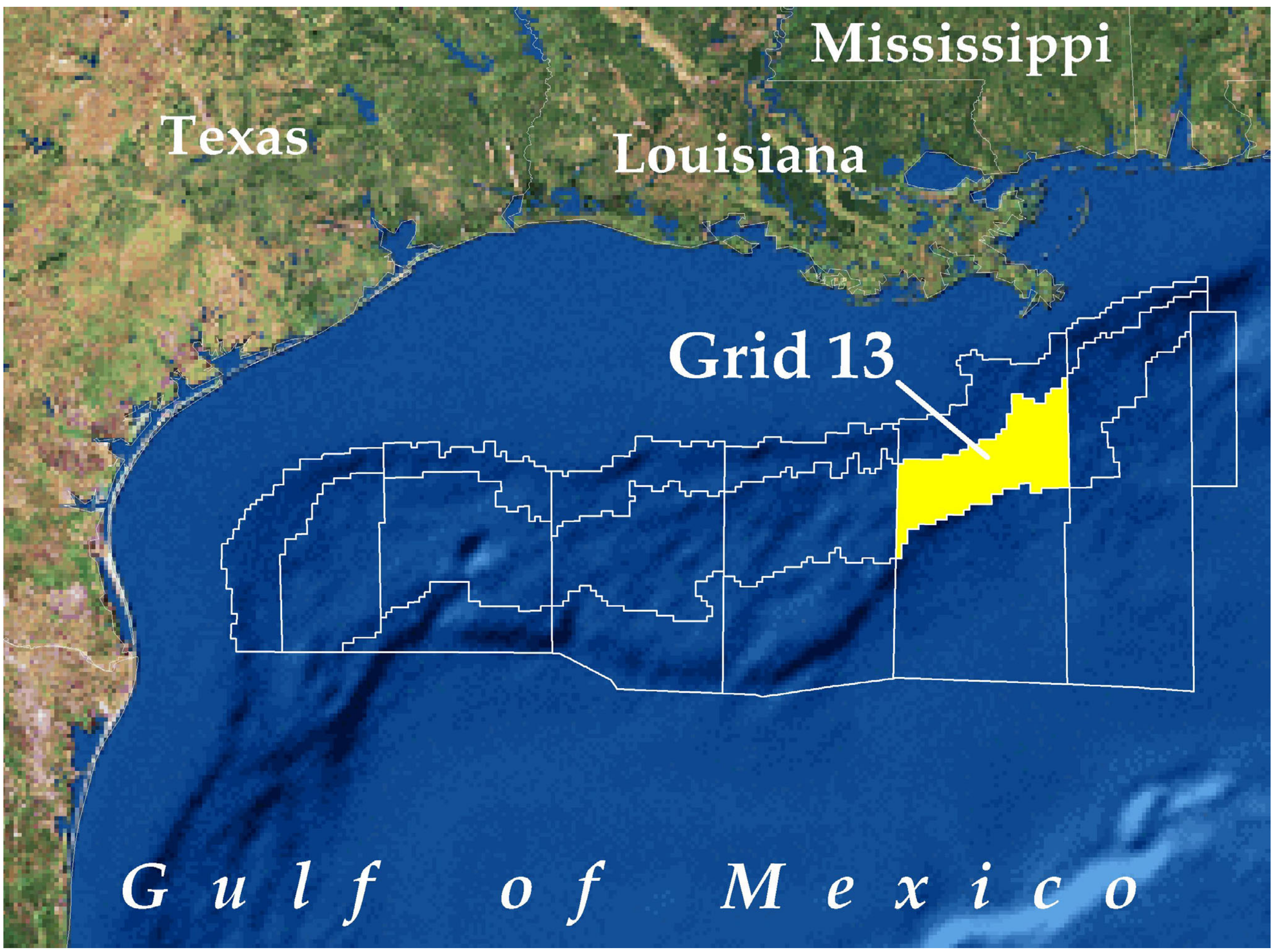
OCS EIS/EA
MMS 2003-067

Programmatic Environmental Assessment for Grid 13

Site-Specific Evaluation of Anadarko Petroleum Corporation's Initial Development Operations Coordination Document, N-7753

Marco Polo Project
Green Canyon Block 608



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

OCS EIS/EA
MMS 2003-067

Programmatic Environmental Assessment for Grid 13

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Marco Polo Project
Green Canyon Block 608

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
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PROGRAMMATIC ENVIRONMENTAL ASSESSMENT FOR GRID 13 AND SITE-SPECIFIC EVALUATION FOR ANADARKO'S MARCO POLO PROJECT

Finding of No Significant Impact

Anadarko Petroleum Corporation's (APC) Initial Unit Development Operations Coordination Document (DOCD) proposes to complete a total of six subsea production wells in Green Canyon Block 608 (OCS-G 18402). Gas and liquid production will tie back to a tension leg platform in Block 608 and separate tie-ins to right-of-way pipelines that eventually landfall in Patterson, Louisiana, and Houma terminal, respectively. Our programmatic environmental assessment (PEA) and site-specific evaluation of the proposed action (N-7753) 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 affect the quality of the marine and human environments (40 CFR 1508.27). Preparation of an environmental impact statement is not required. During this evaluation MMS identified mitigations for this proposed action that are listed below.

Mitigations

1. In accordance with Notice to Lessees 2003-G03, the Minerals Management Service has determined that you will not need to conduct the two Remotely Operated Vehicle surveys you have proposed in your plan.

2. Our review indicates that APC's proposed activities are in the vicinity of areas that could support high-density chemosynthetic communities. Therefore, please be advised that APC will use a state-of-the-art positioning system (e.g., differential global positioning system (DGPS)) on the anchor-handling vessel to ensure that any seafloor disturbances resulting from your use of anchors (including that caused by the anchors, anchor chains, and wire ropes), and specifically anchor/anchor chains PS-4, does not occur within 500 ft of the areas depicted on your submitted map, "Water Depth and Seafloor Features Map Entire Proposed Anchoring Area" (DWG NO. 2403-2015-Feat.DWG, PLATE 1, Sheet No. 1 of 1, dated March 5, 2003). Additionally, within 60 days after completion of operations, APC will resubmit to this office the above map that depicts the features to be avoided, and depicts with DGPS accuracy the "as placed" locations of all bottom disturbances associated with anchor/anchor chain PS-4.

Robert M Rogers

Robert Rogers
Supervisor, Biological Sciences Unit
Leasing and Environment, GOM OCS Region

9/25/03
Date

Dennis Chew

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

9/25/03
Date

Pasquale Roscigno
Chief, Environmental Sciences Section
Leasing and Environment, GOM OCS Region

9-25-2003
Date

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

9/25/03
Date

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ABBREVIATIONS AND ACRONYMS

A&M	agricultural and machinists
APC	Anadarko Petroleum Corporation
bbl	barrel(s)
BH	bottom hole
BNWR	Breton National Wildlife Refuge
BOD	biochemical oxygen demand
BOPD	barrels of oil per day
B.P.	before present
BTU	British thermal unit
C	carbon
CER	categorical exclusion review
CFR	Code o*f Federal Regulations
CH4	methane
cm	centimeter
CPA	Central Planning Area
CSA	Continental Shelf Associates
CZM	Coastal Zone Management
DGPS	differential global positioning system
DO	dissolved oxygen
DOCD	Development Operations Coordination Document
DOI	Department of the Interior (also: USDOI)
DP	dynamically positioned
E&P	exploration and production
EA	environmental assessment
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EIA	Energy Information Administration
EIS	environmental impact statement
EP	Exploration Plan
EPA	Eastern Planning Area
ESA	Endangered Species Act
et al.	and others
FAA	Federal Aviation Administration
FAD	fish attracting device
FEL	from the east line of the lease
FMC	Fishery Management Council
FMP	Fishery Management Plan
FNL	from the north line of the lease
FONSI	Finding of No Significant Impact
FR	*Federal Register*
FSL	from the south line of the lease
ft	foot
FWL	from the west line of the lease
FWS	Fish and Wildlife Service
g	grams
gal	gallon
GOM	Gulf of Mexico
GulfCet	Gulf Cetacean
H_2S	hydrogen sulfide
hp	horse power
IAGC	International Association of Geophysical Contractors
in	inch
kg	kilogram
km	kilometer
l	liter
lb	pounds
LCWCRTF	Louisiana Coastal Wetlands Conservation and Restoration Task Force
LDWF	Louisiana Dept. of Wildlife and Fisheries
LLC	limited liability corporation
MARPOL	International Convention for the Prevention of Pollution from Ships
mi	mile
mm	millimeter
MMCDF	million cubic feet per day
MMS	Minerals Management Service
MODU	mobile offshore drilling unit
MSA	Metropolitan Statistical Area
MWA	military warning area
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NERBC	New England River Basins Commission
ng	nanograms (10-9 grams)
NGMCS	Northern Gulf of Mexico Continental Slope Study
NMFS	National Marine Fisheries Service
NO	nitrogen oxide
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOW	nonhazardous oil-field waste
NPDES	National Pollutant and Discharge Elimination System
NRC	National Research Council
NTL	Notice to Lessees and Operators
NYMEX	New York Mercantile Exchange
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
ONR	Office of Naval Research
OPEC	Organization of Petroleum Exporting Countries
OSRA	Oil Spill Risk Analysis
PAH	polynuclear aromatic hydrocarbons

PCB	polychlorinated biphenyl
PEA	programmatic environmental assessment
ppt	parts per thousand
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
ROV	remotely operated vehicle
SBF	synthetic-based fluid
SIC	Standardized Industry Code
SOV	spill occurrence variable
SWAMP	Sperm Whale Acoustic Monitoring Program
SWSS	Sperm Whale Seismic Study
TCW	treatment, completion, and workover
TLP	tension leg platform
TSS	total solids in suspension
TV	transport variable
USCG	U.S. Coast Guard
USCOE	U.S. Corps of Engineers
USDOC	U.S. Department of Commerce
USDOI	U.S. Department of the Interior (also: DOI)
USEPA	U.S. Environmental Protection Agency
μg	micrograms (10-6 grams)
VOC	volatile organic compounds
WPA	Western Planning Area

INTRODUCTION

The Minerals Management Service (MMS) developed a comprehensive strategy for postlease National Environmental Policy Act (NEPA) compliance for development and production projects in deepwater areas (water depths greater than 400 m (1,312 ft) in the Central and Western Planning Areas (WPA) of the Gulf of Mexico (GOM). The strategy led to the development of a biologically-based grid system to ensure broad and systematic analysis of the GOM's deepwater region, which is explained on the MMS's website (USDOI, MMS, 2003a). This strategy divides the deepwater Gulf into 17 areas or "grids" of biological similarity that generally correlate to water depth.

The area for this programmatic environmental assessment (PEA) is Grid 13 in the Central Planning Area (CPA). Grid 13 is a portion of the OCS in relatively untested water between 1,000 and 2,000 m (3,280 and 6,562 ft) deep. Figure 1 shows the relationship of Grid 13 to the Gulf's coastline and the other 16 grids.

This PEA characterizes the environment of Grid 13 and examines the impacts that may result from the site-specific activities proposed by Anadarko Petroleum Corporation (APC) in an Initial Development Operations Coordination Document (DOCD N-7753) for their proposed Marco Polo project. The APC proposes a tension leg platform (TLP) for Marco Polo in what would be the deepest-water TLP installation worldwide to date. Marco Polo was therefore selected as a suitable development project on which to base this PEA. The PEA is designed to be comprehensive in terms of (1) characterizing the physical, biological, and socioeconomic resources within the grid or that are impacted by the proposed action, (2) describing the impact-producing factors from this proposed development project, (3) describing the potential impacts from this specific proposal that are representative of the grid, and (4) considering the cumulative impacts from OCS development activity in Grid 13. Figure 2 shows the location of the proposed Marco Polo project in Green Canyon Block 608 (OCS-G 18402) among the 468 OCS blocks in Grid 13.

The Grid 13 PEA serves as a reference document for the tiering (40 CFR 1502.20) concept detailed in NEPA's implementing regulations and allows subsequent environmental analyses for individual plans proposed within the grid to focus on specific issues and effects within Grid 13. The PEA tiers primarily from the CPA/WPA Multisale Final Environmental Impact Statement (EIS) (USDOI, MMS, 2002). Relevant information from the Final EIS is incorporated into this PEA by reference.

CURRENT STATUS OF GRID 13

Figure 1 shows the relationship of Grid 13 to the Gulf's coastline and the other 16 grids that have been defined in MMS's comprehensive strategy for postlease NEPA compliance in deepwater areas of the GOM. Figure 2 shows the OCS protraction areas and blocks within Grid 13 and the location of the Marco Polo project in Green Canyon Block 608. Table 1 summarizes the statistics for the OCS areas of Atwater Valley, Green Canyon, Mississippi Canyon, and Walker Ridge, which constitute Grid 13.

Table 1

Protraction Areas, Blocks, and Leases in Grid 13

Protraction Area	No. of Grid Blocks	No. of Grid Blocks Leased	Percentage of Grid Blocks Leased
Atwater Valley	231	170	74
Green Canyon	163	146	90
Mississippi Canyon	71	64	90
Walker Ridge	3	1	33
Grid Totals	468	381	81

The nearest land to Grid 13 is the northeastern corner of the grid, approximately 40 mi (64 km) from the South Pass distributary channel of the Mississippi River Delta. Atwater Valley constitutes about 51 percent of the total number of blocks in Grid 13 and about 45 percent of the total number of leases. Green Canyon contains about 35 percent of the total number of blocks in Grid 13 and has about 38 percent of the total leases. Mississippi Canyon has about 15 percent of the total number of blocks and about 17 percent of the leases. Walker Ridge has 3 blocks in Grid 13. About 81 percent of all blocks in the grid are leased.

Figure 3 shows the bathymetry of Grid 13. Figure 4 shows the location of Military Warning Areas (MWA) relative to Grid 13. The western quarter (85 OCS blocks) of Grid 13 lies within MWA 228A, but not Green Canyon Block 608. Development projects in Grid 13 that lie within the MWA, or service boat traffic traversing it, would be required to contact the Naval Air Station, Chief - Naval Air Training, Office No. 206, Corpus Christi, Texas 78419-5100 [contact Commander M. Thompson at (512) 939-3862 or (512) 939-2621] concerning electromagnetic emissions and the use of boats and aircraft in MWA 228A. The northeastern edge of Grid 13 lies adjacent to a military ordnance disposal area.

No H_2S hazards are present in Green Canyon Block 608 nor have other operators in Grid 13 encountered H_2S in drilling there to date. For additional information regarding H_2S and operational activities, see the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.1.1.3.9, Hydrogen Sulfide and Sulfurous Petroleum).

All of the OCS blocks in Grid 13 are located beyond the 200-km buffer zone of the Breton National Wilderness Area; therefore, operators have no special mitigations or reporting requirements.

Operators holding leases in Grid 13 are shown in Figure 5, and the type of lease and the status of plans that have been submitted in Grid 13 are shown in Figure 6. There are 13 blocks in Grid 13 that have Exploration Plans (EP's) approved by MMS, and 5 blocks have approved DOCD's. Thirty-seven blocks have been designated by their operators as unit developments. Figure 7 shows the location of publicly announced industry prospects and the locations of wells drilled within the grid.

Listed below are the 30 operators and/or leaseholders in Grid 13. These operators include major international oil and gas operators as well as smaller independents. The MMS's databases may not be updated to reflect all recent mergers or acquisitions in the oil and gas industry.

- Agip Petroleum Company Inc.
- Amerada Hess Corporation
- Anadarko Petroleum Corporation
- BHP Billiton Petroleum Inc.
- BP Exploration and Production Inc.
- Burlington Resources Offshore Inc.
- Chevron U.S.A. Inc.
- ConocoPhillips Inc.
- Devon Energy Production Company L.P.
- Dominion Exploration and Production Inc.
- El Paso Production GOM Inc.
- Encana Gulf of Mexico L.L.C.
- Enterprise Oil Gulf of Mexico Inc.
- Exxon Mobil Corporation
- Forrest Oil Corporation
- Kerr-McGee Oil and Gas Corporation
- Marathon Oil Company
- Mariner Energy Inc.
- Maxus Exploration Company
- Mobil Oil Exploration and Producing
- Murphy Exploration and Production Company.
- Newfield Exploration Gulf Coast Inc.
- Noble Energy Inc.
- Samedan Oil Corporation
- Shell Gulf of Mexico Inc.
- Shell Offshore Inc.
- Spinnaker Exploration Company, L.L.C.
- TotalFinaElf Exploration Production USA
- Union Oil Company of California
- Westport Oil and Gas Company

At this time, there are two surface structures within Grid 13 − Green Canyon Block 298 and Mississippi Canyon Block 807, on the northern edge of Grid 13. Figure 8 shows existing and proposed pipelines and the status of wells drilled in the grid.

The APC chose Port Fourchon, Louisiana, as its primary onshore base and Venice, Louisiana, as a contingency or backup shore base. There are numerous onshore support bases that are available along the Gulf Coast and that potentially could serve as logistical infrastructure for Grid 13. These two bases are widely used by industry. Figure 9 shows the distances from the Marco Polo project in Green Canyon Block 608 to the nearest shoreline and to APC's chosen shore bases.

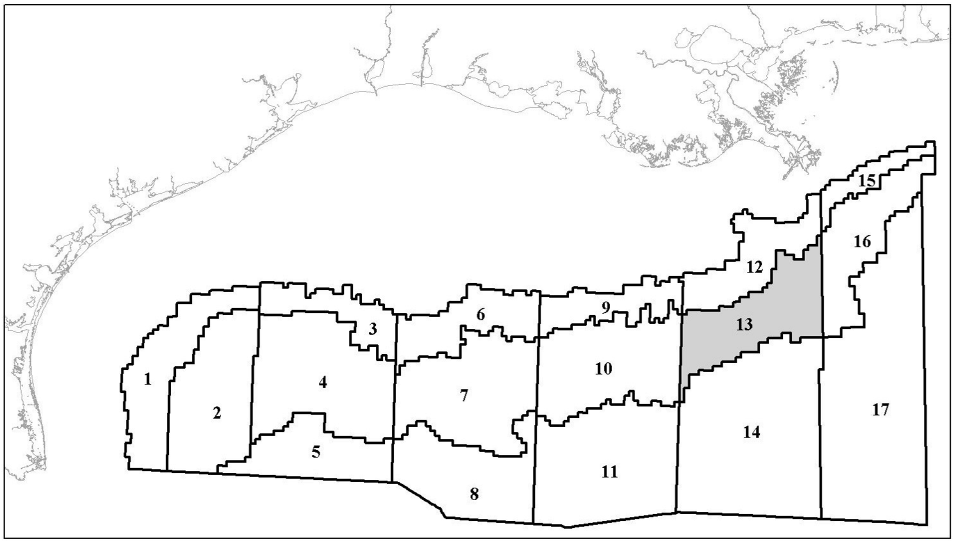


Figure 1. Relationship of Grid 13 to the Gulf Coastline and to Other Grids Defined in MMS's Comprehensive Deepwater Development Strategy.

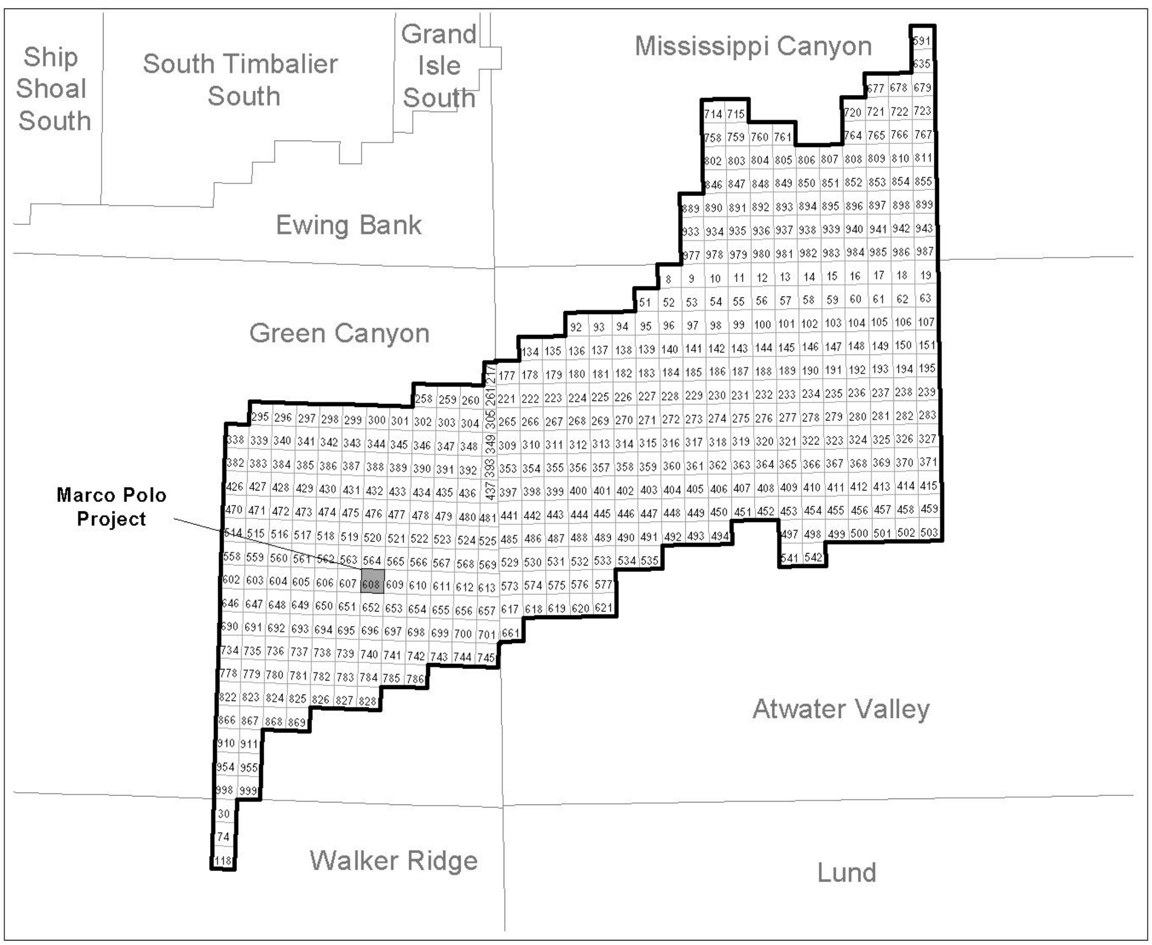


Figure 2. Protraction Areas and Blocks in Grid 13 with the Location for the Proposed Marco Polo Project in Green Canyon Block 608.

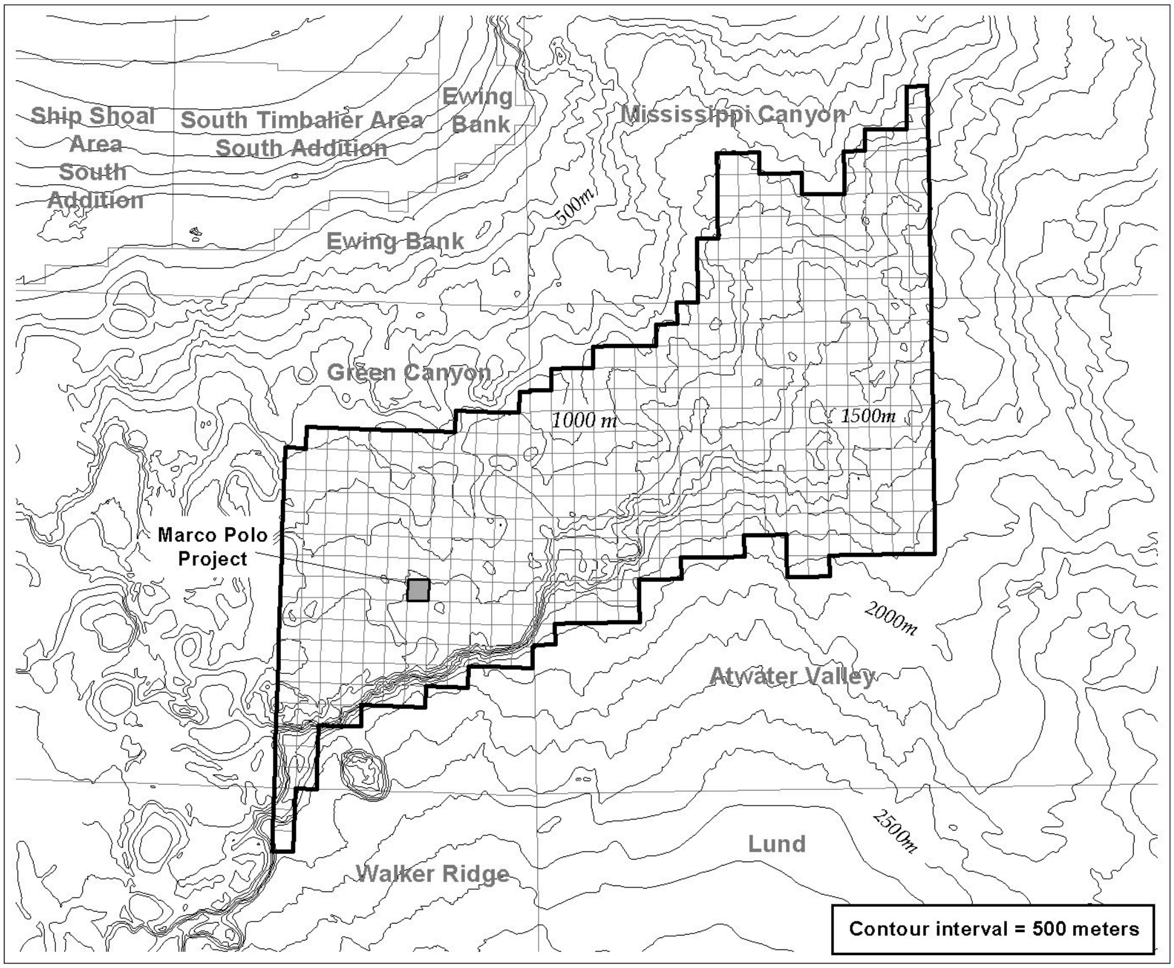


Figure 3. Bathymetric Map of Grid 13.

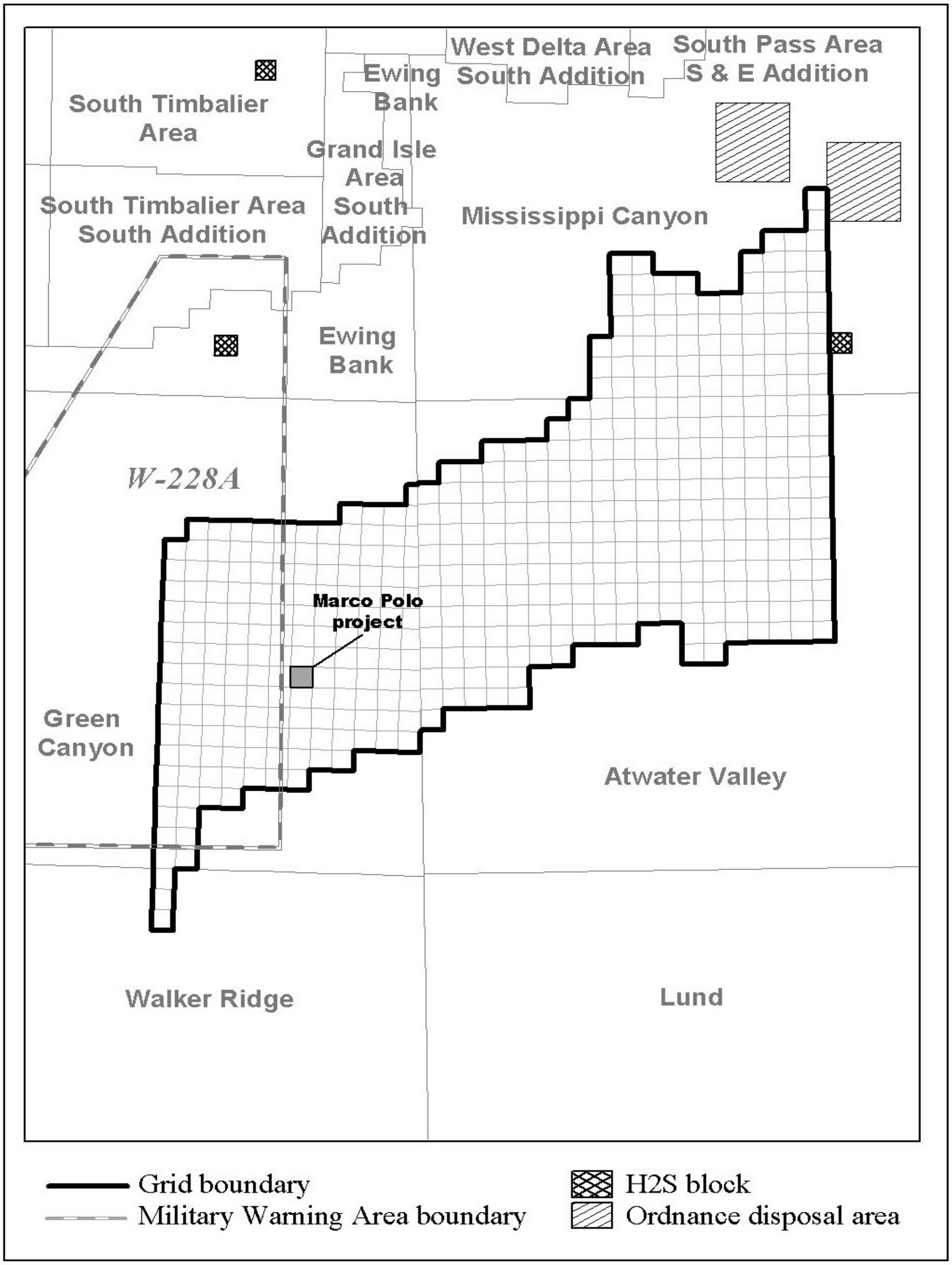
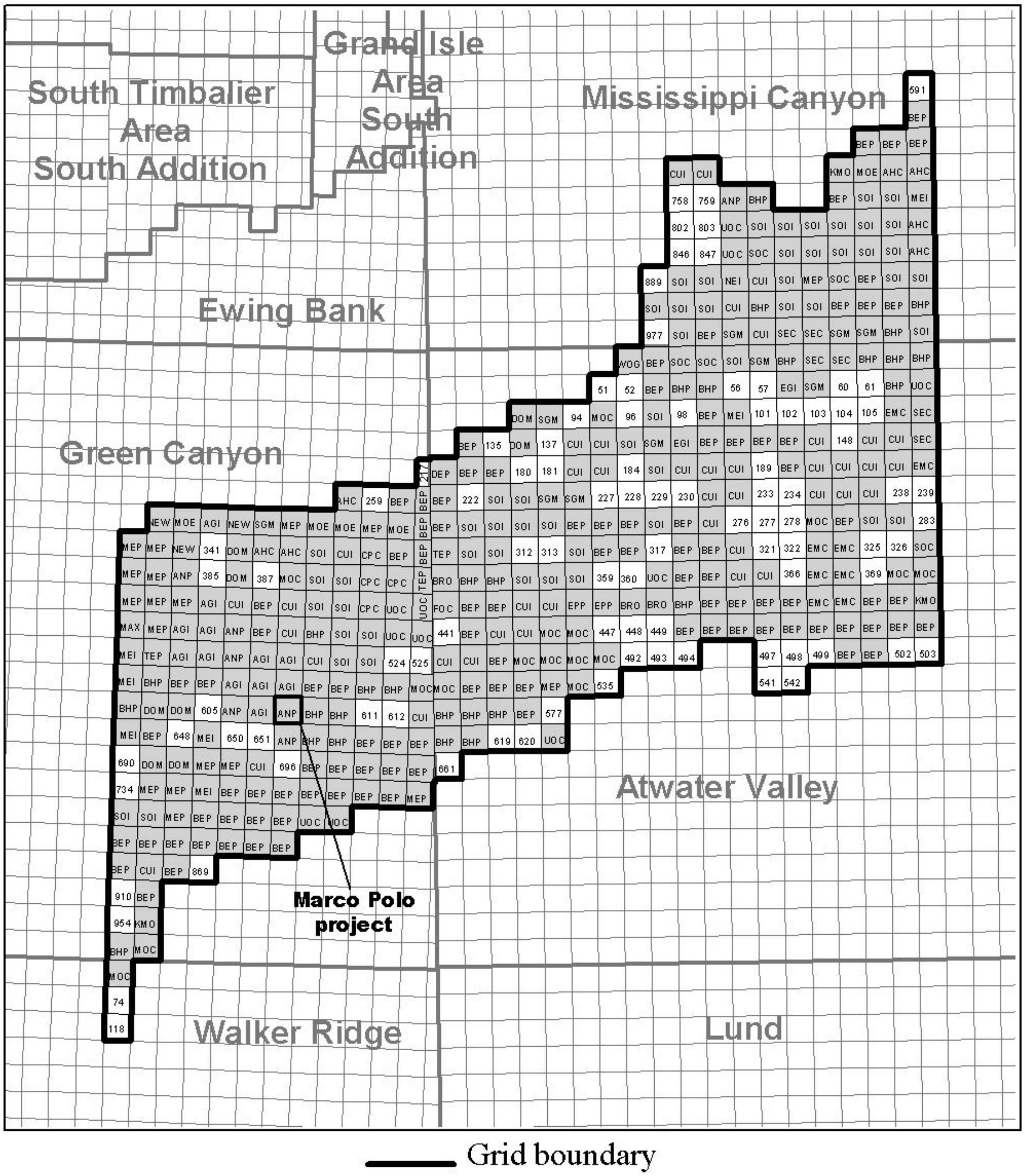


Figure 4. Military Warning Areas Proximal to Grid 13.



- **AGI** AGIP Petroleum Co. Inc.
- **AHC** Amerada Hess
- **ANP** Anarkdo Petroleum Co.
- **BHP** Billiton
- **BEP** BP Exploration
- **BRO** Burlington Resources
- **CUI** Chevron USA
- **CPC** ConocoPhillips Co.
- **DEP** Devon Energy Production
- **DOM** Dominion Exploration Prod.
- **EPP** El Paso Production
- **EGI** Encana GOM
- **EMC** Exxon Mobil
- **FOC** Forrest Oil Corp.
- **KMO** Kerr-McGee
- **MOC** Marathon Oil
- **MEI** Mariner Energy
- **MAX** Maxus US Exploration
- **MOE** Mobil Oil Exploration
- **MEP** Murphy Exploration and Prod.
- **NEW** Newfield Exploration
- **NEI** Noble Energy Inc.
- **SOC** Samadan Oil Corp.
- **SGM** Shell Gulf of Mexico
- **SOI** Shell Offshore Inc.
- **SEC** Spinnaker Exploration Co.
- **TEP** TotalFinaElf E & P
- **UOC** Union Oil Co. of California
- **WOG** Westport Oil & Gas

Figure 5. Operators Holding Leases Within Grid 13.

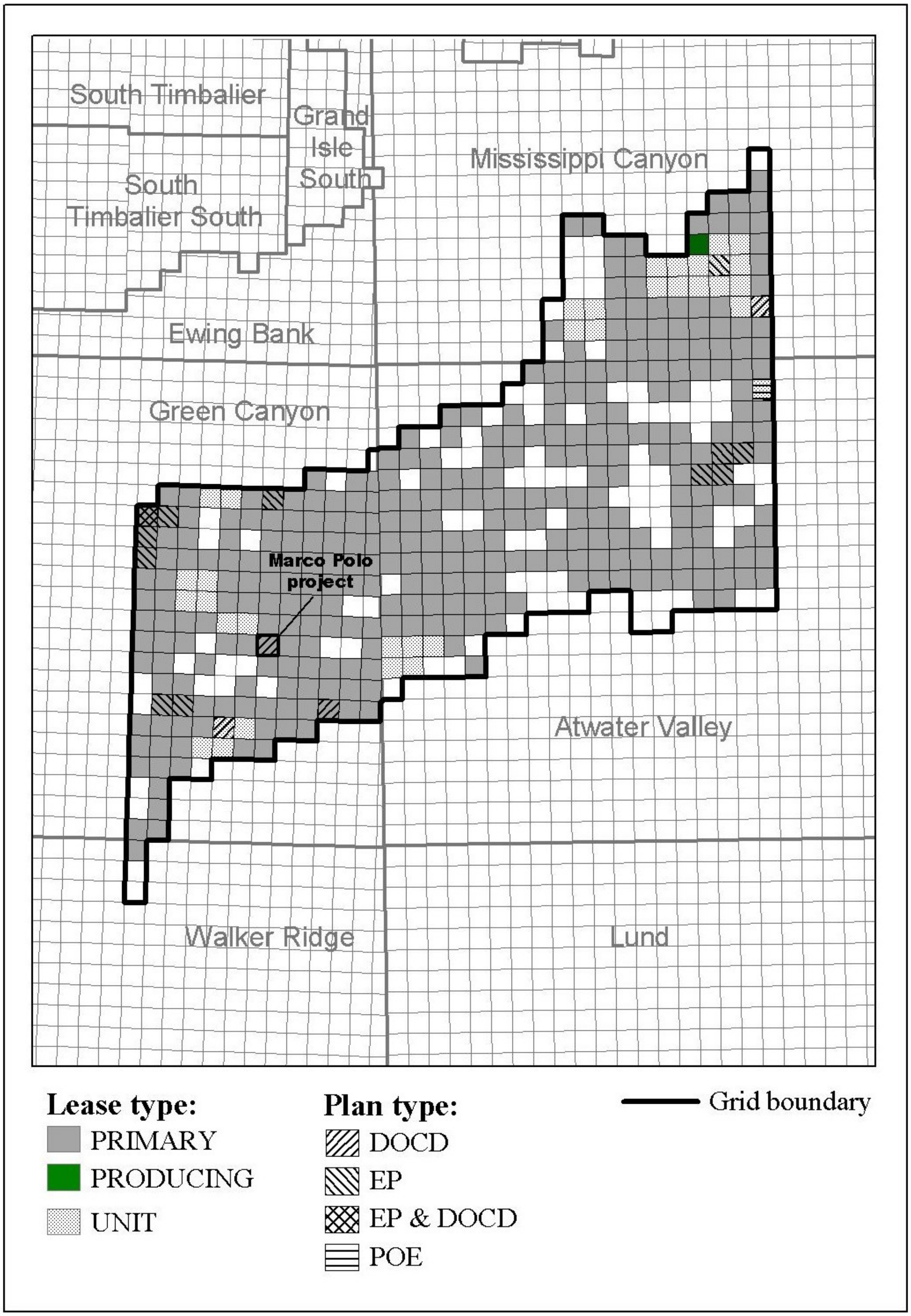


Figure 6. Active Lease Status and Plans Submitted in Grid 13.

