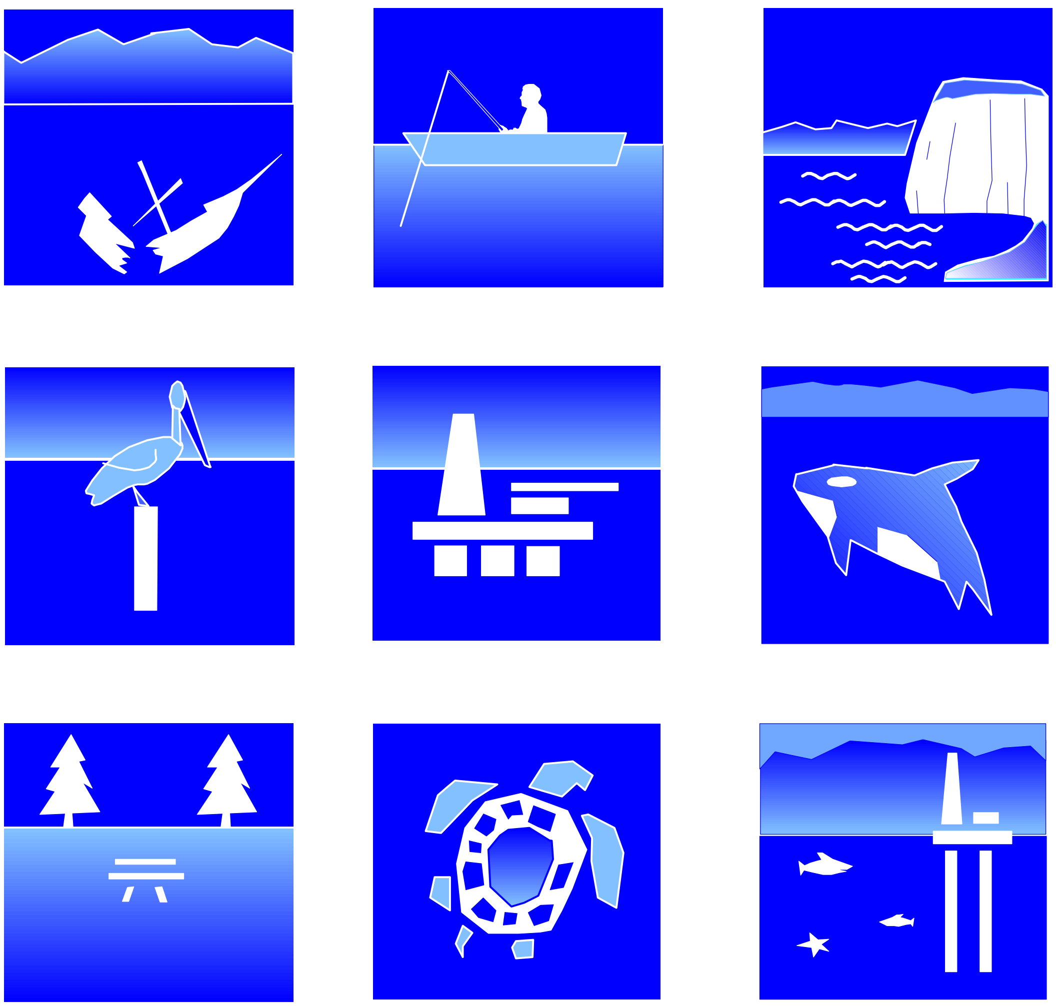
OCS Report
MMS 97-0027

Outer Continental Shelf Oil and Natural Gas Resource Management Program:

CUMULATIVE EFFECTS 1992-1994



MMS U.S. DEPARTMENT OF THE INTERIOR
MINERALS MANAGEMENT SERVICE

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Outer Continental Shelf Oil and Natural Gas Resource Management Program:

CUMULATIVE EFFECTS 1992-1994

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Thank you for your assistance.

If you wish copies of this report, please contact: U.S. Department of the Interior, Minerals Management Service, Environmental Division, Branch of Environmental Assessment, 381 Elden Street, MS 4042, Herndon, VA 20170-4817, (703) 787-1728.

Overview

Section 20(e) of the Outer Continental Shelf Lands Act Amendment (OCSLAA) of 1978 requires the Secretary of the Interior to submit annually to Congress an assessment of the cumulative effects on the human, marine, and coastal environments from the Outer Continental Shelf Oil and Natural Gas Resource Management Program (OCS Program). "Cumulative effects" are defined as the total identifiable long-term effects that: (1) are attributable to activities authorized under the OCSLAA, (2) are evident during the time period analyzed, and (3) can be quantified or evaluated.

This report contains an assessment of the cumulative effects from OCS Program activities (hereafter referred to as “OCS-related activities”) that occurred from 1992 through 1994. It does not evaluate effects from potential OCS or non-OCS-related activities/events. For assessments of cumulative effects prior to 1992, see *Outer Continental Shelf Natural Gas and Oil Resource Management Program: Cumulative Effects, 1987-1991* (Bornholdt and Lear, 1995) and *Outer Continental Shelf Oil and Gas Program: Cumulative Effects* (Van Horn et al., 1988).

To emphasize the key Outer Continental Shelf (OCS) regional issues related to cumulative effects, the format of this report differs from those of the earlier reports (Van Horn et al., 1988; Bornholdt and Lear, 1995). One change was to organize the “effects” discussions under four geographically based sections (Gulf of Mexico, Pacific, Alaska, and Atlantic) instead of under the three Minerals Management Service (MMS) regional-based boundaries. In addition, instead of an “encyclopedic” coverage of all OCS-related subjects, this report (1) discusses specific issues that were relevant to the reported timeframe, (2) tiers off the findings of the last report (Bornholdt and Lear, 1995) by focusing on those areas identified as having cumulative effects, and (3) addresses those subjects identified as being of particular interest to OCS stakeholders. The issues are divided into two groups:

- Special Topics—issues that were chosen because they were of a nonroutine nature (e.g., Northridge Earthquake in the Pacific section), they were unique to the time period examined in this report (e.g., Manteo Prospect Block 467 in the Atlantic section), or they were directly affected by implementation of new MMS regulations that protect special environmental habitats (e.g., Flower Garden Banks National Marine Sanctuary and Archaeological Rulemaking in the Gulf of Mexico section).

- Matters of Interest—OCS issues that were identified in Bornholdt and Lear (1995) as having sustained cumulative effects (e.g. Coastal Wetlands in the Gulf of Mexico section) and OCS issues that were of continuing interest to OCS stakeholders (e.g., Subsistence in the Alaska section).

As with the previous reports, discussions will continue to emphasize "scientific proof" and present a scientifically substantiated assessment.

The years 1992 through 1994 saw subtle, yet significant, changes in the OCS oil and natural gas industry. The decline in offshore activity (characteristic of industry prior to 1992) eased partially because marked changes and technology shifted the outlook for offshore oil and natural gas. The oversupply of natural gas ended, resulting in significantly higher gas prices--the 1994 prices remained higher than those typical since 1986. Consequently, augmented revenue flows improved the economic viability of previously marginal offshore projects. Technological advances led to more frequent discoveries of financially viable deposits. Full implementation of three-dimensional seismic exploration techniques allowed drillers to determine more accurately what is beneath the ocean floor. Also, technology for recovering deep-water resources has improved and has been more widely disseminated and used in the last few years. The net result of these technological advances has been to lower the total effective cost of oil and natural gas production in the GOM.

During the 3 years covered by this report, the following OCS-related activities occurred:

- 6 oil and natural gas lease sales were held
- about $542.0 million in bonuses and $7.1 billion in royalties were collected
- over 850 exploratory wells were drilled
- over 1,200 development wells were drilled
- over 1 billion barrels of crude oil and condensate were produced
- nearly 14 trillion cubic feet of natural gas were produced
- about 681,000 short tons of salt were produced
- nearly 5.4 million short tons of sulphur were produced
- 367 OCS platforms were installed
- over 2,000 line miles of pipeline were installed
- 392 OCS platforms were removed
- less than 7,425 barrels of OCS crude oil and condensate were spilled

Although identifying OCS activities that occurred during 1992 through 1994 is straightforward, isolating OCS-related cumulative effects from those associated with other factors affecting the natural and manmade environments can be difficult. Further, some effects that some members of the public “anticipate” are not realized because of preventive measures (such as stipulations) built into the regulations governing OCS leasing, exploration, development, and production.

Because environmental protection and operational safety are essential parts of the OCS Program, the MMS identifies during evaluation of lease sales and industry projects the potential risks associated with OCS-related activities. The MMS Environmental Studies Program provides the information needed to predict, assess, and manage OCS effects on the human, marine, and coastal environments. Likewise, the MMS uses a formal risk assessment approach based on ocean observations, numerical models, and historic data to assess the probability of occurrence and contact of hypothetical oil spills. Using information from these and other sources, the MMS develops special lease sale stipulations to eliminate or reduce many potential adverse effects before actual OCS activities take place. These stipulations serve to clarify and focus requirements on a specific issue/location.

The OCS leasing and operating activities are regulated by Federal laws, and the MMS reviews OCS plans and drilling applications to develop or institute additional mitigation. Compliance with the MMS requirements and Federal statutes resolves many potential land, water, and natural resource use conflicts before OCS activities begin. Finally, to ensure operator compliance with OCS regulations, conditions, and stipulations, the MMS conducts inspections of all safety equipment designed to prevent blowouts, fires, spills, or other accidents. Some examples of ensuring environmental compliance include checking that staff is well trained and that environmental values are safeguarded. Because of its commitment to excellence in environmental decisionmaking by integrating environmental laws into its planning process, the MMS was the recipient of the 1994 Federal Environmental Quality Award.

During 1992 through 1994, the effects from OCS activities were varied in nature. Some were positive, such as the successful commercial mariculture venture of harvesting mussels from the OCS platforms in the Santa Barbara Channel. Others were temporary and localized in nature, such as effects associated with drilling discharges. Some anticipated negative effects were not realized; for example, major environmental damage to coastal and marine resources from oil spills did not occur in spite of the extensive physical damage to OCS structures from Hurricane Andrew. Other effects were regulatory in nature; for instance, when the National Oceanic and Atmospheric Administration designated the Flower Garden Banks as a national marine sanctuary (NMS), it recognized the effectiveness of existing MMS's mitigation requirements by incorporating them into the regulatory regime covering the newly designated NMS. Also there were cumulative effects: wetland loss (Gulf of Mexico section 2.1B8), social and economic effects (Gulf of Mexico 2.1B9), local onshore impact concerns (Pacific section 2.2B5 and 2.2B6), cultural and subsistence effects (Alaska section 2.3B3), and social impact concerns (Atlantic section 2.4A).

In general, the current OCS regulatory system prevents identifiable significant adverse cumulative effects from OCS-related activities on the human, marine, and coastal environments.

Abbreviations and Acronyms

A

ADFG	Alaska Department of Fish and Game
AEPRP	Approved Exploration Plan Review Process
AEWC	Alaska Eskimo Whaling Commission
ANPR	Advance Notice of Proposed Rulemaking
APCD	air pollution control district
APD	application for permit to drill
API	American Petroleum Institute
AQMD	air quality management district

B

bbl	barrels
BLM	Bureau of Land Management

C

CAAA	Clean Air Act Amendments
CAMP	California Offshore Monitoring Program
CCC	California Coastal Commission
CFR	Code of Federal Regulations
CMI	Coastal Marine Institute
CO	carbon monoxide
COOGER	California Offshore Oil and Gas Energy Resources
COST	Continental Offshore Stratigraphic Test
CSLC	California State Lands Commission
CZM	coastal zone management
CZMA	Coastal Zone Management Act

D

DOC	U.S. Department of Commerce
DOI	U.S. Department of the Interior
DOT	U.S. Department of Transportation
DPP	development and production plan

E

EIS	environmental impact statement
EP	exploration plan
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESP	Environmental Studies Program
ESPIS	Environmental Studies Program Information System
ESRP	North Carolina Environmental Sciences Review Panel

F

FWS	Fish and Wildlife Service
FY	Fiscal Year

G

GAO	General Accounting Office
G&G	geological and geophysical
gm	gram
GOM	Gulf of Mexico
GOOMEX	Gulf of Mexico Offshore Monitoring Experiment

H/I

INC	incident of noncompliance
INTERMAR	Office of International and Marine Minerals Activities
ITL	Information to Lessee

J/K/L

LOA	Letter of Authorization

M

MINT	MMS Intertidal Monitoring Program
MMbbl	million barrels
MMPA	Marine Mammal Protection Acy
MMS	Minerals Management Service
MOA	Memorandum of Agreement
MPRSA	Marine Protection, Research & Sanctuaries Act

N

NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NMS	national marine sanctuary
NO	nitric oxide
NOAA	National Oceanic and Atmospheric Administration
NORM	naturally occurring radioactive material
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRC	National Research Council
NTL	Notice to Lessees and Operators
NWA	national wilderness area

O

OCS	Outer Continental Shelf
OCSLAA	Outer Continental Shelf Lands Act Amendment
OOC	Offshore Operators' Committee
OPA	Oil Pollution Act
OSCP	Oil-Spill Contingency Plan
OS&T	Offshore Storage and Treating Vessel
OSPR	California Office of Oil Spill Prevention and Response

P

pCi	picocurie
PINS	Padre Island National Seashore
PM	particulate matter
ppm	parts per million
PSD	prevention of significant deterioration

R

ROTAC	Regional Operations Technology Assessment Committee
ROV	remotely operated vehicle

S

SAIC	Sciences Applications International Corporation
SALM	single anchor leg mooring
SEMP	Safety and Environmental Management Program
SEMS	Seafloor Earthquake Measurement System
SO_2	sulphur dioxide
SO_x	sulphur oxides
SYU	Santa Ynez Unit

T

TA&R	Technology Assessment and Research
THC	total hydrocarbons

U

USCG	U.S. Coast Guard

V/W/X/Y/Z

VOC	volatile organic compounds

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1.0 Elements of the Outer Continental Shelf Oil and Natural Gas Resource Management Program (OCS Program), 1992 Through 1994

1.1 OCS Exploration, Development, and Production

The years 1992 through 1994 saw subtle, yet significant, changes in the Outer Continental Shelf (OCS) oil and natural gas industry. The decline in offshore activity (characteristic of industry prior to 1992) eased, at least partially, during these years. Changes in markets and technology shifted the outlook for offshore oil and natural gas. For example, the "gas bubble" (a term given to the oversupply of natural gas) burst, resulting in significantly higher gas prices. Although gas prices peaked in 1993, the 1994 prices remained higher than levels that had been typical since 1986. Consequently, augmented revenue flows stemming from these higher prices improved the economic viability of previously marginal offshore projects.

Of even greater, although less obvious, significance was the diffusion of new offshore exploration and production technology in the Gulf of Mexico (GOM) OCS. Full implementation of three-dimensional seismic exploration techniques now allowed drillers to determine more accurately what is beneath the ocean floor. In addition, reevaluation of subsalt geology opened many new oil and natural gas deposits to development. These technological advances led to more frequent discoveries of financially viable deposits, thus improving the efficiency of exploration in the GOM.

Technology for recovering deep-water resources has also improved and has been more widely disseminated and implemented in the last few years. Deep-water development, largely the domain of major oil companies and the bigger independents, comprises a growing percentage of new production from the GOM. The net effect of these technological advances has been to lower the total effective cost of oil and natural gas production in the GOM.

Offshore oil production from southern California increased during 1992 through 1994, both in relative and absolute terms. Extensive consultation and coordination with State and local governments resulted in the granting of previously disputed permits allowing firms active in the region to finally produce the oil and natural gas that were leased and discovered years earlier.

Although total OCS oil production rose only modestly during this report period, the Minerals Management Service (MMS) expects a continued growth as a result of the changes noted above. Natural gas production has remained remarkably stable for the last 4 years, but it is even more likely than oil production to increase as a result of changes noted for the GOM.

From 1992 through 1994, OCS operators produced over 1 billion barrels of crude oil and condensate and more than 13 trillion cubic feet of natural gas. These amounts represent 14 and 24 percent, respectively, of the total 1992-1994 U.S. oil and natural gas production. Also, OCS operators produced over 680,000 short tons of salt and over 5 million short tons of sulphur from 1992 through 1994.

The cumulative totals and yearly breakdowns of oil, natural gas, salt, and sulphur production from 1992 through 1994 are listed in table 1.1-1, and the OCS-related activities during this period are summarized in table 1.1-2.

Table 1.1-1. OCS Production, 1992 through 1994

	Crude Oil & Condensate (MMbbl)			Natural Gas (tcf)			Salt** (short tons)	Sulphur (short tons)
Year	**OCS**	**Total U.S.**	**OCS as % of U.S.**	**OCS**	**Total U.S.***	**OCS as % of U.S.**	**OCS**	**OCS**
1992	338	2,617	13	4.69	18.71	25	265,528	1,047,117
1993	353	2,499	14	4.53	18.98	24	375,081	1,727,317
1994	372	2,431	15	4.66	19.65	24	40,839	2,614,447
Total	1,063	7,547	14	13.88	57.34	24	681,448	5,388,881

tcf = thousand cubic feet; MMbbl = million barrels
* Market production
** Salt production from Federal leases offshore Louisiana
Source: Adapted from *Federal Offshore Statistics: 1994* (MMS, 1996a)

Table 1.1-2. OCS-Related Activities, 1992 through 1994

Year	Exploration Permits Issued	Wells Drilled*	Platforms Removed	Platforms Installed	Pipelines Installed (line miles)
1992	141	490	122	88	628.8
1993	143	766	179	110	484.6
1994	133	845	91	165	948.5
Total	427	2101	392	363	2061.9

* Exploration and development wells only
Source: Adapted from *Federal Offshore Statistics: 1994* (MMS, 1996a)

1.2 OCS Lease Sales

From 1992 through 1994, the MMS held six OCS oil and natural gas lease sales, which are summarized in table 1.2-1.

Table 1.2-1. Summary of OCS Lease Sales, 1992 through 1994

		Sale Offering			Bids Made			Leases Issued	
Sale	**Date**	**Area**	**Tracts**	**Acres**	**Number**	**Tracts**	**Acres**	**Tracts**	**Acres**
				1992					
139	5/13/92	Central GOM	5,213	28,152,199	196	151	717,186	144	693,079
141	8/19/92	Western GOM	4,405	24,227,848	81	61	333,600	60	327,840
				1993					
142	3/24/93	Central GOM	5,443	29,325,669	261	201	976,083	187	906,587
143	9/15/93	Western GOM	4,682	25,744,600	197	157	848,686	149	807,871
				1994					
147	3/30/94	Central GOM	5,759	30,903,699	598	375	1,784,480	368	1,749,480
150	3/17/94	Western GOM	5,102	27,991,341	266	210	1,090,558	192	1,025,534

Source: Adapted from *Federal Offshore Statistics: 1994* (MMS, 1996a)

1.3 OCS Revenues and Disbursements

Bonuses paid to lease offshore tracts for oil and natural gas development increased dramatically over the 1992-1994 period, totaling more than $500 million. These were largely driven by gas prices reaching their peak in 1993. As shown in table 1.3-1, royalties from 1992 through 1994 totaled over $7 billion for offshore oil and natural gas production, about $20,000 for salt production, and approximately $22 million for sulphur production.

Table 1.3-1. OCS Revenues, 1992 through 1994 (in Millions of Current Year Dollars)

	Oil & Natural Gas Leases			Crude Oil & Condensate		Natural Gas		Salt		Sulphur	
Year	**Bonus**	**R&M Roy.**	**Roy.**	**Sales Value**	**Roy.**	**Sales Value**	**Roy.**	**Sales Value**	**Roy.**	**Sales Value**	**Roy.**
1992	85	99	2,302	6,320	968	8,165	1,334	.141	.008	68	4
1993	126	178	2,477	6,874	885	9,893	1,592	.304	.011	96	8
1994	331	181	2,346	5,202	799	9,753	1,545	.047	.001	120	11
Total	**542**	**458**	**7,125**	**18,396**	**2,652**	**27,811**	**4,471**	**.492**	**.020**	**284**	**22**

R&M Roy. = Rentals and Minimum Royalties; Roy. = Royalties
Source: Adapted from Federal Offshore Statistics: 1994 (MMS, 1996a)

1.4 Assessment and Research

The MMS continuously assesses OCS activities and their impact on the environment, the adequacy of information related to OCS operating procedures and technology, the latest technological advances, the need for new, more efficient technology, and the importance of human behavior in offshore safety and pollution prevention. The MMS employs four areas of expertise to address these concerns:

- Environmental Studies Program
- Technology and Assessment Research Program
- Regional Operations Technology Assessment Committees
- Safety and Environmental Management Program

1.4A Environmental Studies Program

The MMS Environmental Studies Program (ESP) supports the OCS Program by providing decisionmakers with information needed to predict, assess, and manage impacts from OCS-related activities on the offshore and nearshore areas. Studies provide information on the status of the environment (human, marine, social, and economic) and on the ways and extent that OCS activities can potentially impact the environment and coastal areas. To improve data management, the MMS developed the Environmental Studies Program Information System (ESPIS), a public text management program, which contains information about the environmental research funded by the ESP since 1973 and the full text of all reports currently available. (For a listing of the studies undertaken during this report period (1992-94), see appendix C.) In addition, the MMS established a bibliographic database of peer reviewed journal articles reporting on ESP research. To assure adequacy of these studies, the ESP relies on expertise from outside entities, such as the National Research Council and the OCS Advisory Board's Scientific Committee.

A major initiative for ESP during this period was establishing the Coastal Marine Institute (CMI) program. This was a follow-on to the University Research Initiative—agreements which MMS had with Louisiana University Marine Consortium and University of California at Santa Barbara. The CMI program emphasizes building partnerships with State educational institutions and sharing costs for OCS-related research. Because MMS funds are matched one-to-one by the university, the cooperative research program is able to accomplish much more than if the participants acted alone. The research agenda, conducted by investigators at State institutions, focuses on environmental and social and economic aspects of offshore oil and natural gas and marine mineral development activities.

The MMS, in cooperation with the State of Louisiana, established a CMI at Louisiana State University in September 1992. By the end of 1994, 24 projects had been initiated to address OCS information needs in the GOM. In Fiscal Year (FY) 1993, a CMI was established with the University of Alaska at Fairbanks and the State of Alaska. By the end of 1994, the second full year of operation, 11 research projects pertaining to environmental issues in the Cook Inlet, Chukchi Sea, and Beaufort Sea Planning Areas had been initiated.

In 1994, the MMS established a CMI at the University of California at Santa Barbara to supplement the ongoing University Research Initiative there.

1.4B Technology Assessment and Research Program

The Technology Assessment and Research (TA&R) program provides a formal technology base for regulatory personnel who work with industry operating in the frontier areas of the deeper oceans and icy waters of the arctic. It assesses and analyzes applicable technologies and sponsors applied research. Study areas are grouped into the categories of operational safety (blowout prevention, fire safety, etc.), verification of offshore structures and pipelines, and technologies to prevent and mitigate pollution. The program findings are used to support MMS operational permits and plan approvals, safety and pollution inspections, enforcement actions, accident investigations, and well-control training requirements. The TA&R program emphasizes several areas, such as improved blowout prevention procedures for deep-water drilling, inspection problems associated with structural aging and deep-water structures, exhaust gas pollution mitigation techniques, oil-spill mitigation techniques, and quantification of earthquake forces on OCS structures and facilities.

