservative future predictions of spill occurrence, a spill number of one was "assigned" to provide a non-zero spill rate for blowouts. The spill period was expanded to 1980 to include a spill for facilities. While there were no facility or blowout spills during the 1985-1999 period for which data are available, spills could occur in the future. In fact, a pipeline spill ≥1,000 bbl was reported subsequent to this period, so it is reasonable to include a spill to provide a non-zero spill rate. 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

The proposed action includes the installation of Platform A, a truss spar platform in 2,223 ft water depth and the completion, tie back, and production of six wells in Mississippi Canyon Block 582. Associated with the proposal are the installation of a 12-inch oil right-of-way pipeline in or through Mississippi Canyon Blocks 582, 538, 494, 450, 406, 362, 361, and 317, and West Delta Blocks 147,148, and 143. Table A-5 presents an estimate of spill risk from the facility to resources. The risk estimate for the facility was calculated using the spill rate of 0.13 per billion barrels of oil produced, the estimated production for the proposed action, and oil-spill trajectory calculations. Table A-6 presents an estimate of spill risk from the pipeline to resources. The risk estimate for the pipeline was calculated using the spill rate of 1.38 per billion barrels of oil transported, the estimated amount of oil to be transported in the proposed pipeline, and oil-spill trajectory calculations for each endpoint of the pipeline.

The coastline and associated environmental resources are presented in Tables A-5 and A-6. The final column in Tables A-5 and A-6 presents the result of combining the SOV's and the TV's. Given the low risk for a spill, spill-prevention requirements, and spill-response requirements, significant impacts to environmental resources are unlikely.

The most recent Final EIS's for Lease Sales 169, 172, 175, 178, and 182 in the Central Planning Area and Lease Sale 181 in the Eastern Planning Area 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 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 and the National Strike force to further improve spill-response capability in the GOM. The Gulf strike force includes 38 members and associated response expertise and equipment. The combined resources of these groups and the resources of commercially contracted oil-spill response organizations results 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 (7 years), an accidental blowout (20,000 bbl/day), a spill of liquid oil stored on the facility (approximately 2,050 bbl total storage capacity), or a spill from the associated oil pipeline. The worst-case discharge for the proposed oil pipeline, which was assumed to be capable of transporting 45,000 bopd, was estimated by the operator to be 6,149 bbl. The pipeline was assumed to have a lifetime of 30 years. The operator has addressed these spill sources in their oil-spill response plan and has demonstrated spill response preparedness for accidental releases from these sources.

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)	3,189	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 non-zero risk

b There have been no spills ≥1,000 bbl from blowouts during the period 1985-1999. One spill was "assigned" to provide a non-zero spill rate.

c There were no facility or blowout spills ≥1,000 bbl for the period 1985-1999; however, a nonzero spill rate was calculated by expanding the facility period to 1980 and by "assigning" a blowout spill. Therefore, the spill rates for these categories are presented as greater than zero but below the rates calculated by expanding the data period and assigning a spill.

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	<0.5	<0.5
Willacy, Tex.	1	<0.5	<0.5
Kenedy, Tex.	1	<0.5	<0.5
Kleburg, Tex.	1	<0.5	<0.5
Nueces, Tex.	1	<0.5	<0.5
Aransas, Tex.	1	<0.5	<0.5
Calhoun, Tex.	1	<0.5	<0.5
Matagorda, Tex.	1	1	<0.5
Brazoria, Tex.	1	<0.5	<0.5
Galveston, Tex.	1	1	<0.5
Chambers, Tex.	1	<0.5	<0.5
Jefferson, Tex.	1	1	<0.5
Cameron, La.	1	4	<0.5
Vermilion, La.	1	3	<0.5
Iberia, La.	1	1	<0.5
St. Mary, La.	1	<0.5	<0.5
Terrebonne, La.	1	5	<0.5
Lafourche, La.	1	5	<0.5
Jefferson, La.	1	2	<0.5
Plaquemines, La.	1	12	<0.5
St. Bernard, La.	1	1	<0.5
Harrison, Miss.	1	<0.5	<0.5
Jackson, Miss.	1	<0.5	<0.5
Baldwin, Ala.	1	<0.5	<0.5
Mobile, Ala.	1	1	<0.5
Escambia, Fla.	1	1	<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

Table A-5. Spill Risk Estimate for Facilities (continued).

Environmental Resource	Spill Occurrence Variable [1] (%)	Transport Variable [2] within 30 days (%)	Spill Risk [3] within 30 days (%)
Sarasota, Fla.	1	<0.5	<0.5
Charlotte, Fla.	1	<0.5	<0.5
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	3	<0.5
Louisiana (Western) State Offshore Waters	1	36	<0.5
Louisiana (Eastern) State Offshore Waters	1	4	<0.5
Mississippi State Offshore Waters	1	1	<0.5
Alabama State Offshore Waters	1	1	<0.5
Florida Panhandle State Offshore Waters	1	2	<0.5
Florida Peninsula State Offshore Waters	1	<0.5	<0.5
Major Recreational Beach Areas			
TX Coastal Bend Area Beaches	1	<0.5	<0.5
TX Matagorda Area Beaches	1	1	<0.5
TX Galveston Area Beaches	1	1	<0.5
TX Sea Rim State Park	1	1	<0.5
LA Beaches	1	9	<0.5
AL/MS Gulf Islands	1	1	<0.5
AL Gulf Shores	1	<0.5	<0.5
FL Panhandle Beaches	1	2	<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 MC Blocks 538 or 582 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 (Price et al., 1997). 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 C4-1 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%.

Table A-6

Spill Risk Estimate for the Oil Pipeline

Environmental Resource	Spill Occurrence Variable [1] (%)	Transport Variable[2] within 30 Days for MC Block 582 (%)	Transport Variable[2] within 30 Days for WD Block143 (%)	Spill Risk[3] within 30 Days (%)
Counties/Parishes				
Cameron, Tex.	49	<0.5	<0.5	<0.5
Willacy, Tex.	49	<0.5	<0.5	<0.5
Kenedy, Tex.	49	<0.5	<0.5	<0.5
Kleburg, Tex.	49	<0.5	<0.5	<0.5
Nueces, Tex.	49	<0.5	<0.5	<0.5
Aransas, Tex.	49	<0.5	<0.5	<0.5
Calhoun, Tex.	49	<0.5	<0.5	<0.5
Matagorda, Tex.	49	1	1	<0.5
Brazoria, Tex.	49	<0.5	<0.5	<0.5
Galveston, Tex.	49	1	1	<0.5
Chambers, Tex.	49	<0.5	<0.5	<0.5
Jefferson, Tex.	49	1	1	<0.5
Cameron, La.	49	4	5	2
Vermilion, La.	49	3	3	1
Iberia, La.	49	1	1	<0.5
St. Mary, La.	49	<0.5	<0.5	<0.5
Terrebonne, La.	49	5	7	2 - 3
Lafourche, La.	49	5	9	2 - 4
Jefferson, La.	49	2	3	1
Plaquemines, La.	49	12	15	6 - 7
St. Bernard, La.	49	1	1	<0.5
Harrison, Ms.	49	<0.5	<0.5	<0.5
Jackson, Ms.	49	<0.5	<0.5	<0.5
Baldwin, Ala.	49	<0.5	<0.5	<0.5
Mobile, Ala.	49	1	1	<0.5
Escambia, Fla.	49	1	<0.5	<0.5
Santa Rosa, Fla.	49	<0.5	<0.5	<0.5
Okaloosa, Fla.	49	<0.5	<0.5	<0.5
Walton, Fla.	49	<0.5	<0.5	<0.5
Bay, Fla.	49	<0.5	<0.5	<0.5
Gulf, Fla.	49	<0.5	<0.5	<0.5
Franklin, Fla.	49	<0.5	<0.5	<0.5
Wakulla, Fla.	49	<0.5	<0.5	<0.5
Jefferson, Fla.	49	<0.5	<0.5	<0.5
Taylor, Fla.	49	<0.5	<0.5	<0.5
Dixie, Fla.	49	<0.5	<0.5	<0.5
Levy, Fla.	49	<0.5	<0.5	<0.5
Citrus, Fla.	49	<0.5	<0.5	<0.5
Hernando, Fla.	49	<0.5	<0.5	<0.5
Pasco, Fla.	49	<0.5	<0.5	<0.5
Pinellas, Fla.	49	<0.5	<0.5	<0.5
Hillsborough, Fla.	49	<0.5	<0.5	<0.5
Manatee, Fla.	49	<0.5	<0.5	<0.5
Sarasota, Fla.	49	<0.5	<0.5	<0.5
Charlotte, Fla.	49	<0.5	<0.5	<0.5
Lee, Fla.	49	<0.5	<0.5	<0.5
Collier, Fla.	49	<0.5	<0.5	<0.5
Monroe, Fla.	49	<0.5	<0.5	<0.5

Table A-6. Spill Risk Estimate for the Oil Pipeline (continued).