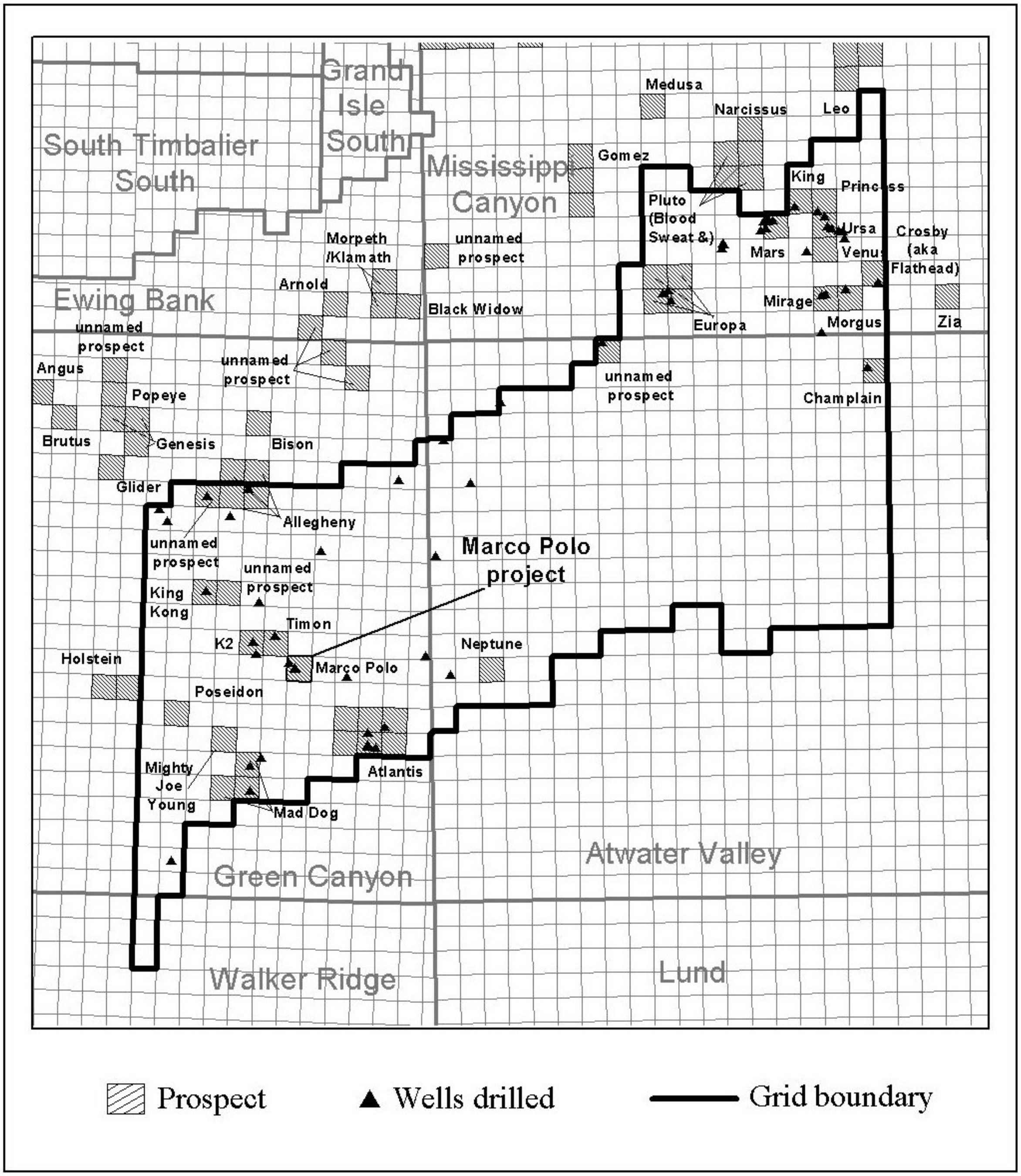


Figure 7. Publicly Announced Prospects and Wells Drilled in Grid 13.

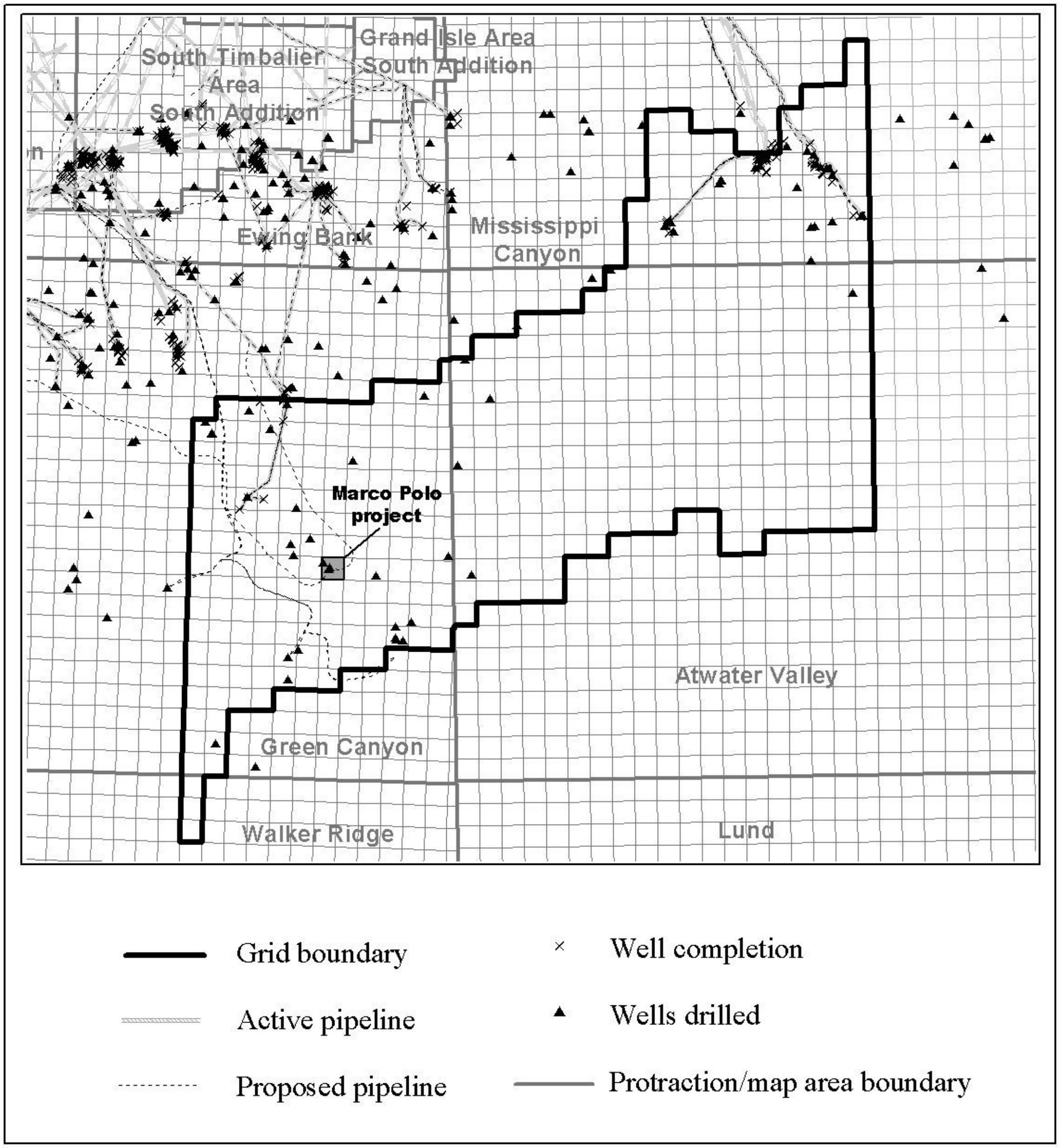


Figure 8. Active and Proposed Pipelines and Wellbore Status in Grid 13.

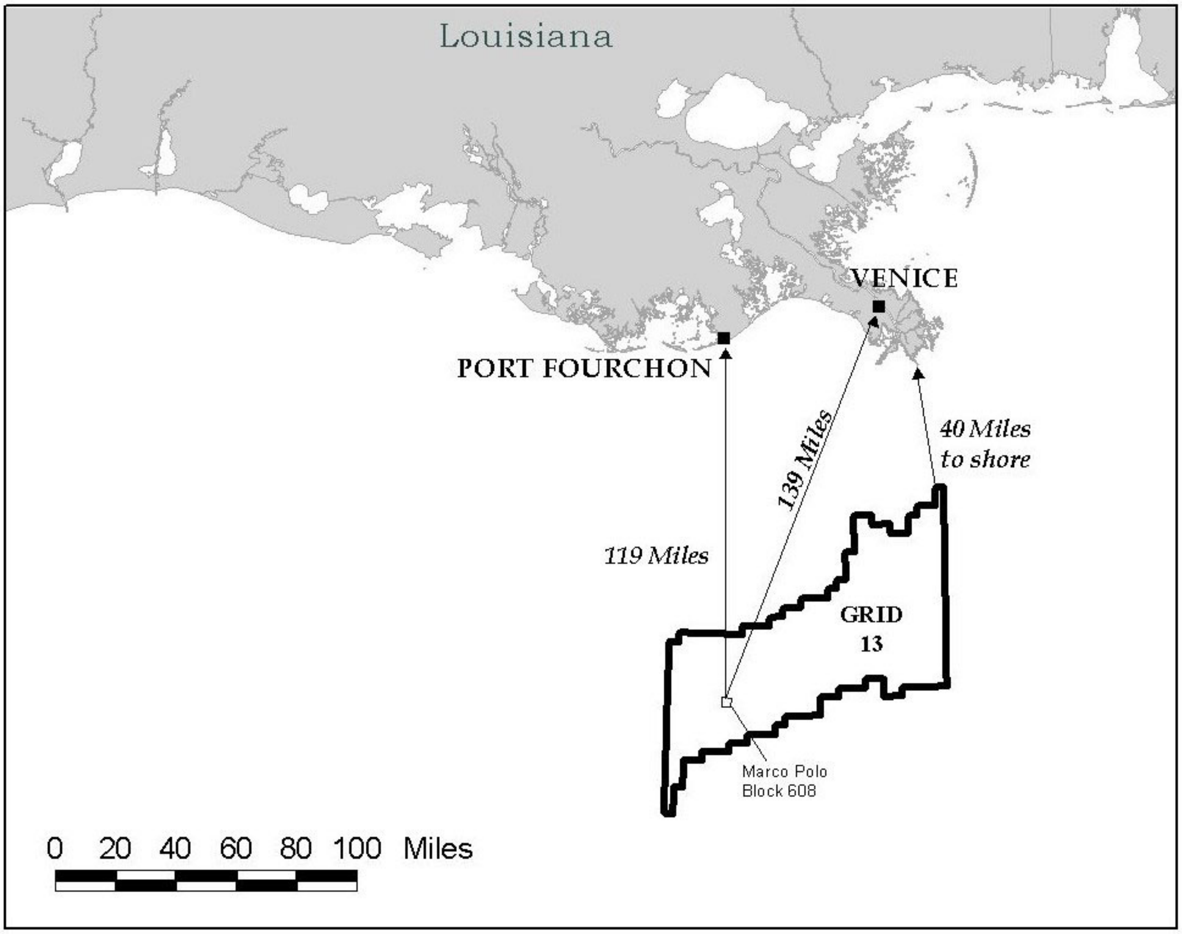


Figure 9. Distances from Marco Polo Project in Green Canyon Block 608 to the Primary Shore Base at Port Fourchon, to the Secondary Shore Base at Venice, and to the Nearest Shoreline.

1. THE PROPOSED ACTION

1.1. PURPOSE OF THE PROPOSED ACTION

The proposed action outlined by Anadarko Petroleum Corporation (APC) in their Development Operations Coordination Document (DOCD) is to produce hydrocarbons from their Marco Polo discovery in Green Canyon Block 608. Production of hydrocarbon resources would help satisfy the Nation's need for energy supplies. Under the Outer Continental Shelf Lands Act (OCSLA), as amended, the Department of the Interior (DOI) is required to manage the leasing, exploration, development, and production of oil and gas resources on the Federal OCS. The Secretary of the Interior oversees the OCS oil and gas program and MMS is the agency charged with this oversight. The Secretary is required to balance orderly resource development with protection of the human, marine, and coastal environments while ensuring that the U.S. public receives an equitable economic return for resources discovered and produced on public lands.

1.2. NEED FOR THE PROPOSED ACTION

The need for the proposed action lies in the need for orderly development of OCS resources. As the designated operator of Green Canyon Block 608, APC has filed a DOCD with MMS consistent with its requirement to file such a plan before production activity commences. Reasons that APC has submitted this proposal to MMS include

- commercial quantities of hydrocarbons have been discovered on a valid lease;
- leaseholders have a legal right to produce hydrocarbon resources; and
- leaseholders are obligated via lease terms to diligently develop resources.

1.3. DESCRIPTION OF THE PROPOSED ACTION

The APC announced initial results of their discovery at the Marco Polo prospect in Green Canyon Block 608 (OCS-G 18402) in a corporate news release on April 13, 2000. Block 608 lies in water depths between 4,240 and 4,420 ft (1,292-1,347 m). Bathymetric relief within the block is approximately 180 ft (55 m).

The APC filed a DOCD for Marco Polo on April 29, 2003. The DOCD proposes to complete six development wells ─ Wells 3, 4, 5, 6, 7, and 8. All but Wells 6 and 7 are deviated holes. Green Canyon Block 608 is located approximately 119 mi (192 km) from the Louisiana coastline (Mississippi River Delta, Plaquemines Parish). The APC is the operator of the project with 100 percent interest.

The APC filed an Initial EP (N-6574) on August 12, 1999, to drill three exploration wells ─ Wells A, B, and C ─ in Green Canyon Block 608. In February 4, 2000, APC filed an amendment to the EP to add a fourth well ─ Well D. On March 29, 2002, APC filed a Revised EP (R-3779) to add a fifth well ─ Well E. This drilling program used the dynamically-positioned (DP) drillship *Cajun Express.*

Of the wells planned in the Initial, Amended, and Revised EP's, Well A (#1) (a deviated hole and 3 sidetracks that tested the bottom-hole locations the EP planned for separate Wells B and C) was drilled, plugged, and permanently abandoned. Well D (#2) and Well E (#3) were drilled and temporarily abandoned. The APC then filed a Supplemental EP (S-5924) on May 14, 2002, to drill three more wells ─ Wells, F, G, and H. Well F (#4) became the surface location for four additional near vertical or deviated holes ─ Wells 5, 6, 7 (G), and 8 (H). Wells 4-8 have been temporarily abandoned. Subsequently, APC filed another Supplemental EP (S-6126) on February 4, 2003, to drill an additional exploration well ─ Well I (#9) ─ which was drilled in March 2003.

The surface locations for the wells in Block 608 are shown in Table 1-1.

Table 1-1

Well Locations from APC's Exploration Program in Green Canyon Block 608

EP	DOCD	Surface Location Calls	Type of Hole
A, B, C	1	FNL 7,201 ft; FWL 5,313 ft	Deviated with 3 sidetracks
D	2	FNL 3,832 ft; FWL 1,003 ft	Deviated
D	2		
E	3	FSL 7,212 ft; FWL 5,033 ft	Deviated
E	3		
F	4	FSL 7,701 ft; FWL 4,934 ft	Deviated
F	4		
	5	FSL 7,726 ft; FWL 4,918 ft	Deviated
	5		
	6	FSL 7,727 ft; FWL 4,950 ft	Vertical
G	7	FSL 7,712 ft; FWL 4,975 ft	Vertical
H	8	FSL 7,686 ft; FWL 4,980 ft	Deviated
H	8		
I	9	FNL 2,438 ft; FEL 4,944 ft	Vertical

The wells intended for completion — Wells 3, 4, 5, 6, 7, and 8 — may not be completed in the order they were drilled. Likewise, they may not begin production in the same order they are completed. The Marco Polo field will develop five reservoir intervals with six dry tree production wells. A 12-year production life for these reservoirs is expected. Estimated peak production is 60,000 BOPD of oil and 60 MMCFD of gas. Estimated average production is 7,000 BOPD of oil and 7 MMCFD of gas.

1.3.1. Schedule of Activities

The scheduled activities for Marco Polo are concurrent in some cases (Table 1-2). The well completion phase of the proposed development is expected to take approximately 9 months. The tension leg platform (TLP) installation and pipeline hook-up is scheduled for September and October 2003, respectively.

Table 1-2

Milestone Dates for the Proposed Marco Polo Project

Activity	Estimated Start Date	Estimated Complete Date
TLP Installation	09/01/2003	10/01/2003
Install Pipelines	10/01/2003	11/01/2003
Compete Wells 3, 4, 5, 6, 7, and 8	11/01/2003	08/15/2004
Well Hook-Up and Production	01/01/2004	08/01/2016

1.3.2. Equipment, Drilling System, and Pipelines

Offshore well completion activities are carried out from mobile offshore drilling units (MODU). The APC proposes to use the Nabors 140 platform rig for well completion activities and for installation of a TLP for production. The Nabors 140 rig is identified as a workover rig on their website (Nabors Industries Ltd., 2003) with a drilling depth capability of 20,000 ft (6,096 m). Crew size for this completion/installation rig is reported to be 26. The TLP will be used for production over the estimated 12-year life of the field. The TLP will be installed in water 4,300 ft (1,310 m) deep — the world's deepest TLP installation to date.

The APC's DOCD identified a MODEC-designed "Moses" style mini tension leg platform (mini-TLP) as "Platform A." Wells 3, 4, 5, 6, 7, and 8 will be completed and tested with the Nabors rig. The wells will then be hooked-up to Platform A by pipeline and produced. The "Moses" style TLP was first designed and installed for El Paso Production Company's Prince Field development in Ewing Bank. MODEC International LLC is a joint company between FMC Technologies and the MODEC/Mitsui group which markets and constructs floating production, storage and offloading systems and TLP's. The TLP hull is being constructed by MODEC International in South Korea. MODEC is responsible for the engineering, procurement, and construction for the hull, and the mooring and riser systems. MODEC is also responsible for the installation, hook-up, and commissioning of the hull, mooring and riser systems, and the deck. Structural fabrication of the topsides is being performed by Kiewit Offshore Services in Ingleside, Texas. The TLP will be owned by El Paso Energy Partners and Cal Dive International, and APC will operate it. It will be installed, inspected, and maintained in accordance with the requirements of 30 CFR 250.900(b). The TLP can accommodate a crew capacity of 26.

The APC proposes to complete the six existing wells and tie them back to the TLP (Platform A) for measurement and processing. Dry gas production will be routed from the Platform A via an 18-in right-of-way pipeline to a subsea tie-in with ChevronTexaco's Typhoon gas pipeline's 20-in gas right-of-way pipeline. The Typhoon gas pipeline boards Burlington's Eugene Island Block 371 A Platform then routes via ANR's 16-in gas right-of-way pipeline for ultimate recovery at ANR's onshore gas processing facility in Patterson, Louisiana. Oil will be routed from Green Canyon Block 608 Platform A via a 14-in right-of-way pipeline to a subsea tie-in to the Allegheny Oil Pipeline. The Allegheny pipeline will flow to the Ship Shoal Block 332 Platform A and connect with the Poseidon Oil Pipeline System for ultimate delivery to Shell's Houma, Louisiana, terminal.

1.3.3. Support Facilities

The onshore support base at Port Fourchon, Louisiana, will serve as the port of debarkation for equipment, supplies, and crews for well completion operations. Port Fourchon lies approximately 119 mi (192 km) north-northeast of Green Canyon Block 608. The designated backup onshore support base at Venice, Louisiana, lies 139 mi (224 km) from Block 608 (Figure 9). Both bases are capable of providing the services necessary for the proposed activity. They each have 24-hour service; a radio tower and phone patch; dock space; indoor and outdoor equipment and supply storage space; forklift, crane, and docking services, tractor trailer parking, and drinking water supplies. Either base will serve as a loading point for the tools, equipment and machinery, drilling and completion chemicals, and crews needed for well completions and platform operations.

1.3.4. Transportation Operations

Personal vehicles will be the main means of transportation to carry rig personnel from various locations to either Port Fourchon or Venice. Crews will then be transported to the drilling rig by the crewboat, and a supply boat will transport large or bulk supplies. Each boat will use the most practical and direct route to and from the Marco Polo TLP permitted by weather and vessel traffic conditions. A helicopter will be used periodically to transport small supplies and personnel. The MMS interprets "periodically" as four trips per week. The most practical and direct air route from the shore base permitted by the weather and traffic conditions will be used. The transportation route by vessel is approximately 140 mi (225 km) to Green Canyon Block 608. Approximately 60 people are estimated to have a direct or supporting role in manning a supply boat or a crewboat. Vessel crews will live on their respective vessels while working and will return to their temporary or permanent residences upon completion of each tour of duty.

Table 1-3 summarizes the vessel travel frequency per week during the 12 months of well completion and TLP installation and pipeline tie backs, and the 12 years of production.

Table 1-3

Support Vessel Travel Frequency for Stages of the Proposed Marco Polo Project

Vessel	Trips/Week 12 Months Well Completion and Development	Trips/Week 12 Years Production
Crewboat	3	3
Supply boat	2	2
Helicopter	Periodically, (*4)	Periodically, (*4)

* MMS estimate.

1.3.5. New or Unusual Technology

The APC plans to use gelled fluid as a means of insulating top tensioned risers in order to reduce convection and conduction heat loss in the production riser system. Gelled fluids have been used in other deepwater projects for flowline and downhole casing annulus applications, and the technology is not completely new. The APC, however, did identify it as the only new or unusual technology for the Marco Polo project.

The APC will use InsulGel™, or a similar product, in two separate annuli in the riser system. The first annulus is between 9-5/8-in production casing riser and the 4-1/2-in production tubing (from the mudline packer at 100 ft below the mudline to the surface tree on the TLP). The volume of fluid in this annulus would be approximately 210 bbl per well. The second annulus is between the 9-5/8-in and 13-3/8-in riser (from the subsea wellhead at the mudline to the surface tree on the TLP). The volume of fluid in this annulus would be approximately 250 bbl per well.

"InsulGel™ Thermally Insulating Packer Fluid" is actually a packer fluid that provides thermal insulation properties that minimizes heat transfer from produced fluids and thereby retards deposition of paraffins, asphaltenes, and gas hydrate. InsulGel™ is a solids-free and hydrocarbon-free fluid incorporated into a brine base. The fluid's physical, reactivity, hazard, and environmental characteristics make it compatible with most completion fluids and elastomers. The base fluid is viscosified with special polymers (reduces fluid movement in the annulus) and thereby is referred to as a gelled fluid.

Unintended disconnects of a riser system could result in release of some or all of the fluid in the annuli. Riser system failures and disconnects, though not common, have occurred in the past (USDOI, MMS, 2000b and 2003b). Should the InsulGel™ or similar fluid be released into the water column from a riser failure, minimal impact would be expected. This conclusion is based on the fluid's physical characteristics, low toxicity, and the small quantity that would be released in an accident of this type (approximately 500 bbl). This fluid would be rapidly dispersed and diluted in an open marine environment if accidentally released.

1.3.6. Impacts from Potential Geological Hazards

The MMS conducted a geological and geophysical review of the block during review of the Initial EP (N-7753) and Supplemental EP's. The geophysical hazard study revealed acoustic void zones associated with two prominent seafloor mounds located along the western lease line of Green Canyon Block 608. The largest feature was 2,000 ft (609 m) across and 90 ft (27 m) high, and the second mound was 1,500 ft (457 m) across and 20 ft (6 m) high. The mounds were interpreted to be areas of hydrocarbon seepage that may possibly support chemosynthetic communities. The use of a DP drillship for the exploration program precluded the need to avoid these areas with anchors and mooring lines; however, the same advantage does not extend to installation of a production facility. No shallow geologic hazards were identified at the sea-bottom locations for all exploration wells that were drilled.

1.4. OFFSHORE DISCHARGES AND WASTE DISPOSAL

The discharge of wastes into offshore waters is regulated by the U.S. Environmental Protection Agency (USEPA) under the authority of the Clean Water Act. No wastes generated during oil and gas operations can be discharged overboard unless they meet the standards required within a National

Pollution Discharge Elimination System (NPDES) permit. All of the waste types generated from the proposed development and production activities for Marco Polo will be either (1) discharged overboard in compliance with NPDES requirements or (2) transported to shore for disposal in permitted or licensed commercial facilities or for recycling. The wastes for overboard discharge and transport to shore for recycling or disposal are summarized in Tables 1-4 and 1-5, respectively.

Table 1-4

Wastes for Discharge Overboard on the Proposed Marco Polo Project

Type of Waste	Amount to be Discharged*	Maximum Discharge Rate	Treatment, Transport, and Disposal Method
Produced Water	50,000 bbl water/day	2,085 bbl/hr	Discharge at seafloor
Sanitary Wastes	20 gal/person/day	As produced	Chlorinate and discharge overboard
Domestic Wastes	30 gal/person/day	As produced	Grind, remove floating solids
Well Treatment, Workover, or Completion Fluids	Workover – 300bbl/well Treatment – 250 bb/well Completion – 3000 bbl/well	15 bbl/hr (separator discharge rate)	Discharge used fluids overboard, return unused to supplier for credit
Uncontaminated Ballast	5,730 bbl/day	2,400 gal/minute	Discharge overboard

* Expressed as a volume or rate.

Table 1-5

Wastes for Transport to Shore on the Proposed Marco Polo Project

Type of Waste – Approximate Composition	Amount*	Name/Location of Disposal Facility	Treatment and/or Storage, Transport, and Disposal Method
Produced Sand – oil-contaminated produced sand	400 bbl/yr	New Park Transfer Station (Venice, LA)	Land spreading
Chemically Treated Seawater/Freshwater – water to which chemical agents have been added.	20 bbl/well	U.S. Liquids, Fourchon, LA or Newpark Environmental Services, Fourchon, LA	Transport to shore base for pickup
Non-RCRA Exempt Solid Wastes – plastic, paper, aluminum, food refuse	5 m^3/month	Galliano Waste Disposal, Galliano, LA or Waste Management, Raceland, LA	Transport to shore base for pickup by municipal operations

* Expressed as a volume per well or rate.

During the 12-month well completion and TLP installation period, the wastes generated consist of (1) well treatment, completion, and/or workover fluids, (2) chemically treated seawater or freshwater, (3) sanitary and domestic wastes, (4) deck drainage, (5) uncontaminated seawater used for cooling, desalinization, and ballast, and (6) solid trash and debris. Treating chemicals may be added to treat or prevent operational problems that may occur in the production process. Treating chemicals can generally be classified into three categories: production-treating chemicals, gas-processing chemicals, and stimulation and workover chemicals. Chemically treated water and completion fluids are recycled by the supplier and are not expected to exceed 20 bbl per well during the completion phase. Solid waste is transported to shore for disposal in licensed landfills and is not expected to exceed 5 m^3 per month during completion or production phases.

During the 12-year production operation, volumetrically large overboard discharges would include (1) sanitary and domestic wastes, (2) deck drainage, (3) uncontaminated seawater used for cooling, desalinization, and ballast, (4) solid trash and debris, and (5) produced sand. Produced sand is sand in the oil that is entrained in the hydrocarbon flow from the produced formations. Produced sand will be transported to shore for land spreading and is not expected to exceed 400 bbl per year.

The APC indicates that a 48-hour production test is part of each well completion. Produced water from well testing, if any, and produced water from the 12-year production period constitutes the largest single discharge from this proposed development. As a general trend, as oil field age increases the volume of produced water also increases. Produced water (also known as production water or produced brine) is the total water evolved as a byproduct of oil and gas extraction. It is made up of formation water, injection water, and small quantities of various chemicals entrained with hydrocarbon. Produced water is mostly formation water (also called fossil or connate water) that exists in permeable rock formations in their natural state and that is brought to the surface commingled with oil and gas. Injection water is used to enhance oil production or if secondary oil recovery takes place.

Produced waters can have high total solids in suspension (TSS), salinities, levels of organic carbon, metal content, and can be very low in dissolved oxygen. Because these waters are closely intermingled with petroleum, they contain variable concentrations of dissolved and dispersed petroleum hydrocarbons and need to be separated from hydrocarbon on the production platform. High concentrations of other soluble organic compounds have been found in production streams, particularly phenols and carboxylic organic acids (Neff, 1997). High levels of toxic metals such as vanadium, copper, and arsenic have been found in some produced-water discharges. Table IV-8 in the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a) provides typical chemical concentrations that have been measured in Gulf of Mexico produced waters.

Produced water is disposed of by either overboard discharge or reinjection into geologic formations near the drilling site. The APC's DOCD identifies overboard discharge as the disposal method for produced water. The USEPA's NPDES permit establishes limits for free oil in produced water as determined by the visual sheen test. Oil and grease is limited to <42 mg/l daily and 29 mg/l monthly average (USDOI, MMS, 2001a; Table IV-9).

Routine sanitary and domestic wastes necessarily arise from people working offshore on drilling rigs, production platforms, and support vessels. The APC estimated that 20 gal/person/day of sanitary waste and 30 gal/person/day of domestic waste would be discharged from the TLP. Estimates of the amounts of sanitary and domestic wastes discharged from associated service-vessel operations were not provided by APC but are generally estimated to be 60 gal/person/day (NERBC, 1976).

Deck drainage effluent is primarily rainwater containing residual oil and grease from equipment washwater and rainwater. Overboard discharge of deck drainage is governed by the NPDES permit requirement for no visible oil sheen. A maximum for deck drainage during daily operation is estimated by MMS to be 4,000 bbl per month.

1.5. REGULATORY FRAMEWORK

Federal laws mandate the OCS leasing program and the environmental reviews for the actions proposed by operators that seek to explore and produce hydrocarbons from Federal waters. An explanation of applicable statutes and regulations that comprise the regulatory framework for OCS activity, and this proposed action is contained in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 1.3, Regulatory Framework) and is incorporated into this PEA by reference.

2. ALTERNATIVES TO THE PROPOSED ACTION

2.1. NONAPPROVAL OF THE PROPOSAL

The APC would not be allowed complete the six proposed development wells, install the TLP, and produce from the targeted reservoirs as proposed in its Initial DOCD. This alternative would result in no impact from the proposed action but could preclude the development of much needed hydrocarbon resources from a known discovery, and thereby result in a loss of royalty income for the United States and energy for America. Considering these aspects and the fact that MMS anticipates minor environmental and human impacts resulting from the proposed action, this alternative was not selected for further analysis.

2.2. APPROVAL OF THE PROPOSAL WITH EXISTING AND/OR ADDED MITIGATION

The MMS's lease stipulations, OCS 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. This alternative was selected for evaluation in this PEA.

2.2.1. Mitigations

2.2.1.1. ROV Survey Not Required

In accordance with Notice to Lessees 2003-G03, the MMS has determined that APC will not need to conduct the two Remotely Operated Vehicle surveys proposed in the plan.

2.2.1.2. Nonrecurring Mitigation

No chemosynthetic communities are located in the immediate vicinity of the TLP mooring locations, general pipeline routing area, or mooring pre-lay areas. There are seafloor expulsion mounds, however, located near anchor/anchor chain PS-4 that are indicated in APC's submitted materials; specifically, "Water Depth and Seafloor Features Map Entire Proposed Anchoring Area" (DWG NO. 2403-2015-Feat.DWG, PLATE 1, Sheet No. 1 of 1, dated March 5, 2003) for the Nabors 140 well completion/installation barge.

The MMS's review indicates that APC's proposed activities are in the vicinity of areas that could support high-density chemosynthetic communities. Therefore, please be advised that APC will use a state-of-the-art positioning system (e.g., differential global positioning system (DGPS)) on the anchor-handling vessel to ensure that any seafloor disturbances resulting from your use of anchors (including that caused by the anchors, anchor chains, and wire ropes), and specifically anchor/anchor chains PS-4, does not occur within 500 ft of the areas depicted on your submitted map, "Water Depth and Seafloor Features Map Entire Proposed Anchoring Area" (DWG NO. 2403-2015-Feat.DWG, PLATE 1, Sheet No. 1 of 1, dated March 5, 2003). Additionally, within 60 days after completion of operations, APC will resubmit to this office the above map that depicts the features to be avoided and that depicts with DGPS accuracy the "as placed" locations of all bottom disturbances associated with anchor/anchor chain PS-4.

3. DESCRIPTION OF THE AFFECTED RESOURCES

Chapter 3 describes the physical, biological, socioeconomic, and human resources in and adjacent to Grid 13 that could be potentially affected by development and production activities for the proposed Marco Polo project. The descriptions present environmental resources as they are now, thus providing baseline information for the analyses in Chapter 4 where potential impacts from the Marco Polo project in Green Canyon Block 608 are examined. Discussions in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002) are summarized or incorporated into this PEA by reference where appropriate.

3.1. PHYSICAL RESOURCES

Descriptions of the following components of the physical environment are contained in Appendix 9.1 of the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002): (1) geologic and geographic setting; (2) physical oceanography; (3) meteorological conditions; and (4) existing OCS-related infrastructure. These discussions are incorporated into this PEA by reference.

Physical environments in the Central Gulf are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.1) and are incorporated into this PEA by reference. Summaries of these resources follow and include (1) water quality and (2) air quality.

3.1.1. Water Quality

3.1.1.1. Coastal Waters

Coastal water quality along Louisiana is relevant to production activities in Grid 13 and the Marco Polo project. The most likely service bases for development of Grid 13 are located on the coast. Marine transportation to and from Grid 13 would traverse coastal waters, and accidental oil spills could make landfall along this coastline.

The bays, estuaries, and nearshore coastal waters of the north-central Gulf are highly important in that they provide important feeding, breeding, and/or nursery habitat for many commercially important invertebrates and fishes, as well as sea turtles, birds, and marine 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 coastal areas are typically more sensitive to water quality degradation than adult stages.

A comprehensive assessment of water quality in the coastal and estuarine areas of the GOM is contained in the USEPA's estuarine report (USEPA, 1999). Estuaries were classified primarily by aquatic life support, fish consumption, or recreation and whether they are fully, partially, or not supporting of these uses. Of the 78 percent of Gulf estuaries that were surveyed, 35 percent of the surveyed estuaries were designated as impaired in their ability to support one or more of these uses. Impairment factors include pathogen indicators (e.g., fecal coliform) and eutrophication indicators (e.g., nutrients, organic enrichment, and low dissolved oxygen). 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 (USDOC, NOAA, 1992a).

Urban runoff is the leading source of contaminants that impair coastal water quality. Other source categories include (1) agricultural runoff, (2) municipal point sources, (3) land fill leachate, (4) hydromodification, (5) petrochemical plants and refineries, (6) power plants, (7) pulp and paper mills, (8) fish or livestock processors, (9) nonrefinery industrial discharge, and (10) shipping. Hydromodification includes dredging and spoil disposal; channelization (channel straightening); dam, levee, or floodgate construction; and river bank and shoreline modifications that change river flow patterns or sediment load.

There are over 3,700 known point sources of contamination that flow into the Gulf (Weber et al., 1992), with municipalities, refineries, and petrochemical plants accounting for the majority of these point sources. The NRC (2003; Table I-4) estimated that 942 metric tons of oil/yr (about 6,600 bbl/yr) entered Gulf waters from petrochemical and oil refinery industries in Louisiana. Further, the NRC (2003) calculated an estimate for oil and grease loads from all land-based sources per unit of urban land area for rivers entering the sea. The Mississippi River introduced approximately 525,600 metric tons of oil/yr (about 3.7 million bbl/yr) (NRC, 2003; Table I-9) into the waters of the Gulf.

Vessels from the shipping and fishing industries, as well as recreational boaters, add contaminants to coastal water in the form of bilge water, liquid and solid waste, spills, and chemicals leached from antifouling paints. Many millions of cubic feet of sediments are moved each year in coastal areas as a result of channelization, dredging, spoil disposal, and other hydromodifications. Water quality may be affected by these activities because they can lead to saltwater intrusion, increased turbidity, and release of contaminants.

Nonpoint sources of contamination from urban and agricultural runoff are difficult to control and to regulate. Inland cities, farms, ranches, forests, and various industries drain into waterways that empty into the Gulf. About 80 percent of U.S. croplands lie upstream of the Gulf. Nutrient enrichment of river water from nitrogen and phosphorus fertilizers and compounds is another major contributing factor to water quality problems. It can lead to noxious algal blooms, reduced seagrasses, fish kills, and oxygen depletion. The Gulf coastal area alone used 10 million pounds of pesticides in 1987 (USDOC, NOAA, 1992a).

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 decline to 20 ppt during spring and summer due to increased runoff (USDOI, MMS, 2000b; page III-9). Oxygen and nutrient concentrations also vary seasonally. Sediment contamination in U.S. coastal waters is related to proximity to large industrialized cities. High levels of certain contaminants have been reported for all

Gulf State waters (O'Connor and Beliaeff, 1995). Cadmium, copper, and zinc increases have been noted in mollusks at eight sites between Pascagoula Bay, Mississippi, and the Mississippi River.

3.1.1.2. Offshore Waters

The water offshore of the Louisiana coast can be divided into two regions: the continental shelf and the slope west of the Mississippi River (<305 m or 1,000 ft) and deepwater (>305 m). The continental shelf off the modern Mississippi River Delta is narrow because of the outbuilding of sediment from the river onto the shelf. To the west the shelf broadens and is about 100 mi wide in western Louisiana. Waters on the continental shelf and slope are heavily influenced by the Mississippi and Atchafalaya Rivers, the primary sources of freshwater, sediment, and pollutants from a huge drainage basin encompassing 55 percent of the continental U.S. (Murray, 1998). Lower salinities are characteristic nearshore where freshwater from the rivers mix with Gulf waters. While the average discharge from the Mississippi River exceeds the input of all other rivers along the Texas-Louisiana coast by a factor of 10; during low-flow periods the Mississippi River can have a flow less than all these rivers combined (Nowlin et al., 1998).

A zone of hypoxia on the Louisiana-Texas shelf is one of the largest areas of low oxygen in the world's coastal waters (Murray, 1998). Hypoxic conditions are caused by a seasonal stratified water column. Water stratification occurs during the summer months when Mississippi River discharge tends to be lower. The less dense and low-salinity water from the river "floats" on top of denser, more saline water and creates a stratified water column. High nutrient loads in the river water enhance algae production and increase the amount of decaying organic matter accumulating at the sea bottom. Decay depletes oxygen in bottom waters to the point of hypoxia (<2 mg/l dissolved oxygen) while the oxygen content of near-surface water is at or near to saturation. The hypoxic oxygen levels are low enough to affect the abundance, health, and vitality of soft-bottom invertebrate faunas and bottom-dwelling fish. Under severe or prolonged conditions it can kill off bottom faunas. Hypoxic conditions last until local wind-driven circulation mixes the water column. Approximately 7,700 mi^2 (20,000 km^2) of coastal and shelf bottom water off the Louisiana and Texas coasts were affected by hypoxic conditions in 1999 (Simpson, 2001). Increased nutrient loading in the Mississippi and Atchafalaya River systems since the turn of the 19th century correlates with the increased magnitude and frequency of hypoxic events (Eadie et al., 1992) and support the interpretation that hypoxia zones are related to nutrient input into the GOM.

The presence or extent of a nepheloid layer at the sea bottom affects water quality on the shelf and slope. A nepheloid layer is a zone of suspended clay-sized particles that may play a role in transporting fine-grained sediment, and contaminants, from near shore to offshore waters. The nepheloid layer can be thin and near-bottom, or very thick depending on factors such as water depth, depth of water column mixing, season, and sediment input. Freshwater from the Mississippi/Atchafalaya River systems may carry trace amounts of organic pollutants including polynuclear aromatic hydrocarbons (PAH); herbicides such as atrazine, chlorinated pesticides, and polychlorinated biphenyls (PCB's); and trace inorganic (metals) pollutants.

The concentration of hydrocarbons in slope sediments (except in seep areas) is lower than concentrations reported for shelf and coastal sediments (Gallaway et al., submitted). No consistent decrease with increasing water depth is apparent below 300 m (984 ft). In general, the Central Gulf has higher levels of hydrocarbons in sediment, particularly those from terrestrial sources, than the Western and Eastern Gulf (Gallaway and Kennicutt, 1988). Total organic carbon is 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 amounts (Gallaway and Kennicutt, 1988).

Hydrocarbon seeps are extensive throughout the continental slope and contribute hydrocarbons to the surface sediments and water column, especially in the Central Gulf (Sassen et al., 1993a and b). Natural hydrocarbon seepage is considered to be a major source of petroleum into Gulf slope waters (Kennicutt et al., 1987; Gallaway et al., submitted), and the NRC (2003) considers seeps to be the predominant source. MacDonald et al. (1993) observed 63 individual seeps using remote sensing and submarine observations. The NRC (2003; page 191) reported that estimates of the total volume of seeping oil in the GOM vary widely from 28,000 bbl/yr (MacDonald, 1998) to a range of between 280,000 and 700,000 bbl/yr (Mitchell et al., 1999). The NRC's own best estimate is an annual input of 980,000 bbl/yr for the entire Gulf (NRC, 2003; page 191), which is four times the volume of the *Exxon Valdez* spill per year (estimated to have been 260,000 bbl (NRC, 2003; page 14)). Clearly, natural seeps account for a large quantity of oil that enters Gulf waters each year from a phenomena occurring over geologic time scales. Seep oil is a natural component of Gulf water, and oil in the water is called a pollutant or contaminant only when introduced in large quantities in a small area over a short period of time.

In addition to hydrocarbon seeps, other fluids leak from the underlying sediments into the bottom water along the slope. These fluids have been identified to have three origins: (1) seawater trapped during the settling of sediments; (2) brine from dissolution of underlying salt diapirs; and (3) deep-seated formation waters (Fu and Aharon, 1998; Aharon et al., 2001). The first two fluids are the source of carbonate for hardground deposits while the third is rich in barium and is the source of barite deposits in chimneys.

Produced water (formation water) is the volumetrically largest waste stream from the oil and gas industry that enters Gulf waters. Produced water is commonly treated to separate free oil and either injected back into the reservoir or discharged overboard according to NPDES permit limits (see Chapter 1.4, Offshore Discharges and Waste Disposal). The NRC has estimated the quantity of oil in produced water entering the Gulf per year to be 473,000 bbl (NRC, 2003; Table D-8).