The TA&R program administers about 50 active projects at universities, private companies, and government laboratories. Most projects are jointly sponsored with the offshore industry or other U.S. and foreign government agencies. For example, the largest TA&R project, oil-spill response, is a combined MMS-Environment Canada effort. This collaborative undertaking provides a comprehensive approach to improve mechanical, chemical, and in-situ burn technologies as well as the means for detecting and examining slicks. Also, the MMS operates the Oil and Hazardous Materials Simulated Environmental Test Tank, a full-scale spill response facility, which is available for use by other agencies and entities and by the general public.

1.4C Regional Operations Technology Assessment Committees

A network of working groups known as Regional Operations Technology Assessment Committees (ROTAC's) expedites the exchange of technical information among MMS headquarters and regional offices. The ROTAC's review operational problems, consider technology needs, and recommend improvements in the offshore regulatory program. The MMS project scientists and engineers serve as staff adjuncts by participating in ROTAC discussions on their technical specialties. The ROTAC network, together with the TA&R program, is one way for the MMS to comply with the Outer Continental Shelf Lands Act section 21(b) requirement to use the "best available and safest technologies which the Secretary determines to be economically feasible."

1.4D Safety and Environmental Management Program

While the TA&R and ROTAC programs provide information on safe operating procedures and technology, the Safety and Environmental Management Program (SEMP), an emerging

OCS operating concept that was conceived by MMS in 1991, provides an opportunity to implement such technologies. In practice, SEMP is a plan for designing, managing, and conducting OCS operations in ways that emphasize the importance of human behavior in offshore safety and pollution prevention. Because safety in operations is achieved best through active prevention methods, the SEMP places overall performance ahead of rote equipment testing and reliance on prescriptive regulations. In this respect, SEMP is a different way of regulating offshore operations and offers an opportunity for a unique partnership for safety between MMS and the oil and natural gas industry.

A variety of national and global industry and governmental organizations have undertaken SEMP-like efforts, although not all apply specifically to the offshore oil and natural gas industry. Nationally, the Environmental Protection Agency, the U.S. Coast Guard, and the Occupational Safety and Health Administration have developed or are developing SEMP-like regulatory programs. Globally, the International Maritime Organization, the International Organization for Standardization, and the Exploration & Production Forum are also working on guidelines that integrate SEMP principles into a variety of industrial activities, including offshore oil and natural gas operations.

The SEMP does not dictate mandates; instead, it recognizes that operators are ultimately responsible for ensuring safety and environmental protection and that management commitment and encouragement are essential to its success. An operator's SEMP is a plan that contains several key elements:

- commitment from industry's top management to safety and pollution prevention
- active industry programs for identifying, eliminating, and mitigating hazards; assuring safe work practices; managing changes; and properly training all offshore personnel
- operating procedures to address accidents, upsets, and near misses, including a system for reviewing, analyzing, and correcting problems
- industry procurement policies that strengthen safety and environmental protection practices

Additional SEMP details are documented in the American Petroleum Institute's *Recommended Practices for Development of a Safety and Environmental Management Plan for OCS Operations and Facilities* (RP75). Resulting from a cooperative effort among the American Petroleum Institute, the Offshore Operator's Committee, the MMS, and others to apply SEMP concepts to oil and natural gas production activities, RP75 is a means for voluntarily adopting SEMP. [A survey conducted by MMS and the American Petroleum Industry in January 1995 showed that 80 percent of the OCS operators are developing SEMP plans or already have one in place.] The MMS continues to work with and assess industry's success in implementing RP75 to determine whether SEMP should be a regulatory requirement.

2.0 Observed Effects of the OCS Program

To emphasize the key Outer Continental Shelf (OCS) regional issues related to cumulative effects, the format of this report differs from those of the earlier reports (Van Horn et al., 1988; Bornholdt and Lear, 1995). One change was to organize the "effects" discussion under four geographically based sections (Gulf of Mexico, Pacific, Alaska, and Atlantic) instead of under the three Minerals Management Service (MMS) regional-based boundaries. In addition, instead of an "encyclopedic" coverage of all OCS-related subjects, this report (1) discusses specific issues that were relevant to the reported timeframe, (2) tiers off the findings of the last cumulative effects report (Bornholdt and Lear, 1995) by focusing on those areas identified as having cumulative effects, and (3) addresses those subjects identified as being of particular interest to OCS stakeholders. The issues are divided into two groups:

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As with the previous reports, discussions will continue to emphasize "scientific proof" and present a scientifically substantiated assessment.

2.1 Gulf of Mexico Region

The Gulf of Mexico (GOM) Region is divided into OCS three planning areas: Western, Central, and Eastern GOM (fig. 2.1-1). Various features of these planning areas are illustrated in figures 2.1-2 through 2.1-15. There were six OCS lease sales held for the GOM between 1992 and 1994: three in the Western GOM and three in the Central GOM (see chapter 1, table 1.2-1). During the 3 years covered by this report (1992-1994), the following OCS-related postlease activities took place in the GOM (MMS, 1996a):

- 850 exploration wells were drilled
- 1,197 development wells were drilled
- 363 OCS platforms were installed
- 391 OCS platforms were removed
- 2,040 miles of OCS pipeline were installed
- 77 small OCS spills (1-999 barrels (bbl)) resulted in a total oil spillage of 1,001 bbl, and 2 large OCS pipeline spills ($\geq$1,000 bbl) resulted in a total oil spillage of 6,533 bbl

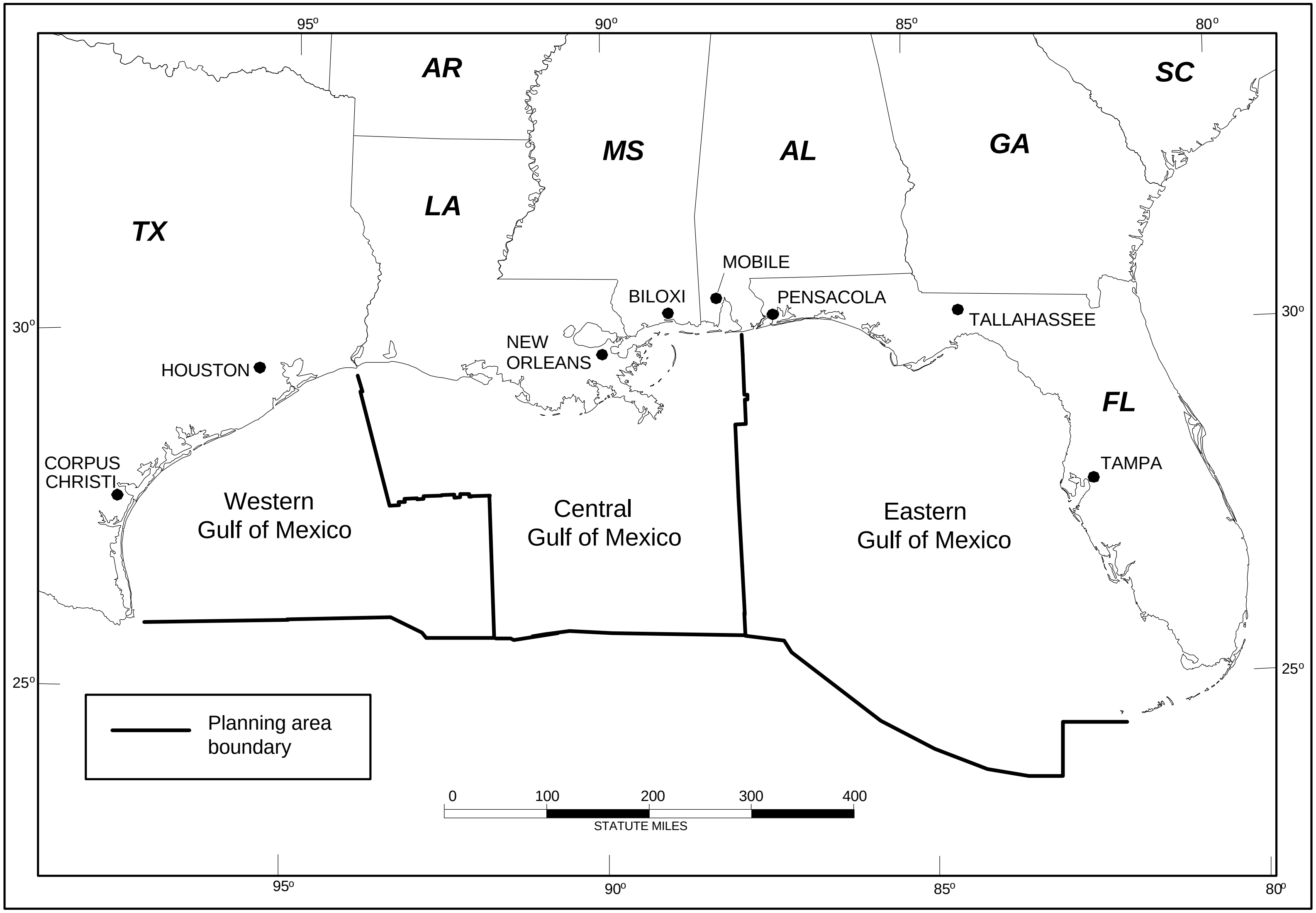
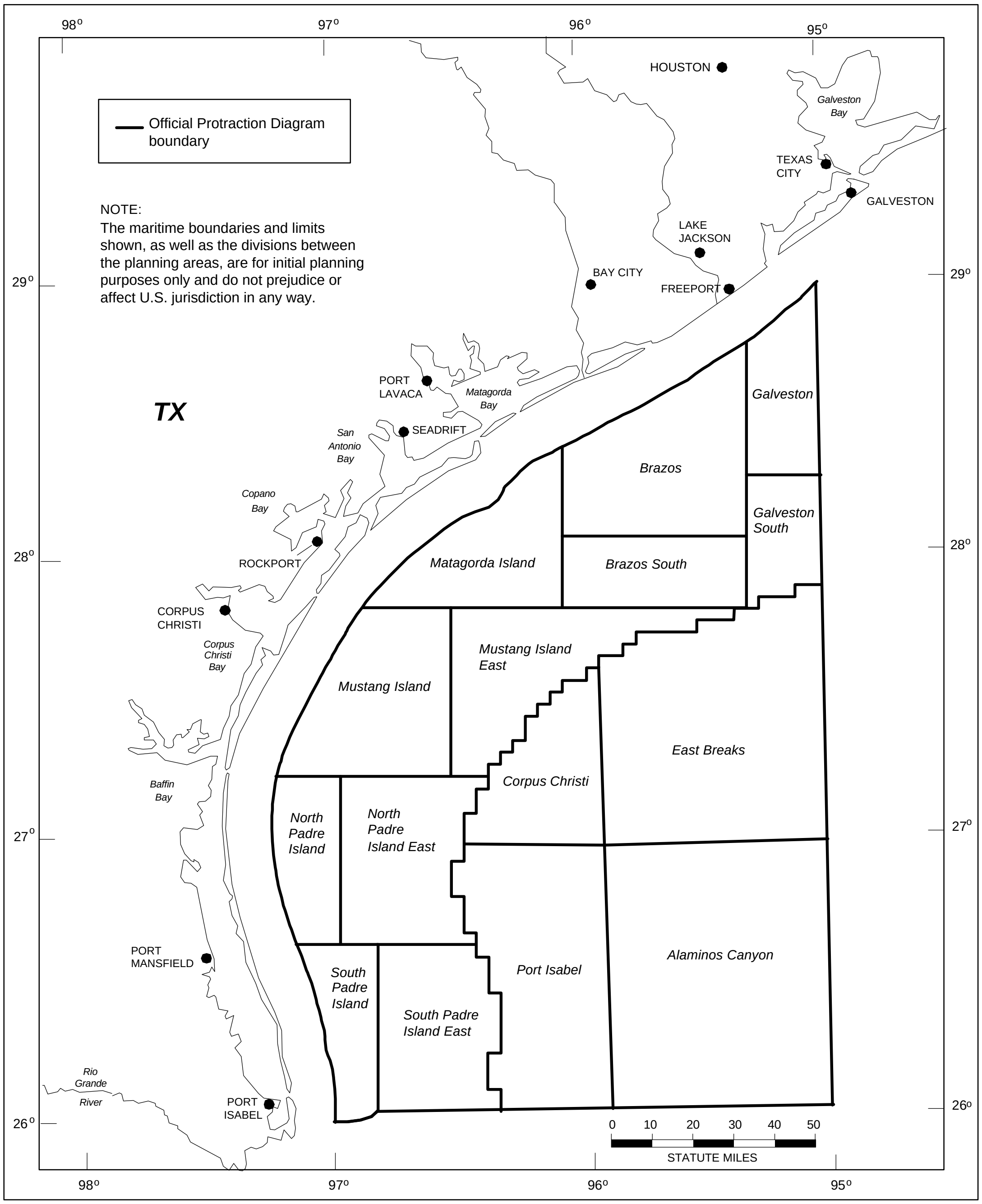
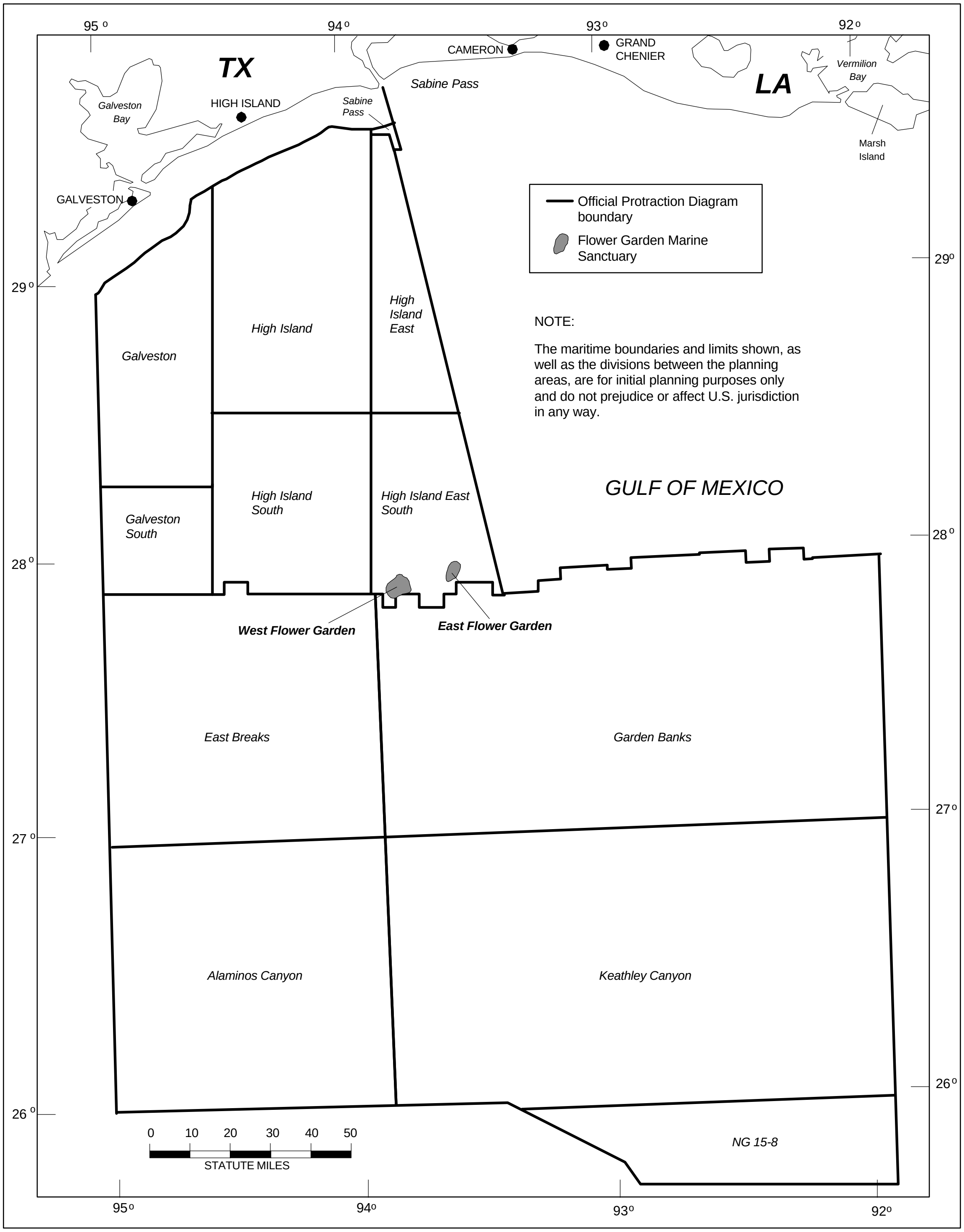


Figure 2.1-1. Gulf of Mexico OCS Planning Areas, 1992-1994



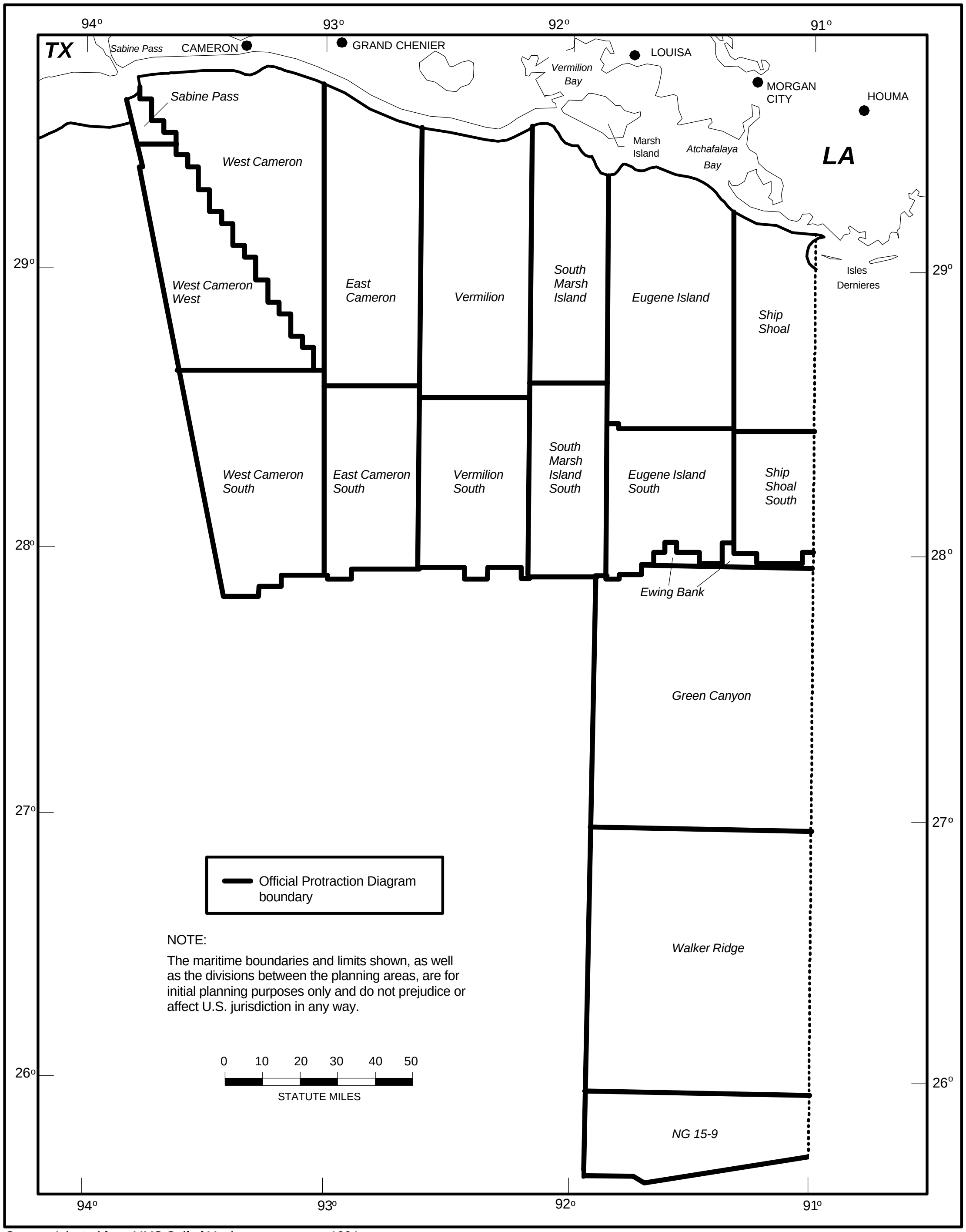
Source: Adapted from MMS Gulf of Mexico source maps, 1994.