Environmental Resource	Spill Occurrence Variable [1] (%)	Transport Variable[2] within 30 days for MC Block 582 (%)	Transport Variable[2] within 30 days for WD Block143 (%)	Spill Risk[3] within 30 days (%)
State Offshore Waters				
Texas State Offshore Waters	49	3	4	1 - 2
Louisiana (Western) State Offshore Waters	49	36	49	18 - 24
Louisiana (Eastern) State Offshore Waters	49	4	3	1 - 2
Mississippi State Offshore Waters	49	1	1	<0.5
Alabama State Offshore Waters	49	1	1	<0.5
Florida Panhandle State Offshore Waters	49	2	1	<0.5 - 1
Florida Peninsula State Offshore Waters	49	<0.5	<0.5	<0.5
Major Recreational Beach Areas				
TX Coastal Bend Area Beaches	49	<0.5	<0.5	<0.5
TX Matagorda Area Beaches	49	1	1	<0.5
TX Galveston Area Beaches	49	1	1	<0.5
TX Sea Rim State Park	49	1	1	<0.5
LA Beaches	49	9	13	4 - 6
AL/MS Gulf Islands	49	1	1	<0.5
AL Gulf Shores	49	<0.5	<0.5	<0.5
FL Panhandle Beaches	49	2	1	<0.5 - 1
FL Big Bend Beaches	49	<0.5	<0.5	<0.5
FL Southwest Beaches	49	<0.5	<0.5	<0.5
FL Ten Thousand Islands	49	<0.5	<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 MC 582 or WD 143 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 (Price et al., 1997). 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 C4- and C3-4 cluster areas.

(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%.

Appendix B

Air Quality/Meteorological Conditions

Appendix B

Air Quality/Meteorological Conditions

N-7269 and S-5886 (DOCD)
Mississippi Canyon (MC) Blocks 538 and 582, OCS-G 16614 and 16623 and Proposed Right-of-Way Pipelines
Pipeline Segment No. P-13776: 20 mi, 12", Oil to WD-143
Pipeline Segment No. P-13688: 37 mi, 12", Gas to SP-55

The post-lease NEPA compliance for offshore oil and gas development in deepwater (>400 m) areas of the Central and Western Planning Areas of the Gulf of Mexico employs a biologically-based grid system to ensure broad and systematic analysis of potential effects from development. Seventeen grids of biological similarity have been established and a comprehensive programmatic environmental assessment (PEA) is required for the first development within each of the respective grids. This PEA is for the Medusa Project, the first proposed in Grid 12.

The air emissions associated with this DOCD would be from the drilling activities, pipeline installation activities, facility installation activities, oil and gas production activities, and minimal fugitive emissions. The Mississippi Canyon Blocks 538 and 582 wells' (i.e., A-1, A-2, A-3, A-4, A-5, and A-6) production would be routed through 12-inch right-of-way pipelines. The oil produced would be transported via Segment Number P-13776 from the proposed Mississippi Canyon Block 538 "A" platform to a shelf platform located in West Delta Block 143. The gas produced would be transported via Segment Number P-13688 from the proposed Mississippi Canyon Block 538 "A" platform to a shelf platform located in South Pass Block 55.

Description of the Environment: Air Quality

The proposed operations would occur west of 87.5 degrees west longitude and hence fall under MMS's jurisdiction for enforcement of the Clean Air Act. The air over the OCS water is not classified, but it is presumed to be better than the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants. he blocks involved, Mississippi Canyon Blocks 538 and 582, are offshore south of the Mississippi River Delta. These blocks are located between 100 kilometers and 200 kilometers (km) of the Breton National Wilderness Area (BNWA) Prevention of Significant Deterioration (PSD) Class I Area. Although, the closest onshore areas are with in 60 km and located in Plaquemines Parish, Louisiana, this area is in attainment of the NAAQS (USEPA, 2001), and for PSD purposes is classified as Class II.

The influence to onshore air quality is dependent upon meteorological conditions and air pollution emitted from the proposed action. The pertinent meteorological conditions are the wind speed and direction, the atmospheric stability, and the mixing height, which govern the dispersion and transport of emissions. The typical synoptic wind flow for this area is driven by the clockwise circulation around the Bermuda High, resulting in a prevailing southeasterly to southerly flow, which is conducive to transporting emissions toward shore. However, superimposed upon this synoptic circulation are smaller meso-scale wind flow patterns, such as the land/sea breeze phenomena. In addition, there are other synoptic-scale patterns that occur periodically, namely tropical cyclones, and mid-latitude frontal systems. Because of the routine occurrence of these various conditions, the winds blow from all directions in the area of concern (USDOI, MMS, 1988).

The atmospheric stability is typically expressed using the Pasquill-Gifford stability classes. However, not all of the Pasquill-Gifford stability classes are routinely found offshore in the GOM. Specifically, the F stability class is rare. "F" stability is characterized by the extremely stable condition (i.e., a strong radiative inversion), that usually develops at night, over land, with rapid radiative cooling of the ground surface and the air directly above it. This type of atmospheric stability strongly limits the vertical dispersion of emitted air pollutants. The large heat capacity of the GOM is simply incapable of loosing enough heat overnight to set up a strong radiative inversion. Likewise, the A stability class is also rare.

"A" stability is characterized by the extremely unstable condition that develops over land with very rapid warming of the ground surface and the air directly above it and the occurrence of colder air aloft. This type of atmospheric stability strongly enhances the vertical dispersion of air pollutants. Although, once again, the large heat capacity of the GOM does not allow for the ocean surface warming rapidly. Therefore, the most common stability classes over the GOM are slightly unstable to neutral, which are conducive to only a moderate amount of buoyant vertical dispersion.

The mixing height is a measure of the upward extent for the vertical dispersion of emitted air pollutants. Offshore mixing heights are rather shallow, generally less than 1,000 m (3,281 ft), as compared to onshore mixing heights, which are typically greater than 2,000 m (6,362 ft) during the day. Close to shore, the mixing height over the water increases notably from the typical offshore level, due to the water being shallower and the influence of the land which penetrates out over the water for a short distance. Thus, with a typical southeasterly to southerly wind flow, which is conducive to transporting emissions toward shore, the extent of the vertical dispersion will increase as the shore line is approached. This has the effect of lowering the resultant air pollutant concentration arising from emissions.

The composite of these meteorological conditions that influence the dispersion and transport of emissions is represented by an exemption level that can be compared to the projected air pollutant emissions for a proposed action.

Effects on the Environment: Air Quality

The projected air emissions submitted by Murphy Exploration & Production Company in this application and evaluated here by MMS represent the maximum potential to emit for equipment to be used in the activities proposed for the DOCD's and pipelines project. The emissions are summarized in the table below.

Emissions by Activity (tons)

	TSP	SO_x	NO_x	VOC	CO
2002	23.7	108.00	847.0	28.6	200.0
2003	6.08	27.00	377.0	25.3	157.0
2004-2007 (annually)	1.36	5.31	215.0	20.5	121.0
Max. 12-month period (5/01/02-4/30/03)	28.00	127.00	1,050.0	39.0	268.0
MMS exemption level	1,230.00	1,230.00	1,230.0	1,230.0	37,800.0
PSD major source (permanent non-construction emissions)	250.00	250.00	250.0	250.0	250.0

These emissions are below the MMS exemption levels. However, since the NO_x emissions are greater than the PSD major source criteria (i.e., 250 tons) and the emissions occur between 100 km and 200 km of the BNWA, MMS did evaluate the potential for a significant air quality impact. The evaluation indicated that the emissions were not "larger" enough to potentially impact the BNWA, and as such a review by the U.S. Fish and Wildlife Service (FWS) is not required.