Grid 13 is entirely in deep water, for which limited information is available on water quality. Generally, the water quality in deep water could be considered significantly better than that of the coastal waters (USDOI, MMS, 2002). Water at depths >1,400 m (4,593 ft) is relatively homogeneous with respect to temperature, salinity, and oxygen (Nowlin, 1972; Pequegnat, 1983; Gallaway et al., 1988). Offshore Texas, Louisiana, and Alabama show detectable levels of petroleum hydrocarbons, likely from natural seeps (USDOI, MMS, 1997 and 2000b). Pequegnat (1983) pointed out the importance of water column mixing and flush time for the GOM. Oxygen in deep water must originate from the surface and be mixed into deep water by some mechanism, but the time for turnover or the mechanism by which oxygen replenishment takes place in the deep GOM is essentially unknown.

Deepwater sediments, with the exception of barium concentrations in the vicinity of previous drilling, do not appear to contain elevated levels of metal contaminants (USDOI, MMS, 1997 and 2000b). 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). Petroleum hydrocarbons including aromatic hydrocarbons (<5 ppb) were present at all sites sampled.

3.1.2. Air Quality

Grid 13 is located west of 87.5° W. longitude and hence falls under the 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 Marco Polo project in Green Canyon Block 608 is located approximately 120 mi (193 km) southeast of Plaquemines Parish, Louisiana, an area that is in attainment of all of the NAAQS and for PSD purposes is classified as a Class II area.

The influence to onshore air quality is dependent upon meteorological conditions and air pollution emitted from operational activities. The pertinent meteorological conditions regarding air quality 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 the Grid 13 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 phenomenon. 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 (Florida A&M University, 1988).

3.2. Biological Resources

3.2.1. Sensitive Coastal Resources

Sensitive coastal environmental resources in the Central Gulf are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.2.1) and are incorporated into this PEA by reference. Summaries of these resources follow and include (1) barrier beaches and dunes, (2) wetlands, and (3) seagrass communities.

3.2.1.1. Barrier Beaches and Dunes

The coastal barrier beaches and associated dunes that occur along the GOM are typically composed of sandy beaches that are divided into several interrelated environments. Most of southeastern Louisiana's barrier beaches are composed of medium to coarse-grained sand. The Isles Dernieres and Timbalier barrier islands lie a few miles off the central Louisiana coastline and protect major bays and estuaries. Beaches and barrier islands in the Gulf have these features:

- a shoreface — underwater seaward slope from the low tide waterline;
- a foreshore — exposed, usually nonvegetated slope from the ocean to the beach berm crest; and
- a back shore — exposed, sparsely vegetated area between the beach berm-crest and dune area, occasionally absent due to storm activity.

Barrier beaches are in a state of constant change and include landforms such as islands, shorelines, spits, and dunes. They are formed by sediment transported by rivers, waves, currents, storm surges, and winds and are usually long and narrow in shape. The accumulation and movement of sediments in barrier islands and beaches can be described in terms of regressive and transgressive shorelines. A transgressive shoreline moves landward as the sea oversteps terrestrial sediments. Transgressive coastal landforms around the Gulf have low profiles and are characterized by (1) rapid erosion, (2) lower profiles and narrow widths; (3) sparse vegetation and discontinuous dunes; and (4) numerous, closely spaced, active wash-over channels. In coastal Louisiana, heights of dune lines range from 0.5 to 1.3 m above mean high tide levels. A regressive shoreline moves seaward as the land oversteps marine environments. A regressive shoreline is characterized by (1) wider and higher profiles, (2) well-vegetated dunes, and (3) few if any wash-over channels (USDOI, MMS, 2002). Thick accumulations of sand may form parallel ridges, such as those that typify the Chenier Plain of western coastal Louisiana.

Most barrier shorelines of the Mississippi River Delta in Louisiana are transgressive and mark the seaward remains of a series of five abandoned delta lobes. Distributary channels of the modern Mississippi River cut through the sixth lobe, the Belize Delta (more commonly known as the Birdfoot Delta), delivering and depositing sediment to the shelf. Because the continental shelf is very narrow offshore the Birdfoot Delta, the bulk of the coarser-grained bed load is deposited directly onto the edge of the continental shelf and directly into slope and deepwater environments. In deep water these sediments are removed from reworking by waves and longshore currents and are not available for building and maintaining barrier islands and beaches.

Movement of a barrier shoreline may be caused by any combination of erosion, subsidence, sea-level rise, and storm breaching or washover. It can also be accentuated by manmade structures such as groins, seawalls, and jetties, or channelization (channel straightening) that cause sediment to bypass areas that previously had been areas of deposition. Movement of barrier systems is not a steady incremental process because the passage rates and intensities of cold fronts and tropical storms, as well as the intensity of seasonal changes, are not consistently steady (Williams et al., 1992). Both transgressive and regressive shorelines are important ecologically. Barrier islands, particularly vegetated ones with fresh- and/or saltwater pools, may serve as habitat for a wide variety of animal life, especially birds. The islands and spits protect the bays, lagoons, estuaries, salt marshes, seagrass beds, and other wetland environments, some of which may contain threatened or endangered species.

Barrier beaches and dune environments are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.2.1.1, Coastal Barrier Beaches and Associated Dunes).

3.2.1.2. Wetlands

According to the U.S. Dept. of the Interior (Dahl, 1990; Henfer et al., 1994), during the mid-1980's, 4.4 percent of Texas (3,083,860 ha) (Henfer et al., 1994), 28 percent of Louisiana (3,557,520 ha), 14 percent of Mississippi (17,678,730 ha), and 8 percent of Alabama (1,073,655 ha) were considered wetlands. These states' wetland areas decreased by 1.6-5.6 percent since the mid-1970's. Most of coastal Louisiana (90 percent) is <1 m above sea level. The state contains 25 percent of the Nation's coastal wetlands and 40 percent of all salt marshes in the lower 48 states.

Coastal wetland habitats occur as bands around waterways and as broad expanses of saline, brackish, and freshwater marshes, mud and sand flats, and forested wetlands of cypress-tupelo swamps and bottomland hardwoods. Saline and brackish habitats support sharply delineated, segregated stands of single plant species, while fresh and very low salinity environments support more diverse and mixed communities of plants. High organic productivity and efficient nutrient recycling are characteristic of coastal wetlands. They provide habitats for a great number and wide diversity of resident plants, invertebrates, fishes, reptiles, birds, and mammals. They are important nursery grounds for many economically important fishes and shellfish juveniles. The marsh edge, where marsh and open water meet, is particularly important for its higher productivity and greater concentrations of organisms. Emergent plants produce the bulk of the energy that supports salt-marsh dependent animals. Gulf coastal wetlands also support the largest fur harvest in North America, producing 40-65 percent of the nation's yearly total in Louisiana (Olds, 1984). Gulf coastal wetlands support over two-thirds of the Mississippi Flyway wintering waterfowl population and much of North America's puddle duck population.

Wetland ecology and inventory studies are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.2.1.2, Wetlands).

3.2.1.3. Seagrass Communities

Seagrass communities are extremely productive, providing essential habitat for wintering waterfowl, as well as spawning and feeding habitat for several commercial and recreational species of fish, such as black drum, spotted sea trout, juvenile southern flounder, immature shrimp, and shellfish, and endangered or threatened species of manatee and sea turtles.

Three million hectares (7,413,100 ac) of submerged seagrass beds are estimated to exist in exposed, shallow coastal waters of the northern Gulf (USDOI, MMS, 2002 and 2003c; page 24). Approximately 98.5 percent of all coastal seagrass communities in the northern Gulf are located off coastal Florida, primarily due to coarser sediment substrates and higher salinities. Texas and Louisiana contain approximately 0.5 percent; and Mississippi and Alabama have the remaining 1 percent of known seagrass meadows. Handley (1995) had a much lower estimate for the size of the seagrass resource in the northern Gulf. They estimated a total of 1.02 million ha (2,520,500 ac) for all the Gulf States; with Florida containing about 693,000 ha (1,712,400 ac).

Seagrass beds grow in shallow, relatively clear and protected waters with predominantly sand bottoms. The distribution of seagrasses depends on an interrelationship among a number of environmental factors that include temperature, water depth, turbidity, salinity, turbulence, and substrate suitability. Primarily because of lower salinity and high turbidity in waters west of the Mississippi River Delta, robust seagrass beds and the high-diversity invertebrate and fish populations found in association with them are found only in a few scattered clear, estuarine areas in the central and western GOM. The soft, organic-rich sediments of Louisiana's estuaries and coastal areas also limit widespread distribution of seagrass communities. Only a few areas in offshore Louisiana, mostly in Chandeleur Sound, support seagrass beds. Handley (1995) reported that Louisiana had a large amount of submerged vegetation but only a small area of seagrass habitat (about 5,657 ha (13,979 ac) in 1988).

Seagrass communities are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.2.1.3 Seagrass Communities).

3.2.2. Sensitive Offshore Resources

Sensitive offshore environments in the Central Gulf are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapters 3.2.3 to 3.2.9) and are incorporated into this PEA by reference. Summaries of these resources follow and include (1) deepwater benthic communities, (2) soft-bottom benthic communities (3) chemosynthetic communities, (4) coral reefs, (5) marine mammals, (6) sea turtles, (7) coastal and marine birds, and (8) essential fish habitat and fish.

3.2.2.1. Deepwater Benthic Communities

"Deep water" is a term of convenience referring to vast areas of the Gulf with water depths ≥1,000 ft (305 m) that are typically covered by pelagic clay and silt. The Grid 13 area encompasses a range of habitats in water depths between 2,953 and 7,546 ft (900 and 2,300 m) deep. In, on, and directly above these sediments live a wide variety of single-celled organisms, invertebrates, and fish. Their lifestyles are extremely varied as well and can include absorption of dissolved organic material, symbiosis, collection of food through filtering, mucous webs, seizing, or other mechanisms. These organisms can also include chemosynthetic organisms. Chemosynthetic communities are a remarkable assemblage of invertebrates, found in association with hydrocarbon seeps, that use a carbon source independent of photosynthesis and the sun-dependent photosynthetic food chain that supports all other life on earth.

The continental slope in the GOM extends from the edge of the continental shelf (about 200 m) to a water depth of approximately 3,000 m (9,840 ft) (USDOI, MMS, 2002; page 9.1-6). Grid 13 lies in the middle part of the continental slope, which corresponds to the upper part of the abyssal depth zone as characterized by Pequegnat (1983) and Gallaway et al. (1988).

3.2.2.2. Soft-Bottom Benthic Communities

The vast majority of the Gulf of Mexico seabed is comprised of soft sediments. Major groups of animals that live in this habitat include (1) bacteria and other microbenthos, (2) meiofauna (0.063-0.3 mm), (3) macrofauna (greater than 0.3 mm), and (4) megafauna (larger organisms such as crabs, sea pens, sea cucumbers, crinoids, and bottom-dwelling (demersal) fish. All of these groups are represented throughout the entire Gulf − from the continental shelf to the deepest abyssal depths (about 3,850 m (12,630 ft)).

The “abyssal” zone (≥1,000 m or 3,281 ft) has the following divisions and characteristic faunal assemblages:

- Upper Abyssal Zone (1,000-2,000 m or 3,281-6,562 ft) — 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 or 7,546-9,843 ft) — Fish species are few and echinoderms continue to dominate the megafauna.
- Lower Abyssal Zone (3,200-3,800 m or 10,499 to 12,468 ft) — Large asteroid, *Dynaster insignis*, is the most common megafaunal species.

3.2.2.2.1. 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; page 3-63). Exceptions include the chemosynthetic communities.

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; page 3-60). Megafaunal communities in the offshore Gulf have historically been zoned by depth, which are typified by certain species assemblages (Menzies et al., 1973; Pequegnat, 1983; Gallaway et al., 1988; Gallaway and Kennicutt, 1988; Pequegnat et al., 1990; USDOI, MMS, 2001b; page 3-64).

Carney et al. (1983) postulated a simpler system of zonation having three zones: (1) a distinct shelf fauna in the upper 1,000 m (3,281 ft); (2) indistinct slope fauna between 1,000 and 2,000 m (3,281-6,562 ft); and (3) a distinct abyssal fauna between 2,000 and 3,000 m (6,562-9,843 ft).

The baseline Northern Gulf of Mexico Continental Slope (NGMCS) Study conducted in the mid- to late 1980’s trawled 5,751 individual fish and 33,695 invertebrates, representing 153 and 538 taxa, respectively. That study also collected 56,052 photographic observations, which included 76 fish taxa and 193 non-fish taxa. The photographic observations were dominated by sea cucumbers, bivalves, and sea pens, groups that were not sampled effectively (if at all) by trawling. Decapod crustaceans dominated the trawls and were fourth in abundance in photos. Decapod density generally decreased with depth but abundance peaks were determined at 500 m (1,640 ft) and between 1,100 and 1,200 m (3,609 and 3,937 ft), beyond which numbers diminished. Fish density, while variable, was generally high at depths between 300 and 1,200 m (984 and 3,937 ft); it then declined substantially.

Gallaway et al. (submitted) concluded that megafaunal composition changes continually with depth such that a distinct upper slope fauna penetrates to depths of about 1,200 m (3,937 ft) and a distinct deep-slope fauna is present below 2,500 m (8,202 ft). A broad transition zone characterized by low abundance and diversity occurs between depths of 1,200 and 2,500 m (3,937 and 8,203 ft). The proposed Marco Polo development, at a depth of approximately 1,310 m (4,300 ft), lies within this broad transition zone.

3.2.2.2.2. Macrofauna

The benthic macrofaunal component of the NGMCS Study (Gallaway et al., submitted) included sampling in nearby areas at similar depths, both east and west of the Marco Polo project. A transect (the central transect) of 11 baseline stations through Grids 12, 13, and 14 from 305 m (1,000 ft) to nearly the 3,000-m (9,843-ft) contour was sampled in this study. All of these data are relevant to the proposed Marco Polo development because they were taken from the same geographic area and encompass the same depths and substrates.

The study NGMCS examined 69,933 individual macrofauna from over 1,548 taxa; 1,107 species from 46 major groups were identified (Gallaway et al., submitted). 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., 2000). 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., submitted).

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; page 3-64). This decline in benthos has been attributed to the relatively low productivity of the Gulf offshore open waters (USDOI, MMS, 2001b; page 3-60). Pequegnat et al. (1990) reported mid-depth maxima of macrofauna in the upper slope at some locations with high organic particulate matter, and Gallaway et al. (submitted) noted that the decline with depth is not clear cut and is somewhat obscured by sampling artifacts. There is some suggestion that the size of individuals decrease with depth (Gallaway et al., submitted).

3.2.2.2.3. 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., submitted; USDOI, MMS, 2001b; page 3-64). 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), polychaete worms, ostracods, and kinorhynchs accounting for 98 percent of the total numbers. Nematode worms 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., submitted). 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., submitted). 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., submitted).

3.2.2.2.4. Microbiota

Less is known about the microbiota in the GOM than the other size groups, especially in deep water (USDOI, MMS, 2000b; page IV-15; CSA, 2000). While direct counts have been coupled with some *in situ* and repressurized metabolic studies performed in other deep ocean sediments (Deming and Baross, 1993), none have been made in the deep GOM. Cruz-Kaegi (1998) made direct counts using a fluorescing nuclear stain at several depths down the slope, allowing bacterial biomass to be estimated from their densities and sizes. Mean biomass was estimated to be 2.37 g of C/m^2 for the shelf and slope combined, and 0.37 g of C/m^2 for the abyssal plain. In terms of biomass, data indicate that bacteria are the most important component of the functional infaunal biota. Cruz-Kaegi (1998) developed a carbon cycling budget based on estimates of biomass and metabolic rates in the literature. She discovered that, on the deep slope of the Gulf, the energy from organic carbon in the benthos is cycled through bacteria.

3.2.2.3. 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 are similar to (but not identical with) the hydrothermal vent communities of the eastern Pacific (Corliss et al., 1979). 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 those that are symbiotic for sulfide and methane energy sources. Enhanced densities of heterotrophic organisms typical of soft-bottom communities have been reported in association with chemosynthetic communities near seep locations (Carney, 1993).

Initial discoveries of cold-water seep communities indicated that they are primarily associated with hydrocarbon and hydrogen sulfide (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 (1,640 to 7,218 ft) (Rosman et al., 1987; MacDonald, 1992). Four general community types have been described by MacDonald et al. (1990). These are communities dominated by (1) vestimentiferan tube worms, (2) mytilid mussels, (3) vesicomyid bivalves, and (4) infaunal lucinid or thyasirid bivalves. 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. Figure 3-1 shows the location of known chemosynthetic communities and their relationship to Grid 13 and Green Canyon Block 608.

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 energy source for the Gulf communities is a hydrocarbon seep. Faults in hydrocarbon reservoirs at depth may have allowed oil and gas to migrate upward to the seafloor over the past several million years (Sassen et al., 1993a and b). 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 bivalves rely on H_2S, whereas mytilid mussels used dissolved methane (CH_4). Mud volcanoes and mineral seeps provide similar chemosynthetic source material, but they are far less common 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 (951 and 7,218 ft) (Roberts et al., 1990; MacDonald, 1992). The total number of chemosynthetic communities in the Gulf is now known to exceed 50; however, little exploration for potential chemosynthetic community sites has occurred below a depth of 1,000 m (MacDonald, 1992; Boland, personal communication, 2000; Gallaway et al., 2000).

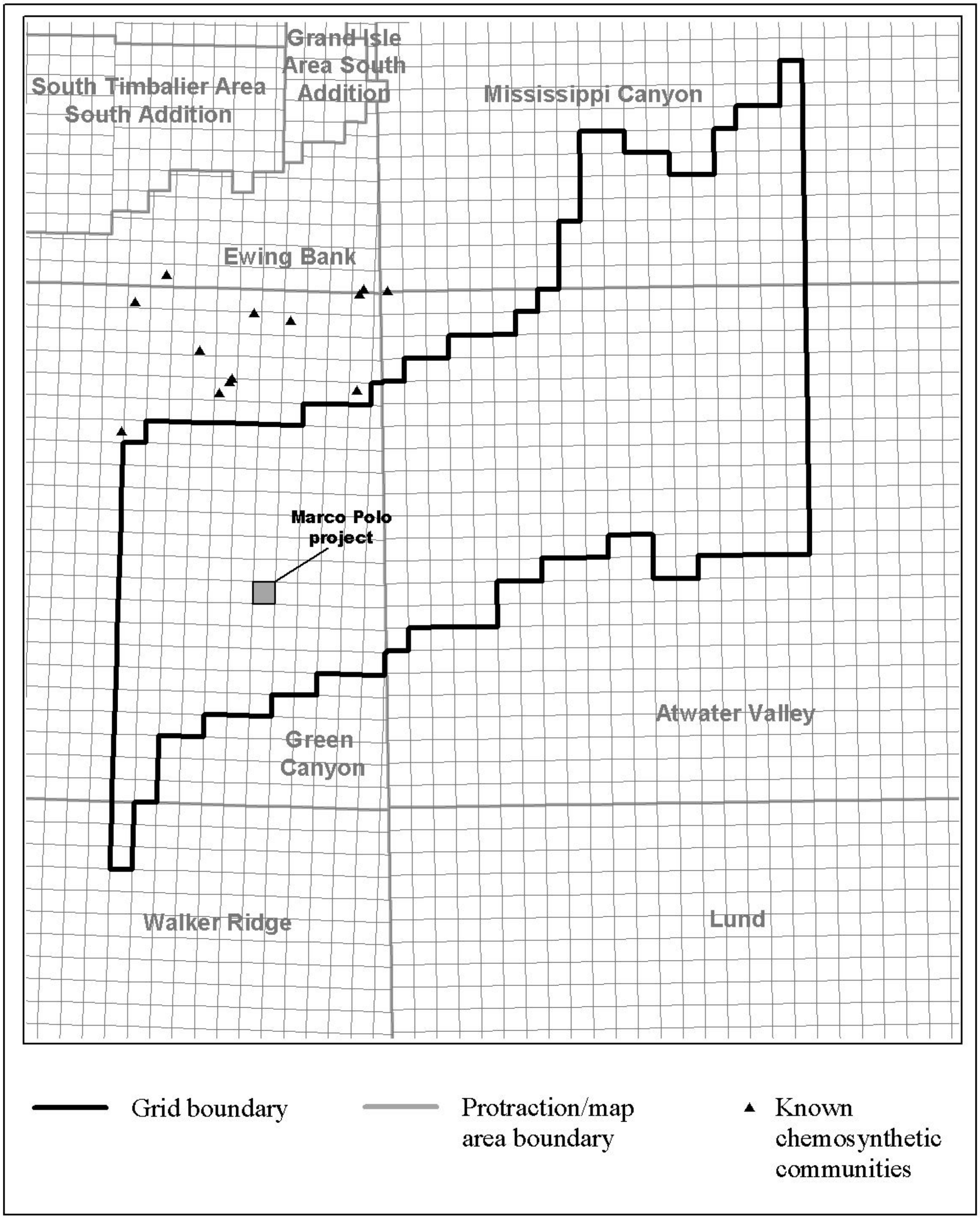


Figure 3-1. Known Chemosynthetic Communities and Their Relationship to Grid 13.

A review for the potential occurrence of chemosynthetic communities associated with the TLP location and subsea infrastructure for the proposed Marco Polo project was performed for this EA. Grid 13 includes numerous lease blocks that contain areas of high seabed seismic amplitude reflectivity that could represent natural gas hydrates, carbonate hardground substrates, and the potential for the occurrence of chemosynthetic communities. As reported in Chapter 1.4.7 (Impacts from Potential Geologic Hazards), there are two prominent seafloor mounds located along the western lease line of Green Canyon Block 608 interpreted to be areas of hydrocarbon seepage that may possibly support chemosynthetic communities. The nearest known chemosynthetic community is located in Green Canyon Block 210, approximately 27 nmi (31 mi; 50 km) north-northwest from the Marco Polo project in Block 608.

3.2.2.4. Corals

In the northern GOM, shallow-water coral reefs are associated with topographic highs such as the well-known East and West Flower Garden Banks and corals do occur, although not as thriving coral reefs (USDOI, MMS, 2002; Figure 3-4). No shallow-water coral reefs occur in the water depths of Grid 13.

Currently, there is little information regarding deepwater coral habitats and their abundance in the Gulf. Moore and Bullis (1960) collected more than 136 kg (300 lb) of scleractinian coral, *Lophelia prolifera*, from a depth of 421 to 512 m (1,381 to 1,680 ft), about 23 mi (37 km) from Viosca Knoll Block 907 (USDOI, MMS, 2000b; page IV-14). Recently, there have been observations of large amounts of *Lophelia* in Viosca Knoll Block 826 (Roberts, personal communication, 2002) and video recordings of another deepwater scleractinian coral, *Madrepora oculata*, in Green Canyon Block 238 (Childs, personal observation, 2002).

3.2.3. Marine Mammals

Twenty-eight cetacean (whales and dolphins) and one sirenian (manatee) species have confirmed occurrences in the northern GOM (Table 3-1) (Davis and Fargion, 1996). Cetaceans are divided into two major suborders: Mysticeti (baleen whales) and Odontoceti (toothed whales and dolphins). Of the seven baleen whale species occurring in the Gulf, five are listed as endangered or threatened (Table 3-1). Of the 21 toothed whale species occurring in the Gulf, only the sperm whale is listed as endangered. The only member of the Order Sirenia found in the Gulf is the endangered West Indian manatee. The manatee has been reported in Louisiana coastal waters, but the coastal waters of Peninsular Florida and the Florida Panhandle are the manatee's normal habitat.

Information on each marine mammal species listed in Table 3-1 can be found in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.2.4) and is incorporated into this PEA by reference. During 1991-1994, MMS funded the first phase of the Gulf of Mexico Cetacean Program (GulfCet), which was jointly conducted by the Texas Institute of Oceanography, Texas Agriculture and Machinists (A&M) University, and NOAA Fisheries. GulfCet I consisted of aerial and shipboard surveys to determine the seasonal and geographic distribution of cetaceans along the continental slope in the north-central and western Gulf (Davis and Fargion, 1996; Davis et al., 1998). Additionally, acoustic recordings of shelf-edge and deepwater species were made. The GulfCet I study showed that several poorly known species are moderately common in GOM waters (beaked whales, pygmy and dwarf sperm whales, melon-headed whale, and Fraser's and Clymene dolphins). The GulfCet II Study (surveys conducted 1996-1997), administered by the U.S. Geological Survey's Biological Resources Division, continued work on patterns of distribution and abundance of Gulf cetaceans and identified possible associations between cetacean high-use habitats and the ocean environment (Davis et al., 2000). The Sperm Whale Acoustic and Monitoring Program (SWAMP) studies were conducted under an interagency agreement with NOAA Fisheries during the summers of 2000 and 2001. An expanded sperm whale study, the Sperm Whale Seismic Study (SWSS), in conjunction with Texas A&M Research Foundation, the Office of Naval Research (ONR) and the International Association of Geophysical Contractors (IAGC), completed the first field season in 2002.

Table 3-1

Marine Mammals of the Northern Gulf of Mexico

Order, Suborder and Family of Cetacea	Common Name
Suborder Mysticeti (baleen whales)	
Family Balaenidae	
Eubalaena glacialis	northern right whale*
Family Balaenopteridae	
Balaenoptera musculus	blue whale*
Balaenoptera physalus	fin whale*
Balaenoptera borealis	sei whale*
Balaenoptera edeni	Bryde's whale
Balaenoptera acutorostrata	minke whale
Megaptera novaeangliae	humpback whale*
Suborder Odontoceti (toothed whales)	
Family Physeteridae	
Physeter macrocephalus	sperm whale*
Kogia breviceps	pygmy sperm whale
Kogia simus	dwarf sperm whale
Family Ziphiidae	
Mesoplodon bidens	Sowerby's beaked whale
Mesoplodon densirostris	Blainville's beaked whale
Mesoplodon europaeus	Gervais' beaked whale
Ziphius cavirostris	Cuvier's beaked whale
Family Delphinidae	
Orcinus orca	killer whale
Pseudorca crassidens	false killer whale
Feresa attenuate	pygmy killer whale
Globicephala macrorhynchus	short-finned pilot whale
Grampus griseus	Risso's dolphin
Peponocephala electra	melon-headed whale
Tursiops truncatus	Atlantic bottlenose dolphin
Steno bredanensis	rough-toothed dolphin
Stenella coeruleoalba	striped dolphin
Stenella attenuate	pantropical spotted dolphin
Stenella clymene	Clymene dolphin
Stenella frontalis	Atlantic spotted dolphin
Stenella longirostris	spinner dolphin
Lagenodelphis hosei	Fraser's dolphin
Order Sirenia	
Family Trichechidae	
Trichechus manatus	West Indian manatee*

* endangered.

Cetacean distribution in the Gulf is influenced by both water depth and by the presence of mesoscale hydrographic features (cold-core and warm-core rings and confluences). The GulfCet studies showed that cetaceans were concentrated along the upper continental slope in water depth from 200 to 1,000 m (650 to 3,280 ft) and sighted less often over the abyssal regions in water depths >2,000 m (6,560 ft). Cetaceans are observed frequently on the upper continental slope and tend to be associated with upwelling events, cyclones and the confluence between cyclone-anticyclone pairs. These hydrographic features concentrate zooplankton and micronekton biomass, and indicate richer concentrations of cetacean prey. Since cyclones in the northern Gulf are dynamic and usually associated with westward moving cyclone-anticyclone pairs, cetacean distribution tends to be dynamic. Bottlenose dolphins, Atlantic spotted dolphins, and possibly Bryde's whale that typically occur on the continental shelf or along the shelf break are outside the influence of major eddies. Another preferred area for foraging by sperm whales is the area south of the mouth of the Mississippi River. The continental shelf here is narrow compared to the east or west, and is a deepwater environment with locally enhanced primary and secondary productivity. For any given area in the offshore GOM, observing species of marine mammals known to occur in that area is as much a function of survey effort and currents at the time of the survey as it is actual animal occurrences.

3.2.4. Sea Turtles

Five species of sea turtle are found in the waters of the GOM: green, leatherback, hawksbill, Kemp's ridley, and loggerhead. All are protected under the Endangered Species Act (ESA), and all except the loggerhead turtle (threatened) are listed as endangered. Sea turtles are long-lived, slow-reproducing animals that spend nearly all of their lives in the water. Females must emerge periodically from the ocean to nest on beaches. It is generally believed that all sea turtle species spend their first few years in pelagic waters, occurring in driftlines and convergence zones (in *Sargassum* rafts) where they find refuge and food in items that accumulate in surface circulation features (Carr and Caldwell, 1956; Carr, 1987). Genetic analysis of sea turtles has revealed in recent years that discrete, non-interbreeding stocks of sea turtles make up "worldwide extensive ranges" of the various species.

Adult turtles are apparently less abundant in the deeper waters of the Gulf than they are in waters less than 27-50 m (80-160 ft) deep (NRC, 1990) and more abundant in the northeastern Gulf than in the northwestern Gulf (Thompson, 1988). Sea turtle abundance appears to increase dramatically east of Mobile Bay (Davis et al., 2000). Factors such as water depth and turbidity, bottom sediment type, salinity, and prey availability may account for this. In the offshore Gulf, sea turtle distribution has been linked to zones of convergence.

Information on each turtle species can be found in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.2.5) and is incorporated into this PEA by reference.

Green

The green turtle (*Chelonia mydas*) is the largest hard-shelled sea turtle and commonly reaches 150 kg (330 lb) (USDOC, NMFS and USDOI, FWS, 1990). The green turtle has a global distribution in tropical and subtropical waters. Green turtles primarily occur in coastal waters, where they forage on seagrasses, algae, and associated organisms (Carr and Caldwell, 1956; Hendrickson, 1980). Some green turtles may move through a series of "developmental" feeding habitats as they grow (Hirth, 1997). Small pelagic sea turtles are omnivorous. Adult green turtles in the Caribbean and GOM are herbivores, feeding primarily on seagrasses and, to a lesser extent, on algae and sponges. Known feeding areas for green turtles in Florida include the Indian River, Florida Bay, Homosassa River, Crystal River, and Cedar Key (USDOC, NMFS and USDOI, FWS, 1990). Green turtles in the Western Gulf are primarily restricted to the lower Texas coast where seagrass meadows and algae-laden jetties provide them developmental habitat, especially during warmer months (Landry and Costa, 1999).

Leatherback

The leatherback (*Dermochelys coriacea*) is the largest of the sea turtles and commonly reaches 200-700 kg (440-1,540 lb) (USDOC, NMFS and USDOI, FWS, 1992a). Leatherbacks have unique deep-diving abilities (Eckert et al., 1986), a specialized jellyfish diet (Brongersma, 1972), and unique physiological properties that distinguish them from other sea turtles (Lutcavage et al., 1990; Paladino et al., 1990). This species is the most wide-ranging of sea turtles, undertaking extensive pelagic migrations following depth contours for hundreds, even thousands, of kilometers (Morreale et al., 1996; Hughes et al., 1998).

The leatherback's distribution is not entirely oceanic. Numerous references cited in recent MMS publications (USDOI, MMS, 2003c, page 40; USDOI, MMS, 2002; Chapter 3.2.5 Sea Turtles) indicate it is commonly found in relatively shallow continental shelf waters along the U.S. Atlantic Coast. Based on a summary of several studies, Davis and Fargion (1996) concluded that primary habitat of the leatherback in the northwestern Gulf is oceanic (>200 m (656 ft)). In contrast, the overall densities of leatherbacks in the Eastern Gulf on the shelf and in water >200 m were similar (Davis et al., 2000). Davis and Fargion (1996) suggested that the region from Mississippi Canyon east to DeSoto Canyon appears to be an important habitat for leatherbacks. The majority of sightings of leatherbacks during the GulfCet surveys occurred just north of DeSoto Canyon (Davis and Fargion, 1996; Davis et al., 2000). The nearly disjunct summer and winter distributions of leatherback sightings on the 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. Large numbers of leatherbacks in waters off the northeast U.S. have been associated with concentrations of jellyfish (Shoop and Kenney, 1992). Other clusterings of leatherback sightings have been reported for the northern Gulf: 8 leatherbacks were sighted on one day in DeSoto Canyon (Davis and Fargion, 1996), 11 during one day just south of the Mississippi River Delta, and 14 during another day in DeSoto Canyon (Lohoefener et al., 1990).

Hawksbill

The hawksbill sea turtle (*Eretmochelys imbricate)* is a medium-sized sea turtle that can reach up to 80 kg (176 lb) (Hildebrand, 1982) (USDOC, NMFS and USDOI, FWS, 1993). The hawksbill occurs in tropical and subtropical seas 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 species is recorded from all the Gulf States and from along the eastern seaboard as far north as Massachusetts, with the exception of Connecticut; however, sightings north of Florida are rare (USDOC, NMFS and USDOI, FWS, 1993). Stranded hawksbills have been reported in Texas (Hildebrand, 1982; Amos, 1989) and in Louisiana (Koike, 1996); these tend to be either hatchlings or yearlings. They have been reported accidentally caught in a purse seine net offshore of Louisiana (Rester and Condrey, 1996). Texas and Florida are the only states where hawksbill turtles are sighted with any regularity (USDOC, NMFS and USDOI, FWS, 1993).

Kemp's Ridley

The Kemp's ridley (*Lepidochelys kempi*) is the smallest sea turtle and the most imperiled, generally weighing less than 45 kg (100 lb). The GOM's population of nesting females has dwindled from an estimated 47,000 in 1947 to a current nesting population of approximately 1,500 females (Byles et al., 1996). The population crash that occurred between 1947 and the early 1970's may have been the result of both intensive annual harvesting of the eggs and mortality of juveniles and adults in trawl fisheries (NRC, 1990). The recovery of the species has been forestalled primarily by incidental mortality from commercial shrimping that has prevented adequate recruitment into the breeding population (USDOC, NMFS, and USDOI, FWS, 1992b).

There is little prolonged utilization of offshore habitats by this species. Hatchlings appear to disperse offshore and are sometimes found in *Sargassum* mats (Collard and Ogren, 1990; Manzella et al., 1991). In the pelagic stage, the turtle is dependent on currents, fronts, and current gyres to determine their distribution. In the Gulf, Kemp's ridleys inhabit nearshore areas, being most abundant in coastal waters from Texas to west Florida (Ogren, 1989; Marquez, 1990 and 1994; Rudloe et al., 1991). Kemp's ridleys display strong seasonal fidelity to tidal passes and adjacent beachfront areas of the northern Gulf (Landry and Costa, 1999).

Loggerhead

The loggerhead sea turtle (*Caretta caretta*), reaching 110 kg (250 lb), is the most common sea turtle species in the northern Gulf (e.g., Fritts et al., 1983; Fuller and Tappan, 1986; Rosman et al., 1987; Lohoefener et al., 1990) and the most abundant species of sea turtle occurring in U.S. waters. The loggerhead occurs throughout the inner continental shelf from Florida through Cape Cod, Massachusetts.

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 are generalist carnivores that forage on nearshore benthic invertebrates (Dodd, 1988). The banks off the central Louisiana coast and near the Mississippi River Delta are also important sea turtle feeding areas (Hildebrand, 1982).

Aerial surveys indicate that loggerheads are largely distributed in water depths less than 100 m (328 ft) (Shoop et al., 1981; Fritts et al., 1983). Loggerheads were sighted throughout the northern Gulf continental shelf, near the 100-m isobath during GulfCet aerial surveys (Davis et al., 2000) and also in deep water (>1,000 m). Loggerhead abundance in slope waters of the eastern Gulf increased appreciably during winter (Davis et al., 2000). It is not clear why adult loggerheads would occur in oceanic waters, unless they were traveling between foraging sites in distant and separate areas on the continental shelf or were seeking warmer waters during winter (Davis et al., 2000). Loggerheads have been found to be abundant in Florida waters (Fritts and Reynolds, 1981; Fritts et al., 1983; Davis et al., 2000). In the Central Gulf, loggerheads are very abundant just offshore of Breton and Chandeleur Islands (Lohoefener et al., 1990).

3.2.5. Coastal and Marine Birds

The offshore waters, coastal beaches, and contiguous wetlands of the northeastern GOM are populated by both resident and migratory species of coastal and marine birds. This analysis assumes six major groups: (1) seabirds; (2) shorebirds; (3) marsh and wading birds; (4) waterfowl; (5) raptors; and (6) diving birds. Many species are mostly pelagic and are rarely sighted nearshore. Fidelity to nesting sites varies from year to year along the Gulf Coast (Martin and Lester, 1991). Birds may abandon sites along the northern Gulf Coast because of altered habitat and excessive human disturbance.

Information on coastal and marine birds can be found in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.2.7) and is incorporated into this PEA by reference.

Seabirds

Seabirds are a diverse group of birds that spend much of their lives on or over saltwater (Table 3-2). Species diversity and overall abundance is highest in the spring and summer and lowest in the fall and winter. Four ecological categories of seabirds have been documented in the deepwater areas of the Gulf: summer migrants (e.g., shearwaters, storm petrels, and boobies), summer residents that breed in the Gulf (e.g., sooty, least, and sandwich tern, and frigate birds), winter residents (e.g., gannets, gulls, and jaegers), and permanent resident species (e.g., laughing gulls and royal and bridled terns) (Hess and Ribic, 2000). Collectively, they live far from land most of the year, roosting on the water surface, except at breeding time when they return to nesting areas along coastlines (Terres, 1991). Seabirds typically aggregate in social groups called colonies; the degree of colony formation varies between species (Parnell et al., 1988). They also tend to associate with various oceanic conditions including specific sea-surface temperatures, salinities, areas of high planktonic productivity, or current activity. Seabirds obtain their food from the sea with a variety of behaviors including piracy, scavenging, dipping, plunging, and surface seizing.

Table 3-2

Common Seabirds of the Northern Gulf of Mexico

Common Name	Scientific Name	Occurrence*	Feeding Behavior and Diet
Wilson's storm-petrel	*Oceanites oceanicus*	Summer resident	Picks crustaceans, fish, and squid from the sea surface
Magnificent frigatebird	*Fregata magnificens*	Summer resident	Dives to pluck jellyfish, fish, and crustaceans from the sea surface
Northern gannet	*Morus bassanus*	Wintering resident	Fish and squid
Masked booby	*Sula dactylatra*	Wintering resident	Plunge dives for flying fishes and small squid
Brown booby	*Sula leucogaster*	Wintering resident	Prefers to perch; comes ashore at night to roost
Cory’s shearwater	*Calonectris diomedea*	Summer resident	Feeds at the water surface at night on crustaceans and large squid
Greater shearwater	*Puffinus gravis*	Summer resident	Dives to catch fish
Audubon shearwater	*Puffinus lherminieri*	Summer resident	Dives to catch fish, squid, and other organisms

*All major seabirds are distributed Gulfwide.

Shorebirds

Shorebirds are those members of the order Charadriiformes generally restricted to coastline margins (beaches, mudflats, etc.). Gulf of Mexico 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, observers have recorded 44 species of shorebirds. Six 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 plants and a variety of marine and freshwater invertebrates and fish.

Marsh and Wading Birds

"Wading bird" is a collective term referring to birds that have adapted to living in marshes and shallow water. These birds have long legs for wading in shallow water, while they use their usually long necks and long bills to probe under water or to make long swift strokes to seize fish, frogs, aquatic insects, crustaceans, and other prey (Terres, 1991) (Table 3-3). These families have representatives in the northern Gulf: Ardeidae (herons, bitterns, and egrets), Ciconiidae (storks), Threskiornithidae (ibises and spoonbills), and Gruidae (cranes).

Seventeen species of wading birds in the Order Ciconiiformes currently nest in the U.S., and all except the wood stork nest in the northern Gulf coastal region (Martin, 1991). Louisiana supports the majority of nesting wading birds. Great egrets are the most widespread nesting species in the Gulf region; they often occupy urban canals (Martin, 1991). Members of the Rallidae family (rails, moorhens, gallinules, and coots) are elusive marsh birds, 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 27 species are regularly reported along the north-central and western Gulf Coast (Table 3-4). Among these are 1 swan, 4 geese, 7 surface-feeding (dabbling) ducks and teal, 4 diving ducks (pochards), and 11 others (including the wood duck, whistling duck, sea ducks, 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 northern U.S. 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 social and have a diverse array of feeding adaptations related to their habitat (Johnsgard, 1975).