Figure 2.1-2. Western Gulf of Mexico (Western Portion) Official Protraction Diagrams, 1992-1994



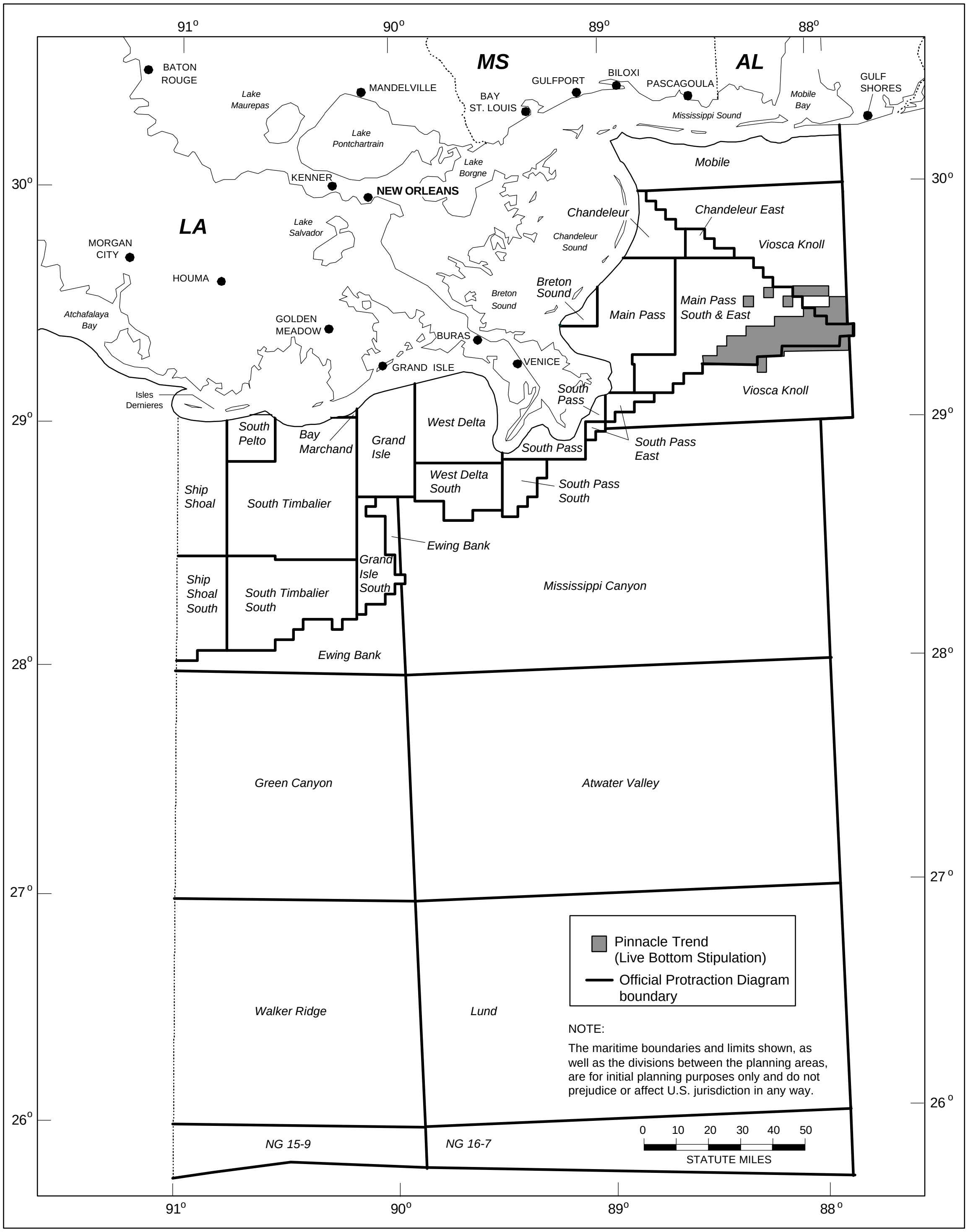
Source: Adapted from MMS Gulf of Mexico source maps, 1994

Figure 2.1-3. Western Gulf of Mexico (Eastern Portion) Official Protraction Diagrams, 1992-1994



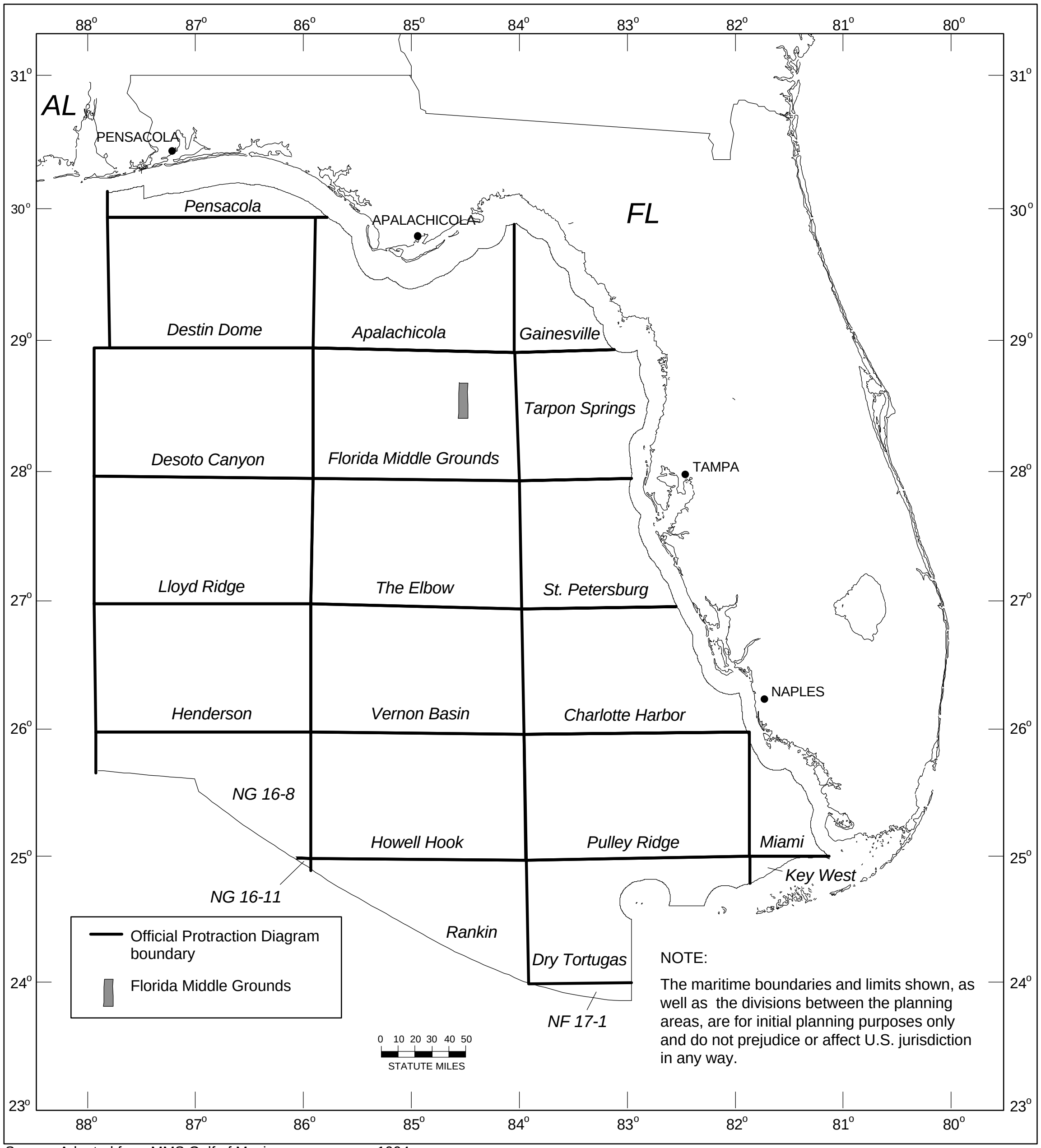
Source: Adapted from MMS Gulf of Mexico source maps, 1994.

Figure 2.1-4. Central Gulf of Mexico (Western Portion) Official Protraction Diagrams, 1992-1994



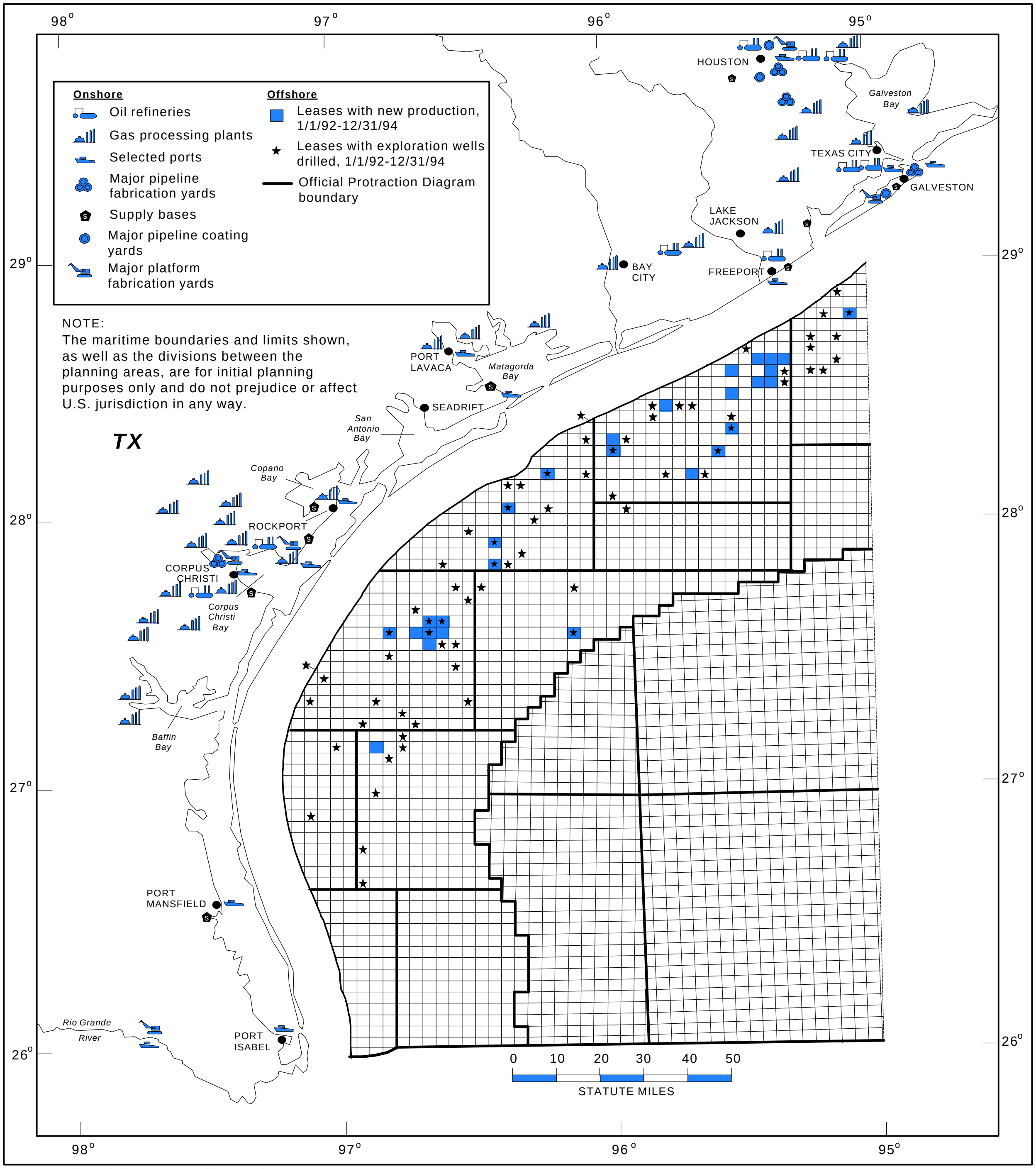
Source: Adapted from MMS Gulf of Mexico source maps, 1994.

Figure 2.1-5. Central Gulf of Mexico (Eastern Portion) Official Protraction Diagrams, 1992-1994



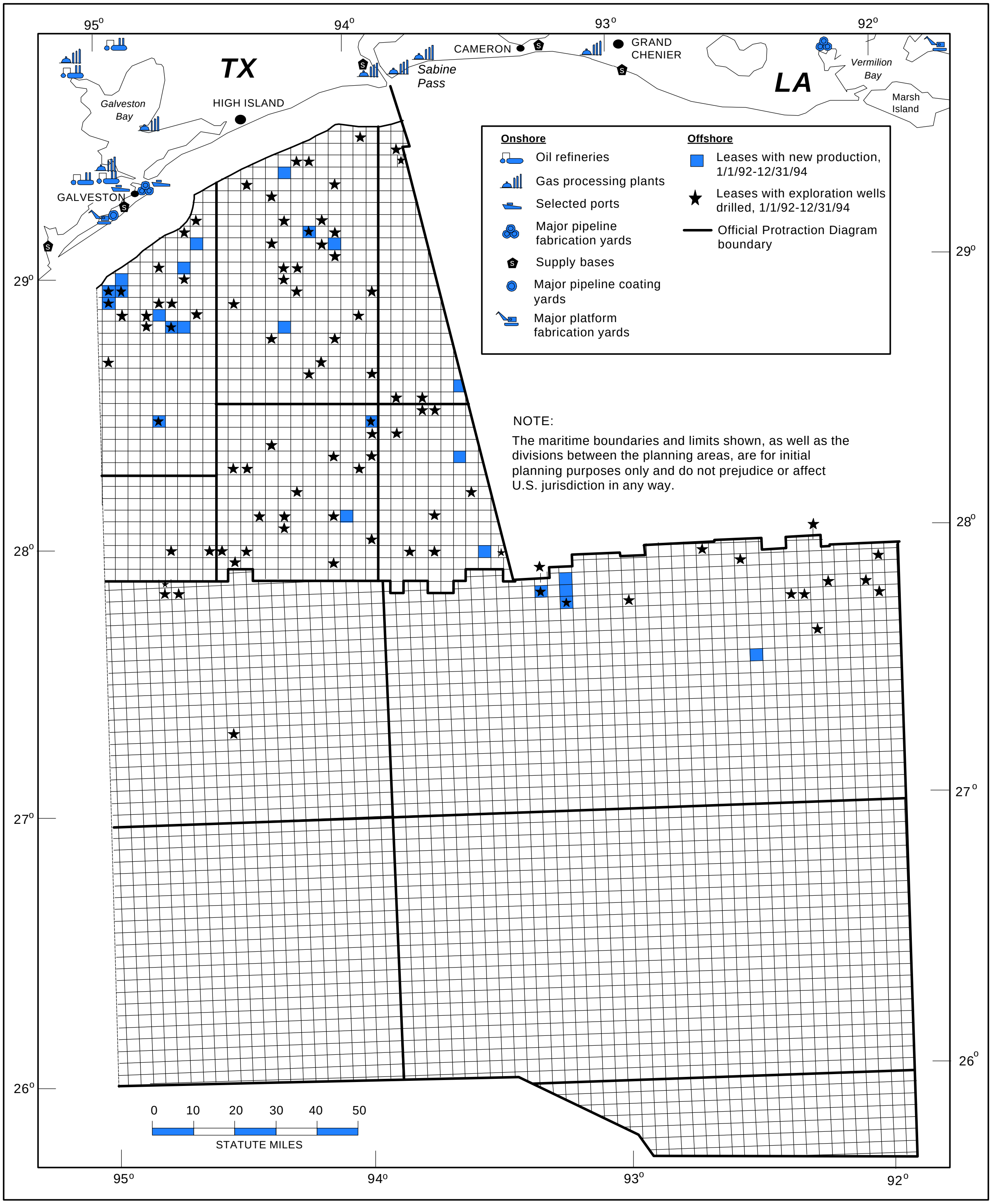
Source: Adapted from MMS Gulf of Mexico source maps, 1994.

Figure 2.1-6. Eastern Gulf of Mexico Official Protraction Diagrams, 1992-1994



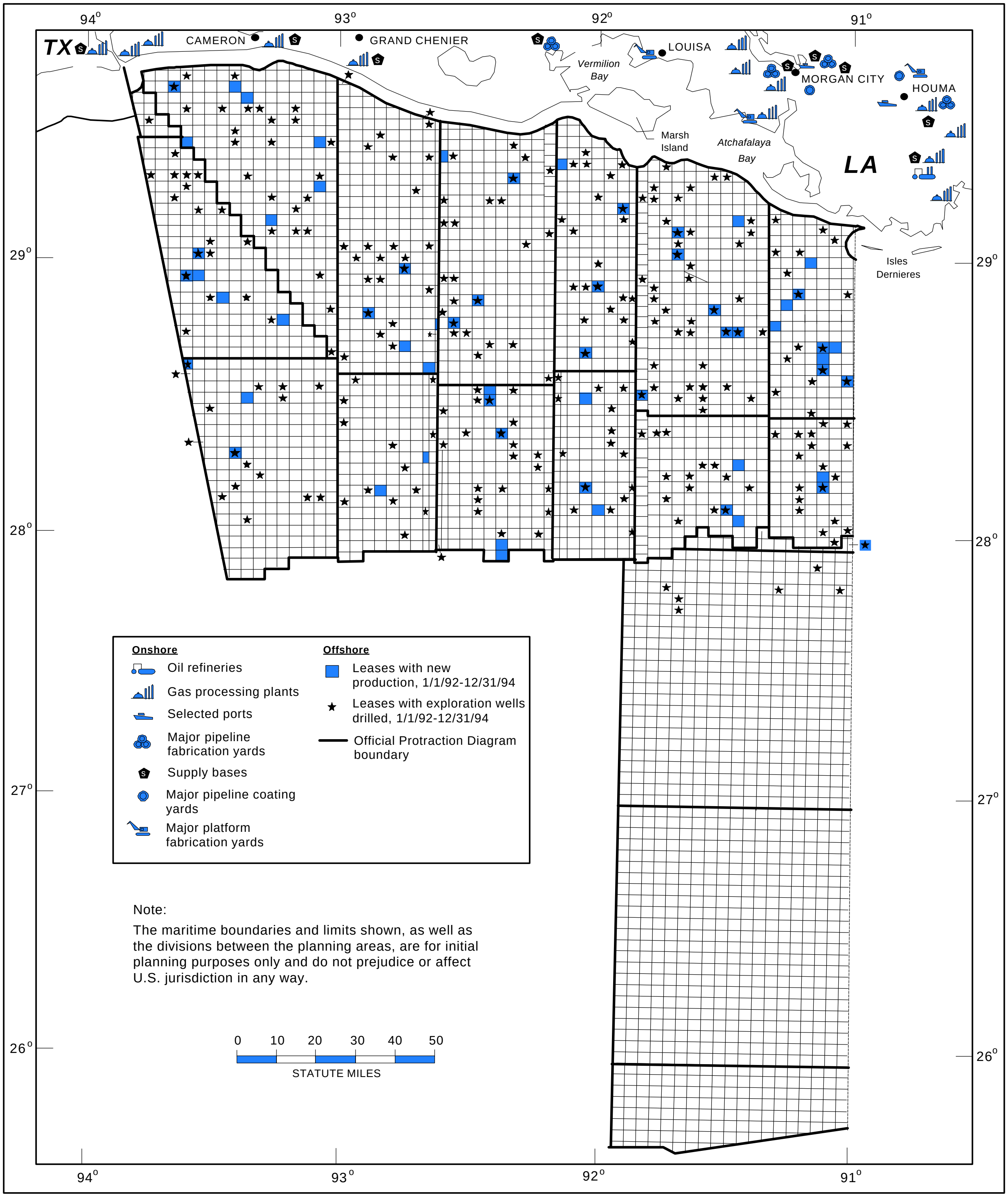
Source: Adapted from MMS Gulf of Mexico source maps, 1994.

Figure 2.1-7. Western Gulf of Mexico (Western Portion), Status of Leases, 1992-1994



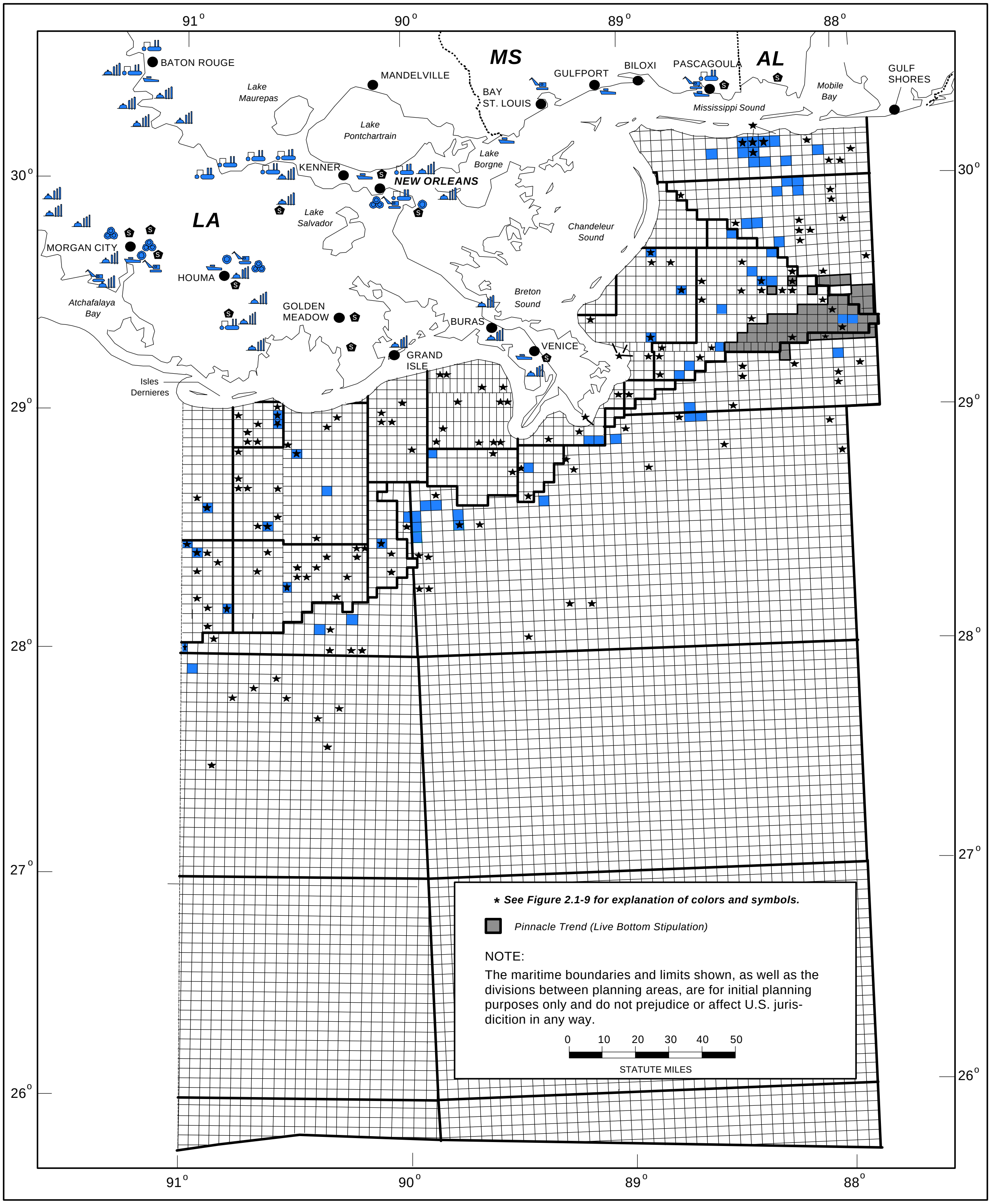
Source: Adapted from MMS Gulf of Mexico source maps, 1994.