Unavoidable Impacts

The oil and gas activities proposed for the Medusa Project will generate air pollutants due to emissions from the operation of diesel and turbine equipment, such as generators, compressors, crew and supply vessels, barges, tugs, and drilling rigs. These emissions will only affect the immediate vicinity of the oil and gas operation. 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) will be highest during the first year when drilling, laying pipeline and construction are taking place.

Sulfur oxide (SO_x) emissions will be highest during emergency events when flaring is required. Hydrogen sulfide (H_2S), a minor contaminate (i.e., at a concentration less than 100 ppm) in the gas stream, would only be vented into the atmosphere, in the event of a well blowout (assuming no fire). The released large quantities of low concentration H_2S would be entrained in the well stream gas, which is under high pressure and likely exiting the wellbore at or near sonic speed. This mechanism effectively transports the majority of the H_2S above the mixing height and disperses it in the middle to upper troposphere (USDOI, MMS, 1997).

Under normal operations, a minor amount of volatile organic compounds (VOC's) will be emitted directly into the atmosphere from a various facilities and equipment, such as pipe-fittings, storage tanks, pumps, glycol dehydrators, and turbines. Since this plan stipulates that VOC emissions from the wet oil tank and the glycol dehydrator will be routed to a vapor recovery system, VOC emissions are expected to be even lower than normal. The VOC's are precursors to photo-chemically produced ozone. A spike in VOC's, arising from a malfunction or well blowout, could contribute to a corresponding spike in ozone, especially if the release were to occur on a hot sunny day in a NO_x-rich environment. However, the nearby onshore areas are all currently in attainment for ozone (USEPA, 2001), thus such a spike would not contribute to an existing public health problem. If a fire occurs, particulate and combustible emissions will be released in addition to the VOC's.

Mitigation

As indicated above a vapor recovery system is to be employed for emissions from the wet oil tank and glycol dehydrator. No additional air quality mitigation need be applied.

References

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Appendix C

Geology

Appendix C

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.

Appendix D

Physical Oceanography

Appendix D

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 watermasses in the Central/Western Gulf of Mexico (USDOI, MMS, 2000):

- 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., 2001).

In addition to the above water masses, 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 (25-50 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 50-200 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 regions are 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 1 m 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).

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Appendix E

Socioeconomic Conditions

Table E-1

Onshore Expenditure Allocation by Subarea

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 (Misc 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
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

Table E-1. Onshore Expenditure Allocation by Subarea (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
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	Misc 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	Misc. 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/Misc 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
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

Table E-2. Population Forecast from 2000 to 2041 by Year and by Subarea (in thousands) (continued).

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
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

Table E-3

Employment Impacts Projected
from Murphy's Initial Development Operations Coordinations Document
(peak employment is projected for the year 2002 as shown)

Onshore Subarea	Direct Employment	Indirect Employment	Induced Employment	Total Employment	Baseline Employment	Murphy's Plan as a % of Baseline
FL-1	1.0	0.7	0.5	2.3	442,848	0.00%
FL-2	0.1	0.1	0.0	0.3	46,099	0.00%
FL-3	1.6	1.3	0.9	3.8	2,347,939	0.00%
FL-4	0.5	0.3	0.2	1.0	1,341,807	0.00%
EGOM	1.1	0.9	0.6	2.6	4,178,693	0.00%
LA-1	170.2	37.5	64.2	271.9	386,145	0.07%
LA-2	131.0	47.0	53.7	231.7	590,659	0.04%
LA-3	209.0	63.8	83.5	356.3	793,664	0.04%
MA-1	13.8	5.2	5.4	24.5	529,892	0.00%
CGOM	524.0	153.6	206.8	884.4	2,300,360	0.04%
TX-1	20.5	5.8	7.5	33.9	466,673	0.01%
TX-2	332.9	173.9	190.6	697.5	3,143,659	0.02%
WGOM	353.4	179.8	198.2	731.4	3,610,332	0.02%
Total GOM	878.6	334.2	405.5	1,618.0	10,089,385	0.02%

Table E-4

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
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

Table E-4. Employment Forecast from 2000 to 2041 by Year and by Subarea (in thousands) (continued).

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
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
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
2031	558.17	857.17	1,052.71	779.13	675.46	4,872.81	696.65	62.77	3,909.68	1,908.97	3,247.18	5,548.27	6,578.07	15,373.52
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

(Woods & Poole, 2002)
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Table E-5

Employment Impacts Projected from the Blowout Scenario
in Murphy's Initial Development Operations Coordination Document
(peak employment is projected for the year 2002 as shown)

Onshore Subarea	Direct Employment	Indirect Employment	Induced Employment	Total Employment	Baseline Employment	Murphy's Blowout Scenarios a % of Baseline
FL-1	11.6	7.1	5.4	24.0	442,848	0.01%
FL-2	0.0	0.0	0.0	0.0	46,099	0.00%
FL-3	20.1	13.8	10.2	44.0	2,347,939	0.00%
FL-4	3.5	2.1	1.5	7.1	1,341,807	0.00%
EGOM	11.6	7.1	5.4	24.0	4,178,693	0.00%
LA-1	656.5	146.4	326.8	1,129.6	386,145	0.29%
LA-2	823.0	159.6	386.3	1,368.9	590,659	0.23%
LA-3	1,250.6	261.3	712.9	2,224.8	793,664	0.28%
MA-1	536.4	104.7	286.0	927.1	529,892	0.17%
CGOM	3,266.4	672.0	1,712.0	5,650.3	2,300,360	0.25%
TX-1	589.7	136.8	300.1	1,026.6	466,673	0.22%
TX-2	2,725.4	872.4	1,769.3	5,367.1	3,143,659	0.17%
WGOM	3,315.1	1,009.2	2,069.4	6,393.7	3,610,332	0.18%
Total GOM	6,593.1	1,688.3	3,786.8	12,068.1	10,089,385	0.12%