Raptors

The American peregrine falcon was removed from the endangered species list on August 20, 1999. The species is still protected under the Migratory Bird Treaty Act. The FWS will continue to monitor the falcon's status for 13 years to ensure that recovery is established.

Table 3-3

Common Marsh or Wading Birds in the Northern Gulf of Mexico

Common Name	Scientific Name	Occurrence*	Feeding Behavior and Diet
American bittern	*Botaurus lentiginosus*	*	Amphibians, small fish, small snakes, crayfish, small rodents, and water bugs
Least bittern	*Ixobrychus exilus*	Summer resident	NA
Great blue heron	*Ardea herodias*	*	Various aquatic animals
Great egret	*Casmerodias albus*	*	Fish, frogs, snakes, crayfish, and large insects
Snowy egret	*Egretta thula*	*	Arthropods, fish
Little blue heron	*Egretta caerulea*	*	Small vertebrates, crustaceans, and large insects
Tricolored heron	*Egretta tricolor*	*	NA
Reddish egret	*Egretta rufescens*	Pan-Gulf except for central and eastern FL Panhandle	NA
Cattle egret	*Bulbulcus ibis*	*	NA
Green-backed heron	*Butorides striatus*	Permanent resident in central LA and eastward; summer resident in TX and western LA	NA
Black-crowned night heron	*Nycticorax nicticorax*	*	NA
Yellow-crowned night heron	*Nyctanassa biolacea*	Permanent resident TX, eastern LA, MS, AL, and eastern FL Panhandle	Aquatic organisms, especially crustaceans
White ibis	*Eudocimus albus*	*	NA
Glossy ibis	*Plegadis falconellus*	*	Snakes, crayfish, and crabs
White-faced ibis	*Plegadis chini*	Permanent resident in TX and western and central LA; summer resident in eastern LA	NA
Roseate spoonbill	*Ajaia ajaja*	Permanent resident; summer resident in LA	NA

*All wading birds are permanent residents Gulfwide unless otherwise indicated.
NA = Not available.

Table 3-4

Common Waterfowl in the Northern Gulf of Mexico

Common Name	Scientific Name	Occurrence*	Feeding Behavior and Diet
Wood duck	*Aix sponsa*	Year-round	Dabbler; eats plants, invertebrates, tadpoles, and salamanders
Canvasback duck	*Aythya valisineria*	Year-round	Diver; feeds on molluscs and aquatic plants
Redhead duck	*Aythya americana*	*	Diver; mostly herbivorous
Ring-necked duck	*Aythya collaris*	*	Diver
Fulvous whistling duck	*Dendrocygna bicolor*	Nests in TX, LA	Feeds nocturnally on land plant seeds
Lesser scaup	*Aythya affinis*	High abundance	Diver; feeds on plants and animals
Greater scaup	*Aythya maarila*	*	Feeds on plants, insects, and invertebrates in nesting season; diet at sea in winter is mostly molluscs and plants
Black scoter	*Melanitta nigra*	Low abundance	Diver; feeds mostly on molluscs
White-winged scoter	*Melanitta fusca*	TX, LA, AL; low abundance	Diver; feeds mostly on shellfish
Surf scoter	*Melanitta perspicilla*	Low abundance	Diver; feeds mostly on molluscs and crustaceans
Common goldeneye	*Bucephala clangula*	*	Diver; needs on molluscs, crustaceans, insects, and aquatic plants
Bufflehead	*Bucephala albeola*	*	Diver; in fresh water, eats aquatic adult and larval insects, snails, small fish, and aquatic plant seeds; in salt water, eats crustaceans, shellfish, and snails
Common merganser	*Mergus merganser*	*	Diver; feeds on molluscs, crustaceans, aquatic insects, and some plants
Red-breasted merganser	*Mergus serrator*	*	Eats mostly fish
Hooded merganser	*Lophodytes cucullatus*	*	Diver; thin serrated bill adapted to taking fish; also feeds on crustaceans and aquatic insects
Tundra swan	*Cygnus columbianus*	Winters on Atlantic Coast, minor presence in Gulf	NA
Greater white-fronted goose	*Answer albifrons*	TX, LA, AL	Feeds on plants and insects
Snow goose	*Chen caerulescens*	TX, LA, MS, AL	Dabbler, grazer, herbivore
Canada goose	*Branta canadensis*	*	Dabbler; herbivore
Brant	*Branta bernicla*	FL	Herbivore
Mallard	*Anas platyrhynchos*	*	Dabbler; usually a herbivore; female supplements diet with invertebrate protein source when producing eggs
Mottled duck	*Anas fulvigula*	TX, LA year-round	Dabbler; invertebrates and some plant material
American widgeon	*Anas americana*	*	Dabbler; may feed on widgeon grass
Northern pintail	*Anas acuta*	Abundant in TX	Dabbler mostly herbivorous
Northern shoveler	*Anas clypeata*	*	Dabbler; strains food through combs of teeth on inside of bill
Blue-winged teal	*Anas discors*	*	Dabbler; mostly herbivorous
Cinnamon teal	*Anas cyanoptera*	TX, west LA	Dabbler; eats invertebrates, plant seeds, and algae; sometimes skims water surface with bill
Gadwall	*Anas strepera*	*	Dabbler; mostly herbivorous
Ruddy duck	*Oxyura jamaicensis*	*	Diver; mostly herbivorous

*All waterfowl are wintering residents Gulf-wide unless otherwise indicated; NA = not available

Diving Birds

There are three main groups of diving birds, cormorants and anhingas, loons, and grebes (Table 3-5). Of the two pelican species in North America, only the brown pelican is listed as endangered under the ESA.

Table 3-5

Common Diving Birds in the Northern Gulf of Mexico

Common Name	Scientific Name	Occurrence*	Feeding Behavior and Diet
Common loon	*Gavia immer*	Wintering resident	Dives from surface for fish, arthropods, snails, leeches, frogs, and salamanders
Horned grebe	*Podiceps auritus*	Wintering resident	Fish and some arthropods
Eared grebe	*Podiceps nigricollis*	TX, LA, MS, AL	Arthropods
Pied-billed grebe	*Podilymbus podiceps*	Permanent resident	Arthropods, small fish
Anhinga	*Anhinga anhinga*	Permanent resident	Swims underwater for fish, frogs, snakes, and leeches
Olivaceous cormorant	*Phalacrocorax olivaceus*	*	NA
Double-crested cormorant	*Phylacrocorax auritus*	Permanent resident	NA

*All of these diving birds are distributed Gulfwide except where otherwise indicated.
NA = Not available.

3.2.5.1. Listed Species of Coastal and Marine Birds

The following coastal and marine bird species that inhabit or frequent the northern GOM coastal areas are protected under the ESA as either endangered or threatened: piping plover, whooping crane, least tern, bald eagle, and brown pelican.

Piping Plover

The piping plover (*Charadrius melodus*) is a migratory shorebird that is native to North America. The piping plover was designated as threatened in December 1985 over its range in the Gulf Coast states. It breeds on the northern Great Plains (especially in open flats along the Missouri River), in the Great Lakes, and along the Atlantic Coast (Newfoundland to North Carolina). It winters on the Atlantic and Gulf Coasts from North Carolina to Mexico and in the Bahamas West Indies. Hypothetically, plovers may have a preferred prey base and/or the substrate coloration provides protection from aerial predators due to camouflage by color 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. This species remains in a precarious state given its low population numbers, sparse distribution, and continued threats to habitat throughout its range.

Critical habitat is specially managed or protected only in the case of a Federal action. On July 6, 2000, the FWS proposed critical habitat for the wintering population of piping plover in 146 areas along approximately 2,700 mi of the coast of North Carolina, South Carolina, Georgia, Florida, Alabama, Louisiana, and Texas. Critical habitat identifies specific areas that are essential to the conservation of a listed species and that may require special management consideration or protection. The primary constituent needs for the piping plover are those habitat components that are essential for the primary biological needs of foraging, sheltering, and roosting.

Whooping Crane

The whooping crane (*Grus americana*) is an omnivorous, wading bird. The whooping crane formerly ranged from summer breeding grounds within the central Canadian provinces and northern prairie states to southern coastal wintering grounds from central Mexico to the Carolinas (Bent, 1926). Whooping cranes currently exist in three wild populations and at five captive locations (USDOI, FWS, 1994). The only self-sustaining wild population nests in Canada's Northwest Territory and adjacent areas of Alberta and winters in coastal marshes and estuarine habitats along the Texas Gulf Coast.

Least Tern

The least tern is not considered federally endangered or threatened in coastal areas within 50 mi of the Gulf (Patrick, personal communication, 1997). Only the interior nesting colonies are endangered.

Bald Eagle

In July 1995, the FWS reclassified the bald eagle from endangered to threatened in the lower 48 states (*Federal Register*, 1995). The bald eagle (*Haliaeetus leucocephalus*) is the only species of sea eagle that regularly occurs on the North American continent (USDOI, FWS, 1984). Its range extends from central Alaska and Canada to northern Mexico. The bulk of the bald eagle's diet is fish, though bald eagles will opportunistically take birds, reptiles, and mammals (USDOI, FWS, 1984). The general tendency is for winter breeding in the south with a progressive shift toward spring breeding in northern locations. In the southeast, nesting begins in early September and egg-laying begins as early as late October and peaks in late December. The historical nesting range of the bald eagle within the southeastern U.S. included the entire coastal plain. Nesting habitat was especially on the shores of major rivers and lakes. Certain general elements seem to be consistent among nest site selection. These include (1) the proximity of water (usually within 0.5 mi) and a clear flight path to it, (2) the largest living tree in a span, and (3) an open view of the surrounding area. The proximity of good perching trees may also be a factor in site selection. Bald eagles may not use an otherwise suitable site if there is excessive human activity in the area. The current range is limited, with most breeding pairs occurring in Peninsular Florida and Louisiana, and some in South Carolina, Alabama, and east Texas. Sporadic breeding takes place in the rest of the southeastern states. A total of 120 nests have been found in Louisiana, but only 3 nests occurred within 5 mi of the coast (Patrick, personal communication, 1997).

Brown Pelican

The brown pelican (*Pelicanus occidentalis*) remains endangered (*Federal Register*, 1985) in Louisiana and Mississippi, where it inhabits the coastal areas. It is not federally listed in Florida, rather it is a State species of special concern. The brown pelican is one of two pelican species in North America. It feeds entirely upon fishes captured by plunge diving in coastal waters. Organochlorine pesticide pollution apparently contributed to the endangerment of the brown pelican. In recent years, there has been a marked increase in brown pelican populations along its entire former range. The population of brown pelicans and their habitat in Alabama, Florida, Georgia, North and South Carolina, and points northward along the Atlantic Coast were removed from the endangered species list in 1985.

The Louisiana Department of Wildlife and Fisheries submitted a request to the FWS in March 1994 to officially remove the brown pelican from the endangered species list in Louisiana (LDWF, 1994). Ten thousand nests and an estimated 25,000 adults were found in a recent Louisiana survey (Patrick, personal communication, 1997).

3.2.6. Essential Fish Habitat and Fish Resources

Healthy fish resources and fishery stocks depend on essential fish habitat (EFH); waters and substrate necessary to fish for spawning, breeding, feeding, and growth to maturity. Due to the wide variation of habitat requirements for all life history stages for managed species, EFH has been identified throughout the Gulf of Mexico, including all coastal and marine waters and substrates from the shoreline to the seaward limit of the Exclusive Economic Zone (EEZ) (200 mi from shore).

The Magnuson Fishery Conservation and Management Act (USDOI, MMS, 2002; page 1-12) established the provisions for Fishery Management Councils (FMC) and Fishery Management Plans (FMP). There are FMP's in the GOM region for (1) shrimp, (2) red drum, (3) reef fishes, (4) coastal migratory pelagics, (5) stone crabs, (6) spiny lobsters, (7) coral and coral reefs, (8) billfish, and (9) highly migratory species. The Gulf of Mexico FMC's *Generic Amendment for Addressing Essential Fish Habitat Requirements* amends the first seven FMP's listed above, identifying estuarine/inshore and marine/offshore EFH for over 450 managed species (about 400 in the coral FMP). The Gulf of Mexico

FMC's *Generic Amendment* also identifies threats to EFH and makes a number of general and specific habitat preservation recommendations for oil and gas exploration, production, and pipeline activities within State waters and OCS areas. These recommendations can be found in the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; page III-91).

Pelagic fishes occur throughout the water column from the beach to the open ocean. Temperature, salinity, and turbidity of the water column are the only partitioning of this vast habitat. On a broad scale, pelagic fishes recognize different watermasses based upon physical and biological characteristics. Three ecologic groups of pelagic fish are recognized, primarily by water depth: (1) coastal pelagics species; (2) oceanic species; and (3) mesopelagic species. Two of these three pelagic ecological groups − oceanics and mesopelagics − would be encountered in Grid 13 and in the area of the Marco Polo project. Coastal pelagic species occur in waters from the shoreline to the shelf edge, generally delineated by the 200-m (656 ft) isobath, and would not be extant in Grid 13.

Oceanic pelagic species occur throughout the GOM, especially at or beyond the shelf edge; however, some species venture onto the shelf with watermass intrusions (e.g., Loop Current). Common oceanic pelagic species include tunas, marlins, sailfish, swordfish, dolphins, wahoo, and mako sharks. In addition to these large predatory species, there are halfbeaks, flyingfishes, and driftfishes (Stromateidae). Lesser-known oceanic pelagics include opah, snake mackerels (Gempylidae), ribbonfishes (Trachipteridae), and escolar. 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. The occurrence of bluefin tuna larvae in the GOM associated with the Loop Current boundary and the Mississippi River discharge plume is evidence that these species spawn in the GOM (Richards et al., 1989). Many of the oceanic fishes associate with drifting *Sargassum*, which provides areas for foraging, and where young fish can be protected and grow.

Data on oceanic pelagic species distribution and abundance comes from commercial longline catches and recreational fishing surveys. The NOAA Fisheries has conducted routine surveys of the GOM billfishery since 1970 (Pristas et al., 1992). Effective July 1, 2000, additional restrictions have been placed on the harvest of some sharks, which may be temporary migrants or might spend some of their life cycles in oceanic pelagic or mesopelagic habitats. It is now prohibited to retain, possess, sell, or purchase the following sharks: white, basking, sand tiger, bigeye sand tiger, dusky, bignose, Galapagos, night, Caribbean reef, narrowtooth, Caribbean sharpnose, smalltail, Atlantic angel, longfin, mako, bigeye thresher, sevengill, sixgill, and bigeye sixgill.

Mesopelagic fishes occur deeper in GOM waters than the oceanic species group, usually at depths between 200 and 1,000 m (656-3,280 ft) below the surface. Mesopelagic fishes are numerically dominated by myctophids (lanternfishes), with gonostomatids (bristlemouths) and sternoptychids (hachetfishes) common but less abundant in collections. These fishes make extensive vertical migrations during the night from mesopelagic depths to feed in shallower, food rich layers of the water column (Hopkins and Baird, 1985). Mesopelagic fishes are important ecologically because they transfer substantial amounts of energy daily between depth zones. Mesopelagic species are not harvested commercially but have been collected in special, discrete-depth nets that provide some quantitative data on relative abundance (Bakus et al., 1977; Hopkins and Lancraft, 1984; Hopkins and Baird, 1985; Gartner et al., 1987).

3.2.7. Gulf Sturgeon

The Gulf sturgeon (*Acipenser oxyrinchus desotoi*) is one of just two threatened fish species listed in the GOM. Gulf sturgeons are bottom suction feeders that have ventrally located, highly extrusible mouths. Two pairs of barbels are present with taste buds. Fishes that forage by taste are opportunistic feeders because taste is much more discriminating than smell. The importance of smell to foraging sturgeons is not known. Another adaptation of sturgeon to major rivers and offshore waters is mobility (an adaptation to the large habitat scale). According to Wooley and Crateau (1985), Gulf sturgeon historically occurred in most major river systems from the Mississippi River to the Suwannee River, Florida, and marine waters of the Central and Eastern GOM south to Florida Bay. The decline of the Gulf sturgeon is believed to be due to overfishing and habitat destruction, primarily the damming of coastal rivers and the degradation of water quality (Barkuloo, 1988).

A subspecies of the Atlantic sturgeon, the Gulf sturgeon is anadromous (ascends rivers to breed), 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 live in riverine and estuarine habitats throughout the year (Clugston, 1991). In spring, large subadults and adults that migrate from estuaries into major river passes feed primarily on lancelets, brachiopods, amphipods, polychaete worms, and snails. Small sturgeon in river passes feed on amphipods, shrimp, isopods, oligochaetes, and aquatic insect larvae (Clugston, 1991). During the riverine stage, adults cease feeding, undergo gonadal maturation, and migrate upstream to spawn. Spawning occurs over coarse-grained substrates in deep river channels and in deep holes in the river bed.

Critical habitat for the Gulf sturgeon includes 14 geographic areas in rivers emptying into the Gulf of Mexico that encompass 1,760 mi (2,783 km) of river and 2,333 mi^2 (6,042 km^2) of estuarine and marine habitat (*Federal Register*, 2003). Information on the Gulf sturgeon can be found in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.2.8) and is incorporated into this PEA by reference

3.3. SOCIOECONOMIC AND HUMAN RESOURCES

3.3.1. Socioeconomic Resources

Socioeconomic resources in the Central Gulf are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.3) and are incorporated into this PEA by reference. Summaries of these resources follow and include (1) the impact area for the proposed Marco Polo project, (2) commercial fisheries, (3) recreational resources, and (4) archaeological resources.

3.3.1.1. 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, which are listed below. Ten subareas divide the impact area for analysis purposes and are considered in Chapter 4.3 (Impacts on Socioeconomic and Human Resources) as the economic impact area for the proposed Marco Polo project in Grid 13.

LA-1	LA-2	LA-3	MA-1
Acadia, LA	Ascension, LA	Jefferson, LA	Baldwin, AL
Calcasieu, LA	Assumption, LA	Orleans, LA	Mobile, AL
Cameron, LA	East Baton Rouge, LA	Plaquemines, LA	Hancock, MS
Iberia, LA	Iberville, LA	St. Bernard, LA	Harrison, MS
Lafayette, LA	Lafourche, LA	St. Charles, LA	Jackson, MS
Livingston, LA	St. James, LA	Stone, MS	St. Landry, LA
St. Martin, LA	St. Mary, LA	St. John the Baptist, LA	
Vermilion, LA	Tangipahoa, LA	St. Tammany, LA	
	Terrebonne, LA		
	West Baton Rouge, 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

The criteria for including counties and parishes in this impact area are explained in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.3.3.1, Socioeconomic Analysis Area; Figure 4-1). This impact area is based on the results of a recent MMS socioeconomic study (USDOI, MMS, 2003d) designed to allocate expenditures from the offshore oil and gas industry to the representative onshore subarea where dollars are spent. Table B-1 (Appendix B) presents these findings in percentage terms. The MMS uses software called IMPLAN (Impact Analysis for Planning) to model economic impacts for OCS Program activity. In Table B-1 the IMPLAN number is the code given to the industry (sector). It is analogous to the standardized industry code (SIC). Very little has been spent in the Florida subareas, given the lack of offshore leasing in this area and Florida's attitude towards oil and gas development off their shores. Table B-1 also makes clear the reason for including all of the GOM subareas in the economic impact area: (1) expenditures in Texas for several sectors are either exclusively found there or make up a very large percentage of the total and (2) a significant percentage of total sector expenditures is allocated to each Louisiana subarea.

3.3.1.2. 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 these 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 fisheries on the continental shelf. Historically, the deepwater offshore fishery contributes less than 1 percent to the regional total weight and value (USDOI, MMS, 2001b; page 3-98). Target species can be classified into three groups: (1) epipelagic (open waters into which enough light penetrates for photosynthesis) fishes, (2) reef fishes, and (3) invertebrates. The Marco Polo development and Grid 13 are 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 in extreme water depths. In addition, considerable time, effort, and finances would have to be expended to develop 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, silky and tiger sharks (many other species of shark are now protected and harvest is prohibited), snake mackerels (escolar and oilfish), swordfish, tunas (bigeye, blackfin, bluefin, and yellowfin), and wahoo (USDOI, MMS, 2001b; page 3-98). These species are widespread in the Gulf and assuredly occur in Grid 13. Oceanic pelagic fishes were not landed in high quantities relative to other finfish groups. During 1983-1993 in the Eastern Gulf, however, they were very valuable, ranking second to reef fishes in average dollar value of landings. The most important species, yellowfin tuna and swordfish, were caught primarily by surface longline near the edge of the continental shelf and offshore. Catches responsible for specific State landings could have been made in waters outside the area because these fisheries operate in the open Gulf.

3.3.1.3. Recreational Resources

Over the past 20 years the northern Gulf of Mexico coastal zone has become increasingly developed, with residential and recreational land use dominating the transition. In addition to homes, condominiums, and some industry, the Gulf Coast is one of the major recreational regions of the U.S., particularly for marine fishing, sports diving, 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, administered, or designated. These would include (1) national and State seashores, parks, beaches, wildlife refuges, wilderness areas, and preservation areas, (2) historic sites and landmarks such as forts and lighthouses, (3) research reserves, and (4) scenic rivers and highways.

National reserves are located in the parishes with Gulf coastline − Cameron, Terrebonne, Lafourche, Jefferson and Plaquemines − and include (1) Barataria-Terrebonne National Estuary Program, (2) Atchafalaya National Wildlife Refuge, (3) Jean Lafitte National Historic Park and Reserve, and (4) Breton National Wilderness Area and Wildlife Refuge. The State of Louisiana owns or manages additional acreage in wildlife management areas. Among these are (1) Pointe-au-Chien in Terrebonne and Lafourche Parishes, (2) Wisner Wildlife Management Area in Lafourche Parish, close to Port Fourchon, and (3) Pass a Loutre in Plaquemines Parish. Birdwatching is a growing activity in Gulf Coast areas.

Although there is recreational use of the Central Gulf Coast year round, the primary season for activity on shorelines and on the water is the spring and summer. Gulf Coast residents and tourists from throughout the nation and from foreign countries use these resources extensively and intensively for recreational activity. Marine fishing and diving are important to Louisiana's economy, generating millions of dollars in sales of equipment, transportation, food, lodging, insurance, and services. Just over one-third of the marine recreational fishing trips in the Gulf of Mexico extend into OCS water under Federal jurisdiction (>3 mi from shore). Very few fishing trips, however, go beyond the 200-m isobath (approximate edge of continental shelf) or are >100 mi (160 km) from shore. Recreational fishermen catch a variety of species including barracuda, shark, drum, snapper, and flounder. Recreational diving trips are popular in near shore and offshore waters near natural and artificial reefs. An MMS study found that fishing, party, and diving trips originating from Louisiana's coast numbered over 3 million in 1999, higher than any of the other three states lining the Gulf of Mexico (Hiett and Milon, 2002; pages 2-4). Commercial and private recreational facilities and establishments, such as resorts, casinos, marinas, amusement parks, and ornamental gardens, are also attractions.

3.3.1.4. Archaeological Resources

Archaeological resources are any material remains of human life or activity that are at least 50 years old and that are of archaeological interest. The archaeological resources regulation (30 CFR 250.194) provides specific authority to each MMS Regional Director to require archaeological resource surveys, analyses, and reports. Surveys are required prior to any exploration or development activities proposed on leases within the high-probability areas (NTL 2002-G01 *Archaeological Resource Surveys and Reports*).

3.3.1.4.1. Prehistoric

Available geologic evidence indicates that sea level in the northern GOM was at least 90 m (295 ft), and possibly as much as 130 m (427 ft), 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 above sea level and exposed, 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 (148 ft) below the present level (CEI, 1977 and 1982). On this basis, the continental shelf shoreward of the 45-m to 60-m (148 to 197 ft) bathymetric contours has a potential for prehistoric sites dating after 12,000 B.P. Because of inherent uncertainties in both the extent of emergent continental shelf depth and the entry date of prehistoric man into North America, MMS adopted the 12,000 years B.P. and the 60-m (197 ft) water depth as the seaward extent of the prehistoric archaeological high-probability area.

3.3.1.4.2. Historic

With the exception of the Ship Shoal Lighthouse structure, historic archaeological resources on the OCS consist of historic shipwrecks. An historic shipwreck is defined as a submerged or buried vessel, at least 50 years old, that has sunk, stranded, wrecked, burned, or was destroyed by hostile action and is at present 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 (0.9 mi) of shore and most of the remainder lie between 1.5 and 10 km (0.9 and 6.2 mi) (CEI, 1977). Garrison et al. (1989) found that changes in the late 19th and early 20th century sailing routes increased the frequency of shipwrecks in the Eastern Gulf to nearly double that of the Western and Central Gulf. The highest observed frequency of shipwrecks occurred within areas of intense marine traffic, such as the approaches and entrances to seaports and the mouths of navigable rivers and straits.

The Garrison et al. (1989) and Pearson et al. (2002) shipwreck databases list about 2,100 wrecks in the Gulf of Mexico. They should not be considered exhaustive compilations of shipwrecks, but they do constitute the most comprehensive surveys available. The shipwreck database lists six shipwrecks that lie, or are presumed to lie, in Grid 13 (Table 3-6). While the identity and loss dates of two of the six vessels is known, *Holly Ann Visier* (1986) and *Southern Cross* (1982), their location on the seabed is unknown. Two vessels have been located on the seafloor in Mississippi Canyon by pipeline or lease block side-scan-sonar surveys; however, their identities remain unknown. They are located in Mississippi Canyon Blocks 855 and 892, which have been designated high-probability shipwreck blocks. Regular reporting of shipwrecks did not occur until late in the 19^{th} century, and losses of several classes of vessel, such as small fishing boats, were largely unreported in official records.

Aside from acts of war, hurricanes cause the greatest number of wrecks in the Gulf. Wrecks occurring in deeper water on the Federal OCS would have a moderate to high preservation potential because they lie beyond the influence of storm currents and waves. Additionally, temperature at the seafloor in deep water is extremely cold, which slows the oxidation of ferrous metals and helps to preserve wood structures and features. The cold water would also eliminate the wood-boring shipworm *Terredo navalis* (Anuskiewicz, 1989).

Shipwrecks occurring in shallow water nearer to shore are more likely to have been reworked and disturbed by storms. Historic research indicates that shipwrecks occur less frequently in Federal waters, where they 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.

Table 3-6

Shipwrecks in the Grid 13 Area

Area	Shipwreck Name	Date Sunk
Green Canyon	*Holly Ann Visier*	1986
Mississippi Canyon	Unknown	Unknown
Mississippi Canyon	Unknown	Unknown
Mississippi Canyon	*Southern Cross*	1982
Mississippi Canyon	Unknown	Unknown
Mississippi Canyon	Unknown	Unknown

3.3.2. Human Resources and Economic Activity

Human resources and economic activity in the Central Gulf are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.3.3) and are incorporated into this PEA by reference. Summaries of these resources follow and include (1) population and education, (2) infrastructure and land use, (3) navigation and port use, (4) employment, (5) current economic baseline data, and (6) environmental justice.

3.3.2.1. Population and Education

Table B-2 (Appendix B) shows 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 dominates 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. Many of these same areas experienced a loss in population following the mid-1980's drop in oil prices (Gramling, 1984; Laska et al., 1993). All subarea populations would be expected to grow at a higher rate than the United States' average annual population growth rate over the 13-year total lifecycle of the proposed action. This trend reflects continuation of historic regional migration patterns favoring the south and west over the northeast and Midwest (USDOC, Bureau of the Census, 2001). Average annual population growth projected over the life of the proposed action ranges 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.

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 received bachelor's degrees. 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 degrees (20.2%). Florida mirrors Texas; its educational attainments are higher than the national rates – 81.9 and 23.2 percent, respectively.

3.3.2.2. Infrastructure and Land Use

The Gulf of Mexico OCS 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. Most of this 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) where only exploration activities have taken place to date. The high level of offshore oil and gas activity in the GOM is accompanied by an extensive development of onshore service and support facilities (USDOI, MMS, 2002; Figure 3-12). 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.

Louisiana's coastal impact area is mostly vast areas of wetlands and small communities and industrial areas that extend inland. 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. Land use in the impact area varies from state to state. The coasts of Florida and Texas are a mixture of urban, industrial, recreational beach, wetland, forest, and agricultural areas.

3.3.2.3. Navigation and Port Use

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 (>27 ft or 8 m) 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: (1) a strong and reliable transportation system; (2) adequate depth and width of navigation channels; (3) adequate port facilities; (4) existing petroleum industry support infrastructure; (5) location central to OCS deepwater activities; (6) adequate worker population within commuting distance; and (7) insightful and strong leadership.

Port Fourchon and Venice, Louisiana, have longstanding and intensively used support facilities. Port Fourchon lies approximately 119 mi (192 km) north-northeast of Green Canyon Block 608. The designated backup onshore support base at Venice, Louisiana, lies 139 mi (224 km) from Block 608 (Figure 9). Both bases are capable of providing the services necessary for the proposed activity. They each have 24-hour service; a radio tower and phone patch; dock space; indoor and outdoor equipment and supply storage space; forklift, crane, and docking services; tractor trailer parking; and drinking water supplies. Either base will serve as a loading point for tools, equipment and machinery, drilling and completion chemicals, and crews needed for well completions and platform operations.

3.3.2.4. Employment

Table B-3 (Appendix B) 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 13-year total life cycle of the proposed action ranges 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 this time employment for the U.S. 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. These projections assume continuation of existing trends in OCS activity and in other area industries.

The industrial composition for the subareas in the WPA and those 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 and is also the fastest growing industry.

3.3.2.5. Current Economic Baseline Data

Oil and natural gas prices are used to evaluate the oil and gas industry's ability to economically develop resources. As of June 11, 2003, Henry Hub Natural Gas closed at $6.055 per million BTU (Oilnergy, 2003). Tight natural gas supplies could force up prices in the event of a cold winter.

The price of crude oil to be delivered in July 2003 settled at $32.36 per barrel on the New York Mercantile Exchange (NYMEX) following a Department of Energy weekly report showing that U.S.

crude oil inventories fell 4.6 million barrels in early June 2003 to 284.4 million barrels. The Organization of the Petroleum Exporting Countries (OPEC) agreed on June 11, 2003, to maintain its current production quotas, postponing any significant output cuts until Iraqi oil exports return to the market. The pace and extent of the return of Iraqi crude to the market is still unclear as of early June 2003. Furthermore, high natural gas prices are bolstering oil demand at a time when consumption normally takes a seasonal dip. As natural gas prices rise, some utilities are able to switch to oil burning for power generation.

Exploration and production (E&P) expenditures are another indicator of the energy industry's strength. Two major year-end spending surveys (Lehman Brothers and Salomon Smith Barney) indicate modest expectations for global E&P in 2003. Energy analysts at Raymond James Associates, however, indicate the potential growth in E&P spending resulting from high commodity prices is astounding. This disparity (a 4% versus a 20% jump in E&P spending from that made in 2002) typifies the energy forecast business in times of geopolitical and economic uncertainty. Both Lehman Brothers and Salomon Smith Barney used direct survey techniques to poll management at E&P firms for specific figures on budgeted expenditures. Raymond James Associates extrapolated expenditures from the free cash flow generated through industry economics. The key to industry's 2003 spending levels involves commodity price assumptions. Both spending surveys identified price assumptions that are lower than the current market, while the underlying assumption for Raymond James notes that operators historically spend more cash in the field than they generate. The higher commodity prices, specifically for natural gas, will generate greater free cash flow in 2003 so that E&P firms will be challenged to spend it all on drillable prospects. The Raymond James group bases their spending model on the premise that cash flow is the chief driver for capital spending while budgets are simply planning guidelines. While the issue is not about which methodology is correct, the disparity illustrates that oil and gas is a dynamic industry subject to frequent, unexpected changes like those witnessed throughout 2002 into summer 2003.

In addition to E&P spending, drilling rig use is employed by the industry as a barometer of economic activity. As of June 6, 2003, the fleet utilization rate for all marketed mobile rigs in the GOM was 69.2 percent, compared to 62.0 percent four months ago. For those MODU's capable of deployment in Grid 13, this breaks down as a 72.9 percent fleet utilization rate for semisubmersibles (average day rates of \$35,000-\$201,800); 87.5 percent for drillships (average day rates of \$105,000-\$205,000); and 57.1 percent for submersibles (average day rates of \$16,500-\$24,000). Platform rigs in the Gulf recorded a 51.5 percent fleet utilization rate, while inland barges had a 48.6 percent utilization rate. Some analysts see indicators to improving rig demand in the Gulf of Mexico in the late spring of 2003: Gulf of Mexico drilling contractors are beginning to see longer contract terms by operators signing rigs to more 60-day terms rather than the 30-day and one-well requirement that has been the norm for some time. Some contractors also report an increase in the number of bid requests they are receiving.

There are several views as to whether the industry will see a significant increase in drilling activity during 2003 or if it will have to wait until 2004. Some contractors have seen signs of increased activity in their Gulf of Mexico shallow and inland water business segment but with "limited" recovery. Other contractors take a dimmer view. Market analysts, however, believe that a recovery in drilling activity could take shape soon. Standard supply vessel utilization and day rates increased between January 2003 and July 2003. The July 2003 average day rates for supply boats and crewboats used by the offshore oil and gas industry decreased from the July 2002 figures; however, for the most part, utilization rates for these vessels rose. Anchor-handling tug/supply vessel average day rates decreased over the year and maintained a 100 percent utilization rate. Average day rates for these vessels ranged from \$10,000 for under 6,000-hp vessels (down \$2,000 from last year's rate) to \$11,750 for over 6,000-hp vessels (down \$3,250 from last year's rate); utilization rates were 100 percent for both. Supply boat average day rates ranged from \$4,773 for boats up to 200 ft (down \$707 from a year ago) and \$6,850 for boats 200 ft and over (down \$2,973 from a year ago); utilization was 83 percent and 87 percent, respectively. Crewboat average day rates ranged from \$2,115 for boats under 125 ft (down \$122 from a year ago) to \$2,765 for boats 125 ft and over (down \$71 from last year's average rates); utilization was 84 percent and 89 percent, respectively (Greenberg, 2003).

The MMS's royalty provisions have impacted leasing on the OCS significantly. 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 govern the next three years of lease sales, and coupled with higher natural gas prices, resulted in a dramatic increase in leasing since the enactment. Western GOM Lease Sale 180 and Central GOM Lease Sale 178 Part 2 (also in 2001), offered the newly available United States' blocks beyond the EEZ. New royalty relief provisions for both oil and gas production in the GOM's 400- to 799-m depth range were offered beginning with Central GOM Sale 182 in March 2002.

3.3.2.6. Environmental Justice

On February 11, 1994, President William J. Clinton issued Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, which directs Federal agencies to assess whether their actions have disproportionate environmental effects on people of ethnic or racial minorities or people with low incomes. Those environmental effects encompass human health, social, and economic consequences. The Federal agency in charge of the proposed action must provide opportunities for community input during the NEPA process (See Chapter 5 for a discussion of scoping, and community consultation and coordination.). There are no environmental justice issues in the actual offshore Gulf of Mexico OCS planning areas; however, environmental justice concerns may be related to nearshore and onshore activities in support of the proposed Marco Polo project. Environmental justice issues are in two categories – those related to routine operations and those related to accidental events. Issues related to routine operations center on increases in onshore activity (such as employment, migration, commuter traffic, and truck traffic) and on additions to or expansions of the infrastructure supporting this activity (such as fabrication yards, supply ports, and onshore disposal sites for offshore waste). Issues related to accidents focus on oil spills.

4. POTENTIAL IMPACTS ON PHYSICAL, BIOLOGICAL, SOCIOECONOMIC, AND HUMAN RESOURCES

This chapter provides a survey of the impact-producing factors and the potential impacts on physical, biological, socioeconomic, and human resources from the proposed Marco Polo project in Green Canyon Block 608. Impacts on these resources can be found in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.2.1) and are incorporated into this PEA by reference. Cumulative impacts of development and production activity in Grid 13, including non-OCS activity, are discussed in Chapter 4.4.

4.1. IMPACTS ON PHYSICAL RESOURCES

4.1.1. Impacts on Water Quality

Sources that originate upriver from the Mississippi River Delta as well as coastal sources contribute to water quality degradation in nearshore and offshore environments of the GOM. These sources can be broadly characterized as point or nonpoint, and industrial, agricultural, or municipal. They include the following: (1) petrochemical industry; (2) agriculture, including livestock and fish processing; (3) forestry, including pulp and paper mills; (4) paved and developed urban areas; (5) municipal and industrial point sources; (6) power generation; (7) marinas and recreational boating; (8) maritime shipping; and (9) hydromodification activities.

No blowouts are projected as a result of development drilling, well completions and workovers, or hydrocarbon production associated with the Marco Polo project based on historical trends in the GOM (Appendix A). Spills that do occur from development and production activity would be few (if any), volumetrically small, and take place near or in Green Canyon Block 608.

A discussion of impacts to coastal and offshore water quality from OCS activity is provided in Chapters 4.1.3.4 (Major Sources of Oil Contamination in the Gulf of Mexico), and 4.2.1.3 (Impacts on Water Quality) in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002) and is incorporated into this PEA by reference.

4.1.1.1. Impacts on Coastal Waters

The impact-producing factors associated with development and production of the Marco Polo project in Green Canyon Block 608 that could affect coastal water quality include (1) effluents from onshore support bases and OCS service vessels, such as sanitary and domestic wastes, (2) turbidity increases from vessel traffic, and (3) accidental spills of crude oil, diesel fuel, or other materials from vessels in coastal waters.

Domestic and sanitary waste would be discharged from support vessels after required treatment. Effects on coastal waters from the Marco Polo project would primarily occur in heavy traffic areas such as navigation corridors and turning basins at Port Fourchon and Venice, Louisiana, the onshore support bases. State regulations are in place to control contaminants associated with waste discharges that take place onshore. Minor and transient changes in water quality caused by vessel or onshore discharges, such as enriched nutrient contents or oxygen depletion, would be intermittent.

Service vessels that use navigation channels, turning basins, shallow harbors, and docking facilities can cause increases in water turbidity from mud that is resuspended by propeller wash. Dredging and spoil dumping carried out to maintain, deepen, or straighten navigation channels can also increase the turbidity of coastal waters. Actions specifically attributed to vessels supporting the Marco Polo project would have an insignificant impact.

Effluents from the petrochemical industry are regulated by USEPA NPDES permits or State environmental agency permits and by USCG regulations. Petrochemical infrastructure includes facilities for the development, transportation, and processing of the extensive oil and gas resources found onshore in Louisiana, within State waters, on the Federal OCS, and transported into the area from other states and countries.

The NRC recently released a revised assessment of *Oil in the Sea III: Inputs, Fates, and Effects* (NRC, 2003). Nearly 85 percent of the 672,700 bbl of petroleum that enter North American ocean waters each year as a result of human activity comes from activities based on the consumption of petroleum such as (in relative order): (1) land-based runoff and polluted rivers; (2) recreational boats and jet skis; particularly those with 2-cycle engines; (3) deposition from the atmosphere; and (4) jettison of aircraft fuel (NRC, 2003; Table 3-2). Approximately 9 percent comes from transportation activity, such as tanker or pipeline spills, and only 3 percent from spills during oil exploration and extraction (NRC, 2003; pages 2-3).

The Marco Polo project is located approximately 119 mi (192 km) from the nearest Louisiana coastline (Mississippi River Delta, Plaquemines Parish). The distance of this project and Grid 13 from coastal waters introduces lengthy spill travel times and tremendous dilution factors for any accidental spills of crude oil, diesel fuel, or other materials. Spills that affect coastal waters would tend to originate from vessels in transit to or from the coastal area. Spills that may occur in Green Canyon Block 608 present an extremely small likelihood of affecting coastal water resources. Spills of crude oil and diesel fuel can occur in offshore waters from pipeline ruptures, vessel and transfer accidents, and in well blowouts. If a large spill (≥1,000 bbl) were to occur at the surface or originate from a well blowout, the oil would form a surface slick. Response efforts can recover or disperse some of the slick, and high surf could contribute to its break up while at sea. Weathering and evaporation of volatile organics can degrade a slick while at sea. Slicks existing for 10 days or more have a small chance to wash ashore. Coastal environments can take several years to recover from oiling, as was observed on Texas beaches after the *Ixtoc* blowout in 1979-1980. Oil can also be trapped in the marsh grass of coastal wetlands where it would affect the local water quality while degrading.