Figure 2.1-8. Western Gulf of Mexico (Eastern Portion), Status of Leases, 1992-1994



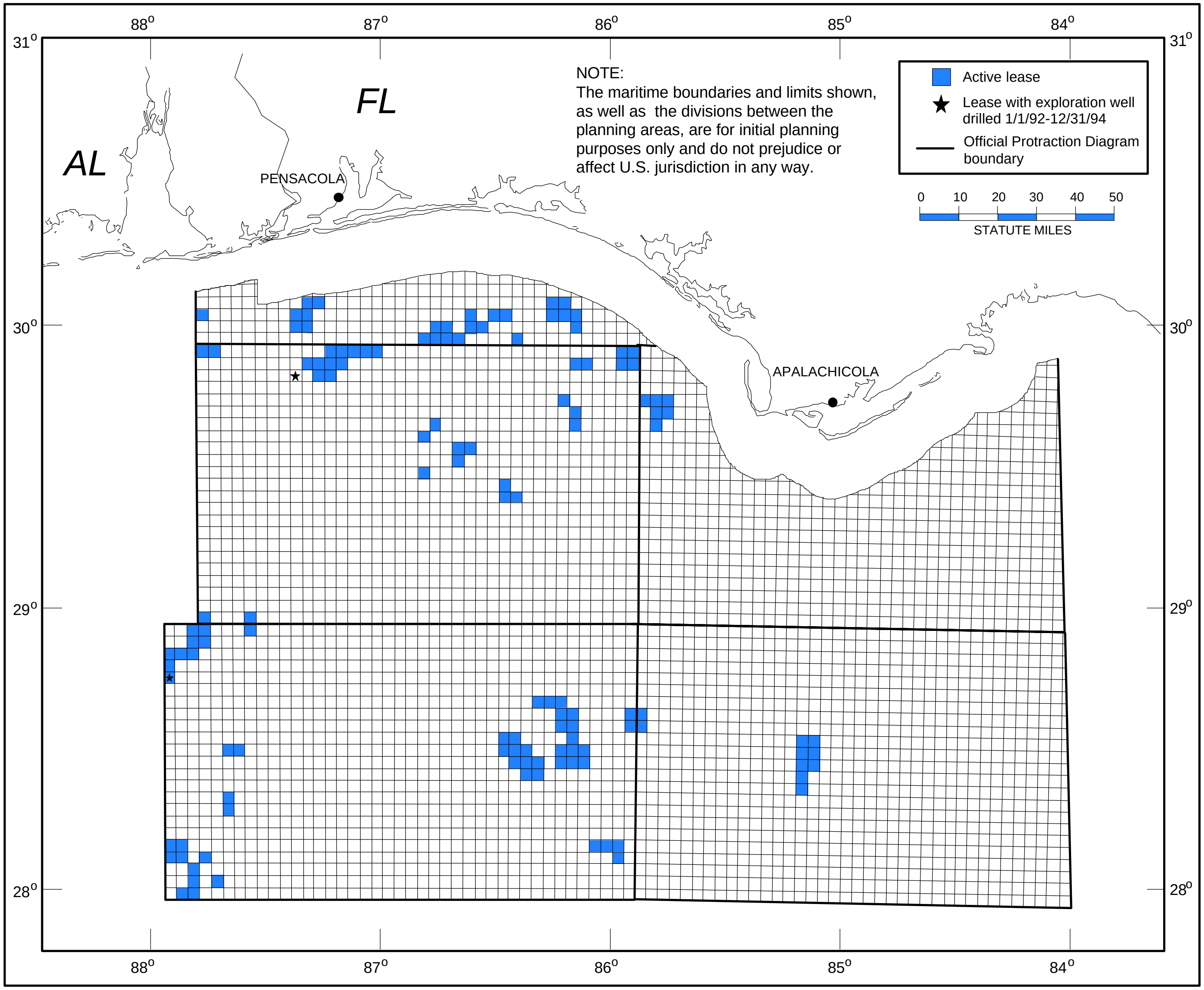
Source: Adapted from MMS Gulf of Mexico source maps, 1994.

Figure 2.1-9. Central Gulf of Mexico (Western Portion), Status of Leases, 1992-1994



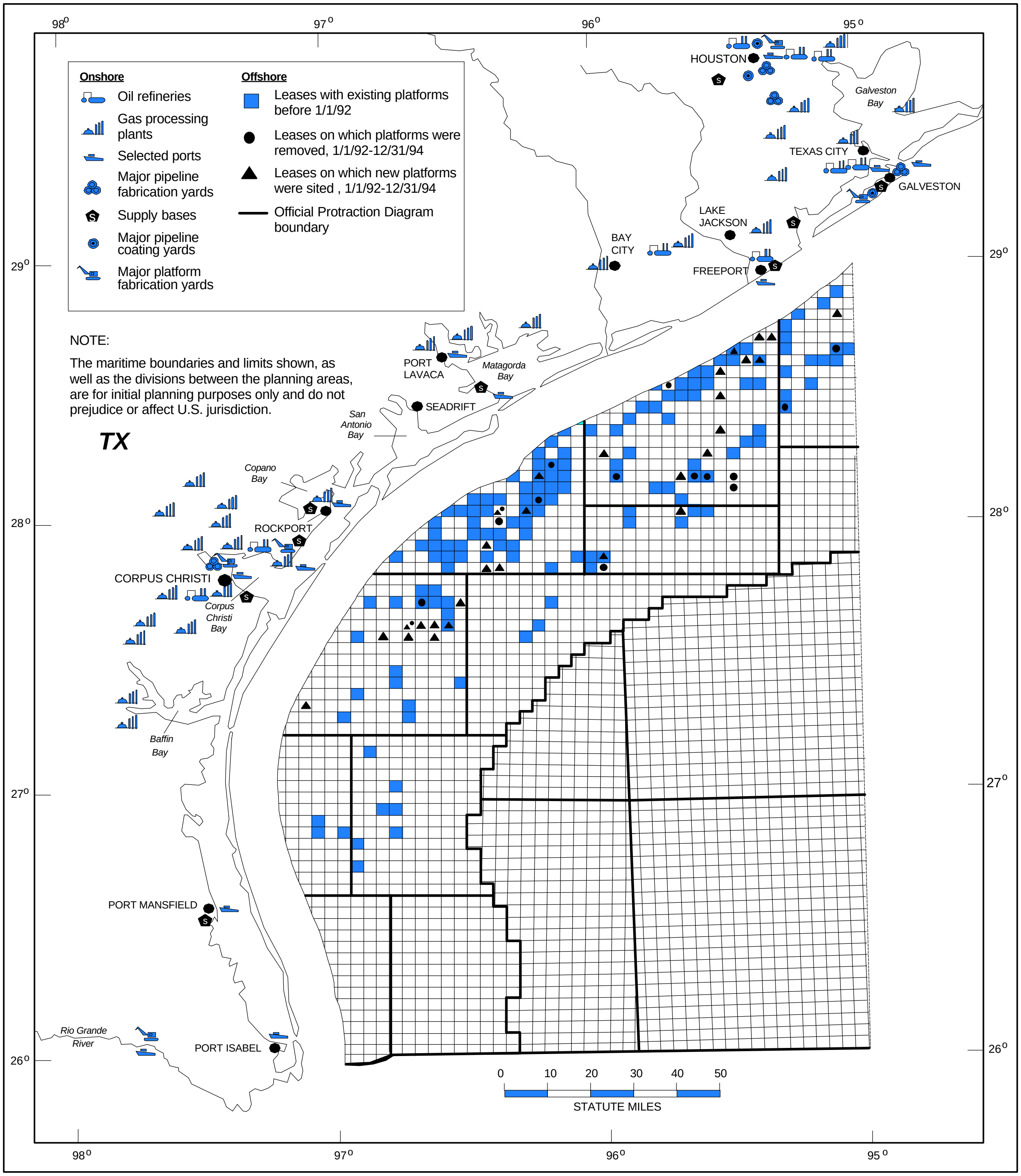
Source: Adapted from MMS Gulf of Mexico source maps, 1994.

Figure 2.1-10. Central Gulf of Mexico (Eastern Portion), Status of Leases, 1992-1994



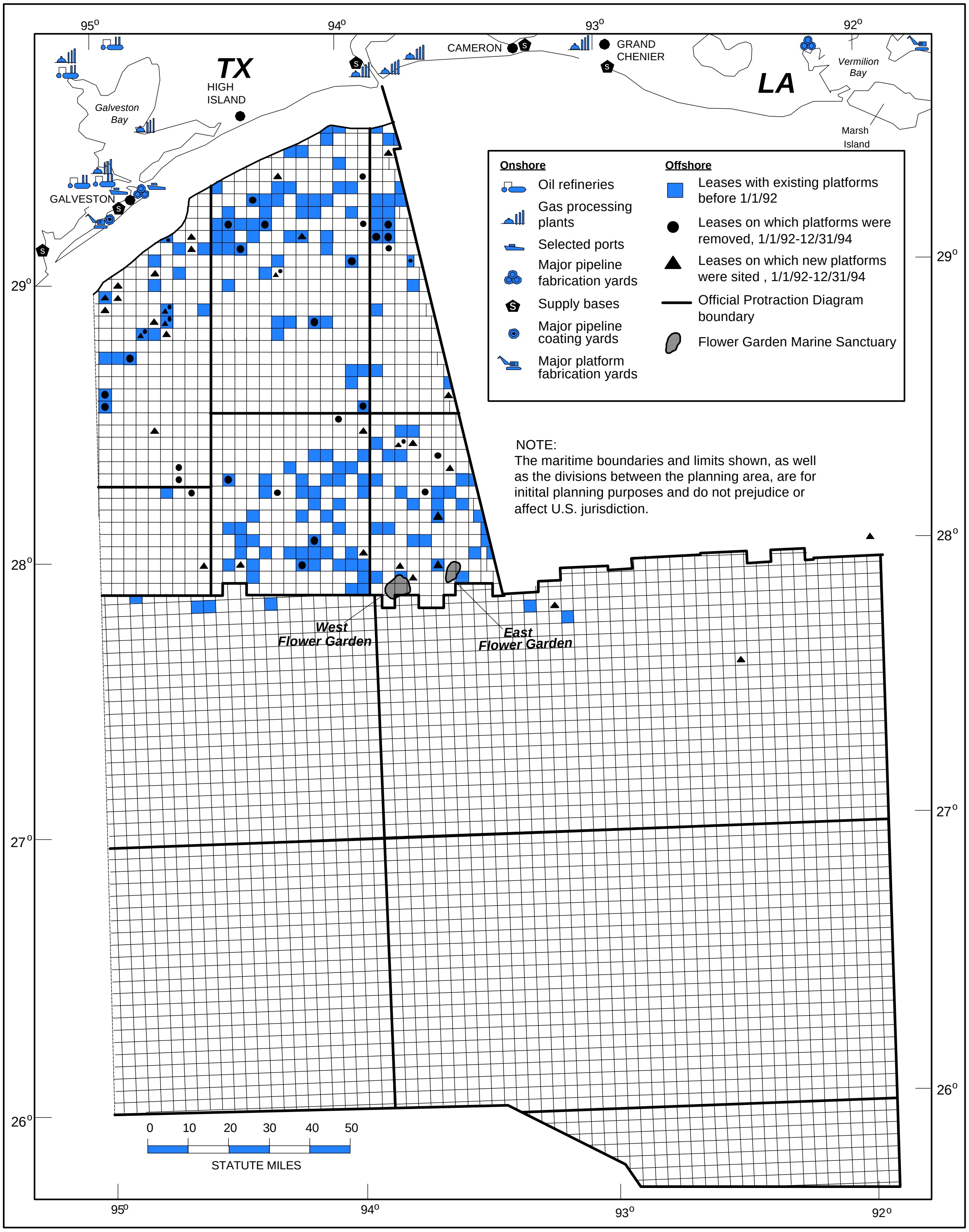
Source: Adapted from MMS Gulf of Mexico source maps, 1994.

Figure 2.1-11. Eastern Gulf of Mexico, Status of Leases, 1992-1994



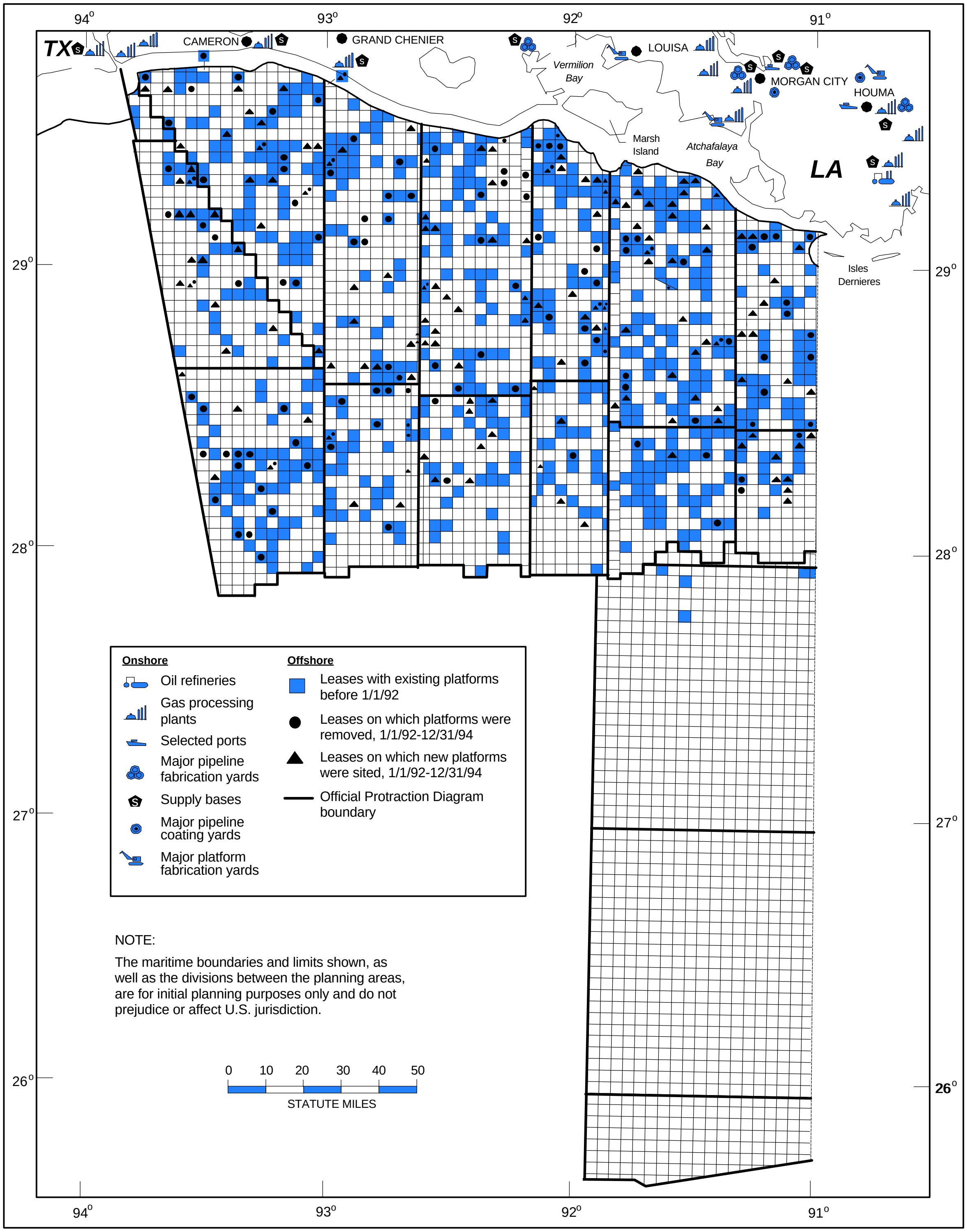
Source: Adapted from MMS Gulf of Mexico source maps, 1994.

Figure 2.1-12. Western Gulf of Mexico (Western Portion), Status of Platforms, 1992-1994



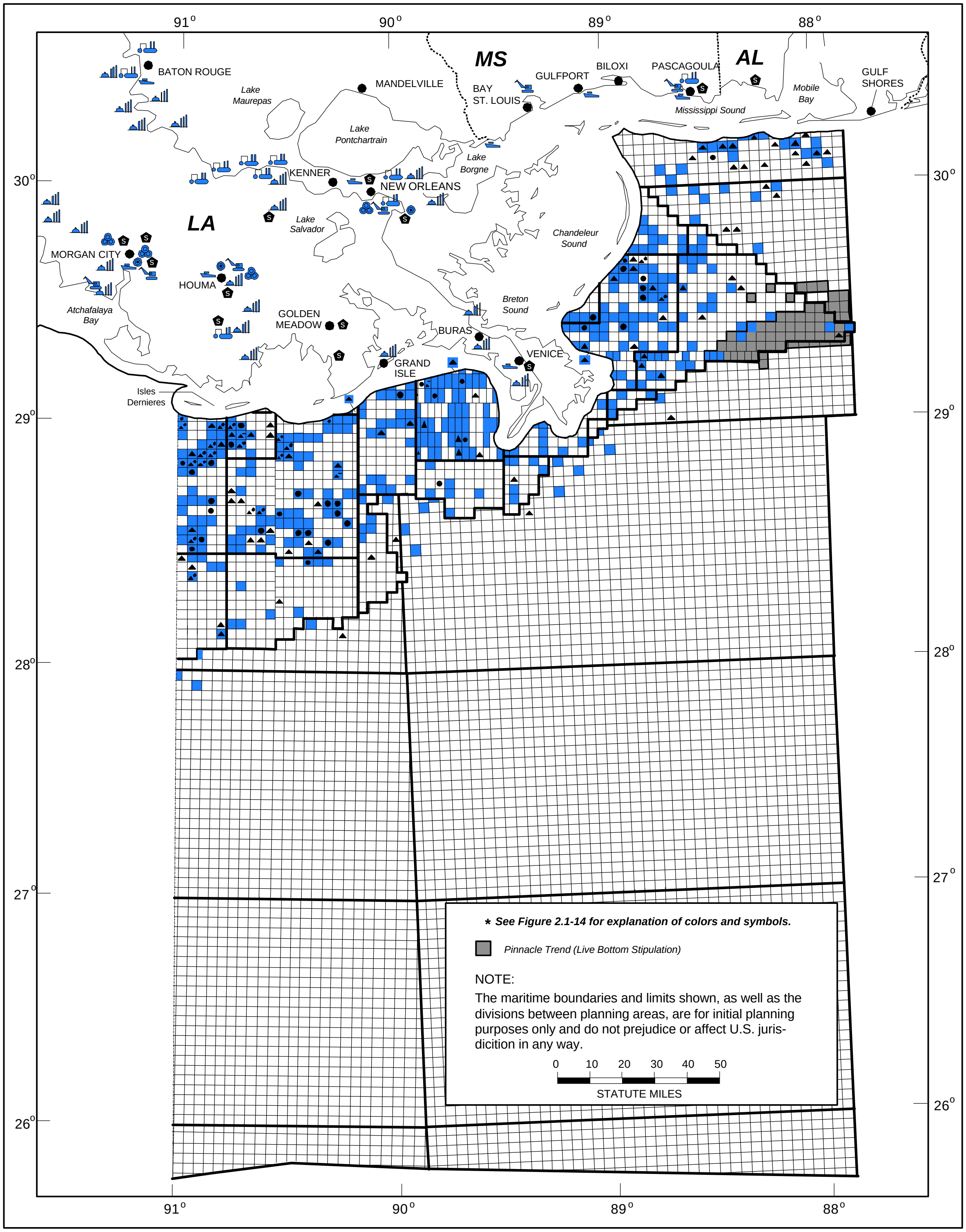
Source: Adapted from MMS Gulf of Mexico source maps, 1994.

Figure 2.1-13. Western Gulf of Mexico (Eastern Portion), Status of Platforms, 1992-1994



Source: Adapted from MMS Gulf of Mexico source maps, 1994.

Figure 2.1-14. Central Gulf of Mexico (Western Portion), Status of Platforms, 1992-1994



Source: Adapted from MMS Gulf of Mexico source maps, 1994.

Figure 2.1-15. Central Gulf of Mexico (Eastern Portion), Status of Platforms, 1992-1994

2.1A Special Topics

The "Special Topics" for the GOM Region discussed in this report are:

- Damage to OCS Facilities from Hurricane Andrew
- OCS Exploratory Drilling off the Florida Panhandle
- Flower Garden Banks National Marine Sanctuary
- MMS Archaeological Rulemaking

These topics were chosen because (1) their effects on the marine and human environment were nonroutine (Damage to OCS Facilities from Hurricane Andrew), (2) they were unique to the time period examined in this report (OCS Exploratory Drilling off the Florida Panhandle), or (3) they were directly affected by implementation of new MMS regulations during this time period that protect special environmental habitats (Flower Garden Banks National Marine Sanctuary) or archaeological resources (MMS Archaeological Rulemaking).

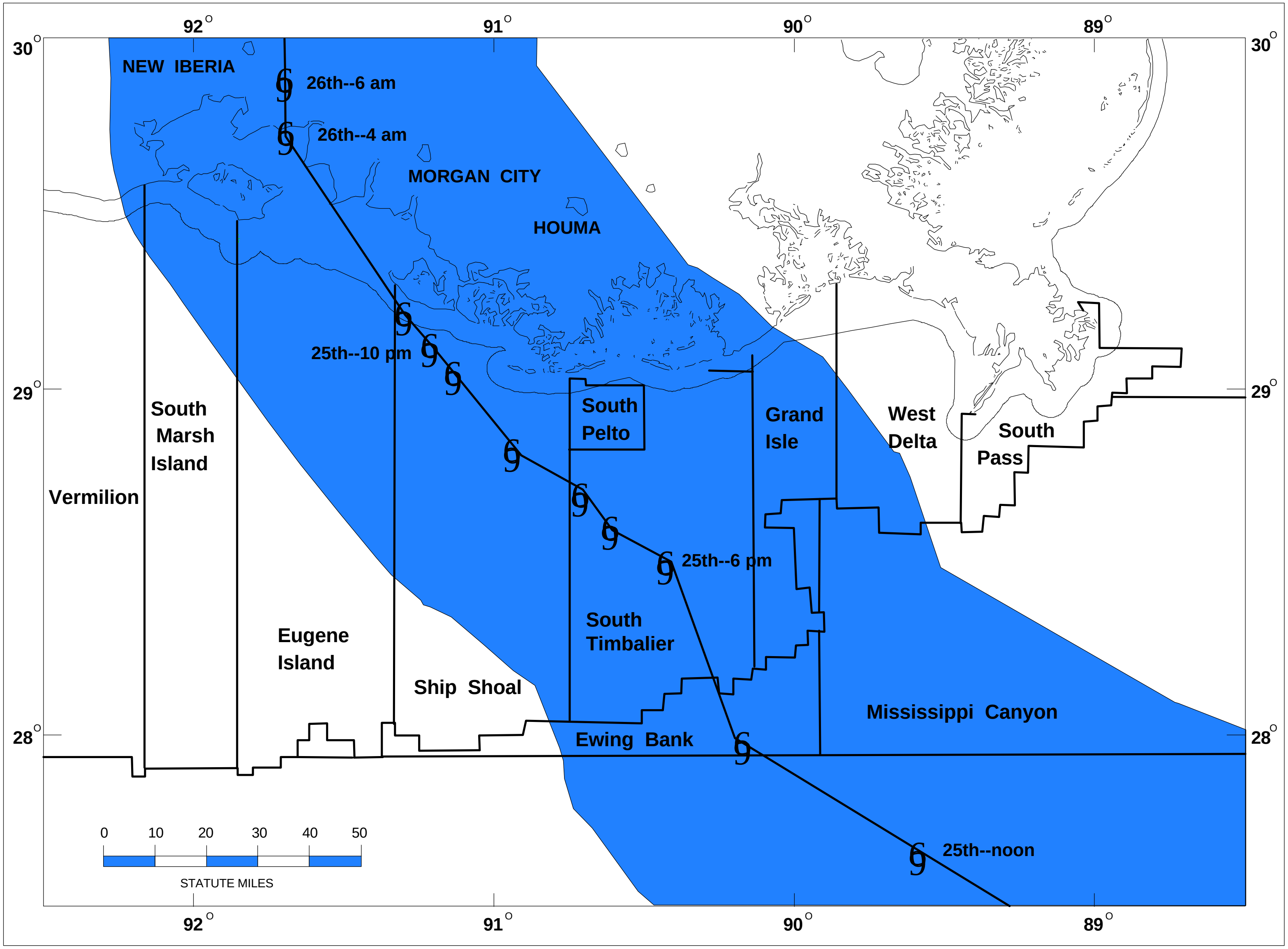
2.1A1 Damage to OCS Facilities from Hurricane Andrew

In August 1992, Hurricane Andrew traveled from the Atlantic Ocean into the Gulf of Mexico where it passed through intensively developed oil and natural gas areas of the OCS (Daniels, 1994). By the time it reached the OCS fields, Hurricane Andrew was a full category-4 storm with sustained winds of 140 mph and gusts to 160 mph, which generated significant wave heights estimated at 35 to 40 feet. Figure 2.1-16 shows the path of the hurricane's eye and the corridor affected by the storm. The OCS areas severely affected by the hurricane were in the Central GOM Planning Area: South Pelto, South Timbalier, Ewing Bank, Ship Shoal, and Eugene Island (Mandke et al., 1995).