Appendix F

Other Information on Grid 12

Table F-1

Grid 12 — Exploration and Development Drilling Activities

Area	Well	Operator	Spud Date	Total Depth Date	Water Depth (ft)	Remarks
EW 438	001	Exxon Mobil	4/14/1984	6/18/1984	1,375	ST
EW 438	001	Exxon Mobil	6/23/1984	7/18/1984	1,373	ST
EW 438	001	Exxon Mobil	7/26/1984	12/27/1984	1375	P&A
EW 438	002	Exxon Mobil	1/25/1985	4/2/1985	1,280	P&A
EW 834	001	McMoRan	7/11/1998	8/3/1998	1,105	P&A
EW 878	001	Texaco	2/7/1986	3/28/1986	1,585	P&A
EW 878	001	Walter O & G	6/9/2000	7/3/2000	1,523	COM
EW 878	002	Walter O & G	7/27/2000	8/10/2000	1,523	ST
EW 878	002	Walter O & G	8/11/2000	8/25/2000	1,523	COM
EW 917	001	Marathon	8/6/1996	11/5/1996	1,195	COM
EW 919	001	Elf	9/19/1983	12/10/1983	1,235	P&A
EW 919	001	Devon	8/13/1997	8/26/1997	1,432	TA
EW 921	001	Agip	12/11/1990	2/8/1991	1,630	ST
EW 921	001	Agip	2/15/1991	2/25/1991	1,630	P&A
EW 922	001	Amerada	6/7/1998	8/31/1998	1,811	TA
EW 963	001	Texaco	12/10/1987	2/21/1988	1,472	P&A
EW 963	001	Marathon	5/15/1996	6/12/1996	1,740	COM
EW 963	002	Marathon	11/19/1996	12/22/1996	1,758	COM
EW 963	003	Marathon	1/19/1997	2/15/1997	1,758	TA
EW 965	001	Agip	7/6/1996	9/8/1996	1,694	ST
EW 965	001	Agip	10/4/2001	10/17/2001	1,694	ST
EW 965	001	Agip	10/22/2001	11/3/2001	1,694	DRL
EW 965	002	Agip	10/23/1997	10/24/1997	1,692	ST
EW 965	002	Agip	10/28/1997	12/1/1998	1,694	ST
EW 965	002	Agip	11/4/1997	12/29/1997	1,694	ST
EW 965	002	Agip	1/23/1998	2/21/1998	1,692	ST
EW 965	002	Agip	12/8/1998	1/3/1999	1,696	ST
EW 965	002	Agip	1/7/1999	1/17/1999	1,696	ST
EW 965	002	Agip	2/5/1999	2/14/1999	1,696	COM
EW 965	002	Agip	6/2/1999	6/8/1999	1,692	ST
EW 965	002	Agip	7/21/1999	8/2/1999	1,692	ST
EW 965	002	Agip	10/23/1999	11/14/1999	1,692	COM
EW 965	002	Agip	2/3/2000	2/8/2000	1,692	ST
EW 965	002	Agip	2/13/2000	3/13/2000	1,694	COM
EW 966	001	ORYX	1/16/1988	2/13/1988	1,773	P&A
EW 966	001	Mariner	3/1/1998	4/19/1998	1,853	ST
EW 966	001	Mariner	4/27/1998	5/2/1998	1,853	COM
EW 966	002	ORYX	3/7/1988	5/12/1988	1,755	ST
EW 966	002	ORYX	6/21/1988	8/1/1988	1,761	P&A
EW 966	003	ORYX	5/27/1989	6/1/1989	1,766	P&A
EW 966	004	ORYX	6/17/1989	7/30/1989	1,776	P&A
EW 999	001	Placid	3/15/1985	4/27/1985	1,462	ST
EW 999	001	Placid	5/8/1985	5/18/1985	1,462	ST
EW 999	001	Placid	5/25/1985	6/11/1985	1,462	P&A
EW 1001	001	Placid	3/30/1985	6/12/1985	1,527	P&A
EW 1001	002	Placid	6/29/1985	10/26/1985	1,660	P&A
EW 1003	001	BP	3/24/1985	8/24/1985	1,765	P&A
EW 1003	003	Argo	2/23/2001	5/2/2001	1,560	TA
EW 1003	A001	Argo	3/29/1994	7/20/1994	1,450	TA
EW 1003	A002	Argo	8/7/1994	10/22/1994	1,490	COM
EW 1003	A003	Argo	8/23/1998	10/14/1998	1,488	ST
EW 1003	A003	El Paso	10/27/1998	12/19/1998	1,489	TA
EW 1003	A004	El Paso	11/14/1999	1/11/2000	1,490	ST
EW 1003	A004	El Paso	1/26/2000	3/5/2000	1,490	TA

Table F-1. Grid 12 — Exploration and Development Drilling Activities (continued).

Area	Well	Operator	Spud Date	Total Depth Date	Water Depth (ft)	Remarks
EW 1005	001	Marathon	3/3/1992	4/16/1992	1,681	P&A
EW 1006		MOBIL	11/28/1987	1/26/1988	1,783	ST
EW 1006	001	MOBIL	2/3/1988	3/14/1988	1,783	P&A
EW 1006	001	Marathon	9/18/1993	9/24/1993	1,879	P&A
EW 1006	002	Walter O & G	10/8/1993	11/5/1993	1,884	COM
EW 1008	001	Marathon	10/28/1997	11/5/1997	2,055	ST
EW 1008	001	Marathon	11/8/1997	11/27/1997	2,055	P&A
EW 1010	001	Texaco	7/20/1988	8/29/1988	1,722	P&A
EW 1010	001	Shell	7/5/2000	8/5/2000	1,657	ST
EW 1010	001	Shell	8/7/2000	10/16/2000	1,657	P&A
GC 31	001	EP OLP	8/15/1984	8/20/1984	2,084	P&A
GC 31	002	EP OLP	8/24/1984	8/31/1984	2,090	P&A
GC 31	003	EP OLP	9/26/1984	2/14/1985	2,044	ST
GC 31	003	EP OLP	2/18/1985	3/19/1985	2,044	P&A
GC 31	004	EP OLP	4/4/1985	6/2/1985	2,243	ST
GC 31	004	EP OLP	6/24/1985	8/28/1985	2,243	P&A
GC 31	005	EP OLP	6/12/1986	8/13/1986	2,220	P&A
GC 31	006	EP OLP	8/22/1988	1/17/1989	2,234	P&A
GC 32	001	Amoco	8/14/1987	8/26/1987	2,269	P&A
GC 32	002	Amoco	9/7/1987	2/18/1988	2,264	P&A
GC 37	001	Agip	12/29/1996	3/22/1997	2,019	P&A
GC 39	001	Placid	2/10/1984	4/26/1984	2,004	P&A
GC 39	002	Placid	11/13/1984	1/27/1985	1,829	P&A
GC 165	001	BP	5/17/2000	7/11/2000	2,705	P&A
GC 165	002	BP	8/30/2000	11/20/2000	2,780	ST
GC 165	002	BP	11/27/2000	12/2/2000	2,780	ST
GC 165	002	BP	12/11/2000	12/13/2000	2,780	ST
GC 165	002	BP	12/16/2000	1/5/2001	2,780	ST
GC 165	002	BP	1/16/2001	3/12/2001	2,780	P&A
GC 166	001	Exxon Mobil	12/15/1985	3/18/1986	2,381	ST
GC 166	001	Exxon Mobil	3/25/1986	4/18/1986	2,381	P&A
GC 166	002	Exxon Mobil	5/27/1989	10/31/1989	2,315	P&A
GC 167	001	Exxon Mobil	5/3/1986	8/4/1986	2,254	ST
GC 167	001	Exxon Mobil	8/10/1986	12/10/1986	2,254	P&A
GC 173	001	Marathon Oil	4/8/1997	5/17/1997	3,080	P&A
GC 212	001	TotalFinaElf	7/19/1998	10/9/1998	2,585	P&A
GC 254	001	Enserch	12/1/1984	1/21/1985	3,135	ST
GC 254	001	Enserch	2/4/1985	3/13/1985	3,135	ST
GC 254	001	Enserch	3/22/1985	3/31/1985	3,135	ST
GC 254	001	Enserch	4/26/1985	6/13/1985	3,135	P&A
GC 254	002	Enserch	7/18/1991	7/20/1991	3,225	P&A
GC 254	003	Agip	7/29/1991	11/15/1991	3,226	ST
GC 254	003	Agip	9/24/2001	10/1/2001	3,226	DSI
GC 254	004	BP	3/4/1994	5/13/1994	3,225	ST
GC 254	004	BP	5/29/1994	6/22/1994	3,225	ST
GC 254	004	BP	11/13/2000	12/12/2000	3,225	ST
GC 254	004	Agip	12/19/2000	12/23/2000	3,225	COM
GC 254	005	Agip	7/20/1995	10/30/1995	3,234	ST
GC 254	005	Agip	5/14/2000	6/4/2000	3,234	COM
MC 194	001	Shell	6/28/1975	7/17/1975	1,023	P&A
MC 194	001	Shell	7/22/1975	8/14/1975	848	P&A
MC 194	001	Shell	1/22/1976	2/20/1976	1,125	P&A
MC 194	002	Shell	11/21/1975	1/5/1976	1,023	P&A
MC 194	003	Shell	8/29/1975	9/10/1975	1,023	P&A
MC 194	004	Shell	10/2/1975	11/2/1975	1,023	P&A
MC 194	006	Shell	4/18/1990	5/13/1990	1,125	ST
MC 194	006	Shell	5/16/1990	6/6/1990	1,125	P&A
MC 194	A001	Shell	10/26/1978	11/10/1978	1,024	ST

Table F-1. Grid 12 — Exploration and Development Drilling Activities (continued).