Some wastes not permitted for offshore disposal are brought ashore for disposal or recycling and can present spill hazards if not handled properly. Disposal of synthetic-based fluids (SBF) from development drilling in Grid 13 are governed by a USEPA general NPDES permit, which does not allow the fluid fraction to be discharged overboard on the OCS. Nonhazardous oil-field wastes (NOW) include oil-based drilling fluids and cuttings, liquid wastes ("fracing" fluids, i.e., fluids forced into formations to fracture, dissolve cement, or prop open pore throats), emulsifiers, workover fluids, mud additives, etc.), and possibly well test solids and produced sand are also transported across coastal waters to shore. The recycling or disposal facilities for these waste products generally lie inland rather than directly on the coasts. Spillage or improper storage of these wastes at dockside facilities can adversely impact surrounding coastal waters and wetland areas.

Conclusion

No significant long-term impacts on coastal water quality would be expected from the proposed Marco Polo project. Because the proposed action would use existing onshore support bases, only discharges from these support bases and service vessels there or in transit would result in effects to coastal waters. The contribution by the proposed action to the level of these effects is expected to be very minor, transient, and not contribute significantly to decline in coastal water quality. Spilled oil originating in coastal waters and attributable to the Marco Polo project would not be ≥1,000 bbl and is expected to be substantially recovered while still at sea.

4.1.1.2. Impacts on Offshore Waters

The impact-producing factors associated with development and production of the Marco Polo project in Green Canyon Block 608 that could affect offshore water quality include (1) degradation of GOM offshore waters from coastal activity, runoff, and riverine inputs; (2) discharges, such as produced water, from offshore OCS oil and gas production; (3) activities that contact or disturb the sea bottom and increase turbidity; and (4) accidental spills of crude oil, diesel fuel, or other materials from vessels in offshore waters.

Operations

Water depths in Grid 13 range from 900 to 2,300 m (2,953 to 7,546 ft). These deep marine waters and environments would be most directly affected by the Marco Polo development activities. Localized sediment disturbance and increased turbidity near the sea bottom will occur from emplacing the anchors and mooring system for the Nabors rig and the TLP. The Nabors 140 completion/installation rig that will be used to emplace the TLP is conventionally-moored with eight anchors. The TLP itself has eight anchors. Each anchor would disturb a footprint area of about 5 ac (2 ha), for a total of 80 ac (32 ha). Installation and maintenance of subsea infrastructure, such as blowout preventers, manifolds, umbilicals, flow lines, risers, and right-of-way pipelines will also cause bottom sediment disturbance in an area estimated to be 5 ac (2 ha) per producing well, for a total of 30 ac (12 ha). The total area of sea bottom that could be disturbed is estimated to be 110 ac (45 ha). These disturbances would not adversely affect offshore water quality because the area of potential disturbance is small and the affects would be most intense during the first year of the project. Elevated turbidity would be a short term, localized, and reversible condition once the disturbance ceases. Epifaunal or infaunal invertebrates within the disturbed footprints may be crushed or buried. Elevated turbidity levels in the bottom water may interfere with the feeding organs of invertebrate filter-feeders. Bottom disturbances from anchoring by service vessels supporting the Marco Polo TLP would not be an issue because the waters are too deep for anchoring by individual vessels, and the TLP will be equipped with a mooring buoy system for vessel docking.

A range of effluents and wastes would be discharged overboard from the Marco Polo TLP. Overboard discharges and wastes intended for onshore disposal from the project are shown in the wastes and discharge tables (Tables 1-4 and 1-5), respectively. The types and discharge rates will be in accordance with the USEPA NPDES General Permit No. GMG 290000 for USEPA Region 6, or an individual NPDES permit if one is secured by APC. Wastes destined for onshore disposal or recycling pose no potential impacts to affected resources unless spilled.

Estimates for total overboard discharges and wastes taken onshore during the Marco Polo project are shown in Table 4-1. The cumulative estimates in Table 4-1 are based on APC's per well estimates or were calculated with the discharge rates noted in this chapter over 156 months (4,680 days), except where otherwise noted.

Table 4-1

Estimates of Total Overboard Discharges and Wastes
for the Proposed Marco Polo Project

Waste Type	Duration (yr)	Cumulative Volumes (bbl)
TLP Domestic Water	13	86,900
TLP Sanitary Water	13	57,900
Nabors Domestic Water	1	6,700
Nabors Sanitary Water	1	4,500
2 Service Vessels – Sanitary and Domestic Water*	13	802,285
TLP Deck Drainage	13	9,360,000**
Produced Water (sea bottom)	12	216,000,000
Produced Sand (taken onshore)	12	4,800
Uncontaminated Ballast Water	13	26,816,400
Well Treatment, Workover, or Completion Fluids	+	21,300
Chemically Treated Seawater or Freshwater (taken onshore)	+	120
Solid Wastes (taken onshore)	13	4,905++

Note: Wastes discharged overboard on water surface if not otherwise indicated.
* Service vessels (1 crew boat and 1 service boat).
** Dependent on rainfall; using one half of APC's maximum daily estimate.
\+ Based on per well estimate.
++ Total of 780 m^3; conversion factor 1 m^3 = 0.0238095 U.S. gallon; 1 bbl = 42 U.S. gallons.

Calculations were made based on APC's schedule for the project. The APC estimates 1 month to install the TLP, 1 month to tie production pipelines into the TLP, 10.5 months to complete Wells 3, 4, 5, 6, 7, and 8, followed by 12 years (144 months) of production. Some of these activities are concurrent. Installation work is estimated to begin in September 2003 and production is estimated to end in August 2016. For simplicity, the project duration is estimated at 13 years or 156 months. The volumetrically largest overboard discharge would be produced water (see discussion of produced water in Chapter 1.4 (Offshore Discharges and Waste Disposal), for which APC indicates that discharge would be at the sea bottom. The maximum discharge rate at the sea bottom is indicated to be 50,000 bbl/day. Production is estimated to extend over 12 years (4,320 days). The dilution factor for produced water discharged at the sea bottom in water 1,310 m (4,300 ft) deep and located 120 mi (193 km) from the nearest coast is extremely large and no impacts would be expected.

Sanitary and domestic waste discharges from the TLP and service vessels are based on their crew size. The APC estimates 20 gal/day/person and 30 gal/day/person, respectively, for the TLP and Nabors rig (crew of 26 each, Nabors rig on station only 365 days). A combined total of 60 gal/day/person for domestic and sanitary wastes is estimated for service vessels (NERBC, 1976). A crew boat and a supply boat are each estimated to have a crew of 60. Domestic and sanitary discharges would be expected to increase nutrient input and biochemical oxygen demand (BOD) slightly in receiving water, but this is not normally a concern in open oceanic waters. Other discharges from development activities such as deck drainage, excess cement, well treatment or completion fluids, and uncontaminated seawater used for cooling are either benign or would affect water quality slightly (e.g., TSS, nutrients, chlorine, and BOD) within tens of meters of the discharge. Uncontaminated ballast water is completely benign. Deck drainage, sanitary wastes, and domestic wastes undergo treatments in separators to remove small fractions of grease or oil, or chlorination and grinding to reduce particle size, respectively, before discharge. The nutrient content or BOD of water within 30 m of the discharge point may be increased slightly. No significant impacts on any physical or biological resources in Green Canyon Block 608 or in Grid 13 would be expected from the overboard discharge of any of these wastes.

Decommissioning effects would be similar in scope and magnitude with offshore construction and installation operations, unless the subsea production infrastructure is left in place, in which case the impacts on the sea bottom would be reduced or eliminated. All discharges would be expected to adhere to NPDES discharge criteria designed to mitigate adverse environmental effects.

Accidental Events

Failure or disconnects of a riser system could result in release of some or all of the fluid in the annuli. Riser system failures and disconnects, though not common, have occurred in the past (USDOI, MMS, 2000a and 2003b). Should the InsulGel™ or similar fluid be released into the water column from a riser failure, no impacts to physical or biological resources would be expected for the following reasons: (1) the maximum quantity of fluid that could be released in an incident is small (approximately 500 bbl); (2) the physical characteristics and low toxicity of the fluid itself (brine based) are essentially benign; and (3) any incident would take place in water 1,310 m deep and any released fluid would be rapidly dispersed and diluted.

No blowouts are projected as a result of drilling, well completions, workovers, or hydrocarbon production associated with Marco Polo project based on historical trends in the GOM (Appendix A). Spills that occur from development and production activity for the Marco Polo project would be few (if any), volumetrically small, and be located near project activities in Green Canyon Block 608.

A surface slick from an oil spill begins to weather as soon as it forms, depending on 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. Evidence from a recent experiment in the North Sea indicated that oil released during a deepwater blowout [844 m (2,769 ft) water depth] would quickly rise to the surface and form a slick (Johansen et al., 2001). A variety of physical, chemical, and biological processes act to disperse and degrade the slick once oil enters the ocean. 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 on the surface or in a rising subsurface plume from a blowout would be temporarily affected by the solubility of hydrocarbon components and by small, dispersed oil droplets that do not rise to the surface due to current activity or that are mixed downward by surface turbulence. Dispersion by currents and microbial degradation remove the oil from the water column and eventually dilute the constituents to background levels.

Conclusion

No significant long-term impacts on offshore water quality would be expected from the proposed Marco Polo project. Near-bottom water quality would be affected by increased turbidity and disturbed substrates during the period of installation of subsea infrastructure, including the anchors and mooring chains, subsea production infrastructure, risers, and pipelines that would transport the oil and gas to the TLP and from the Marco Polo development to shore. Any effects from the elevated turbidity would be short term, localized, and reversible. Small numbers of bottom-dwelling invertebrates may be killed or adversely impacted.

Impacts on offshore water quality from the operational discharges that would be expected to result from the Marco Polo project are insignificant because of (1) existing environmental regulations, (2) great water depth, (3) distance of the project and grid from the coast, (4) spill transit times, and (5) dilution factors. An accidental oil spill would affect water quality at the surface (top few meters of the water column). Spilled oil originating from the project would not be ≥1,000 bbl and is expected to be substantially recovered while still at sea. Operator-initiated activities to contain and clean up an oil spill would begin as soon as possible after an event. Small quantities of unrecovered oil would weather and largely biodegrade within two weeks.

4.1.2. Impacts on Air Quality

Air quality will be affected in the immediate vicinity of the completion/installation rig, TLP, service vessels, and aircraft. The cumulative impact from emissions for APC's DOCD will not exceed the MMS's exemption levels. The proposed well completion, TLP installation, and production activities are not expected to significantly affect onshore air quality. The distance from Green Canyon Block 608 to any Prevention of Significant Deterioration Class I air quality area such as the Breton National Wildlife Refuge (BNWR) is >200 km (124 mi). Lafourche Parish, the location of the primary service base of Port Fourchon, is not in attainment for ozone (USDOI, MMS, 2002; Figure 3-1).

Air quality could be affected in the event of spilled oil. The volatile organic compounds (VOC), which would escape to the atmosphere from a surface slick, are precursors to photochemically produced ozone. A spike in VOC's could contribute to a corresponding spike in ozone, especially if the release were to occur on a hot sunny day in a NO_2-rich environment. The corresponding onshore area is in attainment for ozone. If a fire occurs, particulate and combustible emissions will be released in addition to the VOC's.

Conclusion

No significant long-term impacts on air quality would be expected from the proposed Marco Polo project. The air quality in the immediate vicinity of the proposed activities will be affected by the projected emissions. The distance between Grid 13 and the shoreline introduces tremendous dilution factors for point-source emissions in Green Canyon Block 608. No special mitigation, monitoring, or reporting requirements apply to this project.

4.2. IMPACTS ON BIOLOGICAL RESOURCES

4.2.1. Impacts on Sensitive Coastal Resources

The impact-producing factors associated with the proposed development and production of the Marco Polo project in Green Canyon Block 608 that could affect barrier beaches and dunes, wetlands, and subtidal seagrass communities include (1) oil spills from blowouts or vessel collisions, (2) chemical and drilling fluid spills, and (3) oil-spill response and cleanup. Of these, oil spills represent a high consequence and low-probability accidental event. Chapter 4.2.1.1 (Impacts on Sensitive Coastal Environments) in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; pages 4-62 through 4-73) contains a discussion of impacts from OCS activity on barrier beaches and dunes, wetlands, and seagrass communities and is incorporated into this PEA by reference.

No blowouts would be expected as a result of well completions, workovers, or hydrocarbon production associated with the proposed Marco Polo project, based on historical trends in the GOM (Table A-1). Spills that occur from development and production activity would be few (if any), volumetrically small, and be located near project activities in Green Canyon Block 608.

Appendix A (Table A-4) indicates Gulfwide oil-spill occurrence rates. The statistics show that there have been numerous spills of >1 but <50 bbl but very few spills ≥1,000 bbl for all OCS operations per billion barrels of oil handled. A blowout is the only accident category that could yield a spill ≥1,000 bbl over the 12-year life cycle of Marco Polo field production. The probability of a blowout is small, less than 1 in 100,000, and the combined probability of a spill ≥1,000 bbl making landfall in Louisiana or adjacent states would be extremely small (<0.5%).

Spills occurring in the deepwater environment of Grid 13 would not be large enough to enable them to persist long enough in the marine environment before weathering processes significantly degrade the spill before it landfalls. The transport time would allow a slick to weather, dissolve, and disperse while still in the marine environment. If a spill occurs at sea, mechanical cleanup is assumed to collect up to 10 percent of spilled oil and approximately 30 percent is assumed to be chemically dispersed, further reducing the overall probability and severity of spills that may enter coastal waters and make landfall. Because landfall of spilled oil, diesel fuel, drilling fluids, or chemicals is highly unlikely from the proposed activities, the potential impacts from spill landfall, (i.e., response and cleanup activities on barrier beaches and dunes, wetlands, and seagrass communities) would not be expected to occur.

Oil-spill response activity is governed by area contingency plans (ACP) authorized by the Oil Pollution Act and coordinated by the USCG. These plans specify response procedures, priorities, and appropriate countermeasures for local coastal resources. The cleanup of slicks that come to rest in wetland areas 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. Oil-spill cleanup personnel in water shallower than about 1 m may simply wade through the water to complete their tasks. Trampling by foot traffic, swamp buggies, and cleanup equipment can cause damage to sensitive coastal resources by working oil more deeply into the sediments so that it is less available for dissolution, oxidation, or microbial degradation.

The loss of sensitive coastal environments from subsidence due to fluid withdrawal, dredging to maintain channels, flood control projects, and channelization can occur (USDOI, MMS, 2002; page 4-54). Insofar as the oil and gas industry on the OCS is one of many industrialized uses of coastal waters, it contributes to cumulative impacts like subsidence consistent with its proportion of activity.

4.2.1.1. Impacts on Barrier Beaches and Dunes

The Isles Dernieres and Timbalier barrier islands lie a few miles off the Louisiana coast and inshore of Grid 13. These islands lie seaward of, or adjacent to, large bays or estuaries. Spill volumes of drilling fluids, chemicals, or diesel that could occur from the proposed activity are very unlikely to be large enough to impact barrier beaches or dunes. The likelihood of contact of spilled materials with these resources is dependent on the meteorological and current conditions at the time of the spill, and the quantity and location of the spill.

In coastal Louisiana, heights of dune lines range from 0.5 to 1.3 m above mean high tide levels. An analysis of 37 years of tide-gauge data from Grand Isle, Louisiana, shows that the probability of water levels reaching lower sand dune elevations ranges up to 16 percent. For spilled oil to move onto beaches or across dunes, strong southerly winds must persist for an extended time prior to or immediately after the spill to elevate water levels. Strong winds would accelerate oil-slick dispersal, spreading, and weathering, thereby reducing impact severity at a landfall site. Any barrier beach or dune contacted by a spill associated with the proposed activity is very unlikely except during abnormally high water levels, such as might occur during a hurricane. A study in Texas showed that oil disposal on sand and vegetated sand dunes had little deleterious effects on the existing vegetation or on the recolonization of the oiled sand by plants (Webb, 1988). Oil or its components that remain in the sand after cleanup may be (1) released periodically when storms and high tides resuspend or flush beach sediments, (2) decomposed by biological activity, or (3) volatilized and dispersed during hot or sunny days.

The cleanup operations associated with large oil spills can affect the stability of barrier beaches more than the spill itself. Cleanup of oil spills that contact beaches is described in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002). Beach cleanup can affect beach stability if large quantities of sand are removed. Affects from no noticeable change to accelerated rates of shoreline erosion in sand-starved or eroding barrier beaches, such as those found on the Louisiana coast, can occur when beach profiles are changed by sand removal. Disturbed beach would adjust to approximately predisturbance conditions within a few months to 2 years after a cleanup. Some beached oil and tarballs would penetrate or be buried to various depths under the sand, depending upon the viscosity of the oil, wind and wave energies, and the temperature, wetness, and nature of the sand. Some of this oil may be beneath the reach of cleanup methods and may remain in the sand.

Conclusion

There is a very low probability of a spill from the proposed Marco Polo development contacting barrier beaches; therefore, no significant, long-term impacts to the physical shape and structure of barrier beaches and dunes would be expected to occur from accidental spills of oil, diesel fuel, drilling fluids, or chemicals. Should a spill make landfall and a cleanup take place, impacts to barrier beaches and dunes would be minimal. Recovery periods longer than 2 years would be very unlikely.

4.2.1.2. Impacts on Wetlands

Forested wetlands (bottomland and swamp), bay and canal-fringing wetlands, and marshes occur along the southern Louisiana coastline. Spill volumes of crude oil, diesel fuel, or drilling fluids that might occur from the proposed development and production activities are extremely unlikely to be large enough to impact wetlands. Elevated tides or strong southerly winds would be needed to drive a surface slick into coastal waters and environments. High winds would act to disperse oil slicks before they contact vegetated wetlands behind barrier islands, pass over narrow shoreline beaches, or penetrate inland along shorelines lacking beaches; like many parts of coastal Louisiana. The waters in bays and estuaries tend to be warmer and contain more suspended particulate matter than offshore Gulf waters. Small oil droplets can adhere to particles in suspension that act as nucleation points for oil to settle from the water and enter bottom sediments; thereby accelerating dispersion of the slick. For these reasons, no offshore spills related to the development and production activities of the proposed action would be expected to significantly impact inshore wetlands. Should contact occur, oiling would be very light and spatially isolated, with impacts to vegetation unlikely to exceed 2 years.

An inland fuel-oil spill may occur at a shore base or as a result of a vessel collision. The probability of an inland, fuel-oil spill occurring in association with the proposed action is very small. Should a spill occur inshore or in nearshore waters, it presents a much greater potential for adversely impacting wetlands than an offshore deepwater spill simply due to proximity. 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) evaluated the effects of potential spills to area wetlands. For wetlands along the central Louisiana coast, the critical oil concentration is assumed to be 1.0 l/m^2 of marsh. Concentrations above this would result in longer-term effects 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

There is a very low probability of a spill from the proposed Marco Polo development contacting wetland environments; therefore, no significant, long-term impacts to the structure or vitality of wetlands would be expected to occur from accidental spills of oil, diesel fuel, drilling fluids, or chemicals. Should a spill landfall and a cleanup proceed with approved procedures, impacts to wetlands would be minimal Recovery periods longer than 2 years would be very unlikely.

4.2.1.3. Impacts on Seagrass Communities

Seagrass meadows tend to inhabit protected environments behind barrier islands and are among the most common coastal ecosystems in the Gulf. These communities are much less common along coastal Louisiana, however, than elsewhere in the GOM. Spill volumes of crude oil, diesel fuel, or drilling fluids that might occur from the proposed development and production activities are extremely unlikely to be large enough to impact seagrass communities. Subtidal seagrasses have generally experienced little or no damage from oil spills (Chan, 1977; Zieman et al., 1984).

The extensive rhizome root system for seagrass protects much of the biomass in sediment and therefore makes the ecosystem resilient. Seagrasses are usually protected from exposure to the air and therefore from direct contact with spilled oil, except under unusual conditions such as wind-enhanced extreme low tides. If such an extraordinary event is coupled with landfall of an oil slick, dieback of all exposed vegetation could occur until regenerated in the next 1-2 growing seasons. Fauna living among seagrasses and epifauna attached to grass fronds can be fouled and smothered. Minute oil droplets in water, whether emulsified or bound to suspended particulates, may adhere to fronds, other marine life, or settle to the bottom. Oil may be ingested by filter-feeding or sediment-ingesting invertebrates, degrading the health or diversity of the fauna associated with seagrass communities.

Damage could occur to seagrass communities from secondary effects caused by an oil slick on water over a seagrass community. Depending upon slick thickness, currents, and the nature of the coastal geography an oil slick might be large enough to remain over a submerged bed of vegetation long enough to reduce light levels reaching the sea bed. If light reduction continued for several days, chlorophyll contents in grass fronds will decrease (Wolfe et al., 1988) causing yellowing and reduced productivity, but not likely causing mortality.

A slick that resides over submerged vegetation in an embayment will reduce or eliminate oxygen exchange between the air and the water of the embayment (Wolfe et al., 1988). The circulation of oxygenated water between a restricted embayment and the open environment depends on tides, currents, weather, temperature, slick coverage, and biochemical oxygen demand (BOD). Seagrass communities and related epifauna can be stressed and perhaps suffocated if a stationary oil spill shades the sea bed for a matter of days to weeks. Dieback of weakened seagrasses caused by slick shading or high BOD would not seriously damage the ecosystem, nor would irreversible impacts occur.

Vessels that vary their transit route or depart from established navigation channels can directly scar subtidal seagrass beds with their propellers, keels (or flat bottoms), and anchors (Durako et al., 1992). These scars can be significant enough to be visible from Earth orbit.

Conclusion

There is a very low probability of a spill from the proposed Marco Polo development contacting subtidal seagrass communities; therefore, no significant, long-term impacts to the structure or vitality of seagrass communities would be expected to occur from accidental spills of oil, diesel fuel, drilling fluids, or chemicals. Should an oil spill landfall and a cleanup proceed with approved procedures, no irreversible impacts would occur and impacts to seagrass communities would be insignificant.

4.2.2. Impacts on Sensitive Offshore Resources

The impact-producing factors associated with development and production of the Marco Polo project in Green Canyon Block 608 that could affect benthic environments, marine mammals, sea turtles, birds, and fish include (1) physical contact with anchors, mooring lines, and other engineered structures; (2) noise in the air and sea; (3) collisions with vessels; (4) lights in the remote offshore environment; (4) spilled oil and response activities; (5) effluent discharges; and (6) solid trash and debris. Chapter 4.2.1.2 (Impacts on Sensitive Offshore Resource) in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; pages 4-74 through 4-87) contains a discussion of impacts from OCS activity on deepwater benthic communities and is incorporated into this PEA by reference.

Of these potential impact-producing factors, oil spills represent a high consequence and low-probability accidental event. No blowouts are projected as a result of development drilling, well completions, workovers, or hydrocarbon production associated with the Marco Polo project based on historical trends in the GOM (Table A-1). Spills that occur from development and production activity for the Marco Polo project would be few (if any), volumetrically small, and be located near project activities in Green Canyon Block 608.

Appendix A (Table A-4) indicates Gulfwide oil-spill occurrence rates. The statistics show that there have been numerous spills of >1 but <50 bbl but very few spills ≥1,000 bbl for all OCS operations per billion barrels of oil handled. A blowout is the only accident category that could yield a spill ≥1,000 bbl for the duration of the Marco Polo development. The probability of a blowout is small, less than 1 in 100,000.

Spills occurring in the deepwater environment of Grid 13 would not be large enough to enable them to persist long enough in the marine environment before weathering processes significantly degrade the spill before it landfalls. The transport time would allow a slick to weather, dissolve, and disperse while still in the marine environment. If a spill occurs at sea mechanical cleanup is assumed to collect up to 10 percent of spilled oil and approximately 30 percent is assumed to be chemically dispersed, further reducing the overall probability and severity of spills that may move inshore. Because landfall of spilled oil, diesel fuel, drilling fluids, or chemicals is highly unlikely, the potential impacts from spill landfall, i.e., response and cleanup activities on barrier beaches and dunes, wetlands, and seagrass communities are not expected to be incurred.

4.2.2.1. Impacts on Deepwater Benthic Communities

Deepwater benthic communities expected to inhabit Grid 13, i.e., soft-bottom and chemosynthetic communities, that have potential impact-producing factors in common with the proposed action are discussed in this section.

The impact-producing factors associated with development and production of the Marco Polo project in Green Canyon Block 608 that could affect deepwater benthic communities include (1) seafloor disturbances from anchoring and emplacement of facilities and (2) blowouts during well completion and workovers. Some minor cutting discharges overboard will be associated with the drilling of the temporary cement plugs necessary for the completion and production of each well. The deepwater ecosystem in Grid 13 can be characterized as vast expanses of soft-bottom faunas, with a potential for isolated and small patches of exposed hard bottom with associated organisms favoring hardgrounds (such as ahermatypic corals, and isolated and small areas containing chemosynthetic communities that can develop in association with oil and gas seeps.

The most important impact-producing factors on deepwater benthic communities are physical disturbances of the seafloor caused by (1) anchoring of the well completion/installation rig and the TLP platform, (2) installation or maintenance of subsea infrastructure such as production risers, manifolds, flow lines, and umbilicals on the sea bottom, and (3) resuspension of sediment during a blowout from completion or workovers of the six production wells. The maximum bottom area disturbed in any way is estimated to be no larger than 110 ac (45 ha). Anchors and mooring lines from the completion/installation rig or the TLP can cause disturbances with lethal affects in small footprints on the seafloor of a few ac. Among these disturbances would be (1) crushing of benthic faunas by anchors or mooring lines, (2) burial or disruption of fauna from scraping, plowing, or redistribution of bottom sediment by mooring lines that pivot on their anchors, and (3) increased turbidity from sediment that is resuspended as a result of anchor emplacement or mooring line motion that fouls or interferes with filter-feeding organs.

The Nabors completion/installation rig and TLP each have eight anchors. The areal extent and severity of the impact caused by anchors and anchoring are related to the size and configuration of the anchor and mooring system, the length of chain resting on the bottom, and the swing arc that a chain could have as a result of currents or winds. An estimated sea-bottom disturbance footprint for each anchor and the swing arc of its mooring line is approximately 5 ac (2 ha) for a total of 80 ac (32 ha) for 16 anchors. An additional area of sea bottom will be disturbed by the installation of subsea production facilities, such as manifolds, blowout preventers, umbilicals, and flow lines. In total, the potential sea-bottom area that can be disturbed as a result of the Marco Polo project is a very small portion of this vast deepwater environment. The anchoring configuration of a TLP is closer to the central axis of the facility (i.e., mooring lines are drawn up closer to vertical and underneath the platform) than other semisubmersible anchoring configurations. Therefore, the area of total potential disturbance that has been characterized is likely to be overestimated.

A blowout at the seafloor could create a crater on the sea bottom, and resuspend and disperse large quantities of bottom sediments within a 300-m radius of the blowout site, burying both infaunal (live in the sediment) and epifaunal (live on sediment) organisms and interfering with sessile invertebrates that rely on filter-feeding organs. Anchoring and other bottom-disturbing activities can resuspend bottom sediments but not to the degree achieved by a blowout event. Rapid burial by accumulations of sediment >30 cm (1 ft) in thickness is likely to be lethal for all benthic organisms based on analysis of escape trace fossils from the geologic record (Frey, 1975, page 135; Basan et al., 1978, page 20; Ekdale et al., 1984, page 92). Burial by thinner accumulations of sediment (or cuttings) may be lethal to some sessile (attached or immotile) invertebrates and survivable by motile organisms.

Routine surface discharges of drilling cuttings have been documented to reach the seafloor in water depths greater than 400 m (1,310 ft); however, no additional development wells are proposed by APC for the proposed Marco Polo project. However, the development of previously drilled and plugged wells will be necessary. Temporarily abandoned exploratory wells are typically sealed with a cement plug through approximately 100 ft of well bore. These cement plugs will require drilling to allow completion activities. The total amount of discharge will be minimal, amounting to only about 5 bbl of cuttings per plug drilled or around 30 bbl of cement cuttings discharged for a total of six wells.

Conclusion

The proposed Marco Polo project is expected to have minimal impacts on the ecological function, biological productivity, or distribution of either soft-bottom or chemosynthetic communities. Bottom disturbances from (1) anchoring of the well completion/installation rig and the TLP platform and (2) installation or maintenance of subsea infrastructure such as production risers, manifolds, flow lines, and umbilicals on the sea bottom, are unlikely to be of a sufficient size or duration to adversely affect these benthic community types to any significant or permanent degree. Crushing or burial of individual organisms could take place within small areas of a few acres. Minor and temporary impacts, such as interference with filter-feeding organs, could occur over larger areas inside an envelope estimated to be no more than about 110 ac (45 ha) based on the number of anchor points for the proposed project. Routine discharges from the production platform are not expected to adversely impact these community types because of the water depths in Green Canyon Block 608. Bottom disturbance from a blowout during completion or workover of the six production wells is not likely based on the historical record of blowout events in the Gulf.

4.2.2.2. Impacts on Soft-Bottom Benthic Communities

The vast expanse of the GOM deepwater sea bottom is mostly covered by pelagic clay and silt. Deepwater soft-bottom benthic communities are known primarily from box cores, trawls, or photographic surveys. Chapter 4.2.1.2.4 (Nonchemosynthetic Deepwater Benthic Communities) in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; pages 4-85 through 4-87) contains a discussion of impacts from OCS activity and is incorporated into this PEA by reference.

The eight anchor points of the installation barge, the eight TLP anchor points, and the areas for installation of subsea production infrastructure are expected to take place on soft-bottom substrates inhabited by characteristic fauna. Typical reports of soft-bottom faunas (Gallaway et al., 1988) include widespread, low-density associations of bacteria, meiofauna, and larger megafauna such as sea cucumbers, sea pens, crinoids, demersal fish, decapod crustaceans, brittle stars, and various infauna living in burrows, such as polycheate worms. Anchors and mooring chains from the Nabors completion/installation rig and TLP can crush or bury these invertebrates, or foul the environment with resuspended sediment over small areas of the available sea bottom.

Routine discharges from the TLP or any spilled oil are not expected to have any impact on deepwater soft-bottom benthic communities. Routine effluents discharged at the surface, or spilled oil, diesel fuel, or chemicals occur at the surface and would have no direct or indirect impacts on organisms living on the seafloor. Any minor discharge of mud from drilling out cement well plugs would similarly undergo tremendous dilution and cuttings volume would be insignificant.

Conclusion

The proposed Marco Polo project is expected to have minimal impact on the ecological function, biological productivity, or distribution of soft-bottom communities. The area that could be directly affected by installation and operation of the production facilities is very small in comparison with the vast expanse of potentially suitable and habitable soft-bottom area in the deepwater GOM. Recruitment of new organisms would take place from nearby areas, and organisms from undisturbed areas are free to migrate into disrupted areas after the disturbance ceases or structures are removed. Complete recovery could take place in less than 3 years.

4.2.2.3. Impacts on Chemosynthetic Communities

Although no high-density chemosynthetic communities have been reported in Grid 13, it is possible that they could be discovered there. Chapter 4.2.1.2.3 (Chemosynthetic Deepwater Benthic Communities) in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; pages 4-81 through 4-85) contains a discussion of impacts from OCS activity and is incorporated into this PEA by reference.

NTL 2000-G20 (*Deepwater Chemosynthetic Communities*) makes mandatory the search for and avoidance of dense chemosynthetic communities (such as Bush Hill-type communities) or areas that have a high potential for supporting these community types, as interpreted from geophysical records. The NTL is exercised on all applicable leases and is not an optional protective measure. Under the provisions of this NTL, lessees intending to explore or develop in water depths greater than 400 m (1,310 ft) are required to conduct geophysical surveys of the area of proposed activities and to evaluate the data for indications of conditions that may support chemosynthetic communities. If such conditions are indicated, the lessee must either move the operation to avoid the potential communities or provide photodocumentation of the presence or absence of high-density chemosynthetic communities. If such communities are indeed present, no drilling operations or other bottom-disturbing activities may take place in the area; if the communities are not present, drilling or anchoring may proceed.

Two of the eight anchor impact areas designated for the Nabors completion/installation rig occur within areas that have geophysical signatures characteristic of habitats that have the potential for the occurrence of chemosynthetic communities. The geophysical maps provided with the DOCD indicated that there were small areas of hard bottom (high reflectivity) associated with acoustic void areas in close proximity to the impact areas for two anchors. An ROV survey of the two anchor points and the mooring line locations for the Nabors completion/installation rig was performed by the operator. Analysis of the videotape showed small areas of apparent exposed carbonate with no visible large attached megafauna. Some areas exhibited evidence of gassy sediments and apparent mass wasting or mud flows. Other areas along potential mooring line locations showed some patches of bivalve shells (probably lucinids), but it was not evident that any were alive. It is not expected that the physical contact of a mooring line would have any substantial impact on a clam assemblage if any were indeed alive. Some limited mortality could occur but these small areas could be repopulated from nearby undisturbed areas.

Conclusion

The proposed Marco Polo project will not impact known high-density chemosynthetic communities. No communities of this type are known in the vicinity of the proposed activities as shown by geophysical characteristics and video tape documentation. The only areas exhibiting characteristic geophysical signatures that could support chemosynthetic communities were documented by video from an ROV. No high-density chemosynthetic community components were observed in potential impact areas. There could be very limited impact on patches of lucinid bivalves along one of the planned anchor mooring lines for the Nabors completion/installation rig. Assuming these documented bivalve shell accumulations were living, lethal impacts could occur to some individuals from crushing or disruption by the anchor and mooring line. It could be expected that a habitat with some similar pattern and species composition would eventually be reestablished if similar conditions of sulfide or methane seepage persists after the disturbance. Recruitment of new bivalve spats would take place from undisturbed habitats after the disturbance ceases.

4.2.2.4. Impacts on Corals

Hermatypic corals (those containing photosynthetic algae) cannot live in deepwater environments, however ahermatypic corals can live on suitable substrates (hardgrounds) in these environments. Scleractinian corals are recognized in deepwater habitats, but there is little information regarding their distribution or abundance in the Gulf (USDOI, MMS, 2000b; page IV-14). Scleractinian corals may occupy isolated hard-bottom habitats and can occur in association with high-density chemosynthetic communities that often are situated on carbonate hardgrounds. An ROV survey of two anchor points and the mooring line locations for the Nabors completion/installation rig was performed by the operator. Analysis of the videotape showed small areas of apparent exposed carbonate with no visible large attached megafauna.

Conclusion

The proposed Marco Polo project is expected to have no impact on the ecological function, biological productivity, or distribution of deepwater coral habitats. The occurrence and distribution of deepwater scleractinian corals is not well known at the depths of the proposed action. The Marco Polo project will disturb a small area on the sea bottom. The sea-bottom area bearing geophysical characteristics of a possible hardground near anchor points for the Nabors installation barge have been verified to contain no visible fauna.

4.2.3. Impacts on Marine Mammals

The impact-producing factors associated with development and production of the Marco Polo project in Green Canyon Block 608 that could affect marine mammals include (1) excess noise in the atmosphere or water from helicopters, the TLP, or service vessels, (2) degradation of water quality from oil spills or other material spills, (3) collision potential with service vessels, (4) spill-response activities, and (5) trash and debris from the TLP and service vessels. These impact-producing factors are the same for nonthreatened and nonendangered marine mammal species as well as those listed under the ESA. Chapter 4.2.1.5 (Impacts on Marine Mammals) in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; page 4-94) contains a discussion of impacts from OCS activity and is incorporated into this PEA by reference.

Operations

The noise from helicopter operation can cause a startle response and can interrupt whales and dolphins while resting, feeding, breeding, or migrating. The FAA Advisory Circular 91-36C encourages pilots to maintain higher than minimum altitudes over noise-sensitive areas: a minimum altitude of 213 m (700 ft) while in transit offshore and 152 m (500 ft) while working between platforms. Guidelines and regulations promulgated by NOAA Fisheries under the authority of the Marine Mammal Protection Act include provisions specifying that helicopter pilots maintain an altitude of 305 m (1,000 ft) within 91 m (300 ft) of marine mammals.

The proposed action will have approximately 2,688 helicopter flights to and from the TLP (Chapter 1.3.4, Transportation Operations) throughout the 12 months of facility emplacement and subsequent 12 years of production. Both the noise and the shadow cast by the helicopter during routine overflights to the TLP, and landings and take-offs from the TLP, can elicit a response from nearby cetaceans (Richardson et al., 1995). These occurrences would be temporary and pass within seconds, having no long-term impact on cetaceans. Frequent overflights could have long-term consequences if they repeatedly or consistently disrupt important life functions such as feeding and breeding. As more development projects are pursued by industry within Grid 13, helicopter activity is expected to increase. It is unlikely that cetaceans would be affected by routine helicopter traffic operating at prescribed altitudes.

Atmospheric noise inputs, however, are negligible relative to other sources of noise that are propagated in water (e.g., platform and drill rig operations and vessel traffic). The effect of underwater noise on cetaceans is a subject of controversy with little empirical or measured data. Noise from service-vessel traffic may elicit a startle and/or avoidance reaction from whales and dolphins 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 uncertain. It is not known whether toothed whales exposed to recurring vessel disturbance will be stressed or otherwise affected in a negative but inconspicuous way. Smaller dolphins may approach vessels that are in transit to bow-ride. The behavioral disruptions apparently caused by noise and the presence of service-vessel traffic are unlikely to affect long-term survival or productivity of whale populations in the northern GOM.

Well completion and workover activity, and operation of the TLP would produce sounds transmitted to the water at intensities and frequencies that could be heard by whales and dolphins. Noise from installing the TLP could be intermittent, sudden, and at times high-intensity as one-of-a-kind operations take place. Noise during the production phase of operation is expected to be semi-constant but at low-intensity levels. Toothed whales echolocate and communicate at higher frequencies than the dominant sounds generated by production platforms in operation. 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 from oil and gas production is concentrated. There is some concern for baleen whales since they are apparently more dependent on low-frequency sounds than other marine mammals. Except for the Bryde's whale, which is considered uncommon, baleen whales are extralimital and are rare in the GOM (Würsig et al., 2000).

The potential effects that water-transmitted noise have on GOM marine mammals include disturbance (subtle changes in behavior, interruption of previous activities, or short- or long-term displacement), masking of sounds (calls from conspecifics, reverberations from own calls, and other natural sounds such as surf or predators), physiological stress, and hearing impairment. Marine mammals exposed to recurring vessel disturbance could be stressed or otherwise affected in a negative but inconspicuous way. The behavioral or physiological responses to TLP noise, however, are unlikely to affect long-term survival or productivity of whale or dolphin populations in the northern GOM. Whether or not persistent noise-producing loci (like production platforms) cause cetaceans to avoid the area is unknown.

Many types of plastic materials end up as solid waste during drilling and production operations. Some of this material is accidentally lost overboard where whales and dolphins can consume or become ensnared in it. The result of plastic ingestion is certainly deleterious and could be lethal. The probability of a marine mammal encountering trash that appears edible is probably very low. Disposal of solid wastes offshore takes place in covered bins that are warehoused in a secure area on the platform, whereupon the bins are returned to shore by a service vessel for landfill disposal. The MMS issued NTL 2002-G13 (*Marine Trash and Debris Awareness and Elimination*) to help mitigate the potential threat trash and debris pose to marine mammals, fish, sea turtles, and other marine animals.

The APC does not propose to drill additional development or production wells for the Marco Polo project. Consequently, no drilling fluids and cuttings would be discharged offshore to possibly contact whales and dolphins. Produced water is expected to be discharged overboard, after treatment, if required, and is subject to tremendous dilution factors in the offshore environment. The routine discharges from the TLP would be highly diluted in the open marine environment. These effluents would be within permitted limits and therefore have no effects on cetaceans that may come into contact with TLP outfall sources.

Accidental Events

Spills that occur from Marco Polo development and production activity would be few (if any), volumetrically small, and located near project activities in Green Canyon Block 608, if they did occur. Oil spills and spill-response activities have the potential to adversely affect whales and dolphins by causing soft tissue irritation, fouling of baleen plates, respiratory stress from inhalation of toxic fumes, food reduction or contamination, direct ingestion of oil and/or tar, and temporary displacement from preferred habitats or migration routes. Some short-term (months) effects of oil may be as follows: (1) changes in cetacean distribution associated with avoidance of aromatic hydrocarbons and surface oil, (2) changes in prey distribution and human disturbance; (3) increased mortality rates from ingestion or inhalation of oil; (4) increased petroleum compounds in tissues; and (5) impaired health (e.g., immunosuppression) (Harvey and Dahlheim, 1994). Several mechanisms for long-term injury can be postulated: (1) initial sublethal exposure to oil causing pathological damage; (2) continued exposure to hydrocarbons persisting in the environment, either directly or through ingestion of contaminated prey; and (3) altered availability of prey as a result of the spill (Ballachey et al., 1994).