As a precaution to the storm, OCS operators invoked emergency procedures, such as evacuating personnel, curtailing significant oil and natural gas production, depressurizing pipelines, and pumping away oil stored offshore. However, OCS facilities sustained a considerable amount of damage from Hurricane Andrew.

The MMS estimated that about 2,000 OCS facilities were exposed to hurricane force winds. Daniels (1994) and Mandke et al. (1995) reported the following damage to OCS facilities:

- 10 major platforms were completely toppled, and 26 were either leaning significantly or sustained topside damage
- 25 satellite wells were completely toppled, and 120 were leaning
- 10 mobile offshore units were damaged (5 of which were set adrift)
- 480 pipelines and flowlines failed (due to excessive pipeline movement on the seabed, damage to platform risers/riser tie-ins, or damage from anchors and anchor lines)
- 11 oil spills occurred (totaling about 2,300 bbl)
- 2 fires occurred (no reported fatalities, injuries, or equipment damages)



Source: Mandke et al., 1995

Figure 2.1-16. Map of Zone Included in Hurricane Andrew Damage Surveys

On September 17, 1992, the MMS issued Notice to Lessees and Operators (NTL) 92-07 to set standards for the damage surveys that were already underway by most of the OCS operators. The MMS required all operators to submit a plan for visual inspection of all structures and pipelines in an 85-mile-wide band, 50 miles to the northeast of the track of the hurricane's eye and 35 miles to the southwest of the track (fig. 2.1-16). By July 1993, 51 survey reports were filed covering 730 platforms/satellites and hundreds of miles of pipelines.

Because of the damage sustained by OCS structures, MMS initiated several studies to investigate various issues related to storm impact on offshore production facilities. As shown in Daniels (1994), some of the objectives of these studies included:

- developing a shallow-water hindcast model to predict waves and current fields associated with hurricanes for use in deriving the forces against facilities
- determining, for selected Hurricane Andrew platform failures, the accuracy of mathematical models devised for the prediction of such structural failures
- developing guidelines for the design of single-well caissons and for determining fitness for continued service of damaged single-well caissons
- assessing the integrity of the repairs to damaged platforms
- assessing procedures for securing mobile drilling units
- investigating the cases of offshore pipeline damage from Hurricane Andrew and recommending changes to current design and operating procedures
- assessing the performance of offshore safety and pollution control devices
- performing postmortem evaluations to develop a screening system for determining platform susceptibility to hurricane-induced failure

Information on the results of these studies and other MMS investigations involving Hurricane Andrew impacts to OCS structures can be obtained from the Engineering and Research Branch, 381 Elden Street, Herndon, Virginia 20170-4817.

Spilled oil was the OCS source with the greatest potential to damage the environment as a result of the hurricane. The hurricane caused 11 OCS oil spills, 10 of which were slicks or rainbows containing a total of approximately 300 bbl of oil. The eleventh spill was caused by a mobile offshore drilling unit, which had been in mothball anchorage at South Pelto Block 7, breaking loose during the hurricane. As the drilling unit drifted, its anchor punctured a 20-inch oil pipeline located on South Pelto Block 8 (see fig. 2.1-16), causing the release of about 2,000 bbl of oil into the sea (Daniels, 1994). Oil from the South Pelto Block 8 spill did reach shore, contacting approximately 30-40 miles of noncontinuous shoreline areas located in Lake Delto, Northwest Delto, Trinity Bayou, Flat Bayou, and Caillou Boca. However, there was a cleanup effort, which employed both manual and mechanical methods and equipment, such as use of skimmers, absorbent boom, work barges, air boats, and sorbent pads. Although all of the oil was not recovered, the damage from the spill was considered by the State of Louisiana Department of Environmental Quality to be minimal (oral commun., Alex Alvarado, GOM Region, February 1997). Also, the State of Louisiana, which was in charge of the cleanup effort, decided to leave the remaining oil in the marsh areas and wait for natural cleaning by the tides. They believed that it was better to let the tides remove the oil than to risk additional physical damage (crushing resources/habitat) to the marshes from the cleanup equipment that would be needed (Kerry St. Pé, Louisiana Department of Environmental Quality, February 1997). During subsequent overflights, Texaco observers noted that the impacted marshes appeared healthy and that there were no long-term effects from the spill (oral commun., Frank Torres, GOM Region, April 1997).

Overall, given that the physical damage to OCS oil and natural gas facilities from Hurricane Andrew was extensive, damage to the environment from OCS activities was minor. This is due, in part, to the advance planning, contingency plans, and reliable performance of automatic safety controls required by MMS of OCS operators in the GOM.

2.1A2 OCS Exploratory Drilling off the Florida Panhandle

Since 1969, 10 OCS lease sales were held in the Eastern GOM Planning Area, resulting in over 500 tracts being leased to qualified, successful bidders. Since FY 1990, the entire Eastern GOM Planning Area has been under annual congressional leasing moratoria. Additionally, the portion south of latitude 26° N. and east of longitude 86° W. was withdrawn from leasing consideration until after 2000. This executive directive also prescribed studies that must be completed before any further leasing would be considered in that area.

The MMS 5-Year OCS Natural Gas and Oil Leasing Program covering 1992 through 1997 scheduled one lease sale in the portion of the Planning Area that was not subject to the executive withdrawal. Congressional restrictions, however, have prevented initiation of the planning process for that proposed sale; subsequently, MMS deferred the sale in June 1995.

Offshore oil and natural gas exploration drilling is not new off Florida—exploratory activities have occurred there over the past two decades. The principal geologic target offshore the Florida Panhandle is the Jurassic Norphlet Formation. The extremely productive Norphlet Fields off Alabama are part of a deep Jurassic natural gas trend that extends across southern Mississippi and Alabama and into the Gulf of Mexico offshore the Florida Panhandle. Some shallow Miocene development is proposed in the westernmost portion of the Eastern GOM Planning Area.

As of December 1994, there were 159 existing leases in Eastern GOM areas not subject to the 1990 executive directive. From 1974 through 1994, 29 wells were drilled in the Pensacola and Destin Dome areas (see fig. 2.1-6), 6 of which resulted in natural gas discoveries. During the time period examined by this report, two exploratory wells were drilled: Destin Dome Block 97 (Chevron) and Desoto Canyon Block 177 (Amoco) (see fig. 2.1-11). Discussion in this section will focus on Destin Dome Block 97 due to its proximity to the Florida Panhandle—Desoto Canyon Block 177 is located over 100 miles south of the Florida Panhandle. [Note: In 1995, MMS approved Chevron's revised exploration plan (EP) proposing to drill an exploratory well on Destin Dome Block 57. A discussion covering this activity will be included in the next cumulative assessment report.]

Destin Dome Block 97: Destin Dome Block 97, located approximately 29 miles offshore Perdido Key, Florida, was leased December 18, 1985, by Chevron and partners under OCS Lease Sale 94. In 1990, Chevron submitted to MMS an EP proposing to drill a well on Block 97.

After extensive environmental/technical review of Chevron's proposal, the MMS approved the EP (see appendix B for the MMS review/approval process). This environmental evaluation included reviews by the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS). The FWS and NMFS reviews contained no objections to drilling the single exploratory well on Block 97. As a result of the EP review, MMS required Chevron to comply with several stipulations to further mitigate environmental impacts:

- establish an agreement with the Naval Air Station at Corpus Christi, Texas, to cover control of electromagnetic emissions and operations of boat and/or aircraft traffic within the military warning area W-155A
- adhere to the MMS hydrogen sulfide regulations found at 30 CFR 250.67
- use appropriate mitigation to lessen impacts associated with geologic hazards (shallow gas and faulting)

In addition to site-specific lease stipulations, Chevron complied with the following OCS Lease Sale 94 stipulations:

- **Protection of Archaeological Resources**—An archaeological resource is any prehistoric or historic district, site, building, structure, or object (including shipwrecks) in addition to related artifacts, records, and remains. An archaeological survey/report was not required for Block 97 because it is located outside of the Historical and the Prehistoric Cultural Resources high probability lines. However, Chevron was required to report to MMS the discovery of any site, structure, or object of historical or archaeological significance and make every reasonable effort to preserve and protect that cultural resource.

- **Protection of Live Bottom Areas**—The MMS defines live-bottom areas as seagrass communities or those areas containing biological assemblages (e.g., sea fans, sea whips, hydroids, anemones, ascidians, sponges, bryozoans, or corals) living upon or attached to naturally occurring hard or rocky formations with rough, broken, or smooth topography; or areas whose lithotope favors the accumulation of turtles, fishes, and other fauna. Chevron was required to submit with its EP a live-bottom and photodocumentation survey for the well site and the surrounding area within a minimum 1,000-m distance of the activity site. The photodocumentation survey did not reveal any live bottom areas (Continental Shelf Associates, Inc., 1990).

- **Military Warning Areas—**This stipulation contains three provisions:
  (1) holding the U.S. Government harmless (the lessee assumes the risk) for any damage to persons/property caused by any activities associated with the Naval Air Training Command located in Pensacola, Florida
  (2) requiring the lessee to monitor and control electromagnetic emissions emanating from a U.S. Department of Defense warning area (in this case W-155A)
  (3) requiring the lessee to enter into an agreement with the Naval Air Training Command concerning boat and/or aircraft traffic in the U.S. Department of Defense warning area

  Because Block 97 was located inside of W-155A, adherence with this stipulation was required.

- **Transportation—**This stipulation requires the lessee to use pipelines whenever:
  (1) rights-of-way can be obtained
  (2) it is technologically feasible and environmentally preferable
  (3) there is no net social loss when considering incremental costs of pipelines over alternative methods of transportation
  (4) there are any incremental benefits in the form of increased environmental protection or reduced multiple-use conflicts

  Because the activities conducted on Block 97 were exploratory, no oil or gas transportation was involved; therefore, adherence with this stipulation was not necessary.

Additionally, to comply with MMS regulations, Chevon prepared a site-specific oil-spill contingency plan. In this plan, Chevron committed to maintaining a vessel outfitted with a Fast Response Unit and additional cleanup and containment equipment near the drill site.

Although MMS approved the EP, the State of Florida objected to Chevron's consistency certification for the EP. Florida cited concerns with waste and pollution discharges, oil-spill containment, cumulative impacts, and wetland and natural resource protection. This consistency objection prohibited the MMS from permitting any proposed activities described in the EP. Chevron appealed Florida's consistency objection to the Secretary of the U.S. Department of Commerce (DOC), and the Secretary in 1993 overruled the State's decision. After the DOC decision, MMS approved Chevron's application for permit to drill.

As described in appendix B, in addition to MMS-granted permits, OCS operators must obtain other Federal permits to drill on the OCS. In 1991, the U.S. Environmental Protection Agency (EPA) issued Chevron a National Pollutant Discharge Elimination Systems (NPDES) general permit that covered the proposed discharge activities, and in

1994, EPA granted Chevron an air permit to cover emissions associated with the single exploration well on Destin Dome Block 97.

After fulfilling all of its Federal permitting requirements, Chevron began drilling in March 1994 and reached total depth (24,084 feet) in July 1994. In August 1994, Chevron announced that no natural gas was discovered in Block 97 to supplement existing discoveries on neighboring blocks.

The exploration drilling activities on Block 97 lasted less than 5 months, and no oil spills occurred during OCS operations there. Any effects to the water and air quality from the drilling were temporary and localized. For similar drill sites in the Eastern GOM, Shinn et al. (1993) suggests that the effects from the drilling are limited to a 1,000-m zone around the wellbore and that the area will recover over time (see discussion below). Given that a short amount of time has elapsed since drilling in Block 97 ceased in 1994, it is likely that a cuttings signature is evident very near the well site. However, given time, natural events (severe storms/hurricanes), and the usual infaunal burrowing, the sediments are likely to be dispersed or reworked.

Habitat Impacts of Offshore Drilling: Eastern Gulf of Mexico: The purpose of this U.S. Geological Survey study (Shinn et al., 1993) was to document site-specific environmental impacts from exploratory drilling activities in the northeastern Gulf of Mexico. In addition to documenting the drill sites visually with video and still photography, the study attempted to determine the spatial distribution of cuttings and drill muds. It was believed that this distribution data could be used to estimate the aerial extent of measurable impacts. The need for such data was also prompted by public concern over the effects of offshore drilling as well as a National Academy of Sciences, National Research Council (NRC), panel report on the adequacy of environmental information in OCS decisionmaking (NRC, 1989) and a Florida task force report on drilling impacts (State of Florida Governor's Report, 1989), both of which highlighted the lack of site-specific data. It was this lack of data that resulted in a drilling moratorium off southwestern Florida in 1990.

This study examined six well sites, the location of which varied from off northwest Florida to as far west as offshore Alabama. The surveyed wells had been drilled between 1972 and 1990 in water depths ranging from 21 to 149 m, with sediments varying from mud to coarse sand and pebbles. The ages of the sites (the time between cessation of drilling and the study observations) ranged from 15 months to 17 years. Data collection was accomplished by various methods: sample collection, underwater observations (video and still photography), and side-scan sonar (which had limited success).

The study results indicated that one variable, time, clearly had a large effect on the ultimate condition of the bottom and was the single most important factor in determining the nature of habitat recovery—the longer the passage of time, the more complete the recovery. Water depth was also found to be a factor affecting debris distribution; shallow water depth accelerated the normal effects of time. Shinn et al. (1993) also suggested that continued sedimentation and the reworking of sediment by infaunal burial would lead to complete burial of all evidence of drilling.

The occurrence of hurricanes affected the area as well—Passage of Hurricane Elena destroyed virtually all the deep seagrass beds in this area of the western Florida continental shelf. Thus, the amount of habitat recovery (especially the seagrass beds) from drilling impacts alone was difficult to determine because the effects of the drilling and the hurricane were confounded—the seagrass beds recovered from both the hurricane and drilling.

2.1A3 Flower Garden Banks National Marine Sanctuary

The National Marine Sanctuary Program is authorized by Title III of the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA) and is administered by the National Oceanic and Atmospheric Administration (NOAA). Through 1988 amendments to the MPRSA, Congress mandated that four sites (Flower Garden Banks, Western Washington Outer Coast, Cordell Bank, and Monterey Bay) be designated as national marine sanctuaries (NMS's) by prescribed dates—excluding Monterey Bay, these sites were already on NOAA's site evaluation list. Usually, marine sanctuaries are designated in areas without active oil and natural gas leases and existing operations. However, in the case of the Flower Garden Banks NMS, there were extensive ongoing oil and natural gas activities located in the immediate area.

The Flower Garden Banks are located about 120 miles off the Texas coast (see fig. 2.1-3) and contain the northernmost tropical Atlantic coral reefs on the continental shelf. These reefs support some of the most developed and productive offshore fishery habitats in the GOM. Since the early 1970's, the U.S. Department of the Interior (DOI), through MMS and its predecessors, promulgated special regulatory measures to safeguard these nationally significant resources from the effects of OCS activities. Developed in full cooperation with NOAA and several other Federal agencies, these measures include:

- establishing "no activity zones" to prohibit hydrocarbon activities directly over the banks
- establishing a 4-mile "buffer zone" to restrict hydrocarbon activities in the vicinity of the banks (for example, restricting effluent discharges and anchoring by oil and gas operations)

Since the mid-1970's, MMS, its predecessor agencies, or oil companies have funded studies of the community characteristics on the Flower Garden Banks in conjunction with development of OCS leases. Data collected from these studies have allowed for long-term comparisons with data collected during the MMS-sponsored Texas A&M University study conducted from 1989-199l (Gittings et al., 1992).

The study objectives included:

- providing relevant and timely data to decisionmakers charged with developing policies concerning oil and natural gas exploration and development in the vicinity of sensitive ecosystems
- documenting long-term changes in reef-building and associated communities at the Flower Garden Banks caused by impacts of either petroleum exploration and development or other human activities
- documenting long-term natural variations in reef-building and associated communities on the banks

In 1988 and 1989, study sites for the long-term monitoring were established on the East and West Flower Garden Banks. From 1988 through 1991, semiannual monitoring of coral cover, relative dominance, diversity, evenness, and accretionary and encrusting growth rates found the following (Gittings, 1992):

- No significant long-term changes were detected in coral reef populations, cover, or diversity since quantitative surveys of the reefs began; no evidence of downward trends or deterioration.

- Growth rates (retreat and advance) were dictated by natural factors, such as competition for space, rather than man-induced stress.

- While barium incorporation rates analyzed from a coral core were higher than those reported from the Florida Keys, the observed levels did not seem to affect coral growth or other essential function—a finding that the authors suggest may require further investigation.

- The potential for discharged contaminants to reach and affect the reef communities was minimized by the required shunting of discharges within 10 m of the bottom and by negligible upward transport by currents.

- Demonstrable human impacts were limited to mechanical destruction caused by anchors and debris (primarily anchors, chains, and cables) on the reefs.

Offshore activities can coexist with effective protection of sensitive environmental resources, as illustrated by Texaco USA's agreement to reroute its pipeline to service Garden Banks Block 189. In its October 1991 application, Texaco USA requested that the MMS approve an oil pipeline right-of-way near the East Flower Garden Bank. In light of the pending designation of the Flower Garden Banks as an NMS and after consultation with both MMS and NOAA, Texaco USA agreed to adopt a more lengthy and costly pipeline route completely outside of the pending marine sanctuary. This new route enhanced the protection of the sensitive resources at the East Flower Garden Bank and allowed industry to develop the oil and natural gas resources in a timely manner.

When NOAA designated the Flower Garden Banks NMS in January 1992, it recognized the effectiveness of the MMS-promulgated measures by incorporating them into the regulatory protective scheme for the newly designated NMS. As a component of the NMS, the coral reefs at the Flower Garden Banks will be protected permanently from anchoring, dredging, hydrocarbon development, and other activities that may cause destruction of the fragile reef communities. Additionally, MMS was recognized by NOAA in 1996 for providing 20 years of protection for this area, specifically for its commitment to funding surveys, research, and monitoring on the banks. The MMS also received the 1996 Federal Environmental Quality Award for environmental work done in the Flower Garden Banks.

2.1A4 MMS Archaeological Rulemaking

Archaeological resources include historic shipwrecks and submerged prehistoric sites. As shown in the statements below, oil and natural gas exploration and production activities have the potential to affect both prehistoric and historic archaeological resources on the OCS.

- Dredging, anchoring, and siting drilling rigs, production platforms, and pipelines could destroy artifacts or disrupt the provenience and stratigraphic context of artifacts, sediments, and paleoindicators.
- Oil spills could destroy the ability to date prehistoric sites by radiocarbon dating techniques.
- Ferromagnetic debris associated with OCS natural gas and oil activities would tend to mask magnetic signatures of significant historic archaeological resources.

To protect these resources, the Archaeological Resource Stipulation was established in 1973 requiring the OCS lessee to conduct lease-specific archaeological resource surveys in those areas having a high potential for archaeological resources. **If a potential archaeological resource is identified, the operator is required to avoid it or to conduct additional studies to determine its significance.** Where possible, operators have chosen to avoid the potential resource identified. This stipulation was found to effectively protect archaeological resources from OCS activities (Bornholdt and Lear, 1995).

Because the Archaeological Resource Stipulation applied to all leases without exception since December 1973, MMS thought it was a good candidate for conversion into regulation. On October 21, 1994, the MMS published in the *Federal Register* the final rule (30 CFR Parts 250, 256, 280 and 281) regarding archaeological resource surveys/reports on OCS lease tracts. Effective November 21, 1994, this rule replaced the 1973 Archaeological Resource Stipulation. In the new Archaeology Rule, the original wording of the lease stipulation remains unchanged, and the process for invoking the requirement for an archaeological resource survey/report has also remained unchanged. However, due to the nature of a regulation versus the nature of a lease stipulation, one change did result from this conversion—inclusion of pre-December 1973 leases.

An OCS lease stipulation is part of a lease-specific contractual agreement between the lessee (company) and lessor (MMS). In those leases issued prior to December 1973, there was no Archaeological Lease Stipulation; and, therefore, no mechanism for the MMS to subsequently require an archaeological resource survey, even when later baseline studies indicated that there was potential for archaeological sites to occur on those leases. When the MMS converted the provisions of the Archaeological Resource Stipulation into regulation, there was no logical reason or valid mechanism to continue to exclude those pre-December 1973 leases from the archaeological resource survey requirement. However, MMS may exclude an OCS lease from this requirement if the lease area has been so extensively developed that a survey would be logistically impossible and any survey results would be almost useless because of existing magnetic structures and debris.

The effect of converting the Archaeological Resource Stipulation to a regulation was increased protection for archaeological resources on pre-December 1973 OCS leases. Under the auspices of the Archaeological Rule **all** OCS leases, regardless of issue date, must comply with the archaeological resource survey requirement.

2.1B Matters of Interest

For the period 1992-1994, the following issues were discussed because they were identified in the last cumulative effects report as causing or sustaining cumulative effects (Bornholdt and Lear, 1995):

- drilling discharges (Gulf of Mexico Offshore Monitoring Experiment)
- coastal wetlands
- socioeconomics

The GOM regional office selected the following issues for discussion because of their particular interest to OCS stakeholders:

- air quality
- naturally occurring radioactive material
- oil spills
- chemosynthetic communities
- platform abandonment/removal
- marine debris

2.1B1 Air Quality

Air emissions result from routine OCS oil and natural gas operations, such as exploratory drilling, construction, development/production activities, transportation of crude oil, and support vessels and helicopters. Nonroutine emissions result from accidental events, such as oil spills and blowouts.

Most of the air emissions are in the form of nitrogen oxides (NO_x) from power generation equipment (such as gas turbines on platforms and diesel engines on rigs), pumps, and crew and supply boats. Air emissions from OCS operations also appear in the form of volatile organic compounds (VOC), sulfur dioxide (SO_2), particulate matter (PM), and carbon monoxide (CO). The main sources of VOC emissions are glycol dehydration of natural gas, transfer and transport operations of liquid hydrocarbons, and from fugitive sources (such as tanks, seals, and flanges) on platforms. Emissions of SO_2 come from fuel combustion, gas processing, and flaring. Potentially large amounts of SO_2 can be emitted from facilities producing sour natural gas (gas that contains a relatively high concentration of sulfur). Only small quantities of PM and CO are emitted from OCS operations, primarily from diesel engines.

Table 2.1-1 presents the annual average emissions from all OCS oil- and natural gas-related activities in the GOM. The calculations are derived from equipment inventories and fuel consumption data collected from the operators by the MMS for June 1991 through May 1992 (Systems Application Inc. (SAI) et al., 1995). Although these data cover only a portion of this 1992-1994 report period, the emission levels remained consistent throughout the entire period because the extent of OCS activities remained relatively constant throughout this time.