Area	Well	Operator	Spud Date	Total Depth Date	Water Depth (ft)	Remarks
MC 194	A001	Shell	1/17/1998	1/27/1998	1,025	ST
MC 194	A001	Shell	2/1/1998	2/25/1998	1,025	ST
MC 194	A001	Shell	2/28/1998	3/27/1998	1,025	COM
MC 194	A002	Shell	3/8/1979	4/14/1979	1,024	ST
MC 194	A002	Shell	2/5/1999	2/25/1999	1,025	COM
MC 194	A003	Shell	6/23/1979	7/2/1979	1,024	ST
MC 194	A003	Shell	4/8/1995	5/4/1995	1,025	ST
MC 194	A003	Shell	11/20/1997	12/6/1997	1,025	COM
MC 194	A004	Shell	12/19/1979	12/30/1979	1,024	ST
MC 194	A004	Shell	4/13/1990	5/12/1990	1,024	ST
MC 194	A004	Shell	6/18/1995	7/6/1995	1,025	COM
MC 194	A005	Shell	1/10/1979	5/9/1979	1,024	ST
MC 194	A005	Shell	5/10/1990	6/6/1990	1,024	COM
MC 194	A006	Shell	4/24/1979	5/20/1979	1,024	ST
MC 194	A006	Shell	3/10/1995	3/26/1995	1,025	ST
MC 194	A006	Shell	3/21/2001	3/23/2001	1,025	COM
MC 194	A007	Shell	11/21/1978	12/2/1978	1,024	TA
MC 194	A008	Shell	6/1/1979	6/28/1979	1,024	ST
MC 194	A008	Shell	2/17/1994	3/15/1994	1,024	ST
MC 194	A008	Shell	4/7/1996	4/26/1996	1,024	ST
MC 194	A008	Shell	8/3/2000	8/9/2000	1,024	COM
MC 194	A009	Shell	12/25/1978	1/6/1979	1,024	ST
MC 194	A009	Shell	12/13/1989	12/21/1989	1,024	ST
MC 194	A009	Shell	6/24/1998	6/30/1998	1,025	COM
MC 194	A010	Shell	2/6/1980	2/11/1980	1,024	ST
MC 194	A010	Shell	7/17/1990	7/29/1990	1,024	ST
MC 194	A010	Shell	11/23/1996	12/11/1996	1,024	ST
MC 194	A010	Shell	12/21/1996	1/6/1997	1,024	ST
MC 194	A010	Shell	9/1/1997	9/6/1997	1,024	ST
MC 194	A010	Shell	11/10/1998	11/13/1998	1,025	ST
MC 194	A010	Shell	4/29/2001	5/4/2001	1,025	COM
MC 194	A011	Shell	12/5/1978	12/18/1978	1,024	ST
MC 194	A011	Shell	3/28/1990	4/8/1990	1,024	COM
MC 194	A012	Shell	1/6/1980	1/23/1980	1,025	ST
MC 194	A012	Shell	10/31/2000	11/7/2000	1,024	COM
MC 194	A013	Shell	3/3/1979	6/13/1979	1,025	ST
MC 194	A013	Shell	12/20/1994	1/6/1995	1,025	ST
MC 194	A013	Shell	5/11/1998	5/16/1998	1,025	ST
MC 194	A013	Shell	5/20/1998	5/31/1998	1,025	COM
MC 194	A014	Shell	4/18/1979	12/12/1979	1,024	ST
MC 194	A014	Shell	1/18/1990	10/1/1990	1,024	ST
MC 194	A014	Shell	9/5/2000	9/8/2000	1,025	ST
MC 194	A014	Shell	1/16/2001	1/17/2001	1,025	ST
MC 194	A014	Shell	1/20/2001	1/23/2001	1,025	TA
MC 194	A015	Shell	11/26/1979	12/11/1979	1,024	ST
MC 194	A015	Shell	6/1/1995	6/17/1995	1,025	COM
MC 194	A016	Shell	4/25/1980	5/7/1980	1,024	P&A
MC 194	A016	Shell	2/5/1997	5/1/1997	1,024	COM
MC 194	A017	Shell	4/14/1980	4/30/1980	1,024	ST
MC 194	A017	Shell	9/11/1989	9/18/1989	1,025	COM
MC 194	A018	Shell	2/12/1980	4/18/1980	1,024	ST
MC 194	A018	Shell	11/27/1989	1/11/1990	1,024	COM
MC 194	A019	Shell	3/30/1980	4/12/1980	1,024	COM
MC 194	A020	Shell	5/12/1980	5/24/1980	1,025	COM
MC 194	A021	Shell	1/6/1980	1/20/1980	1,024	ST
MC 194	A021	Shell	4/25/1990	5/5/1990	1,024	COM
MC 194	A022	Shell	1/25/1980	1/26/1980	1,024	P&A
MC 194	A023	Shell	12/20/1979	1/4/1980	1,024	ST

Table F-1. Grid 12 — Exploration and Development Drilling Activities (continued).

Area	Well	Operator	Spud Date	Total Depth Date	Water Depth (ft)	Remarks
MC 194	A023	Shell	12/31/1995	1/8/1996	1,024	COM
MC 194	A024	Shell	5/29/1980	6/11/1980	1,024	P&A
MC 194	A024	Shell	11/27/1993	12/30/1993	1,024	P&A
MC 194	A025	Shell	7/5/1979	7/21/1979	1,024	COM
MC 194	A026	Shell	9/28/1980	10/9/1980	1,024	ST
MC 194	A026	Shell	4/30/1994	5/14/1994	1,025	COM
MC 194	A027	Shell	9/10/1980	9/23/1980	1,024	ST
MC 194	A027	Shell	4/11/1990	4/22/1990	1,024	COM
MC 194	A028	Shell	6/14/1980	7/7/1980	1,023	COM
MC 194	A029	Shell	5/4/1980	5/16/1981	1,024	ST
MC 194	A029	Shell	11/27/1989	12/9/1989	1,025	COM
MC 194	A030	Shell	12/4/1980	12/14/1980	1,025	ST
MC 194	A030	Shell	11/4/1994	11/22/1994	1,025	COM
MC 194	A031	Shell	5/19/1980	5/30/1980	1,024	ST
MC 194	A031	Shell	6/2/1994	6/25/1994	1,025	COM
MC 194	A032	Shell	10/15/1980	10/26/1980	1,024	ST
MC 194	A032	Shell	3/3/1996	3/26/1996	1,024	COM
MC 194	A033	Shell	1/26/1980	3/9/1980	1,024	ST
MC 194	A033	Shell	9/23/1989	10/9/1989	1,024	ST
MC 194	A033	Shell	3/6/1995	3/11/1995	1,025	ST
MC 194	A033	Shell	10/4/1997	10/30/1997	1,025	COM
MC 194	A034	Shell	6/16/1980	11/10/1980	1,023	ST
MC 194	A034	Shell	5/2/1995	5/24/1995	1,025	ST
MC 194	A034	Shell	9/25/1998	10/12/1998	1,024	COM
MC 194	A035	Shell	6/1/1980	6/14/1980	1,024	P&A
MC 194	A036	Shell	11/16/1980	11/29/1980	1,024	COM
MC 194	A037	Shell	9/27/1980	10/11/1980	1,024	ST
MC 194	A037	Shell	10/21/1989	11/6/1989	1,024	ST
MC 194	A037	Shell	7/10/1994	8/2/1994	1,025	ST
MC 194	A037	Shell	5/27/2001	6/6/2001	1,025	COM
MC 194	A038	Shell	6/22/1980	9/26/1980	1,024	ST
MC 194	A038	Shell	10/27/1989	11/12/1989	1,024	ST
MC 194	A038	Shell	11/26/1998	12/3/1998	1,025	COM
MC 194	A039	Shell	10/13/1980	10/26/1980	1,025	ST
MC 194	A039	Shell	12/28/1989	1/7/1990	1,025	COM
MC 194	A040	Shell	12/17/1980	12/30/1980	1,024	ST
MC 194	A040	Shell	12/3/2000	12/7/2000	1,024	COM
MC 194	A041	Shell	10/30/1980	11/9/1980	1,024	ST
MC 194	A041	Shell	8/26/1995	9/7/1995	1,024	ST
MC 194	A041	Shell	9/13/1995	11/9/1995	1,024	COM
MC 194	A042	Shell	1/4/1981	1/13/1981	1,025	ST
MC 194	A042	Shell	3/28/1994	4/7/1994	1,024	ST
MC 194	A042	Shell	4/11/1995	4/17/1995	1,024	COM
MC 194	A043	Shell	11/14/1980	11/29/1980	1,025	COM
MC 194	A044	Shell	1/17/1981	1/26/1981	1,023	TA
MC 194	A045	Shell	12/2/1980	12/14/1980	1,025	COM
MC 194	A046	Shell	1/30/1981	2/24/1981	1,024	COM
MC 194	A047	Shell	6/30/1980	7/5/1980	1,024	COM
MC 194	A048	Shell	3/2/1981	3/16/1981	1,024	ST
MC 194	A048	Shell	3/24/1990	4/1/1990	1,024	ST
MC 194	A048	Shell	7/28/1996	8/1/1996	1,024	COM
MC 194	A049	Shell	12/18/1980	12/27/1980	1,025	COM
MC 194	A050	Shell	3/21/1981	4/1/1981	1,025	ST
MC 194	A050	Shell	2/17/2001	2/21/2001	1,025	COM
MC 194	A051	Shell	12/30/1980	1/9/1981	1,024	ST
MC 194	A051	Shell	8/13/1994	9/11/1994	1,025	COM
MC 194	A052	Shell	4/4/1981	4/19/1981	1,024	ST
MC 194	A052	Shell	12/22/1994	2/19/1995	1,025	ST

Table F-1. Grid 12 — Exploration and Development Drilling Activities (continued).