While no conclusive evidence of an impact on whales and dolphins by the 1989 *Exxon Valdez* spill has been documented (Dahlheim and Matkin, 1994; Harvey and Dahlheim, 1994; Loughlin, 1994), investigations on the effects on sea otters and harbor seals revealed pathological effects on the liver, kidney, brain (also evidenced by abnormal behavior), and lungs, as well as gastric erosions (Ballachey et al., 1994; Lipscomb et al., 1994; Lowry et al., 1994; Spraker et al., 1994). Harbor seal pup production and survival also appeared to be affected (Frost et al., 1994). Oil spills have the potential to cause greater chronic (longer-term lethal or sublethal spill-related injuries) and acute (spill-related deaths during a spill) effects on mammals than originally suspected. A few chronic effects include (1) change in distribution and abundance because of reduced prey resources or increased mortality rates, (2) change in age structure in the breeding stock because certain year-classes were impacted more by an oil spill, (3) decreased reproductive success, and (4) increased rate of disease or neurological problems from exposure to oil (Harvey and Dahlheim, 1994). It has been speculated that mortalities of killer whales may be linked to the *Exxon Valdez* spill (Matkin and Sheel, 1996). There was no documented evidence to directly link the Gulf War oil spill to marine mammal deaths that occurred at that time (Preen, 1991; Robineau and Fiquet, 1994). No marine mammal deaths were attributed to the Santa Barbara Channel oil spill in 1969 (Nation, 2003).

The effects of cleanup activities on cetaceans are unknown. The impacts of dispersant chemicals used on a slick may be as much of an irritant to tissues and sensitive membranes as the oil itself. The increased human presence (e.g., vessels) could add to changes in whale and dolphin behavior and/or distribution, thereby stressing animals further, and perhaps making them more vulnerable to various physiologic and toxic effects.

Clearly, the vitality or productivity of some marine mammals can suffer long-term impacts from oil spills, but the evidence for cetaceans being among this affected population has not been convincingly established. There is, however, substantial circumstantial evidence based on effects documented in other marine mammals that harmful effects from contact between spilled oil and individual whales or dolphins can be reasonably expected. Although there may now be a greater awareness of the chronic effects of spilled oil on some types of marine mammals, an interaction between sea turtles at sea and spilled oil are unlikely to be realized. Contact between marine mammals and spilled oil is so unlikely, and the duration of this contact with mobile animals in the open ocean so fleeting, that effects on marine mammals would be insignificant.

Service vessels present a collision hazard to marine mammals. The Marco Polo project will have approximately 1,344 supply boat trips and 2,016 crewboat trips to and from the installation rig and TLP (Chapter 1.3.4, Transportation Operations) throughout the 12 months of facility emplacement and subsequent 12 years of production. As development projects are pursued by industry in Grid 13, increased ship traffic levels could increase the probability of collisions between ships and marine mammals, resulting in injury or death to some animals. The MMS issued NTL 2002-G14 (*Vessel Strike*

Avoidance and Injured/Dead Protected Species Reporting) to help avoid collisions between vessel and marine mammals. Dolphins may bow-ride vessels that are in transit from a shore base to an offshore location in Grid 13. Vessels may also be a collision threat to coastal dolphins, where the majority of OCS vessel traffic occurs. 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 likely caused by a collision with a motor vessel. The consequence of a vessel collision and a marine mammal is likely to be lethal, but the probability of a collision taking place is low with the current mitigations in place.

Conclusion

The proposed Marco Polo project is expected to have little impact on the vitality of any marine mammal species or productivity of any population endemic to the northern GOM. No deaths would be expected from direct exposure to spilled oil or to chronic long-term effects caused by contact with spilled oil. Although interaction between marine mammals and a weathered oil spill is possible, sublethal effects would be the likely result. Collisions between service vessels and marine mammals would be extremely rare, but they could be lethal or crippling if realized. The MMS's regulations and NTL's are designed to reduce the possibility of collisions. There is no conclusive evidence as to whether or not anthropogenic noise in the water has caused displacements of marine mammal populations or is injurious to the vitality of individuals. Marine mammals could be injured or killed by eating indigestible debris or plastic items originating from the proposed development activities, but the likelihood of such an encounter is very small.

4.2.4. Impacts on Sea Turtles

The impact-producing factors associated with development and production of the Marco Polo project in Green Canyon Block 608 that could affect loggerhead, Kemp's ridley, hawksbill, green, and leatherback turtles, all listed as endangered or threatened species, include (1) noise from helicopter, platform, and vessel traffic, (2) possible collisions with service vessels, (3) brightly-lit TLP, (4) project-related trash and debris, (4) oil spills and spill-response activities, and (5) water-quality degradation from platform effluents. Chapter 4.2.1.6 (Impacts on Sea Turtles) in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; page 4-101) contains a discussion of impacts from OCS activity and is incorporated into this PEA by reference.

Operations

The noise from helicopter operation can elicit a startle response and can interrupt sea turtles while resting, feeding, breeding, or migrating. The proposed action will have approximately 2,688 helicopter flights to and from the TLP (Chapter 1.3.4, Transportation Operations) throughout the 12 months of facility emplacement and subsequent 12 years of production. There are no published systematic studies about the reactions of sea turtles to aircraft overflights, and anecdotal reports are scarce. Sea turtles spend more than 70 percent of their time underwater, but it is assumed that sea turtles can hear helicopter noise at or near the surface and that unexpected noise may cause animals to alter their activity (Advanced Research Projects Agency, 1995). There is evidence suggesting that turtles may be receptive to low-frequency sounds, which is the level where most industrial noise energy is concentrated. Atmospheric noise inputs, however, are negligible relative to other sources of noise that are propagated in water (e.g., platform or drill rig operations and vessel traffic). It is unlikely that sea turtles would be adversely affected by routine helicopter traffic operating at prescribed altitudes.

Transportation corridors for service vessels will be through areas where sea turtles have been sighted. Noise from service-vessel traffic may elicit a startle and/or avoidance reaction from sea turtles or mask their sound reception. Potential effects on turtles include disturbance (subtle changes in behavior, interruption of behavior), masking of natural sounds (e.g., surf and predators), and stress (physiological). There is the possibility of short-term disruption of movement patterns and behavior, but such disruptions are unlikely to affect survival or productivity. Sea turtles exposed to recurring vessel disturbance could be stressed or otherwise affected in a negative but inconspicuous way. Whether or not persistent noise-producing loci (like production platforms) cause sea turtles to avoid the area is unknown.

Well completion and workover activity, and operation of the TLP produce sounds transmitted to the water at intensities and frequencies that could be heard by sea turtles. Noise from installing the TLP could be intermittent, sudden, and at times high-intensity as one-of-a-kind operations take place. Noise during the production phase of operation is expected to be semi-constant but at low-intensity levels. The industrial noises from platform installation and operation, and vessel traffic would have sublethal effects on sea turtles.

The proposed action will have approximately 1,344 supply boat trips and 2,016 crewboat trips to and from the installation rig and TLP (Chapter 1.3.4, Transportation Operations) throughout the 12 months of facility emplacement and subsequent 12 years of production. Increased vessel traffic from additional development projects in Grid 13 raises the probability of collisions between ships and sea turtles, which may result in injury or death to some animals.

Brightly-lit, offshore drilling rigs and platforms present a potential distraction to hatchlings (Owens, 1983). Hatchlings are known to be attracted to light (Raymond, 1984; Witherington and Martin, 1996; Witherington, 1997) and could be expected to orient toward lighted offshore facilities (Chan and Liew, 1988). If this occurs, hatchling predation would increase dramatically since large birds and predacious fish also congregate around the platforms (Owens, 1983; Witherington and Martin, 1996). The very short duration of the light attraction for hatchlings, however, would indicate that this is a risk only for facilities very close to nesting beaches.

Many types of materials, including plastic wrapping materials, end up as solid waste during development and production operations. Some of this material could be accidentally lost overboard where sea turtles can consume it. The result of ingesting materials lost overboard could be lethal. Leatherback turtles are known to mistake plastics for jellyfish and may be more vulnerable to gastrointestinal blockage than other sea turtle species. The probability of a sea turtle encountering trash that appears edible is probably very low. Sea turtles could also become entangled or suffer crippling injuries from debris that is lost by service vessels or the Marco Polo TLP. Disposal of solid wastes offshore takes place in covered bins that are warehoused in a secure area on the platform, whereupon the bins are returned to shore for landfill disposal by a service vessel for landfill disposal. The MMS issued NTL 2002-G13 (*Marine Trash and Debris Awareness and Elimination*) to help mitigate the potential threat trash and debris pose to marine mammals, fish, sea turtles, and other marine animals.

The APC does not propose to drill additional development or production wells for the Marco Polo project. Consequently, no drilling fluids and cuttings would be discharged offshore to possibly contact sea turtles. Produced water is expected to be discharged overboard, after treatment, if required, and is subject to tremendous dilution factors in the offshore environment. The routine discharges from the TLP would be highly diluted in the open marine environment. These effluents would be within permitted limits and therefore have no effects on sea turtles that may come into contact with TLP outfall sources.

Accidental Events

Spills that occur from Marco Polo development and production activity would be few (if any), volumetrically small, and located near project activities in Green Canyon Block 608, if they did occur. When an oil spill occurs, the severity of effects and the extent of damage to sea turtles are affected by (1) geographic location, (2) hydrocarbon type, (3) duration of contact, (4) weathering state of a slick, (5) impact area, (6) oceanographic and meteorological conditions, (7) season, and (8) growth stage of the animal (NRC, 1985). All sea turtle species and life stages are vulnerable to the harmful effects of oil through direct contact or by fouling of their habitats and food.

Contact with spilled oil and consumption of oil (tarballs) and oil-contaminated prey may be lethal or have serious long-term impacts on sea turtles. There is direct evidence that sea turtles, especially hatchlings and juveniles, have been seriously harmed by oil spills. Sea turtles directly exposed to oil or tarballs may suffer inflammatory dermatitis, ventilatory disturbance, salt gland dysfunction or failure, red blood cell disturbances, impaired immune system responses, and digestive disorders or blockages (Vargo et al., 1986; Lutz and Lutcavage, 1989; Lutcavage et al., 1995). Although disturbances may be temporary, long-term effects remain unknown, and chronically ingested oil may accumulate in organs.

No deaths would be expected from direct exposure to spilled oil or to chronic long-term effects. Several mechanisms for long-term impacts can be postulated: (1) sublethal initial exposure to oil causing pathological damage and weakening of body systems or inhibiting reproductive success; (2) chronic exposure to residual hydrocarbons persisting in the environment or through ingestion of contaminated prey; and (3) altered prey availability as a result of the spill. Turtles may be temporarily displaced from areas impacted by spills. The magnitude of impacts on sea turtles would depend upon the oils that they are exposed to, the state of weathering of a slick, and the period of exposure. Because sea turtle habitat in the Gulf includes coastal and oceanic waters, as well as numerous beaches in the region, sea turtles could be impacted by accidental spills from vessels supporting the proposed action that are in transit near these environments. Although there is documentation of the harmful effects of acute exposure to spilled oil, the effects of chronic exposure are less certain and are largely inferred. An interaction between sea turtles at sea and spilled oil are unlikely to be realized. Contact between sea turtles and spilled oil is so unlikely, and the duration of this contact with mobile animals in the open ocean so fleeting, that effects on sea turtles would be insignificant.

No juvenile deaths or sublethal impacts on young or newly-hatched sea turtles, or nests on nesting beaches and habitats, would be expected because the probability of shoreline impact from an oil spill from a well blowout on the Marco Polo project is very small. Further, a slick would be unlikely to survive weathering and sea conditions that would bring it to landfall.

Oil-spill-response activities, such as beach sand removal, can adversely affect sea turtles. Vehicular and vessel traffic during spill-response actions in sensitive habitats during nesting season can occur. Harm to sea turtles is expected to be minimized; however, because of efforts to prevent contact between spilled oil and these areas, and protective spill remediation procedures in sensitive habitats that are specified in the spill-response plans required by the Oil Pollution Act. Increased human presence in nesting habitats could alter behavior of turtles, reduce their distribution, or cause them to move to less favorable areas, making them more vulnerable to various physiologic and toxic effects.

Conclusion

The proposed Marco Polo development project is expected to have little impact on the vitality of any sea turtle species or productivity of any population endemic to the northern GOM. A sublethal impact to sea turtle individuals exposed to a weathered oil slick is the most likely result. There is no conclusive evidence whether or not anthropogenic noise in the water has caused displacements of sea turtle populations or is injurious to the vitality of individuals. Collisions between service vessels and sea turtles would be rare, but they could be lethal if realized. Sea turtles could be injured or killed by eating indigestible debris or plastic items originating from Marco Polo development activities, but the likelihood of such an encounter is very small.

4.2.5. Impacts on Coastal and Marine Birds

The impact-producing factors associated with development and production of the Marco Polo project in Green Canyon Block 608 that could affect coastal and marine birds include (1) air emissions, (2) helicopter and service-vessel traffic and noise, (3) lights from the TLP, (4) oil spills and oil-spill-response activities, and (5) trash and debris from the TLP and service vessels. These impact-producing factors apply to nonthreatened or nonendangered bird species as well as those that are listed. Chapter 4.2.1.8 (Impacts on Coastal and Marine Birds) in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; page 4-106) contains a discussion of impacts from OCS activity and is incorporated into this PEA by reference.

Operations

The major effects of air pollution on birds include direct mortality, debilitating injury, disease, physiological stress, anemia, hypocalcemic condition, bioaccumulation of air pollutants with associated decrease in resistance to debilitating factors, and population declines (Newman, 1979). Contamination of birds or other wildlife by air emissions can occur in three ways: inhalation, absorption, and ingestion.

Air emissions from the project will have a negligible effect on coastal or marine birds that inhabit or transit the offshore OCS area in Grid 13. Emissions from activities associated with the proposed action would be expected to have minimal effects on offshore air quality because of the prevailing atmospheric conditions, emission heights, and pollutant concentrations. Because of distance to the shoreline, no effects would be expected on onshore air quality that could be deleterious to birds.

Helicopter and service-vessel traffic related to the proposed action could sporadically disturb birds while feeding, resting, nesting, or reproducing, or cause them to abandon nests or preferred habitat onshore. The FAA (Advisory Circular 91-36C) and corporate helicopter policy state that the specified minimum altitude is 610 m (2,000 ft) when flying over populated areas and biologically sensitive areas such as wildlife refuges and national parks. Approximately 10 percent of helicopter trips would be expected to occur at altitudes somewhat below this minimum because of inclement weather, emergency situations, or aircraft ascent or landings. Bird populations inhabiting helicopter descent corridors at the Port Fourchon or Venice onshore service bases could be disturbed. Although only seconds in duration and sporadic in frequency, these incidents can disrupt coastal bird behavior and, at worst, possibly result in habitat or nest abandonment.

Service vessels would use selected transit 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 in nearshore and coastal navigation corridors, bays, and estuaries would ameliorate disturbances from service vessels on coastal and marine bird populations. The effects of routine service-vessel traffic on coastal and marine birds would be negligible.

No drilling fluids and cuttings would be discharged offshore to possibly contact birds on the water or their food supplies. Produced water is expected to be discharged at the sea bed, and routine discharges from the TLP would be highly diluted in the open marine environment. These effluents would be within permitted limits and therefore have no effects on marine birds that may come into contact with TLP outfall sources.

Seabirds (e.g., laughing gulls and petrels) may be attracted by lights and structures in the remote offshore and may remain to rest and feed in the vicinity of fixed platforms. They may be diverted from traditional migration routes or feeding grounds.

Coastal and marine birds are commonly observed entangled and snared in floating 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's operating regulations 30 CFR 250.300 and NTL 2003-G06 (*Marine Trash and Debris Awareness and Elimination*) prohibits the disposal of equipment, containers, and other materials into offshore waters by lessees. Coastal and marine birds would, therefore, seldom become entangled in or ingest OCS-related trash and debris. MARPOL (Annex V, Public Law 100-220; 101 Statute 1458; effective January 1989) prohibits the disposal of any plastics at sea or in coastal waters. Due to the low potential for interaction between coastal and marine birds and project-related debris, effects would not occur or would have negligible impact.

Accidental Events

Spills that occur from Marco Polo development and production activity would be few (if any), volumetrically small, and located near project activities in Green Canyon Block 608 if they did occur. Contact with spilled oil and oil-contaminated prey may be lethal or have serious long-term impacts on marine birds. Stress and shock can enhance the effects of exposure to oil. The direct oiling of coastal or marine birds in a fresh slick is probably lethal (Nation, 2003). Contact between birds and a weathered or dissipated slick may lead to sublethal effects. Several mechanisms for long-term impacts can be postulated: (1) sublethal initial exposure to oil causing pathological damage and weakening of body systems or inhibiting reproductive success; (2) chronic exposure to residual hydrocarbons in the environment, (3) ingestion of contaminated prey; and (4) altered prey availability resulting from a spill.

Pneumonia can occur in oiled birds after they inhale droplets of oil while cleaning their feathers. Exposure to oil can cause severe and fatal kidney damage (Frink, 1994). Ingestion of oils might reduce the function of the immune system and reduce resistance to infectious diseases (Leighton, 1990). Ingested oil may cause toxic destruction of red blood cells and varying degrees of anemia (Leighton, 1990). It is not clear which, if any, of the pathological conditions noted in necropsies are directly caused by hydrocarbons or are a final effect in a chain of events with oil as the initiating cause followed by an intermediate effect of chronic and generalized stress (Clark, 1984). Low levels of oil could stress birds by interfering with food detection, feeding impulses, predator avoidance, territory definition, homing of migratory species, susceptibility to physiological disorders, disease resistance, growth rates, reproduction, and respiration. Recovery would depend on subsequent in-migration 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) and may reduce chick survival more than exposure to oil alone. Successful dispersal of a spill would generally reduce the probability of exposure of coastal 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 using booms to protect sensitive colonies displays good intentions, but have extremely limited success.

Conclusion

The proposed Marco Polo project is expected to have little impact on the vitality of any coastal or marine birds or productivity of any population endemic to the northern GOM. It is expected that impacts on coastal and marine birds would be sublethal, consisting of behavioral changes and temporary disturbances or displacement of localized groups in inshore areas. Chronic stress such as digestive distress or occlusion, sublethal ingestion, and behavioral changes, however, are often difficult to detect or attribute. Such stresses can weaken individuals and make them more susceptible to infection and disease as well as making migratory species less fit for migration. Recovery would take place in a period of months to 1 year by the cessation of a disturbance and by the influx of birds from nearby feeding, roosting, and nesting habitats that are unaffected.

4.2.6. Impacts on Essential Fish Habitat and Fish Resources

The impact-producing factors associated with development and production of the Marco Polo project in Green Canyon Block 608 that could affect essential fish habitat (EFH) and fish resources include (1) coastal and marine environmental degradation, (2) rig presence, (3) discharge of produced water and permitted effluents, and (4) blowouts or spilled oil. Chapter 4.2.1.10 (Impacts on Fish Resources and Essential Fish Habitat) in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; page 4-110) contains a discussion of impacts from OCS activity and is incorporated into this PEA by reference.

Coastal and marine environmental degradation and adverse effects on EFH result from the loss or degradation of nursery habitat in wetlands and estuaries and from decreased water quality in nearshore and open marine habitats (Chambers, 1992; Stroud, 1992). Loss of wetland environments can take place from subsidence and submergence of nursery habitats. Chronic levels of contamination from spilled hydrocarbons and floating trash can adversely affect fish and EFH, although these impacts would be minor. Produced water would influence water quality and could potentially produce sublethal effects in fish over a limited area. If all produced-water discharge is made near the bottom as anticipated, there would be no impacts to commercially important fish species. Any effects would be local and not significant. Marine EFH includes both high- and low-relief live bottoms and both natural and artificial reefs. No natural reefs or live bottoms have been documented within the deepwater environment of Grid 13, although there are certainly some areas of exposed authigenic carbonate resulting from bacterial precipitation of carbonate that crop out. Intentionally established artificial reefs are not an issue in Grid 13 due to extreme water depth. The Marco Polo production structure that remains over time will establish a defacto artificial reef by providing hard substrate throughout the euphotic zone where none existed before. The resulting artificial reef will both attract some species of pelagic fish and will also allow the establishment of a variety of reef-associated fish that will live on or near the platform structure. Most, if not all, of the species attracted to the structure will represent net biomass production that would not have been possible without the presence of the artificial habitat.

No drilling fluids and cuttings would be discharged offshore to contribute to marine environmental degradation (other than minor cuttings volumes related to drilling through cement plugs), and routine discharges from the TLP would be highly diluted in the open marine environment. Produced water discharged from the platform is expected to be treated, if required, and is subject to tremendous dilution factors in the offshore environment.

Accidental oil spills or blowouts also have the potential to affect fish resources and EFH, but there is no evidence that fish or EFH in the Gulf have been adversely affected on a regional population level by spills or chronic contamination. Spills that occur from Marco Polo development and production activity would be few (if any), volumetrically small, and located near project activities in Green Canyon Block 608, if they did occur. Fish resources can be affected by oil-spill components that become dissolved, dissipated, and dispersed in the water, and by oil that adheres to particulate matter and sinks into sediment. These effects degrade water and substrate quality but the impacts are temporary and recoverable. Adult fish will, for the most part, avoid the oil (Malins et al., 1982; NRC, 1985; Baker et al., 1991). Farr et al. (1995) reported the behavioral avoidance of dissolved concentrations of a polynuclear aromatic hydrocarbon (PAH) as low as 14.7 µg/l by a species of minnow. Furthermore, adult fish must be exposed to crude oil for some time, probably on the order of several months to sustain a dose that causes biological damage (Payne et al., 1988). Adult fish also possess some capability for metabolizing oil (Spies et al., 1982).

Impacts on phytoplankton and zooplankton populations within 300 m (984 ft) of permitted platform discharge outfalls, or in contact with spilled diesel or oil, can receive concentrations of organic materials or chemicals that are toxic and deleterious. Individual plankters may be subject to lethal or sublethal effects for short periods ranging from minutes to hours. Invertebrate larvae, fish eggs, and fish larvae are known to be very sensitive to oil in water (Linden et al., 1979; Longwell, 1977; Baker et al., 1991). Most fish species produce very large numbers of eggs, however, and larvae spread far and wide in the marine nearshore and offshore. In order for an oil spill to affect fish resources at the population level, it would have to be very large and correspond to an area of highly concentrated eggs and larvae. The oil would also have to disperse deep enough into the water column at levels high enough to cause toxic effects. Given the potential for oil spills, none of these events are likely. The use of dispersants, while potentially beneficial for birds, turtles, and mammals at the surface, could add to adverse effects on plankton, eggs, and larvae. An oil spill in a bay or estuary containing eggs and larvae of important inshore species such as menhaden, shrimp, or blue crabs would present the worst case. The potential spawning areas of marine fish are widespread enough in the GOM to avoid catastrophic effects on single species or large population levels of varied species from even a large spill.

Conclusion

The proposed Marco Polo project is expected to have little impact on any coastal or marine fish, EFH, or commercial fisheries endemic to the northern GOM. The TLP will attract a variety of fish species, some permanently residing on and near to the structure. Impacts on adult fish or EFH are not expected. If a spill occurred, plankton, fish eggs, or larvae 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. Specific effects from oil spills would depend on several factors, including timing, location, volume and type of oil, environmental conditions, and countermeasures used. Losses from larvae and plankton mortality would take place in 1-2 years by fish from adjacent unaffected areas that replenish larvae in early phases of the life cycle.

4.2.7. Impacts on Gulf Sturgeon

The existing range of the Gulf sturgeon in 1996 extended from the Mississippi River to Charlotte Harbor in western Florida (Patrick, personal communication, 1996). Gulf sturgeon is not known from estuaries or rivers of coastal Louisiana west of the Mississippi River. If populations of this listed species were identified from these habitats, spilled oil represents the main potential impact-producing factor of the proposed action. Gulf sturgeon can take up oil by direct ingestion, ingestion of oiled prey, or the absorption of dissolved petroleum components across gill mucus and gill epithelium; however, liver enzymes of adult fish oxidize soluble hydrocarbons into compounds that are excreted in the urine (Spies et al., 1982), without lethal effects. If behavioral studies of other fish species provide a guideline (Farr et al., 1995; Nevissi and Nakatani, 1990), adult sturgeon are likely to actively avoid an oil spill.

Conclusion

If the habitat range of the Gulf sturgeon extends west of the Mississippi River Delta, younger sturgeon could suffer physiological stress, irritation, or impaired liver function from an oil spill resulting from the Marco Polo project, if one should occur.

4.3. IMPACTS ON SOCIOECONOMIC AND HUMAN RESOURCES

In Chapter 3.3.1.1 (Socioeconomic Impact Area), MMS defined the potential impact region as that portion of the GOM coastal zone wherein the social and economic well-being (population, labor, and employment) is directly or indirectly affected by the OCS oil and gas industry. In this section, MMS evaluates how and where future changes may occur as a result of the proposed Marco Polo project.

4.3.1. Impacts on Socioeconomic Resources

The impacts on socioeconomic resources including (1) commercial fisheries, (2) recreational resources, and (3) archaeological resources are discussed in the following sections.

4.3.1.1. Impacts on Commercial Fisheries

The impact-producing factors associated with development and production of the Marco Polo project in Green Canyon Block 608 that could affect commercial fishing include (1) underwater OCS obstructions, (2) coastal and marine environmental degradation, (3) space-use conflicts, (4) discharge of produced water and permitted effluents, and (5) blowouts or oil spills. Chapter 4.2.1.11 (Impacts on Commercial Fisheries) in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; page 4-114) contains a discussion of impacts from OCS activity and is incorporated into this PEA by reference.

The most likely objectives for commercial fishing 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. Desirable pelagic fish species may be attracted to the Marco Polo TLP production facility because of the structure acting as a Fish Attracting Device (FAD). The reasons pelagic fish are attracted to deepwater structures are not simple and are not yet clearly understood yet. Some area previously available to longline fishing will be eliminated by the installation of the Marco Polo facility.

Virtually all commercial trawling in the GOM is performed in water depths <200 m (656 ft). Longline fishing is performed in water depths >100 m and usually beyond 300 m (984 ft). Either activity is carried out in water depths that are substantially shallower than the bottom locations of potential obstructions from the Marco Polo project. Subsea production infrastructure would be located in water depths of approximately 1,310 m (4,300 ft). Because these subsea production facilities (i.e., risers, manifolds, umbilicals, and flow lines) are in water depths >800 m (2,624 ft), they could be left in place without the requirement to sever and remove the equipment to a depth of 5 m below the mudline with MMS authorization The USCG could designate and enforce a safety zone radius of 500 m (1,640 ft) from surface structures, if requested or required. As of early 2003, only seven deepwater production structures have established official safety zones, but they do not restrict vessels less than 30.5 m (100 ft) in length.

No drilling fluids and cuttings would be discharged offshore to contribute to marine environmental degradation (other than minor cuttings volumes related to drilling through cement plugs), and routine discharges from the TLP would be highly diluted in the open marine environment. Produced water discharged from the platform is expected to be treated, if required, and is subject to tremendous dilution factors in the offshore environment.

Chronic, low-level contamination of nearshore and open marine environments is a persistent and recurring event resulting in frequent but nonlethal physiological irritation to those resources that lie within the range of impact. Because many commercial species are estuary dependent, coastal environmental degradation has the potential to adversely affect commercial fisheries. Spills that contact coastal bays and estuaries of the OCS when pelagic eggs and fish larvae are present have the greatest potential to affect commercial fishery resources by killing large numbers of fish eggs and larvae. If a spill contacts nearshore waters, commercially important migratory species, such as mackerel, cobia, and crevalle, could be impacted, as would more localized populations, such as menhaden, shrimp, blue crabs, or oysters. Although the quantity of commercial landings of migratory species in the GOM is comparatively small, these species can be of high value. There are no commercially important demersal fish resources in the water depths of Grid 13.

Spills that occur from Marco Polo development and production activity would be few (if any), volumetrically small, and located near project activities in Green Canyon Block 608, if they did occur. A blowout or large oil spill (≥1,000 bbl) from the Marco Polo TLP would be recovered offshore, and what is not recovered would arrive inshore in a highly weathered and degraded state. As discussed in Chapter

4.2.7 (Impacts on Fish Resources and Essential Fish Habitat), adult fish must become exposed to crude oil for some time, probably on the order of several months, to sustain a dose that causes biological damage (Payne et al., 1988). Adult fish also possess some capability for metabolizing oil (Spies et al., 1982). Farr et al. (1995) documented an avoidance reaction by fish to waters containing dissolved hydrocarbon, and analogous behavior can be expected of commercially important fish.

Besides the risk of contact from an offshore spill, Louisiana coastal waters could experience a spill along vessel transit corridors and near ports that support offshore development and production operations. According to the USCG, 95 percent of all reported coastal spills each year are <24 bbl, so the great majority of coastal spills would likely be small, would disperse quickly, and would have no discernable effect on commercial fisheries. The MMS assumes that a degraded petroleum spill from OCS activity will occasionally contact and affect nearshore and coastal areas of migratory Gulf fisheries. There is no evidence that commercial fisheries in the Gulf have been adversely affected on a regional population level by spills or chronic contamination.

Even if fish resources successfully avoid spills, tainting (oily-tasting fish), public perception of tainting, or the potential of tainting commercial catches will prevent fishermen (either voluntarily or imposed by regulation) from operating in a spill area. Restrictions on catch could decrease landings and/or value for several months. Because the ranges of commercially important fish resources are large, Gulf fishermen do not fish in one locale and have responded to past petroleum spills by moving elsewhere for a few months without substantial loss of catch or income. The effect of oil spills on commercial fishing is expected to cause less than a 1 percent decrease in commercial fishing efforts, landings, or value of those landings. Any affected commercial fishing activity would recover within 6 months or by the next fishing season. Potential effects caused by the level of activity of the Marco Polo project would be indistinguishable from variations due to natural causes.

Conclusion

There will be some unavoidable loss of fishing space because of 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 very small 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.

The proposed Marco Polo project is expected to have little impact on the productivity of any commercial fisheries endemic to the northern GOM. There are no commercial fisheries that are restricted exclusively to Grid 13, nor is the Marco Polo project uniquely located to impact a commercial fishery that includes Grid 13 or adjacent grids. Bottom obstructions are not expected to be an issue because of extreme water depths and the lack of commercially important species. Desirable pelagic fish species may also be attracted to the TLP structure and could potentially improve commercial catches using fishing techniques other than longlining. A large oil spill might adversely affect commercial resources, but impacts are recoverable within one year and Gulf fishing fleets can respond by temporarily moving the location of their operations.

4.3.1.2. Impacts on Recreational Resources

The impact-producing factors associated with development and production of the Marco Polo project in Green Canyon Block 608 that could affect recreational resources include trash and debris, and blowouts and spilled oil. Chapter 4.2.1.12 (Impacts on Recreational Beaches) in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; page 4-117) contains a discussion of impacts from OCS activity and is incorporated into this PEA by reference.

Millions of annual visitors attracted to the coast are responsible for thousands of local jobs and billions of dollars in regional economic activity. Most recreational activity occurs along shorelines and includes such activities as beach use, boating and marinas, camping, water sports, recreational fishing, and bird watching. The location of the Marco Polo project precludes any visual impacts on people engaged in activity along the shoreline or in coastal waters. A MODU is visible from sea level to distances of 3-10 mi (5-16 km) depending on atmospheric conditions. The lights on top of a drilling mast could be visible to approximately 20 mi (32 km) under optimal conditions. Grid 13 is everywhere >40 mi (64 km) from the nearest shoreline and no OCS activity will be visible from the shore.

Very few recreational fishing trips go into deep water >100 mi (160 km) from shore and beyond the 200-m isobath (the edge of the continental shelf). No impacts would be expected on recreational fishing.

The oil and gas industry is not the main source for trash and debris that litter shorelines along the Gulf. People engaged in recreational activities along the coast are mainly responsible for this litter, as well as trash and debris originating onshore but ending up in the sea through deliberate or careless acts. The U.S. National Park Service documented the origins of trash and debris on South Padre Island in Texas. About 13 percent of the 63,000+ items collected were attributable to the offshore oil and gas industry (Miller and Echols, 1996). Other sources of trash and debris include (1) accidental loss from staffed structures in State and Federal waters where hydrocarbons are produced, (2) commercial shrimping and fishing, (3) runoff from storm drains, (4) antiquated storm and sewage systems in older cities, and (5) commercial and recreational fishermen who discard plastics.

Spills that occur from Marco Polo development and production activity would be few (if any), volumetrically small, and located near project activities in Green Canyon Block 608, if they did occur. Should a blowout or large oil spill ≥1,000 bbl occur as a result of Marco Polo project activity, the likelihood of contact with shoreline resources is very small. Should one make landfall, it could present aesthetic impacts, but it is likely to be in a degraded state. Recreational beaches may be temporarily closed during cleanup and displace and inconvenience recreational users for up to 1 year. Smaller spills would be subject to weathering and dispersion and would dissipate before landfall.

Conclusion

The proposed Marco Polo project is expected to have little impact on recreational resources. The risk of a large oil spill occurring because of the proposed development operations is very small. The displacements, inconvenience, or closure of recreational resources caused by an oil spill is below the level of social and economic concern. While some accidental loss of solid wastes may occur from the Marco Polo project or service vessels, existing mitigations and regulations that control the handling of offshore trash and debris would be expected to restrict these inputs so that they have a negligible impact on recreational resources.

4.3.1.3. Impacts on Archaeological Resources

The impact-producing factors associated with development and production of the Marco Polo project in Green Canyon Block 608 that could affect archaeological resources include (1) direct contact or disturbance by the installation rig and TLP anchors or mooring chains, (2) ferromagnetic structures or debris on the seabed, (3) onshore development in support of the project, and (4) oil spills. Chapter 4.2.1.13 (Impacts on Archaeological Resources) in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; page 4-118) contains a discussion of impacts from OCS activity and is incorporated into this PEA by reference.

The MMS's operational regulation at 30 CFR 250.196 requires that an archaeological survey be conducted prior to development of leases within the high-probability zones for historic and prehistoric archaeological resources. Neither Green Canyon Block 608 nor the entire Grid 13 (except 2 blocks) is located within the MMS's designated high-probability areas for the occurrence of prehistoric or historic archaeological resources.

4.3.1.3.1. Prehistoric

Lease blocks with a high probability for prehistoric archaeological resources may only be found landward of a line that roughly follows the 60-m (197-ft) bathymetric contour. The MMS recognizes both the 12,000 B.P. date and 60-m (197 ft) water depth as the seaward extent for prehistoric archaeological potential on the OCS. Because of the water depths in Grid 13 (4,240-4,420 ft; 1,292-1,347 m), there is simply no potential for prehistoric archaeological resources in the area. The development activities for the Marco Polo project cannot possibly impact prehistoric archaeological resources.

4.3.1.3.2. Historic

There are areas of the northern Gulf of Mexico that are considered by MMS to have a high probability for historic period shipwrecks (Garrison et al., 1989; Pearson et al., 2002). Statistical analysis of the shipwreck location data identified two specific types of high-probability areas: (1) within 10 km (6 mi) of the shoreline and (2) proximal to historic ports, barrier islands, and other loss traps. Additionally, MMS has created high-probability search polygons associated with individual shipwrecks to afford protection to wrecks located outside the two high-probability areas.

According to Garrison et al. (1989) and Pearson et al. (2002), the shipwreck database lists six shipwrecks that lie, or are presumed to lie, in Grid 13 (Table 3-6). While the identity and loss dates of two of the six vessels is known, *Holly Ann Visier* (1986) and *Southern Cross* (1982), their location on the seabed is unknown. Two vessels have been located on the seafloor in Mississippi Canyon; however, their identities remain unknown. These locations correspond to two high-probability shipwreck blocks in Grid 13 (Mississippi Canyon Blocks 855 and 892). The current state of identification or location data for any shipwreck in Grid 13 is insufficient to anticipate eligibility for listing in the National Register of Historic Places.

The specific locations of archaeological sites cannot be known without first conducting a remote-sensing survey of the seabed and near-surface sediments. The MMS approved the latest revision of NTL 2002-G01 (*Archaeological Resource Surveys and Reports*) on December 15, 2001. This revised NTL (1) continues to require a 50-m (164-ft) line-spacing density for historic shipwreck remote-sensing surveys, (2) extends the maximum water depth for surveys from 60 to 200 m (197-656 ft), and (3) requires submission of an increased amount of magnetometer data to facilitate MMS's analyses. For lease blocks identified as having a high probability for historic resources in water depths greater than 200 m (656 ft), a line spacing of 300 m (984 ft) is required.

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

Offshore operations can introduce tons of ferromagnetic structures, components, and debris onto water that if dropped or accidentally lost without recovery have the potential to mask the magnetic signatures of historic shipwrecks. The site clearance requirements for projects in water depths characteristic of Grid 13 are in a state of flux. Current requirements for site clearance in NTL 98-26 (*Minimum Interim Requirements for Site Clearance (and Verification) of Abandoned Oil and Gas Structures in the Gulf of Mexico*) applies to debris and structures in water <300 ft (91 m) deep. The OCS infrastructure installed on the seabed in water >800 m (2,625 ft) deep may not be cut or explosively-removed below the mudline and could be abandoned in place. The task of locating historic resources via an archaeological survey would be made more difficult as a result of operational practices that leave ferromagnetic debris from OCS activity on the seabed.

No onshore development in support of the proposed action is expected; therefore, no impact to onshore historic sites, such as forts, lighthouses, cemeteries, or buildings, from any onshore development in support of the Marco Polo project would be expected. Cumulative impacts may occur, however.

Should spilled oil contact a coastal historic site, such as a fort or a lighthouse, oil would be in a weathered and degraded state. The major impact would be visual petroleum contamination of the site and surroundings. Impacts to coastal historic sites are not expected to occur, and if a spill does occur impacts would be temporary and reversible.

Conclusion

There is no possibility that the proposed Marco Polo project will impact prehistoric archaeological resources because of the extreme water depths.

The Marco Polo project is expected to have no direct or indirect impact on the inventory of known or unknown historical shipwrecks located in Grid 13. Impacts are possible on a historic shipwreck because of incomplete knowledge about the location of shipwrecks in the Gulf, but they are not likely. Direct contact between anchors and mooring lines for OCS surface structures, or the emplacement of sea-bottom production structures could destroy or disturb important historic archaeological artifacts or information. Other impact-producing factors would not be expected to adversely affect historic archaeological resources.

4.3.2. Impacts on Human Resources and Economic Activity

The impacts on human resources and economic activity including (1) population and education, (2) infrastructure and land use, (3) navigation and port use, (4) employment and economic activity, and (5) environmental justice are discussed in the following sections. Chapter 4.2.1.14 (Impacts on Human Resources and Land Use) in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; page 4-122) contains a discussion of impacts on land use, coastal infrastructure, demographics, economic factors, and environmental justice from OCS activity and is incorporated into this PEA by reference.

The Marco Polo project in Grid 13 is expected to have negligible economic impact throughout all 10 of the coastal subareas identified in Chapter 3.3.1.1 (Socioeconomic Impact Area). Most of the probable changes in population, labor, and employment resulting from the Marco Polo project would likely 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 Marco Polo project would also occur in the six Alabama and Mississippi counties because of their established oil and gas industry and proximity to Grid 13. Changes in economic factors (in minor service and support industries) from the project would occur, to a much lesser extent or not at all, in the 24 counties of the Florida Panhandle because their economy only marginally supports industries in oil and gas development.

4.3.2.1. Impacts on Population and Education

The impact region's population will continue to grow slowly (<2% per year) according to regional trends. Minimal effects on population are projected from activities associated with the project. While some of the labor force is expected to be local to the service base at Port Fourchon or Venice, most of the additional employees associated with the Marco Polo project are not expected to require local housing. The Marco Polo project is not expected to significantly affect the region's educational level.

Conclusion

The proposed Marco Polo project is expected to have a minimal impact on the region's population or educational level.

4.3.2.2. Impacts on 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 Marco Polo project. Changes in land use throughout the region as a result of the proposed activity would 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 APC's planned use is not expected to result in expansion of the Port Fourchon support base.

Conclusion

The proposed Marco Polo project is expected to have minimal impact on the region's existing infrastructure or land-use patterns.