Table 2.1-1. OCS Annual Average Air Emissions in the Gulf of Mexico

Activity	Pollutant Emissions (tons)				
	NO_x	SO_x	PM	THC	CO
Platform Equipment	94,379	164	1,720	38,346	21,421
Flares and Vents	104	--	--	229,679*	567
Gas Sweetening	--	15,705	--	--	--
Storage Tanks	--	--	--	10,646	--
Fugitive Emissions	--	--	--	9,139	--
Support Vessels/Barges	10,682	46	626	846	2,600
Helicopters	205	--	--	171	493
Surveying/Explor. Drill	19,301	44	627	769	2,169
Pipeline Vessels	22,022	108	1,470	4,428	4,104
Total	**146,693**	**16,067**	**4,443**	**294,024**	**31,354**

SO_x — sulphur oxides.
THC — total hydrocarbons (including reactive as well as nonreactive compounds).
* About 90% consists of methane (nonreactive hydrocarbons).

Source: Data collected from June 1991-May 1992 (Systems Application, Inc. et al., 1995).

(a) Ozone Study

Ozone is formed by the photochemical interaction of NO_x and VOC. Conditions are most favorable for ozone formation during periods when atmospheric mixing is limited and the amount of solar radiation is high. The potential impact of OCS emissions on ozone in coastal areas of Texas and Louisiana and issues related to NO_x and SO_2 impacts were investigated through an air pollution study (SAI et al., 1995) and with cooperative oversight by Texas, Louisiana, EPA, MMS, and the offshore industry.

Emissions of NO_x and VOC from OCS activities are relevant to ozone nonattainment because nonattainment events occurred along the OCS. Many areas in southeastern Texas and southern Louisiana are in violation of the Federal ambient air quality standard for ozone, which is 0.120 parts per million (ppm) for the maximum 1-hour average concentration. Areas that do not meet this standard are classified by the EPA as ozone nonattainment areas.

The data analysis and modeling indicated that OCS emissions have only a minor effect on onshore ozone concentrations during periods when the Federal ozone standard is exceeded. The model simulations showed that when the predicted 1-hour average ozone concentrations in the Houston/Galveston and Beaumont/Port Arthur areas of Texas exceeded the Federal standard of 0.120 ppm, the contribution from emissions due to OCS oil and natural gas production was less than 0.002 ppm. When the predicted 1-hour average ozone concentrations in the Baton Rouge, Louisiana, area exceeded the Federal standard, the contribution from emissions due to OCS oil and natural gas production was in the range of 0.000 to 0.002 ppm.

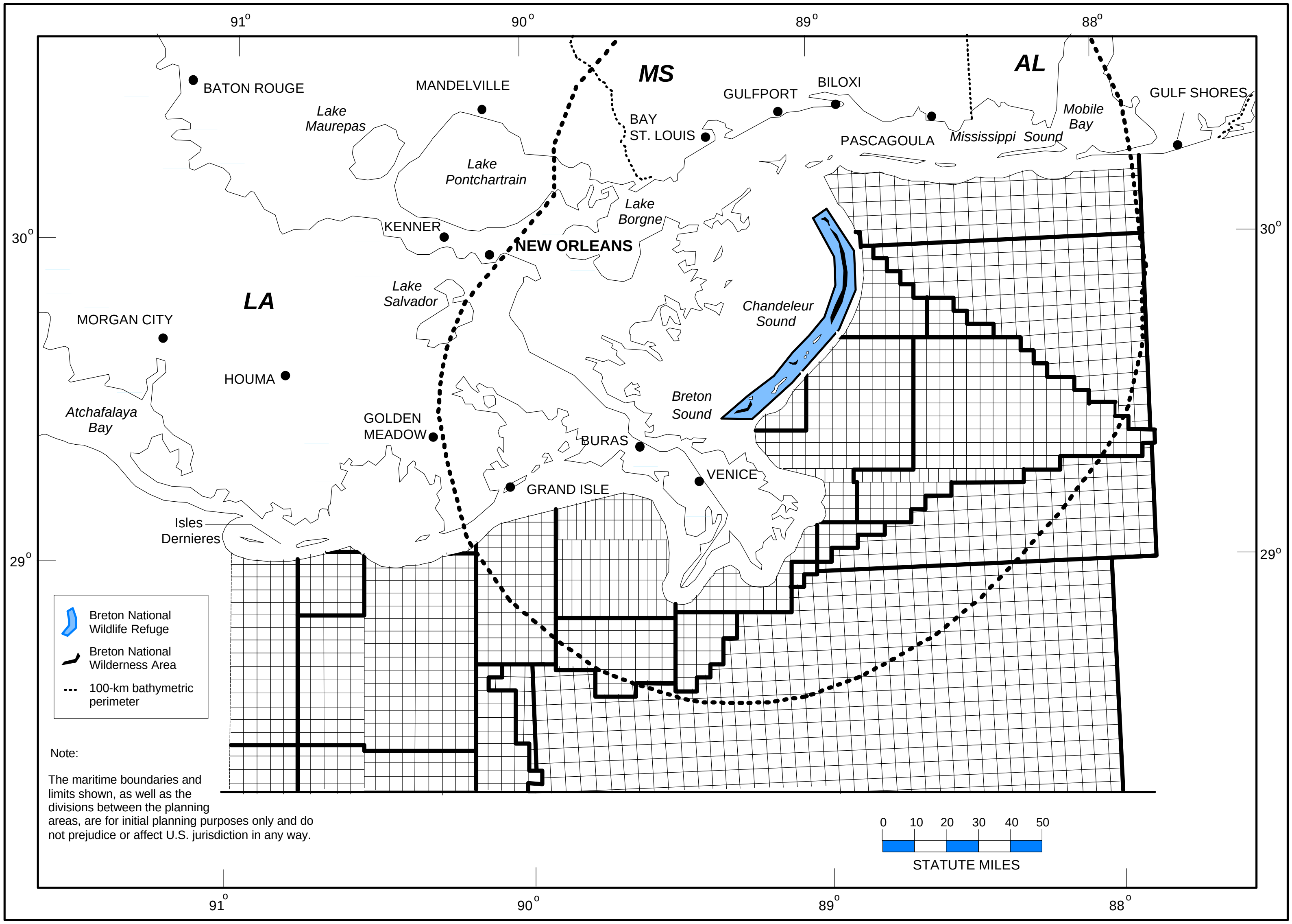
The MMS, in consultation with EPA, is using these study results to determine if existing regulatory requirements for OCS emission sources are adequate to prevent adverse effects on ozone nonattainment areas.

(b) Breton Class I Area

The Breton National Wildlife Refuge (see fig. 2.1-17) was established in 1904 and is managed by the FWS. This refuge provides nesting sites for the loggerhead turtle and numerous birds, including several endangered species (such as the piping plover, brown pelican, and peregrine falcon). In 1974, most of the refuge was classified as a national wilderness area (NWA).

The area adjacent to the Breton NWA has a considerable concentration of oil and natural gas production activities and some sulfur mining. The issue of air quality has received increasing attention recently because OCS activities in this area have the potential of affecting the air quality in the Breton NWA.

The 1977 Clean Air Act Amendments (CAAA) established the Prevention of Significant Deterioration (PSD) program, which was designed to control the amount of air quality degradation in areas where the air quality is better than the national ambient standards.



Source: Adapted from MMS Gulf of Mexico source maps, 1994.

Figure 2.1-17. Area Showing a 100-Kilometer Perimeter Around Breton National Wildlife Refuge

Class I areas are allowed very little air quality degradation, while Class II areas are allowed larger amounts. The Breton NWA was among the parks and wilderness areas where Class I designation was mandated by the 1977 CAAA.

The PSD regulations establish maximum allowable increases in concentration with respect to a baseline level for several types of pollutants. Currently, established increments for SO_2, PM-10, and nitrogen dioxide (NO_2) are as shown in table 2.1-2.

In 1992 and 1993, there were a number of incidents at a particular oil, natural gas, and sulfur facility where the sulfur recovery equipment failed and all of the sour gas was flared, thereby causing very large SO_2 emissions (in some cases, as much as 75 tons/day). Due to the repeated nature of these events, the MMS asked the operator to explain the equipment failures, to perform an analysis of the air quality impacts, and to present a plan for remedying the situation. Subsequent air quality modeling by MMS indicated that the

Table 2.1-2. Maximum Allowable SO_2, NO_2, and PM-10 Increments for Class I Areas

Emission	Annual Concentration	24-Hour Concentration	3-Hour Concentration
SO_2	2µg/m^3	5µg/m^3	25µg/m^3
NO_2	2.5µg/m^3	--	--
PM-10	5µg/m^3	10µg/m^3*	--

* Concentration not to be exceeded more than once per year.

SO_2 emissions during these episodes could possibly cause concentrations in the Breton NWA to significantly exceed the PSD Class I incremental limits for SO_2. Following extensive discussions with the operator, the MMS ordered the company to curtail production whenever any such episode occurred and presented the operator with a timetable for doing the necessary modifications to prevent similar breakdowns. In 1994, the company replaced the Claus unit (a sulfur recovery unit where most of the hydrogen sulfide is reduced to elemental sulfur), and no incidents were reported for the rest of this report period.

These incidents brought to the forefront the issue of determining whether air quality levels in the Breton NWA were within the maximum allowable limits under the PSD program. The FWS has stated that the maximum allowable increment may already have been exceeded due to the cumulative effect of onshore industrial growth and offshore development. However, a comprehensive assessment of emissions and an analysis of impacts using an appropriate air quality model would be needed to make a more definite conclusion. In 1994, MMS and FWS began discussions with EPA, the States, and industry to formulate a cooperative plan to conduct such a study. The study under consideration would involve a meteorological and air quality data collection program, development of an emissions inventory, and air quality modeling.

Meanwhile, starting in 1993, the MMS sponsored an air quality monitoring program in the Breton NWA. During the initial monitoring period in the summer of 1993, SO_2 was monitored at three sites, along with wind direction and speed and some limited upper air soundings. Starting with the 1994 field program, two of the monitoring stations were also equipped with instrumentation for measuring NO_x, NO (nitric oxide), and NO_2. The highest observed 3-hour and 24-hour average SO_2 concentrations were 36 and 7.5 $\mu g/m^3$, respectively (Hsu, 1996). While the period of record is not long enough to compare measurements with the ambient air quality standards, the values obtained represent less than 3 percent of the ambient standard for SO_2. At Breton Island, the average hourly NO_2 concentration for the period was 3.8 $\mu g/m^3$. This figure represents about 4 percent of the ambient standard. Comparisons with the PSD maximum allowable limits are not possible because no measurements are available for the PSD baseline year. Compliance with the PSD standards can only be determined through air quality modeling.

The MMS also consults with the FWS during review of any OCS exploration or development/production plan that would result in emissions greater than 250 tons/year and that are located within 100 km of the Breton NWA (see fig. 2.1-17).

2.1B2 Drilling Discharges—Gulf of Mexico Offshore Operations Monitoring Experiment

One of the more significant environmental issues related to OCS oil and natural gas development and production activities is identifying chronic, low-level stresses from these activities on individual organisms, populations, and ecosystems. Specific concerns associated with this issue include:

- effects from drilling fluids/cuttings and produced waters at the points of discharge
- surface sediment disturbance and texture alterations associated with operating large, multiple-well offshore facilities
- composition and dispersal patterns of OCS-related discharges

To develop early warning monitoring procedures that could warn of any potential harm being done to marine environments from OCS oil and natural gas production facilities, the MMS has funded a three-phased study, the Gulf of Mexico Offshore Operations Monitoring Experiment (GOOMEX). Phase I, conducted by Texas A&M Research Foundation (Kennicutt, 1995), started in 1992 and investigated the biological communities, the chemical contamination, and biochemical responses of resident biota beneath three OCS production platforms in the northwestern GOM. Phase II, as planned, would review and evaluate the possibility of using the testing procedures developed in Phase I as the standard procedures for monitoring the environmental effects of OCS operations. Phase III, contingent upon results of the previous two phases, will continue the measurements selected in Phase II as routine testing for OCS operations.

The primary objectives of Phase I were (1) to document detoxification responses in resident fauna from exposure to contaminants at long-term OCS production sites and (2) to determine impacts resulting from such contaminant exposure at the organism, population, or community level.

The findings associated with various aspects of GOOMEX Phase I (Kennicutt, 1995) are summarized below.

- In general, the platforms had little effect on the seawater that flowed past them.

- Visual examination showed that sediment texture changed with distance from the platform; sediments close to the platform were enriched in sand. Most of this increase in sand content appeared to be related to disposal of cuttings during drilling activities.

- Inorganic carbon generally increased near platforms. This increase was probably from shell debris of animals that inhabit the area near platforms (such as barnacles and clams) because the platform provides the type of structure on which these organisms can live.

- No significant bioaccumulation of hydrocarbons was observed in the soft tissues of megafaunal invertebrates or in the livers and stomach contents of fish residing near the platforms. No significant bioaccumulation of metals in invertebrates or fish was associated with proximity to the platform.

- All of the significant toxicity of the pore water tested, which appeared to be related to the higher level of metal contamination found at some of the sites, was found within 100 m of the platform. These waters were toxic to the three test organisms: a sea urchin, a polychaete, and a copepod.

- The abundance of meiofauna (organisms that live in the space between sand grains, such as copepods and nematodes) was consistently lower near platforms, especially where contaminants were highest. This pattern is consistent with previous studies of copepod sensitivity to toxic chemicals.

- Macroinfauna abundance and the numbers of macroinfauna species (especially polychaetes) were greatest within 100 m of the platforms. However, the abundance and types of amphipods (crustacea with usually seven pairs of legs) and foraminifera (shelled protozoans) were lower near platforms. This is reasonable considering the known sensitivity of these organisms to toxic contamination exposure.

- Few observed effects on megafauna (large organisms such as crabs, shrimp, and fish) could be directly attributed to proximity to platforms or contaminant exposure. The patterns of the factors examined (such as parasites and diseases) varied among the platforms studies and were consistent with natural occurrences.

- No discernable differences in enzyme activities (using biochemical indicators of organic contaminant exposure) were found in fish sampled at the various platform sites.

Phase I provided information critical to leasing decisions and improving operating procedures. It also recommended continuing studies to explain the patterns observed during Phase I. As planned, Phase II would provide additional information concerning the long-term, chronic, low-level effects of offshore oil and natural gas development and production on the marine environment. [Note: The MMS has identified GOOMEX Phase II as one of its highest priority information needs—to be initiated by the Biological Resources Division of the U.S. Geological Survey if funding becomes available.]

2.1B3 Naturally Occurring Radioactive Material

Naturally occurring radioactive material (NORM) exists in many geologic formations, usually in extremely low concentrations. However, during the production of oil and natural gas, radioactive isotopes such as radium 226 (^{226}R) and radium 228 (^{228}R) can co-precipitate out of the production stream with barium, forming a barium sulfate scale in the production tubing and processing equipment. Produced sands, produced waters, and the sludge that accumulates in the bottoms of tanks and vessels may also contain very low levels of radium.

The "curie" is a measure of radioactivity equivalent to the activity of 1 gram (gm) of pure radium, or 37 billion disintegrations per second. The activity of NORM is measured in "picocuries" (pCi), which is one-trillionth of a curie, or 0.037 disintegrations per second. Typical background levels of NORM range from 1.0 to 17.0 pCi/gm in marine sediments and from 0.05 to 2.0 pCi/liter in open-ocean waters. The levels of NORM (^{226}R and ^{228}R) in oil and gas wastes range from tens of pCi/gm in produced sands to several thousand pCi/gm for barium sulfate scales containing radium.

During 1992-1994, there were three offshore disposal methods employed for oil and natural gas wastes containing NORM:

- downhole disposal of oil and gas wastes
- overboard discharge of produced sands
- discharge of produced waters

Discharges from the offshore oil and natural gas industry are regulated by the EPA through its permitting program established under the Clean Water Act. As amended, the Clean Water Act requires EPA to establish guidelines for discharges and to authorize discharges in U.S. waters by issuing NPDES permits. The NPDES permits apply to all sources of wastewater discharges from exploratory vessels and production platforms operating on the OCS.

(a) Downhole Disposal

In 1991, the MMS began allowing downhole disposal of oil and gas wastes containing NORM. There are two methods of downhole disposal: encapsulation and injection. *Encapsulation* is accomplished by sealing NORM wastes in a well casing as the well is being plugged and abandoned. The perforations open to the producing formation are squeezed with cement to isolate the wastes from the formation. These wastes are isolated above and below by cement plugs and/or cast iron bridge plugs within the well casing. *Injection* involves pumping a slurry containing NORM wastes into a discrete suitable geologic formation through perforations in the well casing. Extensive geologic evaluation of the strata to receive the injected material is undertaken. The MMS scientists look for geologic formations sealed by impermeable rock layers to ensure that the injected material remains where it is placed.

During 1992 through 1994, the MMS approved 53 applications for encapsulation (6 of which were later canceled) and 5 applications for injection (2 of which were later canceled). Of the three injections that were completed, two involved the same OCS well.

Encapsulation places wastes containing NORM more than 1,000 feet below the seafloor. The viscosity, specific gravity, and extremely low water-solubility of the NORM wastes, as well as the criteria used in selecting an appropriate wellbore for encapsulation, make it extremely unlikely that any of the NORM will ever enter the marine environment. Injection typically places wastes containing NORM more than a mile below the seafloor. The criteria used to select an appropriate disposal formation and the fact that the formation is isolated above and below with impermeable shale ensure that the wastes will neither re-enter the wellbore nor enter the marine environment. The MMS has prepared an Environmental Assessment that discusses these disposal methods in more detail (MMS, 1996b).

Three of the Gulf Coast States (Texas, Louisiana, and Mississippi) have published regulations regarding the disposal of oil and natural gas wastes containing NORM. These regulations include guidelines for encapsulation of oil and natural gas wastes containing NORM in plugged and abandoned onshore wells and allow injection (without fracturing) of these wastes into onshore Class II injection wells.

In April 1994, the State of Louisiana licensed the Campbell Wells Nonhazardous Oilfield Wastes/NORM Treatment Facility, which can accept oil and natural gas wastes containing NORM with $^{226}Ra/^{228}Ra$ concentrations up to 200 pCi/gm. In October 1994, the State of Texas licensed the Newpark NORM Treatment and Processing Facility. In 1994, this facility could accept oil and natural gas wastes containing NORM with activity levels up to 2,000 pCi/gm. The license for the Newpark facility was amended on June 6, 1995, to allow acceptance of oil and natural gas wastes containing up to 6,000 pCi/gm of ^{226}Ra. The opening of these two onshore NORM treatment and processing facilities initiated a decline in the number of applications for downhole disposal on the OCS.

(b) Overboard Discharge of Produced Sands

The MMS allowed the overboard discharge of produced sands (i.e., well solids) until January 3, 1994, when EPA Region 6 (Central and Western GOM) issued a new NPDES general permit that implemented a "zero discharge" limit. The MMS allowed the overboard discharge of produced well solids provided certain criteria (outlined in a Letter to Lessees dated December 11, 1991) were met, such as:

- The discharge site could not be close to a biologically sensitive area.
- The discharge must be consistent with the NPDES general permit.
- A one-liter sample of the material to be discharged must have a radiation dose equivalent rate of less than 25 microroentgens/hr above background level.
- The volume of well solids to be discharged could not exceed 100 bbl/day.
- The total amount of radium discharged at any one location could not exceed 50,000 microcuries.

During 1992 through 1994, the MMS allowed overboard discharges totaling approximately 25,670 barrels of produced well solids at 42 different GOM locations. The total amount of radium contained within these well solids was 97,635 pCi, as reported by industry. Two studies on the amount of radium contained in produced waters and produced sands were undertaken during the report period, one by the U.S. Department of Energy and one by Brookhaven National Laboratory.

The U.S. Department of Energy began conducting a multiyear study entitled, *Environmental and Economic Assessment of Discharges from Gulf of Mexico Region Oil and Gas Operations*. One of the objectives of this study is to evaluate the environmental fates and impacts of NORM in GOM offshore produced waters and sand discharges. The study was not completed at the time of this report, but an interim report (Continental Shelf Associates, 1995) was prepared.

As found in the Brookhaven National Laboratory study (Meinhold et al., 1993) discussed below, the lifetime risks to the most sensitive subpopulations for the ingestion of radium discharged in produced waters is small. Thus, one can assume that the risk for ingestion of radium associated with produced sands would be similar or perhaps even less.

(c) Discharge of Produced Waters

Produced waters (also known as production water or produced brine) is the total water discharged from the oil and natural gas extraction process and constitutes the largest single source of material discharged during normal oil and natural gas operations. It is estimated that OCS wells produce approximately 400 to 500 million barrels of produced waters per year. Although produced waters may contain NORM, its discharge from OCS platforms is not regulated by the EPA's New Source Performance Standards published March 4, 1993.

The study, *Human Health Risk Assessment for Radium Discharged Offshore in Produced Waters,* was completed by Brookhaven National Laboratory, Department of Applied

Science (Meinhold et al., 1993), for the U.S. Department of Energy. This study assessed the potential for increased human exposure to radium and increased health risk from ingesting marine resources harvested near produced waters discharge sites. The study focused on the average lifetime risk for the two most susceptible user groups, platform workers and recreational fishermen.

Two types of risk assessment were conducted:

- a direct risk assessment based on actual measured radium concentrations in edible fish near three GOM platforms
- a predictive risk assessment based on modeling a range of potential discharge rates and radium concentrations using predicted dilution and concentration factors.

The results of the direct risk assessment indicate a median individual increase in lifetime fatal cancer risk for recreational fishermen from 2.8 to 7.0 in one million and for platform workers from 1.6 to 3.9 in one million. These direct risk assessment estimates can be considered worst-case, because the three platforms studied are in shallower water than most offshore platforms and discharge average or above average amounts of produced waters containing radium.

The results of the predictive risk assessment indicate a median individual increase in lifetime fatal cancer risk for recreational fishermen of 1.7 in ten million and for platform workers who fish an increase of 9.7 in one hundred million. The results of this study indicate that the lifetime risks to the most sensitive subpopulations for the ingestion of radium discharged in produced waters are small; in fact, they are much smaller than EPA's published standards for acceptable risk (Meinhold et al., 1993).

Data available from these studies indicate that there has been no significant effect to human health or to the marine environment from the overboard discharge of produced sands and produced waters, or from downhole disposal of oil and gas wastes containing NORM.

2.1B4 Oil Spills

For purposes of this report, an OCS-related oil spill is an accidental release of crude oil or condensate from an OCS-related activity. The severity of environmental impacts from crude oil spills depends on the chemical composition and physical properties of the spilled oil. Although the composition of OCS oil may vary from area to area, all crude oils contain a combination of hydrocarbon and nonhydrocarbon components. The principal types of hydrocarbons found in crude oil are alkanes, cycloalkanes, and aromatic hydrocarbons (NRC, 1985). Among these groups, the aromatic hydrocarbons (e.g., benzene and toluene) are considered to be the most toxic to marine life.