Area	Well	Operator	Spud Date	Total Depth Date	Water Depth (ft)	Remarks
MC 194	A052	Shell	12/19/1998	12/25/1998	1,025	ST
MC 194	A052	Shell	12/27/1998	1/7/1999	1,025	COM
MC 194	A053	Shell	1/12/1981	1/20/1981	1,024	COM
MC 194	A054	Shell	4/22/1981	5/10/1981	1,024	ST
MC 194	A054	Shell	8/3/1990	9/4/1990	1,024	COM
MC 194	A055	Shell	1/23/1981	2/6/1981	1,024	ST
MC 194	A055	Shell	11/11/1989	11/23/1989	1,024	COM
MC 194	A056	Shell	5/15/1981	5/28/1981	1,024	ST
MC 194	A056	Shell	10/1/1990	11/25/1990	1,024	ST
MC 194	A056	Shell	7/19/1995	8/11/1995	1,024	COM
MC 194	A057	Shell	2/10/1981	2/20/1981	1,024	COM
MC 194	A058	Shell	5/31/1981	6/12/1981	1,025	COM
MC 194	A059	Shell	2/24/1981	3/9/1981	1,024	COM
MC 194	A060	Shell	6/24/1981	8/20/1981	1,024	ST
MC 194	A060	Shell	4/14/2001	4/16/2001	1,024	COM
MC 194	A061	Shell	3/12/1981	3/23/1981	1,024	ST
MC 194	A061	Shell	9/22/1994	10/10/1994	1,025	COM
MC 194	A062	Shell	6/15/1981	8/7/1981	1,023	ST
MC 194	A062	Shell	9/22/1989	10/19/1989	1,024	ST
MC 194	A062	Shell	6/21/1997	7/17/1997	1,024	ST
MC 194	A062	Shell	7/22/1997	8/10/1997	1,024	COM
MC 194	A063	Shell	3/26/1981	3/27/1981	1,024	ST
MC 194	A065	Shell	4/1/1981	4/13/1981	1,024	ST
MC 194	A065	Shell	8/16/1988	8/30/1988	1,024	ST
MC 194	A065	Shell	1/30/1996	2/15/1996	1,024	COM
MC 194	X001	Shell			1,024	CNL
MC 238	001	Conoco Inc.	1/24/1987	2/23/1987	1,452	P&A
MC 239	001	Exxon Mobil	10/16/1984	11/29/1984	1,734	P&A
MC 281	001	Exxon Mobil	3/21/1976	5/7/1976	990	P&A
MC 281	002	Exxon Mobil	5/13/1976	7/19/1976	990	P&A
MC 281	003	Exxon Mobil	8/4/1976	9/26/1976	990	P&A
MC 281	004	Exxon Mobil	10/25/1976	11/15/1976	990	P&A
MC 281	005	Exxon Mobil	12/5/1976	1/6/1977	990	P&A
MC 281	006	Exxon Mobil	1/11/1977	1/22/1977	990	P&A
MC 281	007	Exxon Mobil	4/8/1977	4/21/1977	990	P&A
MC 281	008	Exxon Mobil	4/24/1977	5/5/1977	990	P&A
MC 281	009	Exxon Mobil	8/21/1977	9/17/1977	990	P&A
MC 282	001	Phillips	3/20/1979	7/15/1979	1,747	P&A
MC 282	002	Phillips	1/2/1980	2/9/1980	1,763	P&A
MC 311	001	Shell	12/21/1974	1/10/1975	425	P&A
MC 311	002	Shell	1/26/1975	2/26/1975	425	P&A
MC 311	003	Shell	1/26/1975	3/24/1975	425	P&A
MC 311	003	Shell	3/10/1993	5/5/1993	575	ST
MC 311	003	Shell	5/14/1993	5/29/1993	555	P&A
MC 311	004	Shell	4/24/1975	4/26/1978	425	P&A
MC 311	005	Shell	5/29/1975	6/17/1975	425	P&A
MC 311	006	Shell	2/17/1977	3/11/1977	425	P&A
MC 311	007	Shell	3/28/1977	5/5/1977	425	P&A
MC 311	008	Shell	5/17/1983	6/25/1983	709	P&A
MC 311	A001	Shell	6/16/1979	8/26/1979	425	ST
MC 311	A001	Shell	6/24/1995	6/30/1995	425	ST
MC 311	A001	Shell	7/4/1995	8/1/1995	425	COM
MC 311	A002	Shell	4/11/1979	6/13/1979	425	ST
MC 311	A002	Shell	9/29/1995	10/12/1995	425	COM
MC 311	A003	Shell	9/4/1979	11/16/1979	425	P&A
MC 311	A004	Shell	3/3/1979	11/7/1979	425	P&A
MC 311	A005	Shell	6/21/1980	7/28/1980	425	COM
MC 311	A006	Shell	5/7/1980	6/13/1980	425	COM

Table F-1. Grid 12 — Exploration and Development Drilling Activities (continued).