4.3.2.3. Impacts on Navigation and Port Use

The proposed action would use the existing onshore support base located at Port Fourchon, Louisiana, for completion, facility installation, commissioning, and production support activities. The APC intends to use onshore facilities located in Port Fourchon as a port of debarkation for supplies and equipment. The shore base at Venice, Louisiana, would be used as a backup for support. Both bases operate 24 hours. Each is capable of providing the services necessary for the project. No onshore expansion or construction is anticipated with respect to the proposed action at either base

Three round-trip supply boat trips and two crewboat trips per week would be expected for the completion and development phases of the project over a 12-month period. The same frequency of servicing is expected during the 12-year production operation. Four helicopter trips per week would be expected for the project's completion and development phase of activity. The same frequency of servicing is expected during the 12-year production operation. The proposed activity is expected to impact Port Fourchon and Venice because dredging programs are likely to be needed to upgrade navigational channels, turning basins, and other docking and harbor areas for deeper draft service vessels.

Conclusion

The proposed Marco Polo project is expected to have a minimal impact on navigation and port use.

4.3.2.4. Impacts on Employment and Economic Activity

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.

There are no publicly available models that estimate the expenditures resulting from offshore oil and gas activities. 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 MMS's model for the GOM region has two steps. The first step estimates the expenditures resulting from APC's Initial DOCD (for the construction and deployment of a TLP, the completion of 6 subsea producing wells and operation and maintenance for production activities associated with Marco Polo over 12 years) and assigns these expenditures to industrial sectors in the 10 MMS coastal subareas defined in Chapter 3.3.1.1 (Socioeconomic Impact Area).

The second step uses multipliers from the commercial input-output model IMPLAN (using 2000 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 APC on the platform and development wells from their fabrication/installation or completion through their productive lives. Indirect employment results as the initial spending reverberates through the economy. First, the suppliers of the goods and services for the platform and wells spend the initial direct dollars from the industry. Then, these dollars are re-spent by other suppliers until the initial dollars have trickled throughout the economy. Labor income produces induced spending by the households receiving that income.

Both the level (the amount spent) and the sectoral (the industry in which it is spent) 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 B-4 (Appendix B) shows total employment projections for activities resulting from the Marco Polo project for the peak year of 2003, which corresponds to transportation and installation of the TLP and all subsea production infrastructure, and completion of the six exploration wells. The projections are expressed as absolute numbers and as a percentage of the employment levels expected if no development occurs. 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 direct employment associated with the proposed action is estimated at about 795 jobs. Indirect employment for the peak year is projected at about 350 jobs, while induced employment is estimated to be 420 jobs. The majority of employment is expected to occur in coastal Subarea TX-2; however, employment is not expected to exceed 1 percent of the total employment there or in any other subarea. Total direct, indirect, and induced employment for the peak year is expected at about 1,565 jobs per year throughout all subareas. An additional 15-20 direct, indirect, and induced jobs per year are projected for operation and maintenance and workover activities throughout the 12-year production operation planned for the Marco Polo project.

No project in Grid 13 is expected to exceed the employment impacts associated with the Thunder Horse project in adjacent Grid 16. Peak-year direct, indirect, and induced employment associated with development activities proposed for Thunder Horse, the largest development plan proposed to date on the OCS, is projected to be comparable to that projected for the Marco Polo proposal (at about 1,500 jobs for the peak year of 2003) based on MMS's model results. Should a project comparable in size and complexity to Thunder Horse occur in Grid 13, employment impacts in any given subarea for any given year would still not be expected to exceed 1 percent of the baseline employment for 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 because spills are random accidental events. Given that the platform is fabricated and installed, and the development wells are completed, and production commences as described in the initial DOCD, the timing, numbers, sizes, and offshore locations of occurrence 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 Marco Polo project. Additionally, the cost involved in any given cleanup effort is influenced by a variety of factors: whether or not the oil contacts the shoreline; 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 10,000 bbl for an uncontrolled blowout. Based on model results, should such a spill occur, it is projected to cost about 350 person-years of employment for cleanup and remediation. A blowout of such size in deep water is not expected to contact land. Table B-5 (Appendix B) 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 would be minimal (less than 1%) of total employment in any subarea (even if combined with the employment projected with the proposed activities). Employment associated with oil-spill cleanup is expected to be of short duration (less than 6 months).

Conclusion

The proposed Marco Polo project is expected to have minimal impacts on employment, including those that could result from a blowout and related spill cleanup scenario.

4.3.2.5. Impacts on 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. The existing onshore facilities that can support the projected deepwater developments within Grid 13 are well established along the Gulf Coast, and no disproportionate impacts on ethnic or racial minorities or poor people would result from their continued operation.

Conclusion

The proposed Marco Polo project is expected to have no impacts on existing equities of environmental justice.

4.4. CUMULATIVE EFFECTS

In analyses of environmental impacts for OCS lease sales, MMS uses a time period of 40 years as the life cycle over which the typical activities of industry exploration, development, and production occur. The cumulative effects examined in this section analyzes the impact-producing factors and potential impacts of OCS activity that are likely to occur in Grid 13 for the Marco Polo project and for non-OCS trends that are reasonably projected over the next 40 years. For all of the resources discussed below, the incremental contribution of the Marco Polo project to cumulative impacts would be negligible.

The MMS addressed the cumulative effects of OCS- and non-OCS-related activities for the CPA and the Gulf Coast region in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.5).

4.4.1. Water Quality

Cumulative impacts on water quality include sources of pollutants that affect both coastal and offshore settings. Human sources in coastal waters include effluents, wastes, or surface runoff from varied urban, rural, and industrial sources. These sources include the following: (1) petrochemical industry (inclusive of OCS development and processing); (2) agriculture and animal processing; (3) urban runoff; (4) municipal and recreational sewerage treatment; (5) marinas; (6) commercial fishing; (7) maritime shipping and cruise ships; (8) hydromodification activities; (9) wood processing, pulp, and paper mills; (10) recreational boating and fishing; (11) manufacturing activities; (12) accidental spills of oil, diesel fuel, or other material; and (13) atmospheric deposition of airborne contaminants onto the sea. Contaminants entering coastal waters can also be transported to offshore marine waters.

Human sources in offshore waters include effluents and discharges from fixed (MODU's and production platforms) and mobile sources (vessels of all types). Anchored MODU's and fixed platforms are fixed but temporary. They operate for periods ranging from months to decades. Each fixed or mobile source has routine and permitted effluents and discharges. Fixed platforms and MODU's discharge (1) water-based mud (WBM) and cuttings; (2) cuttings wetted with synthetic-based mud (SBM); (3) small quantities of wellbore cement and treatment, completion, and workover (TCW) chemicals; (4) domestic and sanitary discharges; (5) produced water; (6) bilge, ballast, cooling, and desalinization unit water; and (7) deck wash.

Vessels such as OCS service boats and crewboats, freighters, tankers, barges, fishing boats, and cruise ships discharge (1) bilge, ballast, and cooling water; (2) domestic and sanitary discharges; and (3) deck wash. Both fixed and mobile sources can accidentally spill oil, diesel fuel, or other material, and trash and debris can be lost overboard despite handling requirements.

Worldwide, natural seeps from geologic formations release 4,200,000 bbl (1.8×10^8 gal) of oil into the oceans each year (NRC, 2003; page 2). Natural hydrocarbon seeps are the most significant source of oil entering Gulf waters. Recent studies have suggested that seepage rates in the GOM are much higher than earlier estimates (NRC, 2003; page 191). Mitchell (2000) estimated that 500,000 bbl/yr of oil seeped into northern GOM waters (U.S. territorial waters); a figure NRC doubled to estimate seepage rates for the entire GOM. In the same range, if apportioned to the GOM, would be a recent estimate by MMS (USDOI, MMS, 2003e), which concluded that 1,700 bbl/day are released into all U.S. territorial waters each day by natural seeps (620,000 bbl/yr). The NRC (2003; page 191) estimated that an average of 980,000 bbl of oil enters the entire GOM each year from natural seeps (with a range of 560,000 to

1,400,000 bbl). This average amount is four times the volume of the 1989 *Exxon Valdez* spill (USDOC, NOAA, 1992b) every year.

Table 4-2 reports the annual contribution of oil in marine waters of North America (U.S. and Canada) from various human activities and natural sources. The NRC (2003; Table 3-2) provided a best estimate that 1,820,000 bbl of petroleum enters North American marine waters (U.S. and Canada) each year. The majority of this amount is from natural seeps; approximately 1,120,000 bbl or 62 percent. Table 4-2 shows that the largest fraction of oil entering the water from all sources relates to the consumption of petroleum (33%) and that only 5 percent is related to the production or transportation of oil (including refining). Subtracting out the amount contributed by natural seeps, nearly 85 percent of the 627,700 bbl of oil entering North American marine waters each year from human activities comes from the following sources, in relative order: (1) land-based runoff and polluted rivers; (2) recreational boats and jet skis, particularly those with 2-cycle engines jettisoned aircraft fuel; (3) atmospheric deposition; and (4) jettisoned aircraft fuel (NRC, 2003; Table 3-2). Approximately 9 percent of the total attributable to human activity comes from transportation, pipeline, or refining activity (NRC, 2003; page 3), and 3 percent comes from oil and gas exploration and production (NRC, 2003; page 2).

Table 4-2

Average Annual Releases of Oil in North American Marine Waters (1990-1999) in Barrels

Source	Best Estimate	Minimum	Maximum	Percent of Best Estimate
Natural Seeps	1,120,000	560,000	1,680,000	62.0
Platforms	1,120	1,050	1,260	0.06
Atmospheric Deposition	840	490	3,150	+
Produced Water	18,900	1,470	2,590	1.0
Total Extraction Activity	21,000	16,100	30,100	1.5
Pipeline Spills	13,300	11,900	14,700	0.7
Tank Vessel Spills	37,100	28,000	44,800	2.0
Coastal Facility Spills	13,300	11,900	15,400	0.7
Atmospheric Deposition	70	*	140	+
Total Transportation Activity	63,700	51,800	77,000	3.5
Land-Based (river, runoff)	378,000	18,200	13,300,000	20.7
Recreational Vessels	39,200	15,400	63,000	2.1
Commercial Vessel Spills	8,400	7,700	9,800	0.4
Operational Discharges	154	420	4,200	+
Atmospheric Deposition	147,000	63,700	567,000	8.0
Aircraft Dumping	10,500	7,000	30,800	0.5
Total Consumption Activity	588,000	133,000	14,000,000	33.0
Total All Activity Sources	1,820,000	770,000	16,100,000	100.0**

Notes: * denotes <70 bbl.
** does not add to 100 due to independent rounding.
+ <0.001%.

Source: (NRC (2003; Table 3-2—converted to bbl from metric tons (1 metric ton = 7 bbl)).

No irreversible or irretrievable impacts to the marine environment on a broad oceanic scale are caused by either natural seeps or accidental spills (NRC, 2003). Natural seeps have released oil into the GOM and the oceans of the world in all types of coastal and marine environments for millennia. Natural marine systems can accommodate rather substantial quantities of oil in the sea, apparently without much noticeable impact.

The Gulf Coast has been, and will continue to be, heavily used for industrial, commercial, and recreational enterprises. 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. If the capacity of coastal waters to assimilate contaminants is exceeded, there will be a subsequent, gradual movement of the area of degraded waters farther offshore over time. This degradation could cause short-term loss of the designated uses of large areas of shallow offshore waters due to the contamination itself or the effects of contamination such as lingering hypoxia or episodes of harmful algal blooms. The signs of environmental stress are already evident, among them high nutrient loads, high BOD and low-dissolved oxygen, toxic contamination, high bacteria counts that close shellfish grounds, and wetland loss. Degradation of coastal water quality is expected to continue because no cessation or reduction in any of the sources that contribute to degradation is likely to occur in the near future. Efforts to improve water quality progress slowly because of a complex regional regulatory structure with State and Federal responsibilities, land-use issues, and the costs associated with implementing additional controls.

4.4.1.1. Coastal Waters

The sources identified in Chapter 4.4.1 (Water Quality) contribute to cumulative degradation of coastal waters, which may result in nonattainment of Federal water quality standards in some confined areas. The northwestern Gulf experiences some of the largest average annual inputs of oil to North American marine waters as a result of (1) high tanker traffic volume, (2) large number of oil and gas platforms, (3) inputs carried by the Mississippi River, and (4) occurrence of natural oil seeps (NRC, 2003; page 84). Vessel traffic will add to coastal water quality degradation through routine releases of bilge and ballast water, fuel and tank spills, turbidity caused by vessel propeller wash, trash, and domestic and sanitary discharges. The greatest impacts from vessel traffic will occur along navigation channels within confined harbors, anchorages, and boat yards in populated areas.

Contaminants and high levels of nutrients found in land-based effluents and runoff have been identified as potential causes of hypoxia in nearshore bottom water and possibly contribute to more frequent occurrences of harmful algal blooms. High summer temperatures, low river discharge, a stratified water column, high nutrient loads from upriver, and phytoplankton blooms in surface water are believed to cause the hypoxia that occurs in nearshore and shelf bottom water. When phytoplankton die and sink to the bottom, high BOD strips oxygen from the water making it oxygen-deficient or hypoxic (Rabalais, 1992). Approximately 7,700 mi^2 (20,000 km^2) of coastal and shelf bottom water off the Louisiana and Texas coasts were affected by hypoxic conditions in 1999 (Simpson, 2001).

Elevated contaminant levels in coastal and offshore waters of the northern Gulf were documented by Kennicutt et al. (1988). Some areas within the Gulf (northern Texas coast, Louisiana, and Alabama) show signs of contamination. 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 known natural seeps. Trace organochloride residues appear to exist in many marine species. Higher concentrations of pollutants were generally found in organisms sampled near the Mississippi Delta in comparison to offshore biota (Kennicutt et al., 1988).

Dredging to support coastal development, access for oil and gas activities in State waters, and pipeline emplacements or maintenance would be expected to continue to increase each year. Localized adverse effects from increased turbidity will continue from dredging and dumping of sediment spoils into disposal sites in coastal waters. Onshore service companies that support the OCS oil and gas industry are estimated to contribute to non-spill cumulative water quality degradation to a minor extent.

4.4.1.2. Offshore Waters

The sources identified in Chapter 4.4.1 (Water Quality) contribute to cumulative water quality degradation in offshore waters. Spills of oil, diesel fuel, and other materials may occur from vessels transporting crude oil and petroleum products; from vessels involved in commercial fishing, freight or passenger transport; and from OCS operations. Well blowouts can disturb the bottom, increase turbidity, and put oil into the sea. Should one of these blowouts occur, localized, short-term changes in water quality would be expected. Cumulative impacts would be negligible.

Bottom area disturbances resulting from non-OCS sources are not expected in Grid 13 water depths. Bottom disturbances from anchoring the Nabors MODU and production structures like the Marco Polo TLP produce short-lived effects on water quality on small footprints of about 5 ac (2 ha) per anchor. Cumulative impacts are negligible.

Daily operational discharges to offshore waters occur from vessels moving through Gulf waters and from MODU's and production facilities (Chapter 4.1.1, Impacts on Water Quality). The discharge of drilling fluid, cuttings, and produced water are the main effluents from oil and gas exploration, development, and production operations. Although not an issue for the Marco Polo development in Grid 13, other production projects in Grid 13 that follow may include the drilling of development wells. The discharges from OCS production facilities have been examined in several studies (Avanti Corporation, 1993; CSA, 1997a and b; Kennicutt, 1995; Neff, 1997). These studies concluded that contaminants in produced water, drilling fluid, and cutting discharges should be undetectable in the water column beyond 1,000 m (3,281 ft) from the discharge point. The contaminant deposition and accumulation rate on the sea bottom from discharges is primarily dependent on the water depth and current strength. Sediment contaminants from OCS discharges may occur from several hundred to several thousand meters from the discharge point depending on volumes discharged. Biological responses to contaminant levels retained in bottom sediments are not expected to be detectable beyond a couple hundred meters, and toxic effects to the benthos would be localized, limited to within a hundred meters of the discharge, and of a relatively small magnitude. Toxic effects beyond 100 m (328 ft) should be controlled through the USEPA's NPDES permit requirements.

Well blowouts can resuspend fine-grained sediment in the water to increase turbidity. The rapid accumulation of sediment (or cuttings if well drilling is part of the development project) on the sea bottom that are thicker than 30 cm (1 ft) would be lethal for all sessile and most motile invertebrates (Frey, 1975; Basan et al., 1978; Ekdale et al., 1984). An accumulation rate of this type would not be expected in most deepwater development projects, and most soft-bottom, motile invertebrates would have a chance to react and move. Diluted and discharged slowly over large areas, these wastes contribute in a very small way to the degradation of offshore water quality. Cumulative impacts are negligible.

4.4.2. Air Quality

Cumulative impacts on air quality within the offshore area will come primarily from sources generated outside the Grid 13 area and include emissions from industrial plants, power generation, and urban transportation. The location of Grid 13 is far removed from coastal populations or industrial activity. The OCS activity that takes place in the Grid 13 would be widely spaced production platforms, all >100 mi from shore, and would not affect the overall quality of air over the Louisiana coast. Most of the Gulf's coastal areas are currently designated as "attainment" for all the National Ambient Air Quality Standards-regulated pollutants (USEPA, 2003).

4.4.3. Sensitive Coastal Resources

Cumulative impacts on sensitive coastal resources include (1) water quality degradation from oil, fuel, and material spills, high nutrient loads, urban runoff, industrial discharges, high turbidity, high BOD, pathogens, and upriver contaminants; (2) land development, civil works, channelization, and flood control modifications; (3) removal or destruction of stabilizing plants by dredging, anchoring, and vessels groundings; and (4) natural phenomena such as sea-level rise, subsidence, and storms and hurricanes.

Of these effects, the indirect effects of flood control modifications to the coastline and delta system have the potential to cause the greatest adverse cumulative impacts on sensitive coastal environments over the 40-year exploration and production cycle. Natural effects such as subsidence, however, have been accentuated by cumulative changes made to the input and distribution of sediment from the Mississippi River Delta by flood control programs and other civil works. There is abundant evidence that these effects have already influenced the coastal environment over the last 40 years. These impacts are likely to at least remain constant over the next 40 years as well. The natural influences on sensitive coastal environments caused by sea-level rise, subsidence of the Mississippi River Delta shorelines, and landfall of hurricanes would greatly eclipse any influences from OCS activity.

Water quality degradation will have incrementally small impacts on sensitive coastal environments, but it will have a cumulative effect to create environments that are less healthy, vital, or aesthetically pleasing.

4.4.3.1. Barrier Beaches and Dunes

Cumulative impacts on coastal barrier beaches and dunes include the sources identified in Chapter 4.4.3 (Sensitive Coastal Environments). Barrier beaches along coastal Louisiana have experienced severe erosion and landward retreat (marine transgression) because of natural processes enhanced by human activities. Adverse effects on barrier beaches and dunes have resulted from changes to the natural dynamics of water and sediment flow along the coast trying to control catastrophic floods and change the natural environment to better accommodate navigation on waterways used to support OCS and non-OCS seaborne traffic.

Direct effects from OCS activity include excavation and maintenance of pipeline canals, and dredging to accommodate deep-draft service vessels used to support deepwater projects. Non-OCS activity that contributes to barrier beach and dune erosion, or conversion to another environment, includes the emplacement of levees and stabilization structures for channels and beaches, recreational vehicle use on dunes and beaches, recreational and commercial development, and removal of coastal vegetation.

Barrier beaches and dunes exist on the deltaic plain and are subject to the equilibrium between sediment input, subsidence, and sea level. Without additional sediment the deltaic plain is not replenished and the land no longer aggrades. Inevitably, it begins to subside as sediments on the delta plain compact and dewater. Beach nourishment projects using OCS sand resources (e.g., Ship Shoal) would be expected to increase. Remediation projects for some of the most threatened coastal barrier systems, such as Isles Dernieres, can be expected. Beach nourishment projects will have the effect of slowing the loss or conversion of barrier beaches and dunes, but they will not arrest the natural subsidence of the deltaic plain. The considerable expense and effort to replenish barrier beaches can be lost by the landfall of a major hurricane. Deterioration and loss of Gulf barrier beaches is expected to continue in the future.

4.4.3.2. Wetlands

Cumulative impacts on wetlands include the sources identified in Chapter 4.4.3 (Sensitive Coastal Environments). Because 90 percent of coastal Louisiana is <1 m above sea level, subsidence and transgression of the sea can cause significant wetland loss or conversion into different environments. Estimates for wetland loss or conversion vary but most reported rates are close to 25 mi^2 per year. A recent estimate predicted that about 640,000 ac (1,000 m^2) of existing wetlands will be submerged in less than 50 years (LCWCRTF, 1993).

Wetland loss on the deltaic plain of coastal Louisiana is primarily due to subsidence, erosion, and reduced sediment input from the Mississippi River. Like barrier beaches and dunes, wetlands exist on the deltaic plain and are subject to the equilibrium between the addition of sediment to the delta and shoreline and subsidence that has been disturbed by changes to the river from widespread navigation and flood control projects. The OCS activity of pipeline emplacement, navigation channel deepening or maintenance, and construction of expanded onshore support facilities around Port Fourchon can lead to future wetland loss or conversion. The conversion of wetlands to agricultural, residential, and commercial uses has also been a major cause of wetland loss and will likely continue to be, but at a slower rate as people are prompted to move inland after major storms. Wetland loss is projected to continue around the Gulf, the question being whether the rate stabilizes or increases.

4.4.3.3. Seagrass Communities

Cumulative impacts on seagrass communities include the sources identified in Chapter 4.4.3 (Sensitive Coastal Environments). Seagrass communities occupy less area along coastal Louisiana and become a more significant component of the coastal system east of the Mississippi River Delta. This trend is probably due to natural factors, such as a coarser, sandy substrate or to less turbid water east of the delta. Because seagrass communities are already submerged habitats, subsidence is unlikely to affect them in the same way as interface environments between land and sea, such as beaches or wetlands. The cumulative effects of deltaic plain subsidence, which is profound in habitats existing at the interface between land and water, will have a minimal impact on this particular shoreline environment.

4.4.4. Sensitive Offshore Resources

Cumulative impacts on sensitive offshore resources include those that affect animals living in and on the sea bottom and in the water column, as well as those animals that require nearshore or coastal resources for part of their lifecycle. The cumulative impacts on these resources are discussed under the separate categories below.

4.4.4.1. Deepwater Benthic Communities

Cumulative impacts on deepwater benthic communities include crushing and physical disturbance of the sea bottom from emplacement of drilling rigs, production platforms, and subsea production infrastructure (i.e., production risers, manifolds, umbilicals, and flow lines). The water depths in the Grid 13 area range from 900 to 2,300 m (2,953-7,546 ft). These depths are too deep for anchoring by service vessels, which will use a mooring buoy system. There are no non-OCS activities that could cause sea-bottom disturbances, for example, commercial bottom trawling.

4.4.4.2. Soft-Bottom Benthic Communities

Cumulative impacts on soft-bottom communities include the sources identified in Chapter 4.4.4.1 (Deepwater Benthic Communities). Direct contact between invertebrates and these structures would likely be lethal; however, the footprint size of potential lethal impacts is tiny relative to the total available habitable area and these impacts are insignificant. No impacts from non-OCS-related activities would be expected in Grid 13.

4.4.4.3. Chemosynthetic Communities

Cumulative impacts on chemosynthetic communities include the sources identified in Chapter 4.4.4 (Deepwater Benthic Communities). No impacts to chemosynthetic communities from either OCS- or non-OCS-related activities would be expected. Normal fishing practices should not disturb these areas. Other bottom-disturbing activities such as trawling and anchoring are virtually nonexistent at water depths greater than 400 m. The MMS reviews plans for exploratory and development operations and EP's, DOCD's, or pipeline applications that include geophysical evaluations of bottom characteristics or direct observations in areas planned for OCS activity. Sea-bottom areas liable to be disturbed by these projects are examined to determine if conditions exist that have the potential to host chemosynthetic communities. If these conditions exist, mitigations designed to avoid sea-bottom disturbances to chemosynthetic communities are applied. These reviews and mitigations are designed to protect these unique communities; therefore, cumulative impacts from activity in Grid 13 are not expected. No impacts from non-OCS-related activities would be expected in Grid 13.

4.4.4.4. Corals

Cumulative impacts on coral habitats include the sources identified in Chapter 4.4.4 (Deepwater Benthic Communities). Coral reefs cannot live in this deepwater setting; however, deepwater species have been observed in the Green Canyon OCS area and may be impacted. Corals, perhaps in dense accumulations, on hard substrates may be encountered in Grid 13. Detection and avoidance, however, is expected by the mitigations that apply to chemosynthetic communities, which are designed to identify suspected hardgrounds. No impacts from non-OCS-related activities would be expected in Grid 13.

4.4.5. Marine Mammals

Cumulative impacts on marine mammals include (1) water quality degradation from oil, fuel, and material spills, high nutrient loads, high turbidity, high BOD, urban runoff, industrial discharges, pathogens, and upriver contaminants; (2) noise in the water from infrastructure, vessels, and facility removal; (3) vessel traffic and collision hazard; (4) seismic surveying; and (5) trash and debris. Non-OCS activity that contributes to cumulative impacts includes the same impact-producing factors from OCS activity, but which arise from other industrial, commercial, or recreational activity. Also, commercial fishing activity can kill or injure marine mammals by accident. The cumulative impacts from the major impact-producing factors on sea turtles would be dominantly sublethal, primarily behavioral changes, temporary disturbances, or displacement of localized groups, and rarely lethal. Marine mammal deaths attributable to non-OCS activity, such as commercial fishing, would be much greater than any caused by OCS activity.

Of these effects, the potential for collision between marine mammals and service vessels probably represents the greatest potential for adverse cumulative impacts on marine mammals over the 40-year exploration and production cycle. This judgment is made because collisions between large vessels and cetaceans, though rare events, typically results in crippling injuries or death. The collision hazard from service vessels is expected to decrease because of recent mitigations put into place by MMS, such as observers on vessels who are trained to spot marine mammals and turtles at sea. The potential for collisions with non-OCS vessels remains because requirements applicable to OCS activity do not apply to other industrial or commercial activity. Collisions between marine mammals and freight or cruise ships are not documented. While collision incidents between marine mammal and vessels that result in death attributable to OCS activity decrease or remain the same, the total number of marine mammal deaths resulting from collisions with all vessels associated with non-OCS activity will probably increase or remain the same.

Deaths or serious injuries due to explosive structure-removal operations are not expected or would be extremely rare. Depending on mitigation measures developed during ESA Section 7 consultations and if the removal of subsea production infrastructure is not required in deepwater developments, the chance of harm to marine mammals can be reduced. Noise in the water from platforms or service vessels may (1) disrupt normal activities like feeding, breeding, resting, or deep-dive recovery; (2) cause physiological stress and greater susceptibility to disease or predation; or (3) cause them to avoid these noise sources. There are effective prohibitions on discarding trash or debris from development activity at sea. Marine mammals could be injured or killed from ensnarement in or consumption of marine debris, particularly plastic items, lost from OCS structures and service vessels.

Cumulative impacts on GOM marine mammals include the degradation of water quality resulting from operational discharges, vessel traffic, noise generated at offshore structures, MODU's, helicopters, seismic surveys, explosive structure removals, oil spills, oil-spill-response activities, loss of debris from ocean-going vessels and OCS structures, commercial fishing (capture and removal), pathogens, and negative impacts to prey populations. Cumulative impacts on marine mammals would be expected to result in a number of chronic and sporadic sublethal effects (behavioral effects and nonfatal exposure to or intake of non-OCS and 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 would be expected from chance collisions between marine mammals and OCS service vessels, ingestion of debris such as plastic material, and pathogens.

Oil spills and associated slicks of any size are infrequent events, but if they do occur they have a very small potential to contact marine mammals. Sublethal effects could occur with exposure of marine mammals to a weathered oil slick. Disturbance (noise from vessel traffic and drilling operations, etc.) and/or exposure to platform discharges may cause sublethal effects, may stress animals and weaken their immune systems, and may make them more vulnerable to parasites and diseases.

The net result of any disturbance would be dependent upon the size and percentage of the population affected; ecological importance of the disturbed area; environmental and biological parameters that influence an animal's sensitivity to disturbance and stress; and the accommodation time in response to prolonged disturbance (Geraci and St. Aubin, 1980).

4.4.6. Sea Turtles

Cumulative impacts on sea turtles and their habitats include (1) water quality degradation from oil, fuel, and material spills, high nutrient loads, high turbidity, high BOD, urban runoff, industrial discharges, pathogens, and upriver contaminants; (2) habitat loss or degradation; (3) infrastructure and vessel noise, lighting, and removal; (4) vessel traffic and collision hazard; (5) trash and debris; and (6) natural phenomena such as sea-level rise, subsidence, and storms and hurricanes. Non-OCS activity that contributes to cumulative impacts include commercial and recreational fishing that kill or injure turtles by accident, beach lighting, and entrainment in power plant intakes. The cumulative impacts from the major impact-producing factors on sea turtles would be dominantly sublethal, primarily behavioral changes, temporary disturbances, or displacement of localized groups, and rarely lethal. Turtle deaths attributable to non-OCS activity would be much greater than any caused by OCS activity.

Of these effects, dislocation from preferred beach-nesting habitats or destruction of these habitats probably represents the greatest potential for adverse cumulative impacts on sea turtles over the 40-year exploration and production cycle. Habitat loss or degradation of preferred nesting beaches can link to stresses that act to reduce reproductive success, such as overcrowding on remaining and suitable nesting beaches. Natural influences on habitat displacement or destruction caused by sea-level rise, subsidence of the Mississippi River Delta, and landfall of hurricanes will greatly eclipse any influences from OCS activity. Natural effects such as subsidence, however, have been accentuated by cumulative changes to the river's flow patterns and sediment load as a result of flood control projects, dams, channelization, and other civil works designed to improve navigation.

Deaths due to explosive structure-removal operations should not take place or be extremely rare. It is uncertain that removal of any subsea production infrastructure in the water depths characteristic of Grid 13 will be required by explosive charges or cutting. Grid 13 is far from shoreline nesting habitat, such that hatchlings will be weeks old before they drift into Grid 13, possibly on *Sargassum* mats. By that time their susceptibility for attraction to brightly lit platforms may be less acute or absent. Underwater noise from platforms or service boats may disrupt normal activities and may cause physiological stress, causing turtles to become more susceptible to disease or predation. Collision hazards from service vessels would be expected to decrease because of recent mitigations put into place by MMS, such as observers on vessels trained to spot marine mammals and turtles at sea.

There are effective prohibitions on discarding trash or debris from project activity at sea. Sea turtles could be injured or killed from ensnarement in or consumption of marine debris, particularly plastic items, lost from OCS structures and service vessels.

Oil spills, chemical dispersants, and spill-response activities on sensitive nesting coastlines are potential hazards that may adversely affect sea turtles, or the reproductive success of populations. Contact with and consumption of oil and oil-contaminated prey may seriously affect sea turtles. Large spills are extremely rare events, and for this reason no contact or interaction is expected between turtles and freshly spilled oil. Incidental contact with degraded or weathered oil can be expected between turtles that inhabit or transit through Grid 13 over the next 40 years. The effects from contact with spilled oil in a weathered slick would be sublethal behavioral changes.

The incremental contribution of the proposed Marco Polo project to the cumulative impacts would be negligible. The effects of the most likely impacts, such as the physical presence and operation of the platform facility, or noise from the platform, helicopters, and service-vessel traffic, would only be expected to modify the behavior of turtles that come into contact with these project facilities.

4.4.7. Coastal and Marine Birds

Cumulative impacts on coastal and marine birds include (1) air emissions; (2) water quality degradation from oil, fuel, and material spills, high nutrient loads, high turbidity, high BOD, urban runoff, industrial discharges, pathogens, and upriver contaminants; (3) habitat loss and shoreline modification from construction and development; (4) collisions with aircraft; (5) noise from aircraft and vessels; (6) trash and debris; and (7) natural phenomena such as sea-level rise, subsidence, and storms and hurricanes. Non-OCS industrial, commercial, or recreational activities that contribute to these cumulative impacts involve the same impact-producing factors as OCS activities. These impacts could be especially critical to endangered or threatened bird species that must maintain a viable reproductive population size or depend on a few key habitat areas. The cumulative impacts from the major impact-producing factors on coastal and marine birds would be rarely lethal and dominantly sublethal, constituting behavioral changes, temporary disturbances, or displacement of localized inshore bird groups.

Of these effects, dislocation from preferred habitats or destruction of habitat probably represent the greatest potential for adverse cumulative impacts on coastal and marine birds over the next 40 years. Natural influences on habitat displacement or destruction caused by sea-level rise, subsidence of the Mississippi River Delta, and landfall of hurricanes will greatly eclipse any influences from OCS activity. Natural effects such as subsidence, however, have been accentuated by cumulative changes made to the inputs and distribution of sediment from the Mississippi River Delta by flood control programs, dams, channelization, and other civil works designed to improve navigation.

Industry activity that contributes to habitat modification and destruction includes construction and maintenance of pipelines and corridors, and dredging to accommodate deep-draft service vessels used to support deepwater projects. Non-OCS activity would include coastal development, shoreline modifications, flood control programs, and dredging, which would be done to accommodate international shipping and cruise ship traffic.

The net effect of habitat loss will alter species composition and reproductive success, and would reduce the overall carrying capacity of disturbed area(s) in general. Most birds can potentially produce two or more eggs in one breeding season and have them survive to maturity. Undisturbed populations in optimum habitats could increase and recover if the average reproduction rate was >2 chicks per parent pair that survive to maturity. The time over which recovery takes place depends ultimately on the average reproduction rate. Crowding or the use of sub-optimum habitat can have a deleterious effect on the recovery and sustainability of bird species.

Exposure to contaminants or discarded debris will usually cause behavioral changes, temporary disturbances, or displacement of localized inshore bird groups. The rates of air and water degradation in coastal and marine environments and the amount of shoreline trash and debris is likely to increase slowly in line with regional economic and population growth trends. Behavioral changes can be expected as competition increases among bird groups for favored habitats. The trash and debris burden on shorelines that is attributable to OCS activity is expected to decline because of continuing education programs for offshore workers, enforcement of controls for trash produced offshore and on service vessels, and industry sponsorship and participation in “beach sweeps” to assay the types of trash found along shorelines and remove it. There are effective prohibitions on discarding trash or debris at sea from OCS activity. Trash could ensnare or cripple individual birds and small plastic fragments that are ingested by birds could injure or kill them.

Helicopter traffic will increase slightly but will not present an increased collision hazard because these occurrences are rare even now. Aircraft or vessel traffic could sporadically disturb feeding, resting, or nesting behavior of birds or cause abandonment of preferred habitat.

Accidental events, such as an oil spill, would cause lethal effects in birds that are heavily oiled. Coastal birds can be vulnerable to spills making landfall; for example, 3,686 bird deaths by contact with oil from the 1969 Santa Barbara Channel spill (Nation, 2003; page 16) were estimated. Contact with weathered oil or a dissipated slick, dispersant chemicals, and spill-response activities in wetlands and other biologically sensitive coastal habitats would be expected to cause lethal to sublethal effects to individuals from any or all bird groups through ingestion or inhalation of oil, ingestion of oiled prey, or food being unavailable because of a spill. Large spills are extremely rare events, and for this reason little or no contact or interaction is expected between birds and freshly spilled oil. Incidental contact with degraded or weathered oil can be expected between birds that inhabit or migrate through Grid 13 over the next 40 years.

The incremental contribution of the proposed Marco Polo project to the cumulative impact would be negligible because the effects of the most likely impacts, such as the physical presence and operation of the platform facility, or noise from helicopters and service-vessel traffic, would only be expected to modify the behavior of birds that come into contact with these project facilities.

The cumulative effects of habitat modification or loss on coastal and marine birds is expected to result in a discernible decline in the numbers of birds that form localized groups or populations over a 40-year period, with associated change in species composition and distribution. Some of these changes would be expected to be permanent, as documented in historic census data, and to stem from a net decrease in preferred and/or critical habitat. Chronic stress is often undetectable in birds. It can serve to weaken individuals and expose them to infection and disease.

4.4.8. Essential Fish Habitat and Fish Resources

Cumulative impacts on EFH and fish resources include (1) degradation of water quality from oil, fuel, and material spills, high nutrient loads, high turbidity, high BOD, urban runoff, industrial discharges, pathogens, trash and debris, and upriver contaminants; (2) loss of essential habitat important for parts of the life cycle, such as healthy estuarine systems, (including wetland loss); and (3) commercial overfishing. Of these, water quality degradation from multiple inputs and sources, not unique to OCS oil and gas activity, represents the greatest potential for cumulative impacts on fish resources and EFH over the 40-year exploration and production cycle of the typical OCS lease sale. Cumulative water quality degradation attributable to OCS oil and gas activity, such as large oil spills, can be dramatic and visually striking when it occurs, but historical data show that that the probability of occurrence is extremely low. Planktonic fish eggs and larvae are more susceptible than adults to environmental contaminants. Impacts from these influences may be manifested by diminished representation of fish eggs and larvae in sampling studies.

4.4.9. Socioeconomic Resources

The socioeconomic resources evaluated in this PEA are limited to that portion of the GOM's coastal zone directly or indirectly affected by OCS development and production in Grid 13. The cumulative impacts from the proposed Marco Polo project and subsequent development projects in Grid 13 over the next 40 years would be minimal.

4.4.9.1. Commercial Fisheries

Cumulative impacts on commercial fisheries are the same as on fish resources in general and on EFH. These impacts include (1) degradation of water quality from oil, fuel, and material spills, high nutrient loads, high turbidity, high BOD, urban runoff, industrial discharges, pathogens, trash and debris, and upriver contaminants; (2) loss of essential habitat important for parts of a fishery's life cycle, such as healthy estuarine systems, (including wetland loss); and (3) overfishing.

States on the GOM coastline 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 of the Gulf Coast States have published fish consumption advisories for large king mackerel (Ache et al., 2000). Ache et al. (2000; page 29) identifies a point of contact and an e-mail address for the Gulfwide Mercury in Tissue Database.

The Central GOM, and the area included within Grid 13, will remain one of the Nation's most important commercial fisheries areas. Fisheries management plans (authorized by the Magnuson Fishery Conservation and Management Act, as amended) will be authorized by the GOM Regional FMC to perpetuate commercially important species.

4.4.9.2. Recreational Resources

Cumulative impacts on recreational resources, such as beaches, will continue to be influenced by factors such as (1) land development, civil works, channelization, and flood control modifications; (2) water quality degradation from oil, fuel, and material spills, high nutrient loads, high turbidity, high BOD, urban runoff, industrial discharges, pathogens, and upriver contaminants; (3) trash and debris; (4) OCS pipeline landfalls; (5) dredging and beach nourishment; and (6) natural phenomena such as sea-level rise, subsidence, and storms and hurricanes. These factors have affected, and will continue to affect, the burdens placed on recreational resources by users. The use of OCS sand resources from offshore Louisiana for beach nourishment programs and flood control levees will rise.

The natural influences on recreational resources caused by sea-level rise, subsidence of the Mississippi River Deltaic shoreline, and landfall of hurricanes will greatly eclipse any influences from OCS activity. Natural effects such as subsidence, however, have been accentuated by cumulative changes made to the inputs and distribution of sediment from the Mississippi River Delta by flood control programs and other civil works designed to improve navigation.

The recreational uses of coastal Louisiana will continue to experience pressure caused by local residents and tourists. Water quality degradation contributes to negative aesthetic effects, such as distasteful odors or fish kills that wash onshore. Human health risks can be caused by high bacteria levels, and economic impacts can occur from closure of affected fisheries, e.g., oysters. Trash and debris inputs from non-OCS sources will continue to adversely affect the ambience of recreational shorelines and beaches. The tonnage of material requiring clean up is likely to increase as the density of use increases in line with regional economic and population growth trends. The trash and debris burden on shorelines that is attributable to OCS activity is expected to decline due to continuing education programs for offshore workers, enforcement of controls for trash produced offshore and on service vessels, and industry sponsorship and participation in "beach sweeps" to assay the types of trash found along shorelines.

4.4.9.3. Archaeological Resources

Grid 13 is located in water ranging between 4,240 and 4,420 ft (1,292-1,347 m) deep, precluding the potential for prehistoric sites or artifacts. According to Garrison et al. (1989) and Pearson et al. (2002), the shipwreck database lists six shipwrecks and two high-probability shipwreck blocks in Mississippi Canyon (Blocks 855 and 892), which lies within Grid 13 (Table 3-6). Little information is currently available for these vessels, including the date of construction, identity, and date of loss. The identity of two of the reported wrecks and the date of loss is identified for the *Holly Ann Visier* (1986) and the *Southern Cross* (1982). The current state of identification or location data for any shipwreck in Grid 13 is insufficient to anticipate eligibility for listing in the National Register of Historic Places.