The chemical and physical properties of spilled oil change with time, and the rate of change depends upon both the initial chemical composition of the oil and "weathering" or aging. Weathering processes are reviewed in detail by NRC (1985). Generally speaking, the longer spilled oil is weathered, the fewer ecologically damaging constituents it will contain. Weathering tends to reduce the toxicity of spilled oil because many of its toxic components are lost through evaporation, dissolution, or degradation from photo-oxidation and microbial activity. The impacts caused by heavily weathered oil (e.g., tars and resins) are generally related to its physical rather than its chemical properties.

Usually after oil is spilled onto the water, an oil slick forms. Currents, waves, and winds spread the slick into thin films. The slick dispersion rate is directly influenced by sea state; the higher the sea state and breaking waves, the more rapid the dispersion rate (Mackay, 1985). As the slick spreads, the lighter, more toxic components (e.g., benzene and toluene) quickly evaporate. Evaporation can remove up to 50 percent of the oil from the water within a few days of the spill (NRC, 1985). Many of the lighter hydrocarbons can also dissolve in the water. However, only a small percentage (1-5%) of spilled oil generally goes into solution. Other processes also remove oil from the marine environment, such as sedimentation, photo-oxidation, and microbial breakdown.

During 1992-1994, there were 77 small OCS spills in the GOM, resulting in a total spillage of 1,001 bbl, and 2 large OCS pipeline spills (> 1,000 bbl) resulting in a total spillage of 6,533 bbl.

One of these large pipeline spills (2,000 bbl) occurred in 1992 during Hurricane Andrew (see *2.1A1 Damage to OCS Facilities from Hurricane Andrew*). A mobile offshore drilling unit, which had been in mothball anchorage, broke loose during the hurricane. As the drilling unit drifted, its anchor punctured a 20-inch pipeline located in South Pelto Block 8, causing the release of about 2,000 bbl of oil into the sea (Daniels, 1994). Although this spill did contact land, the damage was minimal (oral commun., Alex Alvarado, GOM Region, February 1997), and after some organized cleanup effort, the State of Louisiana decided to leave the remaining cleanup to natural processes (Kerry St. Pé, Louisiana Department of Environmental Quality, February 1997). Overall, given that the physical damage to OCS oil and natural gas facilities from Hurricane Andrew was extensive, damage to the environment from OCS activities was minor. This is due, in part, to the advance planning, contingency plans, and reliable performance of automatic safety controls required by MMS of OCS operators in the GOM.

The other large spill occurred in 1994 when a trawl hung up on and damaged a 4-inch pipeline in Ship Shoal Block 281, resulting in a total spillage over several days of 4,533 bbl of condensate. It was assumed that the leak began on November 16, 1994 (when losses were first observed on the loss/gain daily report; losses were initially contributed to metering problems). However, losses continued, which led to an investigation and discovery of the source of the leak by a diving team on November 23. Consequently, the pipeline system, which originated at Platform JA, was shut in. Repairs to the pipeline were completed on December 25, 1994, and the pipeline was placed back in service on December 26, 1994. Aerial observation of this spill revealed a 1-mile by 2-mile sheen directly over the spill site, which was approximately 50 miles offshore. Being a condensate spill, it dissipated quickly and did not contact shore (oral commun., Alex Alvarado, GOM Region, April 1997).

2.1B5 Chemosynthetic Communities

Chemosynthetic communities are defined as persistent, largely sessile (nonmotile or attached) assemblages of marine organisms dependent upon symbiotic bacteria for their energy source (MMS, 1992a). Chemosynthetic communities have been discovered in association with hydrocarbon seeps in the northern GOM. Found typically in waters deeper than 400 m, Chemosynthetic organisms derive their energy from Chemosynthetic processes rather than the photosynthetic processes of lighted shallow-water communities. Large benthic organisms that are predominant in these communities include tube worms, clams, and mussels, which feed on petroleum hydrocarbons or hydrogen sulfide.

High-density and high biomass communities, such as those found in the area know as "Bush Hill" (in the Green Canyon area of the northcentral GOM), are associated with hydrocarbon seeps and natural gas- and/or oil-charged sediments. These areas are considered at risk from OCS oil and natural gas operations because of their very slow growth rates. Because this type of community has only recently been studied (since 1984 in the Gulf), its vulnerability and recoverability are only now being researched. To determine the geological, geochemical, physiological, and ecological factors that control the formation and continued existence of these communities, the MMS initiated the Northern Gulf of Mexico Chemosynthetic Ecosystems Study (discussed below) in 1991. The MMS undertook this study as an initial step to protect the chemosynthetic communities from possible harmful OCS-related impacts. Remote sensing instruments, bottom samplers, and manned submersibles were used to collect samples and data to determine the biological composition of these communities and the physical-chemical factors that influence or limit their distribution, abundance, and growth. This study provided important new data for a limited number of sites believed to be representative of upper continental slope chemosynthetic communities.

The OCS-related activities affecting deep-water benthic communities are those that disturb the bottom: anchoring, drilling, pipeline installation, and seafloor blowout accidents. Routine OCS-related effluent discharges such as muds, cuttings, and sanitary wastes generally do not affect chemosynthetic communities because of the rapid dilution and dispersion of effluent components in deep water. In addition, MMS NTL 88-11 prevents OCS-related activities from adversely affecting these communities.

The MMS NTL 88-11 (effective February 1, 1989) requires the mandatory identification and avoidance of "plush" chemosynthetic communities (such as Bush Hill-type) or areas supporting these communities. Under the provisions of this NTL, the MMS requires lessees operating in water depths greater than 400 m to examine the geophysical records for conditions that might support chemosynthetic communities. If such conditions exist, the lessee must either move the operation or provide photodocumentation of the presence/absence of the Bush Hill-type of chemosynthetic communities. **When such**

communities are present, no drilling operations are permitted in the area. Although the NTL requirements are effective, a small percentage (estimated 10-15%) of chemosynthetic community areas may not be properly identified. As new information becomes available, the MMS will modify the NTL requirements as necessary.

Chemosynthetic Research: The MMS-funded Chemosynthetic Ecosystems Study was a 3-year program to ascertain the geological, geochemical, physiological, and ecological factors associated with fostering chemosynthetic communities at hydrocarbon seeps. The first report published from this study, a three-volume literature review and data synthesis (MMS, 1992a-c) prepared by the Geochemical and Environmental Research Group of Texas A&M University, described chemosynthetic communities, compared the GOM communities to those found outside of the GOM area, and provided a general framework for the biological and nonbiological processes that control community development, distribution, and structure.

Six study sites were chosen: Viosca Knoll Block 826, Green Canyon Blocks 184-185, 233-234, and 272, Garden Banks Block 386, and Alaminos Canyon Block 645 (MMS, 1992a). Within each site, sampling stations were marked and subject to photographic documentation to assess natural changes in the communities. Bottom time was spent aboard the U.S. Navy Submarine *NR-1* exploring the study sites and gathering over 830 hours of videotaped observation while conducting detailed visual and side-scan surveys (MMS, 1992b). Seismic data collected during these cruises included side-scan sonar records and sub-bottom profiles. Additional exploration was conducted from the submersible *Johnson-Sea-Link* through video and still photography, grab samples, sediment cores, water samples, and rock and organism collections. Additionally, detailed bathymetric data and high-resolution (3.5 kHz) seismic data routinely collected during exploration and test drilling were made available for use in the study.

Chemosynthetic fauna were found in an approximately 700 km-long corridor between longitudes 88° W. and 95° W. and between the 290-m and 2200-m isobaths. However, the faunal distribution was not uniform—the largest number of communities was found between longitudes 91° W. and 93° W. between the 500-m and 700-m isobaths. The study revealed that chemosynthetic fauna occur across most of the continental slope because the hydrocarbon source rock (a nutrient supply for these communities) and the salt layer that traps hydrocarbons pervade throughout the entire slope in the northern GOM. This widespread distribution contrasts with that of thermal vent communities found elsewhere. In the Pacific Ocean, for example, thermal vent communities occur over a large region, but this occurrence is limited to small, spatially discrete communities found on the geothermal fields associated with ridges or back-arc basins (MMS, 1992b).

The GOM hydrocarbon seep communities tended to be dominated by vestimentiferan tube worms, mytilids (mussels), epifaunal vesicomyid clams, or infaunal lucinid/thyasirid clams (MMS, 1992b). These groups display distinctive attributes in how they aggregate, the size of the aggregations, the geological and chemical properties of their habitats, and the varieties of fauna that occur with them. Although it was not clear what critical or essential geochemical requirements are needed for generation of these communities, the presence of oil, gas, or sulfide seepage is fundamental in creating the chemical environment that supports these communities (MMS, 1992b).

The GOM chemosynthetic communities are affiliated with specific geological processes and features such as faulting, mounds, and brine seepage as well as with a characteristic seismic signature—the “wipe-out zone” (those areas where the seismic signature of marine sediments are obscured by hydrocarbon seepage). These communities are likely to occur in any basin with significant accumulations of hydrocarbon source sediments (MMS, 1992a). The study provided some evidence supporting the theory that if the communities were less than 300 m apart, they shared a common hydrocarbon reservoir (MMS, 1992b).

Building on the information gathered from the literature review and data synthesis, the Geochemical and Environmental Research Group of Texas A&M University used coordinated geological, geochemical, and ecological research efforts to evaluate how seep communities live in the natural environment and the extent to which these communities would be resilient in the face of petroleum-related activities (MacDonald et al., 1995). The overall goal of this phase of the Chemosynthetic Ecosystem Study was to determine to what extent the Gulf of Mexico deep-water petroleum seeps fit into a robust or fragile community category. The study found that seep communities are a unique and important component of the Gulf of Mexico slope ecosystem and are susceptible to mechanical damage by offshore drilling or production activities. However, they are prevalent enough that localized disturbances should not effect their viability as a community type (MacDonald et al., 1995).

In 1996, MMS initiated another related study, *Stability and Change in Gulf of Mexico Chemosynthetic Communities*. This project, to be completed in early 2000 at a total MMS funding of $2.5 million, is designed to provide needed information on the ecological interactions in the chemosynthetic communities, the temporal stability and change within the communities, and the physical-chemical habitat that supports them. This project will provide MMS and the scientific community with information needed to determine whether chemosynthetic communities are robust or fragile and whether they are long-lasting features or features of short duration. Results will also characterize the age, growth, turnover rates, and reproduction and recruitment patterns of the dominant chemosynthetic animals. An additional major objective of this study is to further determine the reliability of methods for detecting chemosynthetic communities using remote acoustic and/or geophysical devices, imaging instrumentation, and hydrocarbon measurements.

In general, because NTL 88-11 prohibits drilling operations at sites inhabited by chemosynthetic communities, the chance for cumulative effects from these activities is minimal.

2.1B6 Structure Removal

When an operator terminates activities on an OCS lease area, a complex process of lease abandonment or structure decommissioning must occur, including plugging and abandoning wells, removing structures, and clearing the ocean floor around the structure sites. The MMS is responsible for ensuring that the lessee/operator bears the costs of abandoning the lease area in a manner that prevents unreasonable harm to marine life and the environment and also ensures no hazards to navigation or to the fishing industry remain.

For the latter concerns, the MMS requires operators to remove all structures to a depth of 15 feet below the mudline within 1 year of the lease termination. Typically, the topside components are disassembled and lifted onto barges. The final step of cutting the supporting columns below the mudline and lifting the jacket is usually accomplished by detonation of explosives placed within the steel columns below the seafloor. Alternative methods of severing the columns using mechanical cutting devices exist; however, explosives are preferred for several reasons including less risk to divers and workers, reduced costs, and reliability.

During the 1992-94 time period examined by this report, 391 offshore structures were removed from Federal lease areas in the GOM. The majority of these removals used explosives. While explosives offer significant engineering advantages, explosive detonations will kill or injure marine organisms close to the blast. Lethal effects can be reduced by removing animals from the blast site and by more precise explosive cutting using smaller shaped charges.

Two of the major concerns related to structure removal activities are reducing fish kills and ensuring that sea turtles, protected under the Endangered Species Act (ESA), and dolphins, protected under the Marine Mammal Protection Act (MMPA), are not harmed.

In June 1988, MMS and NMFS completed a formal Section 7 consultation under the ESA to ensure minimal harm to sea turtles. The resulting agreement was incorporated into the permitting process to specify mitigating measures to protect sea turtles. An NMFS observer program was established to monitor explosive removals. Other measures include:

- specified shipboard and aerial surveys by NMFS observers before and after detonation
- removal of observed turtles and/or delay of detonation if dolphins are in the immediate area
- restricting detonation to daylight hours
- staggered charges to reduce a cumulative pressure wave
- charges at 15 feet below the mudline with a 50-pound limit for generic permitting

The NMFS observer program also produces a detailed report for each removal and an annual summary of observations. Since 1988, only one turtle injury was attributed to removal blasts.

Efforts were made to include protection of both sea turtles and dolphins under the ESA consultation; however, no formal allowance for incidental take (of dolphins) under the MMPA existed. The American Petroleum Institute (API) petitioned NMFS in 1989 for a incidental take permit under the MMPA. Following public comment, API submitted an amended petition in December 1990. During the 1992-94 reporting period covered here, NMFS issued a preliminary Environmental Assessment, public comment followed, and a proposed rulemaking was published on June 17, 1993. In effect, during this period of extended rulemaking, the ESA measures were adequate to protect both sea turtles and dolphins.

It should be noted that on October 12, 1995, a final rule for incidental take of bottlenose and spotted dolphins was issued (50 CFR Part 228). Rules are essentially those in place under the ESA consultation, although observer requirements are more stringent. Each company removing a structure must obtain a Letter of Authorization (LOA). The LOA can be renewed annually, if the company complies to the rules and NMFS survey results indicate that the maximum incidental take (defined in detail in the final rule) has not been exceeded.

The issue of lease abandonment has been gaining attention as the number of offshore structures reaching termination dates is increasing, both in the GOM and worldwide. In June 1994, the U.S. General Accounting Office (GAO) issued the report, *Offshore Oil and Gas Resources: Interior Can Improve Its Management of Lease Abandonment*, evaluating the MMS efforts in the GOM Region to minimize environmental impacts of lease abandonment, estimating the costs of lease abandonment, and assessing MMS's approach to ensure that the Federal Government is not burdened with removal costs (GAO, 1994).

In its report, the GAO found that, although MMS has taken action to protect the GOM marine environment from adverse effects of lease abandonment, the MMS could do more, such as:

- encourage the development of nonexplosive structure removal technologies to minimize or eliminate harm to the environment
- study the costs and benefits of using nonexplosive removal technologies
- improve MMS's overall inspection strategy to ensure that wells are properly plugged and abandoned

In response to the GAO report, the MMS commissioned a study by the National Research Council's Marine Board to examine the technical issues related to explosive and nonexplosive structure removal technologies. During this study, *An Assessment of Techniques for Removing Offshore Structures* (NRC, 1996), the Marine Board:

- reviewed structure removal technology and the cost of alternative removal techniques
- explored the feasibility of alternate removal techniques
- assessed the occupational and environmental hazards of explosive and alternative removal techniques
- identified mitigation of known hazards

Although there were different opinions among the parties about what should be done, the Marine Board Committee found sufficient common ground to make the following recommendations for improving the program (NRC, 1996).

The **MMS** should:

- change the required minimum depth at which structures must be severed from the current 15 feet below the mudline to 3 feet below, provided that measures are employed that do not increase adverse environmental effects
- work with industry representatives, explosives experts, and other interested parties and user groups to develop guidelines for determining the necessary size of explosive charges
- allow partial removal of structures in 300 (or more) feet of water, with a cut at least 85 feet below the water surface when nonexplosive or advanced explosive techniques are used
- remove the limit of a maximum of eight detonations at any one time during the removal process, but retain the requirement of a 0.9-second delay between individual detonations
- incorporate into the permitting process the flexibility to encourage testing of removal techniques that could reduce risks to living marine resources

The **NMFS**, in cooperation with the MMS and appropriate State agencies, should:

- maintain the procedures of the existing Marine Mammal and Sea Turtle Observer Program (including the ban on night-time detonation), but shorten the required observation period from 48 to 24 hours prior to detonation
- gather more information to augment available information about the species, numbers, and age distribution of fish killed and fish surviving after structure removal by explosives
- experimentally compare the number of fish killed (for species of interest) by a series of equally buried detonations separated by the required 0.9 seconds to the number of fish killed by a single detonation of the same size
- experimentally determine the fish kill for species of interest at various depths and horizontal ranges for typical single detonations
- experimentally determine the effectiveness of acoustic systems, tailored for the species of interest, to scare fish away from the sound source to a safe distance

The **offshore oil and natural gas industry**, in cooperation with the appropriate Federal and State agencies, should:

- develop a guidebook on recommended practices for using explosives in the structure removal process
- sponsor and support programs to explore the feasibility and cost effectiveness of acoustic means of keeping fish at a relatively safe distance from removal operations
- investigate means of incorporating safe removal techniques and reducing environmental damage in the initial design

Appropriate **State agencies**, in cooperation with the appropriate Federal Agencies and the offshore industry, should:

- evaluate existing State-administered, artificial reef programs to enhance their potential for accommodating more platforms as well as their potential for providing commercial, recreational, or environmental benefits to other ocean users

The MMS is currently reviewing the Marine Board's recommendations. In addition, MMS and NMFS have reinitiated consultation on "generic" explosive structure removals in the GOM.

Although only one incident of injury to a turtle from a removal blast has been observed since 1988, there are still several areas of concern surrounding platform abandonment/removal activities (regulatory requirements to prevent environmental impacts, economical/feasible considerations, and need for continuous research). The MMS hopes that results of these studies, and other investigations, will help allay adverse effects to the marine environment caused by these techniques.

2.1B7 Marine Debris

The effect of marine debris on the marine and coastal environments has long been a worldwide concern. With the signing of the Marine Plastic Pollution Research and Control Act of 1987, the United States joined 39 other nations in ratifying Annex V of the International Convention for the Prevention of Pollution from Ships (known as MARPOL). This treaty bans the dumping of plastics by vessels at sea, limits the dumping of other vessel-generated garbage to specific distances from shore, and expressly prohibits the dumping of any vessel-generated garbage, except ground-up food wastes, in special designated areas.

Final rules published under the Marine Plastic Pollution Research and Control Act of 1987 explicitly state that fixed and floating platforms engaged in the exploration, exploitation, or associated offshore processing of seabed mining resources (33 CFR 151.73) are required to develop Waste Management Plans (33 CFR 151.57). Before passage of this Act, the MMS fully appreciated the problem of marine debris and, under NTL 86-11, issued guidelines for reducing or eliminating trash and debris in the GOM.

Because of the possible hazards posed by marine debris, many government agencies and private organizations, both internationally and in the United States, have studied the issue of marine debris over the past decade. Most of these studies have focused on answering the question of whether marine pollution laws and regulations are working to decrease the amount of garbage in the world's oceans. However, the problem of marine debris in the GOM cannot be adequately addressed unless the point-sources are identified.

To help in this identification, researchers at Padre Island National Seashore (PINS) conducted intensive marine debris research over 7 years. The shoreline of Padre Island, a barrier island located on the southeastern coast of Texas, is one of the most littered in the United States, with large quantities of garbage washing onto its shores. The primary reason for this large accumulation is that convergent water currents occur off the coastline. Because of these convergent currents, any item discarded into the GOM has the potential of washing onto the PINS shoreline. For this reason, PINS is an excellent location to study marine debris (Miller and Echols, 1996).

The objective of the PINS research was to identify point-source problems and to furnish the results to State and Federal Agencies concerned about the health of the GOM. The researchers have conducted marine debris surveys since 1988 using a variety of methodologies (Miller and Echols, 1996). After analyzing the debris collected during these surveys, researchers discovered that the majority of the debris consisted of 11 items.

In partnership with PINS, a similar survey covering 5 miles of shoreline was initiated by the FWS at the Matagorda Island National Wildlife Refuge, approximately 60 miles north of PINS. The objective of this survey was to ascertain if the 11 items surveyed in the PINS research were also washing onto other areas of the Texas coastline.

Analysis of the data for 1993 indicated that the increase/decrease of all 11 items coincided with shrimping fleet movement along the Texas coast. For both areas, this monitoring established a linkage between the 11 debris items and shrimping vessels. The survey also demonstrated that point-source polluters could be identified (Miller and Echols, 1995). Although the data were convincing, a direct link between the discharge of trash from shrimping vessels and the accumulation along shore could not be made. It was determined that additional surveys would be needed to provide a scientific correlation.

Based on the results of findings from each of the 1993 studies, the National Park Service developed methods to identify and assess the magnitude of point-source marine pollution in the GOM. In 1994, PINS began an investigation to connect the amount of garbage washing onto the beach to specific sources. The 1994 marine debris research project targeted two specific point sources—the *shrimping industry* (15 items selected with the help of the U.S. Coast Guard) and the *offshore oil and gas industry* (15 items selected with the help of MMS and the Offshore Operators Committee)—and a less-specific unknown source (14 items associated with shipping, recreational boating, beach visitation, or land-based nonpoint sources).

From March 1, 1994, to February 28, 1995, over 40,500 debris items were collected along a 16-mile transect at PINS. The following percentages of debris were associated with each of the point sources:

- shrimping industry (65%)
- offshore oil and gas industry (13%)
- unknown source (22%)

In 1994, the FWS initiated another Debris Monitoring Survey at Matagorda Island to supplement the 1994 PINS Point Source Investigation. As expected, items began to appear on the shoreline on July 7 (opening of shrimping season), and over 2,000 items were collected and categorized during the survey. Four of the categories were associated with the shrimping industry and accounted for 50 percent of the total debris (Miller and Echols, 1996).

The results of the 1993 and 1994 surveys indicate that beach garbage continues to be an immense problem, not only at PINS, but also in other coastal areas of Texas. An initial step to solving the marine debris problem is the identification of point sources—as the shrimping industry and oil and natural gas industry were through the Marine Debris Point Source Investigation projects. Unless the sources are identified, actions undertaken to reduce the amount of garbage being dumped into our oceans will be ineffective. Aware of the seriousness of this problem, industry has initiated the Offshore Operator’s Waste Handling and Recycling Committee to address reducing their culpability on this issue. Also, with strong encouragement from MMS, industry is very active in beach cleanup and adoption programs from Alabama to Texas.

2.1B8 Coastal Wetlands

Wetlands are areas periodically inundated or saturated by surface or ground water and that predominantly support vegetation typically adapted for life in saturated soil conditions. The importance of coastal wetlands to the coastal environment has been well documented. Coastal wetlands are characterized by high organic productivity, high detritus production, and efficient nutrient recycling (Bornholdt and Lear, 1995). Wetlands provide habitat for a great number and wide diversity of invertebrates, fish, reptiles, birds, and fish species. Coastal wetlands are affected by canals, pipelines, navigational traffic, support facilities, and oil spills. To understand how these structures or activities/events can affect wetlands and how these effects might be mitigated, the MMS has sponsored various research efforts, such as the two discussed below.