Area	Well	Operator	Spud Date	Total Depth Date	Water Depth (ft)	Remarks
MC 311	A007	Shell	10/16/1980	12/3/1980	425	P&A
MC 311	A008	Shell	11/30/1979	1/29/1980	425	COM
MC 311	A009	Shell	8/22/1980	10/12/1980	425	ST
MC 311	A009	Shell	11/22/1995	12/3/1995	425	TA
MC 311	A010	Shell	12/7/1980	1/3/1981	425	COM
MC 311	A011	Shell			425	AST
MC 311	A011	Shell	1/7/1981	2/19/1981	425	COM
MC 311	A012	Shell	2/28/1981	10/11/1981	425	COM
MC 311	A013	Shell	5/9/1981	6/11/1981	425	COM
MC 311	A014	Shell	12/15/1981	1/16/1982	425	COM
MC 311	A015	Shell	3/5/1982	5/25/1982	425	ST
MC 311	A015	Shell	7/11/1997	7/21/1997	425	COM
MC 311	A016	Shell	6/15/1981	10/20/1981	425	COM
MC 311	A017	Shell	11/3/1981	12/10/1981	425	ST
MC 311	A017	Shell	5/5/1989	6/2/1989	425	ST
MC 311	A017	Shell	6/3/1997	6/6/1997	425	ST
MC 311	A017	Shell	6/12/1997	6/15/1997	425	ST
MC 311	A017	Shell	8/28/2001	8/30/2001	425	ST
MC 311	A017	Shell	9/22/2001	9/22/2001	425	ST
MC 311	A017	Shell	10/1/2001	10/1/2001	425	TA
MC 311	A018	Shell	1/23/1982	2/27/1982	425	TA
MC 311	A019	Shell	5/28/1982	6/30/1982	425	COM
MC 311	A020	Shell	8/30/1988	10/13/1988	425	COM
MC 311	A021	Shell	11/1/1988	11/26/1988	425	ST
MC 311	A021	Shell	7/31/2001	8/13/2001	425	TA
MC 311	A022	Shell	12/3/1988	12/26/1988	425	ST
MC 311	A022	Shell	10/11/2001	10/22/2001	425	DRL
MC 311	A023	Shell	12/19/1988	1/30/1989	425	ST
MC 311	A023	Shell	4/30/1997	5/8/1997	425	COM
MC 311	A024	Shell	2/3/1989	4/2/1989	425	ST
MC 311	A024	Shell	7/10/1989	8/8/1989	425	COM
MC 325	001	Exxon Mobil	12/8/1979	2/1/1980	1,740	P&A
MC 325	002	Exxon Mobil	2/15/1980	3/23/1980	1,740	P&A
MC 326	002	Phillips	7/17/1979	9/9/1979	1,747	P&A
MC 326	003	Phillips	10/15/1979	10/29/1979	1,747	P&A
MC 354	001	Exxon Mobil	6/9/1977	8/3/1977	1,441	P&A
MC 355	001	Exxon Mobil	11/17/1979	12/18/1979	1,446	P&A
MC 355	002	Exxon Mobil	3/1/1981	3/16/1981	1,508	P&A
MC 355	004	Exxon Mobil	3/24/1981	5/8/1981	1,505	P&A
MC 355	A001	Exxon Mobil	4/4/1993	5/6/1993	1,460	COM
MC 355	A002	Exxon Mobil	7/5/1993	7/21/1993	1,458	COM
MC 355	A003	Exxon Mobil	4/13/1993	6/13/1993	1,460	COM
MC 355	A004	Exxon Mobil	3/18/1999	3/24/1999	1,458	ST
MC 355	A004	Exxon Mobil	3/31/1999	5/18/1999	1,458	COM
MC 356	001	Shell	11/26/1975	11/26/1975	500	P&A
MC 356	001	ORYX	8/31/1987	11/2/1987	915	P&A
MC 356	002	Shell	11/29/1975	12/15/1975	500	P&A
MC 370	001	EP OLP	11/14/1984	2/7/1985	1,725	P&A
MC397	001	Exxon Mobil	12/17/1981	12/22/1981	1,389	P&A
MC397	002	Exxon Mobil	1/1/1982	2/7/1982	1,385	P&A
MC397	003	Exxon Mobil	12/27/1983	3/9/1984	1,389	P&A
MC397	A001	Exxon Mobil	10/27/1991	2/15/1992	468	ST
MC397	A001	Exxon Mobil	5/26/2000	6/6/2000	468	COM
MC397	A002	Exxon Mobil	3/23/1992	4/10/1992	468	P&A
MC397	A003	Exxon Mobil	4/18/1992	6/30/1992	468	TA
MC397	A004	Exxon Mobil	12/14/1992	3/18/1993	468	COM
MC397	A005	Exxon Mobil	8/15/1992	10/30/1992	468	COM
MC397	A006	Exxon Mobil	10/23/1993	3/24/1994	468	COM

Table F-1. Grid 12 — Exploration and Development Drilling Activities (continued).

Area	Well	Operator	Spud Date	Total Depth Date	Water Depth (ft)	Remarks
MC397	A007	Exxon Mobil	5/23/1993	9/14/1993	468	COM
MC397	A010	Exxon Mobil	5/11/1994	6/16/1994	468	COM
MC397	A011	Exxon Mobil	7/19/1994	8/25/1994	468	COM
MC397	A012	Exxon Mobil	9/21/1994	10/12/1994	468	COM
MC397	A013	Exxon Mobil	11/12/1994	1/3/1995	468	COM
MC397	A015	Exxon Mobil	2/4/1995	3/15/1995	468	COM
MC397	A016	Exxon Mobil	9/1/1999	11/26/1999	468	COM
MC397	A017	Exxon Mobil	1/6/2000	2/23/2000	468	COM
MC397	A018	Exxon Mobil	4/2/2000	5/16/2000	468	TA
MC398	001	Exxon Mobil	7/28/1979	8/24/1979	1,450	P&A
MC398	002	Exxon Mobil	10/9/1979	10/31/1979	1,499	P&A
MC399	001	Exxon Mobil	1/15/1979	2/25/1979	1,556	P&A
MC 400	001	ORYX	9/15/1984	1/4/1985	1,015	P&A
MC 400	002	ORYX	1/24/1985	8/11/1985	858	P&A
MC 401	001	Kerr-McGee	6/10/1988	6/13/1988	1,367	ST
MC 401	001	Kerr-McGee	3/5/1993	4/4/1993	1,367	P&A
MC 401	002	Kerr-McGee	10/30/1988	12/10/1988	1,700	P&A
MC 401	003	Kerr-McGee	7/7/1989	7/30/1989	1,372	ST
MC 401	003	Kerr-McGee	8/4/1989	8/8/1989	1,372	ST
MC 401	003	ORYX	8/9/1989	9/5/1989	1,372	ST
MC 401	003	Kerr-McGee	9/22/1989	9/28/1989	1,372	P&A
MC 441	003	EEX	2/1/1990	2/5/1990	1,438	P&A
MC 441	004	EEX	2/25/1990	3/2/1990	1,427	ST
MC 441	005	EEX	5/31/1990	6/7/1990	1,431	TA
MC 441	A001	EEX	11/20/1991	12/8/1991	1,438	COM
MC 441	A004	EEX	3/26/1990	4/12/1990	1,438	COM
MC 441	A009	EEX	12/17/1991	1/15/1992	1,438	COM
MC 442	001	EP OLP	11/29/1985	11/30/1985	1,520	P&A
MC 442	001	EEX	1/29/1999	5/6/1999	1,530	ST
MC 442	001	EEX	6/7/1999	7/23/1999	1,530	P&A
MC 442	002	EEX	12/14/1985	4/24/1986	1,520	P&A
MC 442	B006	EEX	7/24/1990	8/21/1990	1,531	COM
MC 442	B007	EEX	8/12/1991	9/4/1991	1,531	ST
MC 442	B007	EEX	9/13/1991	9/18/1991	1,531	ST
MC 442	B007	EEX	9/22/1991	9/30/1991	1,531	COM
MC 442	B008	EEX	8/9/1991	10/27/1991	1,531	COM
MC 447	001	ORYX	2/18/1994	3/5/1994	1,970	P&A
MC 455	001	Union	8/22/1985	2/28/1986	1,400	TA
MC 485	001	Exxon Mobil	9/8/1982	11/1/1982	953	P&A
MC 486	001	Amoco	7/26/1979	9/6/1979	988	P&A
MC 486	001	AEDC	12/30/1987	1/30/1988	1,126	ST
MC 486	001	AEDC	2/5/1988	2/11/1988	1,126	TA
MC 486	003	Amoco	9/11/1979	10/7/1979	988	P&A
MC 486	A001	AEDC	9/19/1990	10/29/1990	582	COM
MC 486	A002	AEDC	11/10/1990	12/9/1990	582	COM
MC 486	A003	AEDC	1/14/1991	2/5/1991	582	COM
MC 486	A004	AEDC	3/12/1991	4/8/1991	582	COM
MC 486	A005	AEDC	5/10/1991	6/1/1991	582	ST
MC 486	A005	AEDC	6/7/1991	7/12/1991	582	TA
MC 486	A006	AEDC	9/28/1997	11/19/1997	582	COM
MC 486	A007	AEDC	12/10/1999	1/2/2000	582	TA
MC 486	A008	AEDC	1/10/2000	3/8/2000	582	COM
MC 487	001	Chevron	1/20/1979	2/27/1979	1,148	P&A
MC 487	001	AEDC	2/20/1988	3/22/1988	1,519	ST
MC 487	001	AEDC	3/30/1988	4/9/1988	1,519	TA
MC 487	002	Chevron	4/16/1979	5/8/1979	1,148	P&A
MC 487	003	Chevron	1/1/1981	2/11/1981	1,200	P&A
MC 487	004	Chevron	10/31/1979	11/19/1979	1,300	P&A

Table F-1. Grid 12 — Exploration and Development Drilling Activities (continued).