No offshore historic properties have been identified in Grid 13. Onshore historic properties include locations such as historic buildings, forts, lighthouses, homesteads, cemeteries, and battlefields. Sites already listed on the National Register of Historic Places and those considered eligible for the National Register have already been evaluated as being able to make a unique or significant contribution to science. At present, unidentified historic sites may contain unique historic information and would have to be assessed after discovery to determine their importance.

Construction of new onshore facilities or pipelines in support of OCS activity or coastal development unrelated to OCS activity could result in the direct physical impact to previously unidentified historic sites. This direct physical contact with a historic site could cause physical damage to, or complete destruction of, information on the history of the region and the Nation. Each facility constructed must receive approval from the pertinent Federal, State, county/parish, and/or community involved. Onshore archaeological resources would be protected through the review and approval processes of the various Federal, State, and local agencies involved in permitting onshore activities.

The site clearance requirements for deepwater projects >800 m should be clarified in the coming years, long before the end of the producing life for any facilities installed in Grid 13.

4.4.10. Human Resources and Economic Activity

The human resources and economic activity evaluated in this PEA are limited to that portion of the GOM's coastal zone directly or indirectly affected by OCS development and production in Grid 13. This economic area is concentrated primarily in Louisiana; however, multiplier effects extend into neighboring states as well. The impacts that result from industry activity on the Federal OCS are taking place in the midst of dynamic commercial and industrial enterprises that move goods and services on Gulf waters and that cause some of the same impact-producing factors as OCS activity. The cumulative impacts on human resources and economic activity in the Gulf region from the proposed Marco Polo project and subsequent development projects in Grid 13 over the next 40 years would be minimal. Certain subareas where onshore support activities are concentrated, however, are likely to experience significant impacts.

4.4.10.1. Population and Education

Activity from OCS development and production is expected to minimally affect the larger impact areas' demographic patterns or population or education levels but to moderately affect the population levels of local onshore areas where OCS activity is now concentrated. The impact region's population will continue to grow at a slow rate because of general economic development, including OCS activity. Baseline patterns and factors as described in Chapter 3.3.2 (Human Resources and Economic Activity) would not be expected to change for the impact area as a whole. Some Louisiana coastal subareas, Port Fourchon in particular, would be expected to experience some impacts due to population growth resulting from increasing demand for OCS labor and deepwater production activity, particularly in the peak years between 2004 and 2012. These impacts would include a strain on the local infrastructure, such as schools, roads, hospitals, housing, and city services.

4.4.10.2. Infrastructure and Land Use

Activity from OCS development and production is expected to minimally affect the larger impact areas' land use but to cause moderate to significant impacts to specific subareas. Most subareas in the analysis area have strong industrial bases and designated industrial parks to accommodate future growth in OCS-related business. Expansion of existing facilities, therefore, can be expected with construction of minimal new infrastructure on vacant or converted land. With the exception of 4-16 projected new gas processing plants (USDOI, MMS, 2002; Chapter 4.5.14.1), expansion or facility upgrades would be contained on available land.

The demands placed on Port Fourchon by OCS operators over the next 40 years would be expected to cause significant impacts on land use. Port Fourchon has limited land available for expansion and onshore service providers have had to create land by filling wetland areas with dredging spoils, thereby causing wetland loss. Heavy industry use is expected to further degrade and erode LA-1, a main artery through Lafourche Parish and the main highway into Port Fourchon. The OCS activity will also place demands on Port Fourchon and Lafourche Parish's freshwater supplies, which will probably require local water system or treatment plant upgrades over the next 40 years. The in-migration of people who work offshore and live in temporary week-to-month apartments and rental units in Port Fourchon or Lafourche Parish will be accommodated by some new construction that will take vacant or converted land. An increased population will place greater demands on infrastructure such as schools, roads, hospitals, and other city services.

4.4.10.3. Navigation and Port Use

Activity from OCS development and production is expected to minimally affect the impact areas' navigation and port usage patterns. The continued use of Port Fourchon by industry operators will place demands for channel maintenance and semi-regular dredging programs to ensure the port's, channels, navigation corridors, turning basins, and berthing areas can handle deeper draft vessels that typically service deepwater facilities. The U.S. Corps of Engineers (USCOE) surveys the navigations channels for which they are responsible every two years to determine the need for dredging. Dredging is then carried out as needed, but typical cycles between maintenance can be 1-6 years. Over the next 10 years the USCOE expects to deepen many port access channels to accommodate deep-draft vessels (to about 7 m (23 ft)) (USDOI, MMS, 2002; page 4-55).

4.4.10.4. Employment

Activity from OCS development and production is expected to minimally affect employment levels in the larger impact area, but to cause moderate to significant impacts to specific subareas. The OCS-related employment levels in coastal Louisiana would be significantly impacted over the next 40 years. Employment is expected to peak with OCS development and production activity between 2004 and 2012 at 3.2 to 6.0 percent, depending on the subarea (USDOI, MMS, 2002; page 4-316). States adjacent to Louisiana will experience little stimulus from OCS activity even in the peak years. Employment associated with OCS activity in these states is minor, generally $\leq$1 percent.

Employment demand will be met primarily with the existing population and available labor force in most coastal subareas. Stevedores and deck hands will be supplied locally. The MMS does expect that some specialized skills will be provided by in-migration due to the shadow effect and from needs that cannot be supplied by the local labor force. Much of the labor pattern will be typical offshore shift schedules, such as two weeks on and two weeks off. Specific areas in heavy use, such as Port Fourchon, are now, or will experience full employment, housing shortages, and stresses on local infrastructure such as roads, schools, hospitals, and water supplies.

4.4.10.5. Environmental Justice

Future years may bring expansion or upgrading of existing onshore facilities that support OCS activities in Grid 13, but entirely new development is unlikely. The existing coastal support facilities are well established, and no disproportionate effects on ethnic or racial minorities or poor people would be expected to result from their continued operation.

5. CONSULTATION AND COORDINATION

The development activities proposed by APC for Green Canyon Block 608 constitute part of OCS activity that was considered by the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002). The MMS conducted early coordination with appropriate Federal and State agencies and other concerned parties to discuss and coordinate the prelease process for lease sales in the Central and Western Planning Areas proposed between 2003 and 2007. Consultation and coordination efforts for the CPA/WPA Multisale Final EIS identified the environmental resources considered in this PEA. Key agencies and organizations with which MMS consulted during the EIS process included NOAA Fisheries, Fish and Wildlife Service (FWS), U.S. Department of Defense (DOD), U.S. Coast Guard (USCG), U.S. Environmental Protection Agency (USEPA), State Governors' offices, and industry groups. The CPA/WPA Multisale Final EIS was issued in November 2002 (USDOI, MMS, 2002).

Consultation specifically for this PEA included a public notification and comment period and certification of consistency by the State of Louisiana's with its CZM program. The MMS mailed the DOCD and other required and necessary information to the Louisiana Department of Natural Resources for CZM concurrence on May 5, 2003. The State of Louisiana provided a letter with a Certificate of Coastal Zone Consistency with the State's CZM Program on May 25, 2003.

The MMS published a description of APC's proposed action in *The Times-Picayune* (southeast Louisiana coverage) and in the *Mobile Register* (southern Mississippi and southern Alabama coverage) on July 11, 2003. The description provided the public with a Notice of Intent (NOI) to prepare an EA and outlined the activities APC proposed for the Marco Polo project. The NOI requested that interested parties submit comments to MMS on issues that should be addressed in the PEA. The 30-day comment period ended on August 11, 2003. No comments were received during this period.

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7. PREPARERS

NEPA Coordinators

Thomas Bjerstedt	Physical Scientist (Geoscientist)
Latonia Viverette	Environmental Scientist

Reviewers and Contributors

David Ball	Archaeologist – Archaeological Issues
Kristen Strellec	Economist – Socioeconomic Issues
Greg Boland	Biologist – Fisheries, Benthic Issues
Darice Breeding	Physical Scientist – Hydrocarbon Spill Issues
Dave Moran	Biologist – Endangered Species Issues
Herb Leedy	Biologist – Shoreline and Wetlands Issues
Margaret Metcalf	Physical Scientist – Water Quality Issues
Janet Diaz	Environmental Protection Assistant
Deborah Miller	Technical Publication Editor
Mike Gravois	GIS/Visual Information Specialist

Reviewers and Supervisors

Dennis Chew	Supervisor, NEPA/CZM Coordination Unit
Jack Irion	Supervisor, Social Sciences Unit
Elizabeth Peuler	Supervisor, Physical Sciences Unit
Robert Rogers	Supervisor, Biological Sciences Unit

8. APPENDICES

Appendix A – Accidental Oil-Spill Review
Appendix B – Economic Impact Tables

APPENDIX A

Accidental Oil-Spill Review

APPENDIX A

ANALYSIS OF THE POTENTIAL FOR AN ACCIDENTAL OIL SPILL AND POTENTIAL FOR IMPACTS FROM THE MARCO POLO PROJECT-GRID 13 (GREEN CANYON BLOCK 608)

Introduction

The National Environmental Policy Act (NEPA) requires Federal agencies to consider potential environmental impacts (direct, indirect, and cumulative) to assist in making decisions and planning proposed actions by agencies. The NEPA analyses address many issues relating to potential impacts, including accidental events such as oil spills.

The past several decades of spill data show that there is a low probability of onshore impacts resulting from accidental oil spills associated with oil and gas activities on the Outer Continental Shelf (OCS) waters of the Gulf of Mexico (GOM), yet the issue of oil spills is important to the public. This appendix summarizes key information about the probability of an accidental spill and the potential for impacts from the proposed project.

Spill Prevention

The MMS has comprehensive pollution prevention requirements that include numerous redundant levels of safety devices, as well as inspection and testing requirements to confirm that these devices work. Many of these requirements have been in place since about 1980. Spill trends analysis for the GOM OCS show that spills from facilities have decreased over time, indicating that MMS engineering and safety requirements have minimized the potential for spill occurrence and associated impacts. Details regarding MMS engineering and safety requirements can be found at 30 CFR 250.800 Subpart H.

OCS Spills in the Past

This summary of past OCS spills presents data for the period 1985-1999. The period 1985-1999 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 bbl from OCS platforms, eight spills ≥1,000 bbl from OCS pipelines, and no spills ≥1,000 bbl from OCS well blowouts (Tables A-1 through A-3). The most recent CPA/WPA Multisale Final EIS (USDOI, MMS, 2002) provides 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 Marco Polo project.

Spill Occurrence Variable (SOV) Representing the Potential for a Spill

The SOV is based on past OCS spill frequency. That is, occurrence of past OCS spills is used to estimate future potential OCS spills. The MMS has estimated spill rates for spills from the following sources: facilities, pipelines, and drilling.

Spill rates for facilities and pipelines have been developed for several periods and an analysis of trends for spills is presented in Anderson and Labelle (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 nonzero 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 1985-1999 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 calculate in a site-specific SOV.

Transport Variable (TV) Representing the Potential for a Spill to Reach Important Environmental Resources

The TV is derived using a 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

Anadarko Petroleum Corporation proposes to install a MOSES-type TLP and develop the field with six dry tree wells. Two right-of-way pipelines (operated by El Paso) will be installed to transport production. 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.

The coastline and associated environmental resources are presented in Table A-5. The final column in Table A-5 presents the result of combining the SOV's and the TV's. The risk of a coastal spill impact from the facility could be considered to be so low as to be near zero.

The most recent CPA/WPA Multisale Final EIS (USDOI, MMS, 2002) provides additional information on spills and potential impacts.

Spill Response

The MMS has extensive requirements both for the prevention of spills and preparedness to respond to a spill in the event that one occurs. 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 USCG and other members of the multiagency National Response System to further improve spill-response capability in the GOM. The combined resources of these groups and the resources of commercially contracted oil-spill-response organizations result in extensive equipment and trained personnel for spill response in the GOM.

Spill Response for this Project

The subject operator has an oil-spill-response plan on file with MMS and has current contracts with offshore oil-spill-response organizations.

Potential spill sources during the life of this development and production project (12 years) would include an accidental blowout (10,000 bbl/day), a spill of liquid oil stored on the platform (approximately 2,675 bbl total storage capacity), a spill of liquid oil stored on the rig (approximately 148 bbl total storage capacity), or a spill from the associated oil flow lines connecting the well to the platform (15 bbl), or the export pipelines. The operator has demonstrated spill-response preparedness for accidental releases in their oil-spill-response plan.

The MMS will continue to verify the operator's capability to respond to oil spills via the MMS Oil-Spill Program. The operator is required to keep their oil-spill-response plan up to date in accordance with MMS regulations. The operator must also conduct an annual drill to demonstrate the adequacy of their spill preparedness. The MMS also conducts unannounced drills to further verify the adequacy of an operator's spill response preparedness; such a drill could be conducted for this proposed action.

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Table A-1

Historical Record of OCS Spills $\geq$1,000 Barrels from OCS Facilities, 1985-1999

Spill Date	Area and Block (water depth and distance from shore)	Volume Spilled (bbl)	Cause of Spill
None	NA	NA	NA

NA = not applicable.

Table A-2

Historical Record of OCS Spills $\geq$1,000 Barrels from OCS Pipelines, 1985-1999

Spill Date	Area and Block (water depth and distance from shore)	Volume Spilled (bbl)	Cause of Spill
February 7, 1988	South Pass Block 60 (75 ft, 3.4 mi)	15,576	Service vessel’s anchor damaged pipeline
January 24, 1990	Ship Shoal Block 281 (197 ft, 60 mi)	*14,423	Anchor drag, flange and valve broke off
May 6, 1990	Eugene Island Block 314 (230 ft, 78 mi)	4,569	Trawl drag pulled off valve
August 31, 1992	South Pelto Block 8 (30 ft, 6 mi)	2,000	Hurricane Andrew, loose drilling rig’s anchor drag damaged pipeline
November 22, 1994	Ship Shoal Block 281 (197 ft, 60 mi)	*4,533	Trawl drag
January 26, 1998	East Cameron Block 334 (264 ft, 105 mi)	*1,211	Service vessel's anchor drag damaged pipeline during rescue operation
September 29, 1988	South Pass Block 38 (110 ft, 6 mi)	8,212	Hurricane Georges, mudslide parted pipeline
July 23, 1999	Ship Shoal Block 241 (133 ft, 50 mi)	3,189	Jack-up barge sat on pipeline

Table A-3

Historical Record of OCS Spills $\geq$1,000 Barrels from OCS Well Blowouts, 1985-1999

Spill Date	Area and Block (water depth and distance from shore)	Volume Spilled (bbl)	Cause of Spill
None	NA	NA	NA

NA = not applicable.

Table A-4

Spill Rates Used to Estimate the Future Potential for Spills

Spill Source	Oil Handled (billion bbl)[a]	Wells Drilled	Spills >1,000 bbl	Risk of Spill from Facilities or Pipelines per Billion Barrels	Risk of Spill from Drilling Blowout per Well
Facilities	7.41[a]	NA	1[a]	>0 to <0.13[c]	NA
Pipelines	5.81	NA	8	1.38	NA
Drilling	NA	14,067	1[b]	NA	>0 to <0.00007[c]

[a] There were actually zero spills ≥1,000 bbl from facilities during the period 1985-1999. The data shown represent 1980-1999. The spill period for facility spills was expanded to 1980 to include a spill for facilities to result in a nonzero risk.

[b] There have been no spills ≥1,000 bbl from blowouts during the period 1985-1999. One spill was "assigned" to provide a nonzero 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, TX	0.4	<0.5	<0.5
Willacy, TX	0.4	<0.5	<0.5
Kenedy, TX	0.4	<0.5	<0.5
Kleburg, TX	0.4	<0.5	<0.5
Nueces, TX	0.4	<0.5	<0.5
Aransas, TX	0.4	<0.5	<0.5
Calhoun, TX	0.4	<0.5	<0.5
Matagorda, TX	0.4	1	<0.5
Brazoria, TX	0.4	1	<0.5
Galveston, TX	0.4	2	<0.5
Chambers, TX	0.4	<0.5	<0.5
Jefferson, TX	0.4	1	<0.5
Cameron, LA	0.4	4	<0.5
Vermilion, LA	0.4	2	<0.5
Iberia, LA	0.4	1	<0.5
St. Mary, LA	0.4	<0.5	<0.5
Terrebonne, LA	0.4	2	<0.5
Lafourche, LA	0.4	1	<0.5
Jefferson, LA	0.4	<0.5	<0.5
Plaquemines, LA	0.4	3	<0.5
St. Bernard, LA	0.4	<0.5	<0.5
Harrison, MS	0.4	<0.5	<0.5
Jackson, MS	0.4	<0.5	<0.5
Baldwin, AL	0.4	<0.5	<0.5
Mobile, AL	0.4	1	<0.5
Escambia, FL	0.4	<0.5	<0.5
Santa Rosa, FL	0.4	<0.5	<0.5
Okaloosa, FL	0.4	<0.5	<0.5
Walton, FL	0.4	<0.5	<0.5
Bay, FL	0.4	<0.5	<0.5
Gulf, FL	0.4	<0.5	<0.5
Franklin, FL	0.4	<0.5	<0.5
Wakulla, FL	0.4	<0.5	<0.5
Jefferson, FL	0.4	<0.5	<0.5
Taylor, FL	0.4	<0.5	<0.5
Dixie, FL	0.4	<0.5	<0.5
Levy, FL	0.4	<0.5	<0.5
Citrus, FL	0.4	<0.5	<0.5
Hernando, FL	0.4	<0.5	<0.5
Pasco, FL	0.4	<0.5	<0.5
Pinellas, FL	0.4	<0.5	<0.5
Hillsborough, FL	0.4	<0.5	<0.5
Manatee, FL	0.4	<0.5	<0.5
Sarasota, FL	0.4	<0.5	<0.5
Charlotte, FL	0.4	<0.5	<0.5
Lee, FL	0.4	<0.5	<0.5
Collier, FL	0.4	<0.5	<0.5
Monroe, FL	0.4	<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 (%)
State Offshore Waters			
Texas State Offshore Waters	0.4	6	<0.5
Louisiana (Western) State Offshore Waters	0.4	15	<0.5
Louisiana (Eastern) State Offshore Waters	0.4	1	<0.5
Mississippi State Offshore Waters	0.4	<0.5	<0.5
Alabama State Offshore Waters	0.4	<0.5	<0.5
Florida Panhandle State Offshore Waters	0.4	1	<0.5
Florida Peninsula State Offshore Waters	0.4	<0.5	<0.5
Major Recreational Beach Areas			
TX Coastal Bend Area Beaches	0.4	<0.5	<0.5
TX Matagorda Area Beaches	0.4	1	<0.5
TX Galveston Area Beaches	0.4	2	<0.5
TX Sea Rim State Park	0.4	1	<0.5
LA Beaches	0.4	5	<0.5
AL/MS Gulf Islands	0.4	<0.5	<0.5
AL Gulf Shores	0.4	<0.5	<0.5
FL Panhandle Beaches	0.4	1	<0.5
FL Big Bend Beaches	0.4	<0.5	<0.5
FL Southwest Beaches	0.4	<0.5	<0.5
FL Ten Thousand Islands	0.4	<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 Green Canyon Block 608 and ending at specified shoreline segments or environmental resources within 30 days. These results arise from a numerical model that calculates the trajectory of a drifting point projected onto the surface of the water using temporally and spatially varying winds and ocean current fields. These probabilities do not factor in the risk of spill occurrence, consideration of the spill size, any spill response or cleanup actions, or any dispersion and weathering of the slick with time. Model results used are for C5-3 cluster area.

(3) The probability of a spill occurring and contacting identified environmental features represents the weighted risk that accounts for both the risk that a large spill will occur and the risk that it will contact locations where the resources occur, given the assumptions already described in (1) and (2).

(4) <0.5 = less than 0.5%.

APPENDIX B

Economic Impact Tables

Table B-1

Offshore Expenditure Allocation by Subarea (in percentage)

IMPLAN Sector	Sector Definition	Subarea										Gulf-Other	US-Other
		TX-1	TX-2	LA-1	LA-2	LA-3	MA-1	FL-1	FL-2	FL-3	FL-4		
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 Constr.	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, 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/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

IMPLAN Sector	Sector Definition	Subarea										Gulf-Other	US-Other
		TX-1	TX-2	LA-1	LA-2	LA-3	MA-1	FL-1	FL-2	FL-3	FL-4		
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
454	Eating/Drinking	0.00	0.24	0.28	0.08	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00
455	Msc Retail	0.09	0.48	0.06	0.10	0.15	0.11	0.00	0.00	0.00	0.00	0.00	0.00
459	Insurance	0.04	0.47	0.07	0.12	0.09	0.00	0.00	0.00	0.00	0.00	0.17	0.03
462	Real Estate	0.09	0.47	0.04	0.08	0.11	0.08	0.00	0.00	0.00	0.00	0.11	0.01
469	Advertisement	0.06	0.45	0.06	0.08	0.15	0.08	0.00	0.00	0.00	0.00	0.12	0.01
470	Other Business Services	0.00	0.60	0.11	0.09	0.06	0.00	0.00	0.00	0.00	0.00	0.09	0.05
473	Msc. Equipment Rental and Leasing	0.09	0.26	0.22	0.10	0.10	0.01	0.00	0.00	0.00	0.00	0.18	0.03
490	Doctors & Veterinarian Services	0.09	0.53	0.06	0.09	0.14	0.08	0.00	0.00	0.00	0.00	0.00	0.00
494	Legal Services	0.07	0.48	0.07	0.11	0.19	0.08	0.00	0.00	0.00	0.00	0.00	0.00
506	Environmental/Engineering Services	0.06	0.38	0.11	0.08	0.08	0.03	0.01	0.00	0.02	0.00	0.20	0.01
507	Acct/Msc Business Services	0.06	0.46	0.05	0.09	0.13	0.07	0.00	0.00	0.00	0.00	0.11	0.01
508	Management/Consulting Services	0.04	0.54	0.04	0.09	0.11	0.05	0.00	0.00	0.00	0.00	0.11	0.01
509	Testing/Research Facilities	0.00	0.38	0.14	0.14	0.05	0.00	0.00	0.00	0.00	0.00	0.21	0.11

Note: NEC = Not Elsewhere Classified.

Table B-2

Population Forecast from 2000-2040 by Year and by Subarea (in thousands)

Year	LA-1	LA-2	LA-3	MA-1	TX-1	TX-2	FL-1	FL-2	FL-3	FL-4	CGOM	WGOM	EGOM	EPA	GOM	Planning Areas
2000	667.12	1009.54	1337.60	920.12	920.58	5158.08	774.39	128.07	3954.32	2340.67	3934.36	6078.66	7197.46	902.46	17210.48	10915.49
2001	672.18	1020.72	1343.62	930.79	930.98	5238.54	787.39	129.53	4022.21	2362.41	3967.32	6169.52	7301.53	916.92	17438.37	11053.76
2002	677.35	1032.14	1350.07	941.63	941.65	5320.26	800.68	131.07	4091.10	2384.86	4001.19	6261.91	7407.70	931.74	17670.81	11194.85
2003	682.66	1043.67	1356.54	952.62	952.51	5402.63	813.99	132.59	4160.34	2408.02	4035.49	6355.14	7514.94	946.59	17905.57	11337.21
2004	688.02	1055.32	1363.04	963.74	963.49	5486.28	827.53	134.14	4230.75	2431.41	4070.11	6449.77	7623.82	961.67	18143.70	11481.55
2005	693.29	1066.73	1369.47	974.61	974.23	5567.43	840.64	135.65	4298.86	2454.36	4104.10	6541.66	7729.51	976.29	18375.26	11622.04
2006	698.71	1078.41	1376.22	985.73	985.31	5650.60	854.05	137.23	4368.64	2478.50	4139.07	6635.91	7838.42	991.28	18613.40	11766.26
2007	704.17	1090.22	1383.00	996.99	996.52	5735.01	867.68	138.82	4439.54	2502.88	4174.37	6731.53	7948.93	1006.50	18854.84	11912.41
2008	709.67	1102.16	1389.81	1008.37	1007.85	5820.69	881.53	140.44	4511.60	2527.50	4210.01	6828.54	8061.07	1021.97	19099.62	12060.52
2009	715.21	1114.23	1396.66	1019.88	1019.32	5907.65	895.60	142.07	4584.83	2552.37	4245.98	6926.96	8174.87	1037.67	19347.81	12210.61
2010	720.38	1125.14	1403.21	1030.25	1029.64	5983.33	907.72	143.54	4647.77	2575.09	4278.97	7012.97	8274.12	1051.26	19566.06	12343.20
2011	726.21	1137.43	1410.76	1041.94	1041.44	6069.89	921.65	145.17	4720.08	2601.27	4316.34	7111.33	8388.17	1066.82	19815.84	12494.49
2012	732.08	1149.86	1418.36	1053.78	1053.37	6157.70	935.79	146.82	4793.52	2627.72	4354.07	7211.07	8503.85	1082.61	20069.00	12647.75
2013	738.01	1162.42	1426.00	1065.74	1065.44	6246.78	950.15	148.48	4868.10	2654.44	4392.16	7312.23	8621.17	1098.63	20325.56	12803.02
2014	743.98	1175.12	1433.67	1077.84	1077.65	6337.16	964.73	150.17	4943.84	2681.43	4430.61	7414.81	8740.17	1114.90	20585.59	12960.32
2015	749.53	1186.60	1440.99	1088.74	1088.63	6416.17	977.37	151.69	5009.36	2706.02	4465.86	7504.81	8844.44	1129.05	20815.11	13099.72
2016	755.66	1199.34	1449.10	1100.88	1100.93	6505.38	991.68	153.38	5083.71	2733.72	4504.98	7606.30	8962.49	1145.06	21073.77	13256.34
2017	761.84	1212.21	1457.26	1113.15	1113.36	6595.82	1006.20	155.09	5159.16	2761.70	4544.46	7709.18	9082.15	1161.29	21335.79	13414.93
2018	768.07	1225.22	1465.47	1125.56	1125.93	6687.53	1020.94	156.82	5235.73	2789.97	4584.32	7813.46	9203.45	1177.75	21601.22	13575.53
2019	774.35	1238.36	1473.73	1138.11	1138.65	6780.51	1035.89	158.56	5313.43	2818.52	4624.55	7919.15	9326.41	1194.45	21870.11	13738.15
2020	780.19	1250.28	1481.58	1149.44	1150.11	6862.28	1048.94	160.14	5381.16	2844.53	4661.48	8012.39	9434.78	1209.09	22108.65	13882.96
2021	786.67	1263.58	1490.31	1162.10	1162.98	6954.79	1063.78	161.94	5461.02	2873.86	4702.66	8117.76	9560.60	1225.72	22381.02	14046.14
2022	793.21	1277.01	1499.10	1174.89	1175.98	7048.54	1078.82	163.76	5539.07	2903.49	4744.23	8224.52	9685.15	1242.58	22653.89	14211.33
2023	799.81	1290.59	1507.95	1187.83	1189.14	7143.55	1094.08	165.60	5618.24	2933.43	4786.18	8332.69	9811.34	1259.68	22930.21	14378.55
2024	806.46	1304.32	1516.84	1200.92	1202.44	7239.84	1109.55	167.46	5698.53	2963.67	4828.53	8442.28	9939.22	1277.01	23210.04	14547.83
2025	812.61	1316.73	1525.25	1212.71	1214.41	7324.63	1123.09	169.14	5765.56	2991.12	4867.31	8539.04	10048.91	1292.22	23455.25	14698.57
2026	819.37	1330.74	1534.25	1226.07	1227.99	7423.36	1138.97	171.04	5847.96	3021.96	4910.42	8651.36	10179.93	1310.00	23741.71	14871.78
2027	826.18	1344.89	1543.30	1239.57	1241.73	7523.43	1155.08	172.96	5931.54	3053.12	4953.93	8765.16	10312.70	1328.03	24031.79	15047.13
2028	833.05	1359.19	1552.40	1253.22	1255.62	7624.84	1171.41	174.90	6016.32	3084.60	4997.86	8880.46	10447.23	1346.31	24325.55	15224.64
2029	839.98	1373.64	1561.56	1267.03	1269.66	7727.63	1187.98	176.87	6102.31	3116.40	5042.20	8997.29	10583.55	1364.84	24623.04	15404.33
2030	846.96	1388.25	1570.77	1280.98	1283.87	7831.79	1204.78	178.85	6189.52	3148.53	5086.96	9115.66	10721.69	1383.63	24924.30	15586.25
2031	854.00	1403.01	1580.03	1295.09	1298.23	7937.37	1221.81	180.86	6277.98	3181.00	5132.13	9235.59	10861.66	1402.68	25229.38	15770.40
2032	861.10	1417.93	1589.35	1309.35	1312.75	8044.36	1239.09	182.89	6367.71	3213.79	5177.74	9357.11	11003.49	1421.99	25538.34	15956.83
2033	868.26	1433.01	1598.73	1323.77	1327.43	8152.80	1256.62	184.95	6458.72	3246.93	5223.77	9480.23	11147.21	1441.57	25851.21	16145.56
2034	875.48	1448.24	1608.16	1338.35	1342.28	8262.70	1274.39	187.03	6551.03	3280.41	5270.24	9604.97	11292.85	1461.42	26168.06	16336.63
2035	882.76	1463.64	1617.64	1353.09	1357.29	8374.08	1292.41	189.13	6644.66	3314.23	5317.14	9731.37	11440.43	1481.54	26488.94	16530.05
2036	890.10	1479.21	1627.18	1368.00	1372.47	8486.96	1310.69	191.25	6739.63	3348.40	5364.49	9859.43	11589.97	1501.94	26813.89	16725.86
2037	897.50	1494.94	1636.78	1383.06	1387.83	8601.36	1329.22	193.40	6835.95	3382.92	5412.29	9989.19	11741.50	1522.62	27142.97	16924.10
2038	904.97	1510.83	1646.44	1398.30	1403.35	8717.31	1348.02	195.58	6933.65	3417.80	5460.53	10120.66	11895.05	1543.60	27476.24	17124.78
2039	912.49	1526.90	1656.15	1413.70	1419.05	8834.81	1367.08	197.77	7032.75	3453.04	5509.23	10253.86	12050.65	1564.86	27813.74	17327.95
2040	920.08	1543.14	1665.92	1429.27	1434.92	8953.91	1386.42	200.00	7133.26	3488.64	5558.40	10388.83	12208.32	1586.41	28155.54	17533.63

Table B-3

Employment Forecast from 2000-2040 by Year and Subarea (in thousands)

Year	LA-1	LA-2	LA-3	MA-1	TX-1	TX-2	FL-1	FL-2	FL-3	FL-4	CGOM	WGOM	EGOM	EPA	GOM	Planning Areas
2000	377.47	571.95	781.67	515.20	454.25	3046.85	427.04	44.99	2248.28	1306.73	2246.29	3501.10	4027.03	472.03	9774.42	6219.42
2001	381.65	580.15	787.95	522.71	460.67	3095.53	435.03	45.55	2298.83	1324.75	2272.46	3556.20	4104.15	480.58	9932.81	6309.24
2002	386.15	590.66	793.66	529.89	466.67	3143.66	442.85	46.10	2347.94	1341.81	2300.36	3610.33	4178.69	488.95	10089.39	6399.64
2003	391.14	597.79	799.20	537.23	472.64	3192.81	450.72	46.63	2396.68	1358.42	2325.36	3665.45	4252.45	497.35	10243.26	6488.16
2004	396.19	605.01	804.78	544.66	478.69	3242.72	458.73	47.17	2446.44	1375.24	2350.64	3721.41	4327.58	505.90	10399.63	6577.95
2005	401.12	612.06	810.28	551.90	484.58	3291.14	466.47	47.69	2494.20	1391.66	2375.37	3775.72	4400.02	514.16	10551.11	6665.25
2006	406.59	620.41	816.61	559.63	490.79	3342.62	474.56	48.24	2543.55	1408.55	2403.24	3833.41	4474.90	522.80	10711.54	6759.44
2007	412.13	628.87	822.98	567.47	497.07	3394.92	482.79	48.79	2593.87	1425.65	2431.45	3891.99	4551.10	531.58	10874.54	6855.01
2008	417.75	637.44	829.41	575.42	503.43	3448.03	491.16	49.34	2645.19	1442.96	2460.02	3951.46	4628.65	540.50	11040.13	6951.98
2009	423.44	646.13	835.89	583.48	509.88	3501.97	499.68	49.92	2697.52	1460.48	2488.94	4011.85	4707.59	549.60	11208.38	7050.38
2010	428.46	653.79	841.92	590.56	515.60	3548.60	506.92	50.41	2740.96	1476.14	2514.73	4064.20	4774.43	557.33	11353.35	7136.26
2011	434.20	662.57	849.68	598.72	522.23	3603.56	515.29	50.97	2791.77	1494.06	2545.17	4125.79	4852.09	566.26	11523.05	7237.21
2012	440.01	671.47	857.50	607.00	528.95	3659.37	523.79	51.53	2843.53	1512.20	2575.99	4188.31	4931.06	575.32	11695.36	7339.63
2013	445.91	680.49	865.41	615.39	535.74	3716.04	532.43	52.11	2896.25	1530.56	2607.20	4251.78	5011.35	584.54	11870.33	7443.52
2014	451.89	689.63	873.38	623.89	542.63	3773.59	541.22	52.68	2949.95	1549.15	2638.79	4316.22	5092.99	593.90	12048.01	7548.92
2015	457.17	697.71	880.71	631.38	548.75	3823.42	548.75	53.20	2995.06	1565.76	2666.96	4372.16	5162.78	601.95	12201.90	7641.07
2016	463.11	706.94	889.98	639.95	555.92	3882.64	557.39	53.77	3047.84	1585.15	2699.99	4438.56	5244.15	611.17	12382.71	7749.72
2017	469.13	716.31	899.36	648.65	563.18	3942.79	566.17	54.35	3101.55	1604.77	2733.44	4505.97	5326.85	620.52	12566.25	7859.93
2018	475.24	725.79	908.83	657.46	570.53	4003.86	575.09	54.93	3156.21	1624.64	2767.31	4574.40	5410.87	630.02	12752.58	7971.73
2019	481.42	735.40	918.40	666.39	577.99	4065.89	584.15	55.52	3211.82	1644.76	2801.60	4643.87	5496.25	639.67	12941.73	8085.15
2020	486.90	743.91	927.09	674.27	584.60	4119.61	591.98	56.06	3259.01	1662.71	2832.17	4704.20	5569.74	648.03	13106.11	8184.40
2021	493.06	753.67	937.99	683.30	592.42	4183.89	600.93	56.64	3314.23	1683.97	2868.01	4776.31	5655.77	657.57	13300.09	8301.89
2022	499.29	763.56	949.00	692.45	600.35	4249.17	610.01	57.23	3370.40	1705.50	2904.31	4849.52	5743.14	667.24	13496.97	8421.08
2023	505.60	773.59	960.15	701.72	608.39	4315.47	619.24	57.83	3427.51	1727.31	2941.07	4923.86	5831.88	677.07	13696.81	8542.00
2024	511.99	783.74	971.43	711.12	616.53	4382.81	628.60	58.43	3485.59	1749.39	2978.29	4999.34	5922.02	687.03	13899.65	8664.67
2025	517.67	792.71	981.53	719.41	623.71	4440.89	636.71	58.98	3535.04	1768.97	3011.32	5064.60	5999.70	695.69	14075.62	8771.62
2026	524.21	803.12	993.06	729.04	632.06	4510.19	646.34	59.60	3594.94	1791.59	3049.44	5142.25	6092.47	705.94	14284.15	8897.62
2027	530.84	813.66	1004.73	738.80	640.52	4580.56	656.11	60.22	3655.86	1814.50	3088.04	5221.08	6186.69	716.33	14495.81	9025.45
2028	537.55	824.34	1016.53	748.70	649.09	4652.04	666.03	60.85	3717.81	1837.70	3127.13	5301.13	6282.39	726.88	14710.65	9155.14
2029	544.35	835.16	1028.47	758.73	657.78	4724.63	676.10	61.48	3780.82	1861.20	3166.71	5382.41	6379.60	737.59	14928.72	9286.71
2030	551.23	846.13	1040.56	768.89	666.59	4798.35	686.33	62.13	3844.89	1884.99	3206.80	5464.93	6478.33	748.45	15150.07	9420.19
2031	558.20	857.23	1052.78	779.19	675.51	4873.22	696.70	62.77	3910.04	1909.10	3247.40	5548.73	6578.62	759.48	15374.75	9555.61
2032	565.26	868.49	1065.15	789.62	684.55	4949.26	707.24	63.43	3976.30	1933.51	3288.52	5633.81	6680.48	770.67	15602.81	9693.00
2033	572.41	879.89	1077.66	800.20	693.72	5026.49	717.93	64.09	4043.68	1958.23	3330.15	5720.20	6783.94	782.02	15834.29	9832.38
2034	579.65	891.44	1090.32	810.91	703.00	5104.92	728.79	64.76	4112.21	1983.27	3372.32	5807.92	6889.02	793.55	16069.26	9973.79
2035	586.97	903.14	1103.13	821.77	712.41	5184.57	739.81	65.44	4181.89	2008.63	3415.02	5896.99	6995.76	805.24	16307.77	10117.25
2036	594.40	914.99	1116.09	832.78	721.95	5265.47	750.99	66.12	4252.76	2034.31	3458.26	5987.42	7104.18	817.11	16549.86	10262.80
2037	601.91	927.01	1129.20	843.93	731.62	5347.63	762.35	66.81	4324.82	2060.33	3502.05	6079.25	7214.31	829.16	16795.61	10410.46
2038	609.52	939.17	1142.47	855.24	741.41	5431.07	773.87	67.51	4398.11	2086.67	3546.40	6172.48	7326.16	841.38	17045.05	10560.27
2039	617.23	951.50	1155.89	866.69	751.33	5515.82	785.57	68.22	4472.64	2113.35	3591.31	6267.15	7439.78	853.79	17298.24	10712.25
2040	625.03	963.99	1169.47	878.30	761.39	5601.88	797.45	68.93	4548.43	2140.37	3636.79	6363.28	7555.19	866.38	17555.26	10866.45

Table B-4

Estimated Employment Impacts for APC's Initial DOCD for the Marco Polo Project

Onshore Subarea	Direct Employment	Indirect Employment	Induced Employment	Total Employment	Baseline Employment	Plan as a % of Baseline
FL-1	1	1	1	2	450,720	0.00%
FL-2	0	0	0	0	46,630	0.00%
FL-3	1	1	1	4	2,396,682	0.00%
FL-4	0	0	0	1	1,358,421	0.00%
Eastern GOM	3	2	2	7	4,252,453	0.00%
LA-1	151	38	62	251	391,137	0.06%
LA-2	119	47	55	222	597,792	0.04%
LA-3	186	70	87	343	799,201	0.04%
MA-1	13	5	6	23	537,227	0.00%
Central GOM	469	161	210	840	2,325,357	0.04%
TX-1	18	6	8	32	472,642	0.01%
TX-2	305	183	200	688	3,192,807	0.02%
Western GOM	323	189	208	720	3,665,449	0.02%
Total GOM	795	352	420	1,567	10,243,258	0.02%

Table B-5

Estimated Opportunity Cost for Clean-Up and Oil Spill Remediation for Marco Polo Project
(based on 10,000 bbl spill in year 2004)

Subarea	Direct	Indirect	Induced	Total	Baseline Employment	Plan as a % of Baseline
FL-1	0	0	0	1	458,721	0.00%
FL-2	0	0	0	0	47,166	0.00%
FL-3	1	0	0	1	2,446,369	0.00%
FL-4	0	0	0	0	1,375,217	0.00%
Eastern GOM	1	1	1	2	2,952,256	0.00%
LA-1	18	4	10	32	396,193	0.01%
LA-2	25	4	12	41	605,011	0.01%
LA-3	35	7	23	64	804,776	0.01%
MA-1	15	3	9	27	544,664	0.00%
Central GOM	93	17	53	164	2,350,644	0.01%
TX-1	15	3	9	28	478,678	0.01%
TX-2	73	22	53	149	3,242,655	0.00%
Western GOM	88	26	63	177	3,721,334	0.00%
Total GOM	183	44	117	343	9,024,234	0.00%

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.