Area	Well	Operator	Spud Date	Total Depth Date	Water Depth (ft)	Remarks
MC 487	005	Chevron	8/2/1980	9/1/1980	1,300	P&A
MC 496	001	Ocean Energy	7/3/1998	8/26/1998	1,780	ST
MC 496	001	Ocean Energy	9/16/1998	10/10/1998	1,780	ST
MC 496	001	Ocean Energy	10/19/1998	11/6/1998	1,780	TA
MC 496	002	Ocean Energy	8/30/2001		1,637	DRL
MC 531	001	Shell	8/20/1998	9/7/1998	1,070	P&A
MC 533	001	Amerada Hess	7/11/1998	7/19/1998	1,630	P&A
MC 541	001	Union	5/21/1999	6/9/1999	2,016	P&A
MC 542	001	Amerada Hess	6/23/1985	6/25/1985	1,837	P&A
MC 542	002	Amerada Hess	7/5/1985	10/25/1985	1,890	P&A
MC 545	001	Agip	7/31/1998	9/8/1998	2,407	ST
MC 545	001	Agip	10/3/1998	10/23/1998	2,396	P&A
MC 546	001	Amoco	7/7/1985	2/2/1986	2,471	P&A
MC 546	001	Agip	5/2/1998	5/23/1998	2,505	ST
MC 546	001	Agip	5/25/1998	7/5/1998	2,505	TA
MC 546	002	Amoco	6/22/1989	6/30/1989	2,500	ST
MC 546	002	Amoco	9/6/1989	9/10/1989	2,501	P&A
MC 580	001	EEX	4/27/1998	12/25/1998	2,611	P&A
MC 582	001	Murphy	8/4/1999	10/17/1999	2,223	ST
MC 582	001	Murphy	10/25/1999	10/28/1999	2,223	ST
MC 582	001	Murphy	11/5/1999	11/14/1999	2,223	ST
MC 582	001	Murphy	12/6/1999	12/24/1999	2,223	ST
MC 582	001	Murphy	1/1/2000	1/2/2000	2,223	ST
MC 582	001	Murphy	6/8/2001	7/2/2001	2,223	TA
MC 582	002	Murphy	1/14/2000	1/28/2000	2,223	ST
MC 582	002	Murphy	2/3/2000	2/24/2000	2,223	ST
MC 582	002	Murphy	3/13/2000	3/29/2000	2,223	ST
MC 582	002	Murphy	4/5/2000	4/8/2000	2,223	ST
MC 582	002	Murphy	4/10/2000	4/23/2000	2,223	TA
MC 582	002	Murphy	7/28/2001	9/1/2001	2,214	ST
MC 582	002	Murphy	9/4/2001	9/9/2001	2,214	TA
MC 582	003	Murphy	7/21/2001		2,219	DSI
MC 582	003	Murphy	7/25/2001	7/27/2001	2,214	DSI
MC 583	001	Shell	9/9/1987	10/28/1987	2,150	P&A
MC 583	001	Samedan	7/9/1998	8/23/1998	2,485	P&A
MC 587	001	BP			2,338	AST
MC 587	001	BP	9/24/2001		2,338	DRL
MC 619	001	EEX	4/29/1996	8/8/1996	1,350	P&A
MC 620	001	EEX	7/9/1999	9/17/1999	2,167	P&A
MC 632	001	BHP	8/18/2000	9/5/2000	2,795	P&A
MC 663	001	Conoco	8/4/1983	9/25/1983	1,283	P&A
MC 667	001	RME	3/3/1998	5/5/1998	2,902	ST
MC 667	001	RME	5/18/1998	5/18/1998	2,902	P&A
MC 667	002	RME	4/6/2001	4/6/2001	2,930	P&A
MC 667	003	RME	4/8/2001	4/8/2001	2,934	P&A
MC 667	004	RME	4/14/2001	5/11/2001	2,932	ST
MC 667	004	RME	6/15/2001	6/16/2001	2,934	ST
MC 667	004	RME	6/27/2001	10/7/2001	2,934	ST
MC 667	004	RME	10/17/2001	11/5/2001	2,934	ST
MC 667	004	RME	11/5/2001		2,934	DRL
MC 674	002	BP	10/9/1996	11/10/1996	2,702	ST
MC 674	002	BP	11/19/1996	12/3/1996	2,710	ST
MC 674	002	Mariner	7/24/1999	8/5/1999	2,710	ST
MC 674	002	Mariner	9/19/1999	9/25/1999	2,710	ST
MC 674	002	Mariner	9/29/1999	10/12/1999	2,710	COM
MC 709	001	ARCO	12/23/1986	2/28/1987	2,599	TA
MC 709	002	ARCO	3/14/1987	5/21/1987	2,488	TA
MC 711	001	RME	7/6/1997	7/8/1997	3,030	P&A

Table F-1. Grid 12 — Exploration and Development Drilling Activities (continued).

Area	Well	Operator	Spud Date	Total Depth Date	Water Depth (ft)	Remarks
MC 711	001	RME	12/15/1998	1/16/1999	2,955	TA
MC 711	002	RME	7/16/1997	9/26/1997	2,985	TA
MC 711	002	RME	1/21/1999	1/22/1999	2,955	P&A
MC 711	003	RME	1/24/1999	2/8/1999	2,950	P&A
MC 711	004	RME	3/6/2000	6/3/2000	2,972	ST
MC 711	004	RME	6/9/2000	7/10/2000	2,972	TA
MC 711	005	RME	9/7/2000	10/25/2000	2,951	TA
MC 713	001	Chevron	3/6/1997	6/10/1997	3,210	P&A
MC 718	001	Mariner	6/3/1995	10/20/1995	2,828	P&A
MC 718	001	BP	11/3/1995	12/20/1995	2,828	TA
MC 751	001	Four Star O&G	1/17/1986	2/5/1986	1,472	P&A
MC 763	001	Shell	1/13/1989	4/18/1989	3,170	P&A
MC 763	A007	Shell	11/1/2001	11/9/2001	2,945	DRL
MC 798	001	RME	6/26/1995	7/22/1995	2,720	ST
MC 798	001	RME	7/25/1995	7/29/1995	2,720	P&A
MC 837	001	Texaco Inc.	9/22/1988	1/15/1989	1,708	P&A
MC 837	SS001	Walter O & G	4/20/2001	5/8/2001	1,524	ST
MC 837	SS001	Walter O & G	5/13/2001	5/19/2001	1,524	COM
MC 881	001	Exxon Mobil	9/14/1990	9/20/1990	1,964	P&A
MC 929	001	Conoco Inc.	10/5/1987	11/23/1987	2,250	P&A
MC 975	001	ORYX	2/21/1986	5/30/1986	2,894	P&A

Remarks:
AST = Approved Sidetrack
COM = Completion
DRL = Drilling
DSI = Drilling Shut In
P&A = Plugged and Abandoned
ST = Sidetrack
TA = Temporary Abandoned

Note: EW is Ewing Bank
GC is Green Canyon
MC is Mississippi Canyon

Table F-2

Grid 12 — Surface Structures (proposed and existing) within and Associated with Grid 12

Project	Area	Structure	Year Installed	Wells	Remarks
Medusa	MC 582	TLP	To be installed in September 2002		
Prince	EW 1003	TLP	2001	10	Located at 1,500 feet water depth with 4 slots; 2 of them are designated as drilling slots.
Morpeth East	EW 921	MTLP	1998	4	Located at 1,700 feet water depth, approximately 72 miles from the shore with 4 underwater completions.
Allegheny SEA	GC 254	MTLP	1999	5	Located at 3,294 feet water depth, approximately 86 miles from the shore with 5 underwater completions.
Structure A (Cognac)	MC 194	Fixed	1978		Located at 1,023 feet water depth, approximately 15 miles from the shore with 62 slots, 60 of them are designated as drilling slots.
Structure A	EW 482	Fixed	1992		Located at 371 feet water depth approximately, 43 miles from the shore with 6 underwater completions.
Structure A	MC 311	Fixed	1978		Located at 425 feet water depth, approximately 46 miles from the shore with 24 drilling slots.
Structure A	MC 397	Fixed	1991		Located at 476 feet water depth, approximately 46 miles from the shore with 3 underwater completions. Also, has 18 slots, 12 of them are designated as drilling slots.
Structure A	MC 486	Fixed	1990		Located at 582 feet water depth, approximately 42 miles from the shore with 12 slots, 7 of them are designated as drilling slots.

Notes: MC = Mississippi Canyon
EW = Ewing Bank
GC = Green 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.