A Comparison of Shallow-Water and Marsh-Surface Habitats Associated with Pipeline Canals and Natural Channels in Louisiana Salt Marshes: Canals are widespread throughout the Louisiana coastal zone. Most canals were constructed for navigation, to access oil and gas drilling sites, or as areas for laying pipelines. Although navigation channels can impact coastal wetlands, canals constructed for developing petroleum resources (access and pipeline canals) have greater direct effects on coastal wetlands because they are more numerous (Turner and Cahoon, 1987).

Placement of dredge material alongside canals converts fringing marshes to an environment that is unavailable to aquatic organisms except at high tides, thus limiting the exchange between canal waters and marshes. Studies have found that canals closed to tidal exchange had fewer species and individuals than open areas (Adkins and Bowman, 1976). The densities of species that spawn outside the estuaries of these closed canals, but use the estuary as nursery areas, were also found to be lower than those found in open canals (Neill and Turner, 1987).

When flooded at high tide, the vegetated surfaces of Louisiana marshes act as habitat to many species of nekton (free-swimming aquatic animals) (Minnello and Zimmerman, 1991). The marshes associated with canals can be divided into two categories based on location to canals and levees—inside-levee marsh occupies the intertidal area between the canal and associated levee; outside-levee marsh occurs behind the canal levee and is inaccessible to nekton residing in the canals.

To continue understanding the effects of oil and natural gas activities, especially canal construction, on coastal wetlands, MMS funded a study (Rozas, 1992) to compare shallow-water and marsh-surface habitats associated with pipeline canals and natural channels. The primary objectives of this study were to assess how pipeline canals affect the way inside-levee marshes function as habitat.

To accomplish this objective, Rozas (1992):

- examined the degree to which inside-levee marshes function as nurseries for nekton residing in canals
- compared shallow subtidal habitats by sampling nekton along the marsh edge at low tide and measuring predator encounter rates at both habitats
- compared the functions of marsh habitat in these pipeline canals to nearby marshes lacking levees
- studied the effects of canals on inside- and outside-levee marsh habitats
- examined the effect of canals on fringing marsh habitats by studying pipeline canals constructed using either of two methods (push or flotation)

Rozas (1992) found that shallow subtidal areas within pipeline canals and adjacent inside-levee marshes support nekton in numbers comparable to similar habitats associated with natural channels. Inside-levee marshes probably enhance the habitat function of pipeline canals by providing area for foraging and refuge during high tide. However, canals with continuous levees are not equivalent to natural channels in terms of the amount of marsh-surface habitat they provide. Because marshes fringing canals are not continuous, the amount of edge associated with canals is even less than along natural channels of equal length.

Backfilled pipeline trenches do not have levees that block access to small tributaries and adjacent marshes; therefore, installing pipeline canals with the push method and backfilling provides more marsh edge habitat for fisheries species than using the flotation method, which requires a canal large enough to accommodate a pipe-laying barge; this canal is seldom backfilled (Tabberer et al., 1985).

Rozas (1992) also found that canal levees did not have a significant effect on outside-marsh habitat function. However, habitat function may be diminished in areas where canal levees intersect and marshes are semi-impounded or completely lost.

Effects of Oil Spills on Coastal Wetlands and Their Recovery: Although the short-term impacts of oil spills on coastal marshes can be easily observed, the long-term effects and any eventual recovery have not been well documented. Factors such as type and concentration of oil, degree of plant coverage, extent of soil penetration, season, species affected, and cleanup activities can all affect vegetation response and recovery (Baker et al., 1993; Webb et al., 1985). At the time of a 300-bbl crude oil spill on a Louisiana brackish marsh in 1985 (which was investigated in Mendelssohn et al., 1993), water levels were relatively high in the marsh due to predominant southeast winds, and it was estimated that the high water level allowed the oil to contact and cover as much as 30-70 percent of the vegetation canopy.

The overall goal of Mendelssohn et al. (1993) was (1) to document the long-term recovery rate of the marsh, (2) to separate the effect of the oil spill on marsh degradation from the ambient rates of degradation, and (3) to test ways to speed vegetative recovery and mitigate damage. A large number of plots that were studied in oiled and control marshes at the study site in 1985 were resurveyed for vegetation and soil recovery in 1989. The plots were also assessed for species composition, live and dead percentage cover, and residual oil impact.

As discovered through Mendelssohn et al. (1993), a relatively low dosage (300 bbl) of Louisiana crude oil spilled into a coastal brackish marsh can have a considerable negative short-term impact on the marsh vegetation. However, vegetation in the study area appeared to fully recover within 5 years after the spill. The health of the recolonizing vegetation (as assessed via photosynthetic response) in oiled plots was found not to be significantly different than that measured in control plots.

Patterns of land loss can show considerable spatial variability. Although the 1985 oil spill had a significant short-term impact on the marsh vegetation, analysis revealed that land loss rates in the oil-impacted marsh were consistent with other periods in the past.

To determine if the oiled areas that had not recovered could be restored through vegetative plantings, a transplanting experiment was begun in July 1991 at two elevations (ambient elevation of the die back sediment surface and at a higher elevation equal to that of adjoining vegetated marsh surface) in both oil-contaminated and oil-free sediments. The transplant experiment revealed that substrate elevation is a significant factor in vegetative restoration. In fact, investigation of factors that may have limited the vegetative recovery of two sites within the oil-impacted marsh revealed that increased flooding stress resulting from lower sediment surface elevation (resulting from compaction from heavy machinery during cleanup operations), and not a residual oil effect, was primary reason for the failure of these sites to revegetate after the spill. Mendelssohn et al. (1993) found that a relatively small increase in elevation resulted in significantly greater transplant success. This suggests that restoration plans for degraded, oil-impacted marshes should consider whether an adequate sediment surface elevation exists prior to conducting a large-scale restoration planting. In many cases, sediment addition, followed by planting or natural colonization, may greatly improve the long-term vegetative recovery success of oil-impacted marshes.

In the case of the 2,000 bbl spill that occurred during Hurricane Andrew in 1992, the State of Louisiana Department of Environmental Quality decided to allow natural processes control the recovery of the impacted marshes because bringing in additional cleanup equipment would cause more damage to the marsh. During subsequent overflights, observers noted that the marshes appeared healthy and that there were no long-term effects from the oil spill (oral commun., Frank Torres, GOM Region, April 1997).

2.1B9 Socioeconomics

In November 1992, the NRC assessed MMS's social and economic studies and found that no systematic program existed to identify and analyze important social and economic issues in the GOM Region (NRC, 1992). As part of its response, an MMS-funded workshop, through its University Research Initiative, assisted in developing a social science agenda. This workshop represented the first step in designing a systematic social sciences program for the GOM Region and addressing the concerns identified in the NRC report. Held in September 1992, the workshop convened social scientists from the United States, Canada, and Norway.

A Social Science Research Agenda for the Minerals Management Service in the Gulf of Mexico: The primary objective of the September 1992 workshop was to develop a social science research agenda by recommending specific studies, providing justification for each study, and identifying methods to perform each study. The recommended studies were organized into three major categories: baseline studies, policy-related studies, and focused studies (see tables 2.1-3 to 2.1-5). Because of their size and complexity, some of the study suggestions will be divided into several stages to be planned and funded sequentially. A complete description of the recommended studies, including method/study design and deliverables, can be found in Gramling and Laska (1993).

Several GOM socioeconomic studies were published during the time period examined by this report, some of which are briefly summarized below. [Note: See appendix C for a complete list of ongoing environmental studies conducted during 1992-1994].

Table 2.1-3. NRC-Recommended GOM Socioeconomic Studies—Baseline Studies	
Title	**Objectives**
An Assessment of the Historical, Social, and Economic Impacts of OCS Development on Gulf Coast Communities	Analyze impacts of hydrocarbon-related developments on the social and economic characteristics and conditions of counties and parishes throughout the Gulf Coast area from 1930 through 1990.
Consequences of OCS Oil and Gas Activities for Individuals and Families	Analyze the impacts of OCS activities on individuals and families, focusing on the historical aspects of change in the GOM oil and natural gas industry, including technology changes, resource depletion, and boom/bust patterns. Design a system to monitor impacts.
Socioeconomic Issue Analysis of Gulf of Mexico OCS Oil and Gas Activity	Identify social and economic issues and concerns related to GOM oil and natural gas activities viewed as important by major stakeholders and other knowledgeable individuals.
Case Studies of Gulf Communities: Analytic and Comparative History of Gulf Impacts of OCS Development Alternatives	Provide an analytical history including case studies representing the range of community adaptions to the effects of OCS activities.
A Study of the Impacts of Decline in OCS Activities in the GOM	Examine the effects of the decline of OCS activities on a sampling of GOM coastal communities, delineate how these effects changed over the phases of OCS operation, and design a monitoring program to follow these effects in the future.
Regional Forecasting/Simulation Model	Develop a regional forecasting/simulation model to estimate potential economic, demographic, public service, and fiscal impacts associated with proposed OCS leasing activities and development scenarios.

Source: Gramling and Laska (1993)

Table 2.1-4. NRC-Recommended GOM Socioeconomic Studies—Policy-Related Studies	
Title	**Objectives**
Mitigation Strategies for Addressing Socioeconomic Impacts from Offshore Oil and Gas Activities	Examine mitigation approaches used by GOM Federal, State, and local decisionmakers since the inception of OCS activities. Assess the extent to which and how various mitigation strategies can be tailored to fit GOM conditions and needs.
MMS Policies and Processes Affecting Socioeconomic Impacts	Identify existing MMS policies related to social and economic effects.
Monitoring Socioeconomic Impacts of OCS Activities in the GOM Region	Review and analyze social and economic monitoring practices which could be used in the GOM.
Factors Influencing Industry Restructuring in the GOM Region, and Government Regulation of OCS Activities	Identify and model investment factors involved in oil company decisions in the GOM to provide projections of industry restructuring. Identify when the regulatory and leasing structures come under pressure from projected changes in industry.

Source: Gramling and Laska (1993)

Table 2.1-5. NRC-Recommended GOM Socioeconomic Studies—Focused Studies

Title	Objectives
Estimates of OCS Development in the GOM Since 1954: Comparison Between Two Accounting Methods	Compare the differences between traditional valuation results and alternative accounting system results for GOM offshore activities since 1954.
Local Government Capacity to Manage Development	Identify the capacity-building needs of local governments, the degree to which they use available Federal and State assistance, and the most effective capacity-building techniques to meet local needs.
Successful Adaptations of Local Offshore Support Businesses to Changes in OCS Activities	Identify the factors leading to successful business adaptability in an environment of declining oil- and gas-based resources and recommend mitigation measures to enhance such success.
Perceptions of Risk	Document salient differences in concerns toward OCS development in different areas of the GOM and develop an understanding of the underlying factors.
Development of "Appropriate Technologies" in the Petroleum Industry	Develop an understanding of technological developments in the petroleum industry, the social and economic forces that shape them, and the human consequences.
OCS Activities and the Human Environment	Provide a comprehensive volume that would assess the known impacts of OCS activities on the human environment.
A Comparative Analysis of the Socioeconomic Impacts Experienced by Mineral Extraction Communities	Provide a comparative analysis of the social and economic consequences of mineral extraction on individuals, families, and communities impacted by rapid growth and/or decline.
Socioeconomic Survey of the GOM	Periodically conduct an inventory/survey of social and economic variables relevant to the impacts of GOM OCS activity fluctuations.

Source: Gramling and Laska (1993)

Impact of Offshore Oil Exploration and Production on the Social Institutions of Coastal Louisiana: This study (Laska et al., 1993) examined the relationship of oil production to five social institutions:

- political economy of the oil industry—how decisions and outcomes of market competition change the role of GOM extraction activities within the world petroleum industry
- community social problems and resources—how involvement affects State communities, especially with regard to social problems, human capital development, and economic health
- government—how the State political institutions and the "boom and bust" dynamics of the petroleum industry impact the delivery of public services
- poverty and social services—how various phases of the petroleum industry (preboom, boom, and bust) affect poverty and how social service agencies accommodate the changing needs for public services
- family—how the unique nature of offshore employment affects family roles and how families cope

Findings of Laska et al. (1993) included the following:

- Oil workers and their families compensate for the father's absence (because of his irregular offshore work schedule) in various ways: the father relinquishes authority in some fashion, the father withdraws functionally from the family, or an egalitarian adjustment is made between the husband and wife.

- Services provided by the local public agencies to assist the poor are augmented by existing nonprofit and religious social service agencies and Federal programs because public funding suffered from reduced limits throughout the 1980's.

- Effects of offshore oil activity on poverty are mixed. Although many jobs are created during the boom phase, boom-town inflation causes increases to the cost of living. During bust phases, immigrant workers, as well as local residents, become impoverished because of unavailability of alternative employment.

- Earnings are higher and transfer payments (unemployment compensation) are lower in parishes that are highly involved in the oil industry. High school graduation rates in more highly involved parishes are also higher during boom periods.

- Coastal zone parishes in Louisiana receive direct economic benefits from offshore investment, but local governments must provide services and infrastructure to support offshore activity without the compensation they would receive if extraction took place in State waters or on land.

- Some major oil companies no longer operate in the State, while others have downsized local operations. All companies have universally reduced exploration and production budgets and employment. Many support companies (towboat, platform construction, and tool companies) went bankrupt or consolidated into larger conglomerates.

- Oil and gas severance taxes provide bedrock funding for high levels of State services, which provided significant benefits to a generation of State citizens. Reliance on severance taxes reverberate into an inability and unwillingness of governors, legislatures, and voters to adapt to new revenue requirements—Louisiana remains politically deadlocked on how to raise revenues to fund services after severance taxes disappear completely.

To mitigate negative effects of oil and gas exploration and production, Laska et al. (1993) suggested:

- implementing policies to curb the sharp increases/decreases in GOM offshore oil activity
- instituting permanent and systematic monitoring of social and economic health by both Federal and State governments

- developing programs to ameliorate negative impacts already identified
- conducting research to better understand how oil extraction can affect an area
- examining ways to distribute tax revenue to highly impacted areas
- promoting contracts with local companies that build offshore platforms and provide other offshore services to reap the benefits of the remaining offshore investments regionally

As a continuation of Laska et al. (1993), the study, *Social and Economic Impact of Petroleum "Boom and Bust" Cycles* (Seydlitz and Laska, 1994), broadened the examination of social impacts from the petroleum industry. The relationship between energy development and social problems, educational attainment, and economic health were examined. Among the Seydlitz and Laska (1994) findings were:

- The relationship between petroleum industry activity and social problems is not clear, consistent, or strong. Rapid changes in the petroleum industry activity are disruptive to the social controls that inhibit social problems (suicide and homicide rates, criminal court cases, and juvenile commitments). However, there is some recovery from these problems during the "bust" (although those rates did not return to preboom levels). The degree of parish involvement in petroleum activities (high vs. low) did not affect the levels of social problems. As mitigation, the study suggested using programs that reduce similar problems in other situations (for example, suicide prevention programs, employment counseling, mental health counseling, and substance abuse prevention).

- Changes in the level of petroleum industry activity affect education, and the effect depends on the degree (high vs. low) and type of parish involvement (extraction or related services). For example, for those students living in parishes highly involved in petroleum activities and involved in extraction activities, a higher percentage completed high school, while a lower percentage of high school graduates enrolled in college. The suggested mitigation strategy involves programs to encourage high school graduates to invest in college while industry levels are high (industry employers instituting flexible hours/part-time schedules that allow time for additional education) and to encourage students to complete high school while industry levels are lower (employers visiting high schools to discuss job opportunities available to graduates).

- The relationship between the level of petroleum industry activity and community economic health is not straightforward. Highly involved parishes, particularly those involved in extraction, do not permanently experience greater economic health from increases in activity—the economic gain is lost shortly after the increase in activity. The effect of petroleum activity on community health does depend on the degree and type of parish involvement—those parishes involved in "related petroleum activities" managed better during the decline of petroleum activity than those involved in extraction activities. A diversified economy is the best mitigation against experiencing economic problems when the petroleum industry is doing poorly. One mitigation suggestion was for the community to set aside money (from sales taxes, severance taxes, and proceeds from leasing) for job training and employment counseling.

Socioeconomic Impacts of Declining Outer Continental Shelf Oil and Gas Activities in the Gulf of Mexico: This study analyzed the social and economic impacts of the recent price-related decline in OCS oil and natural gas activity and formulated a set of conceptual cause-effect models that express the relationships between changes in OCS activities and select social and economic attributes (McKenzie et al., 1993). The study area included 49 counties and parishes located in four States adjacent to the GOM, including select inland counties and parishes encompassing adjacent metropolitan areas. Coastal counties and parishes extended from Baldwin County, Alabama, to Cameron County, Texas.

The study reported that during the 1960's and 70's, the study area grew: the population increased 54 percent, the size of the civilian labor forced increased 101 percent, and the number of jobs available increased about 149 percent (McKenzie et al., 1993). The oil boom culminated, and the bust occurred from 1981 through 1986. Communities along the GOM with economies strongly tied to the oil and natural gas industry were not prepared for the following drastic changes that occurred during this bust phase (McKenzie et al., 1993):

- Population growth dropped to a fraction of the national rate as people moved from the study area—most of the counties and parishes within the study area experienced a negative net migration.
- From 1982 to 1986, the total number of jobs in the study area decreased by 3.11 percent—mining industry jobs decreased by almost 29 percent.
- Mining job earnings decreased by about 28 percent—in southwest Louisiana, the location of the highest proportion of mining jobs, the net earnings decreased by 17 percent.
- Coastal areas within the study area experienced an increase in local government expenditures for interest on debt, highways, and financial administration.

Finally, McKenzie et al. (1993) concluded that the effects of non-OCS and OCS oil and natural gas production are inextricably mixed. Although most of the counties and parishes within the study area exhibited social and economic characteristics closely associated with the oil and natural gas industry, the study found that the association in select areas was more closely aligned with non-OCS oil and natural gas activity. McKenzie et al. (1993) cautioned that it is important to examine other factors that may have negatively affected the Nation’s economy and to acknowledge that there was a general decline in the Nation’s economy as a whole during the time of the GOM decline in oil prices.

2.2 Pacific Region

The Pacific Region is divided into OCS four planning areas: Southern California, Central California, Northern California, and Washington/Oregon (fig.2.2-1). More detailed information relating to the OCS Program can be found in *Pacific Update (December 1989-January 1994)* (Gächter, 1994).

From 1992 to 1994, no OCS lease sales were held in the Pacific Region. However, the average daily oil production in the Pacific Region doubled, and the following activities occurred on the 85 existing OCS leases in the Southern California Planning Area (see figs. 2.2-2 through 2.2-5):

- 50 development wells were drilled
- 2 production platforms were brought online
- 1 OCS structure was removed
- 172 bbl of OCS crude oil and condensate were spilled

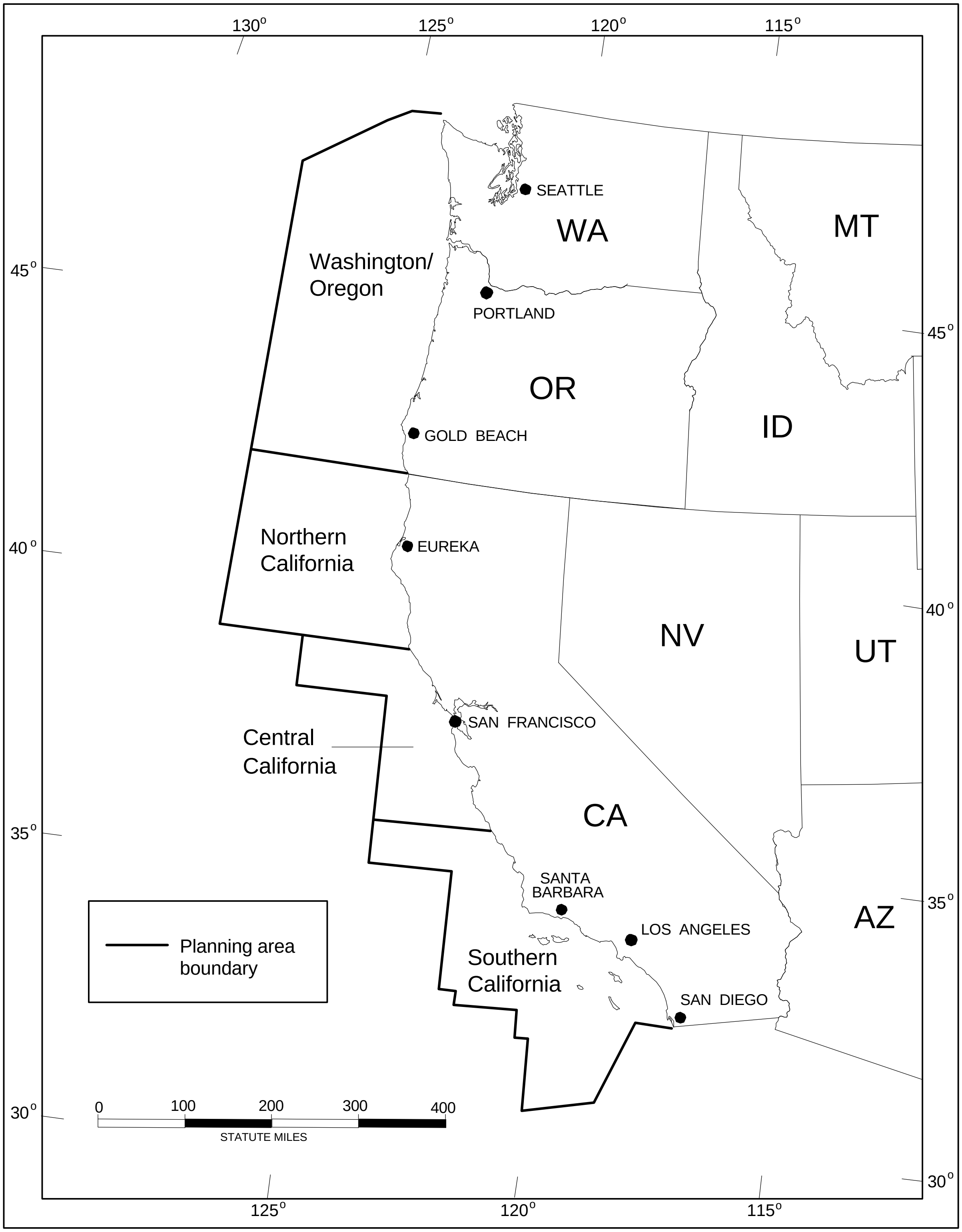
2.2A Special Topic—Northridge Earthquake

California is seismically active in both the onshore and offshore regions. Therefore, the design of OCS offshore facilities must consider seismic and other environmental conditions. Additional preventive measures, such as production safety systems (including automatic shut-in valves), ensure the safety of personnel, operations, and the environment.

On January 17, 1994, an earthquake registering 6.8 on the Richter scale caused significant onshore structural damage in southern California. Personnel at each of the 23 Pacific OCS platforms felt the earthquake—these platforms were located approximately 40-130 miles from the earthquake's epicenter in Northridge. Initial visual inspections of the platforms found no structural damage, and aerial reconnaissance and pressure testing of pipelines indicated no damage to the pipelines. One minor, 3-bbl oil spill occurred from a platform because the produced water treatment facility onshore experienced a power failure; however, the spill was quickly stopped and cleaned up.

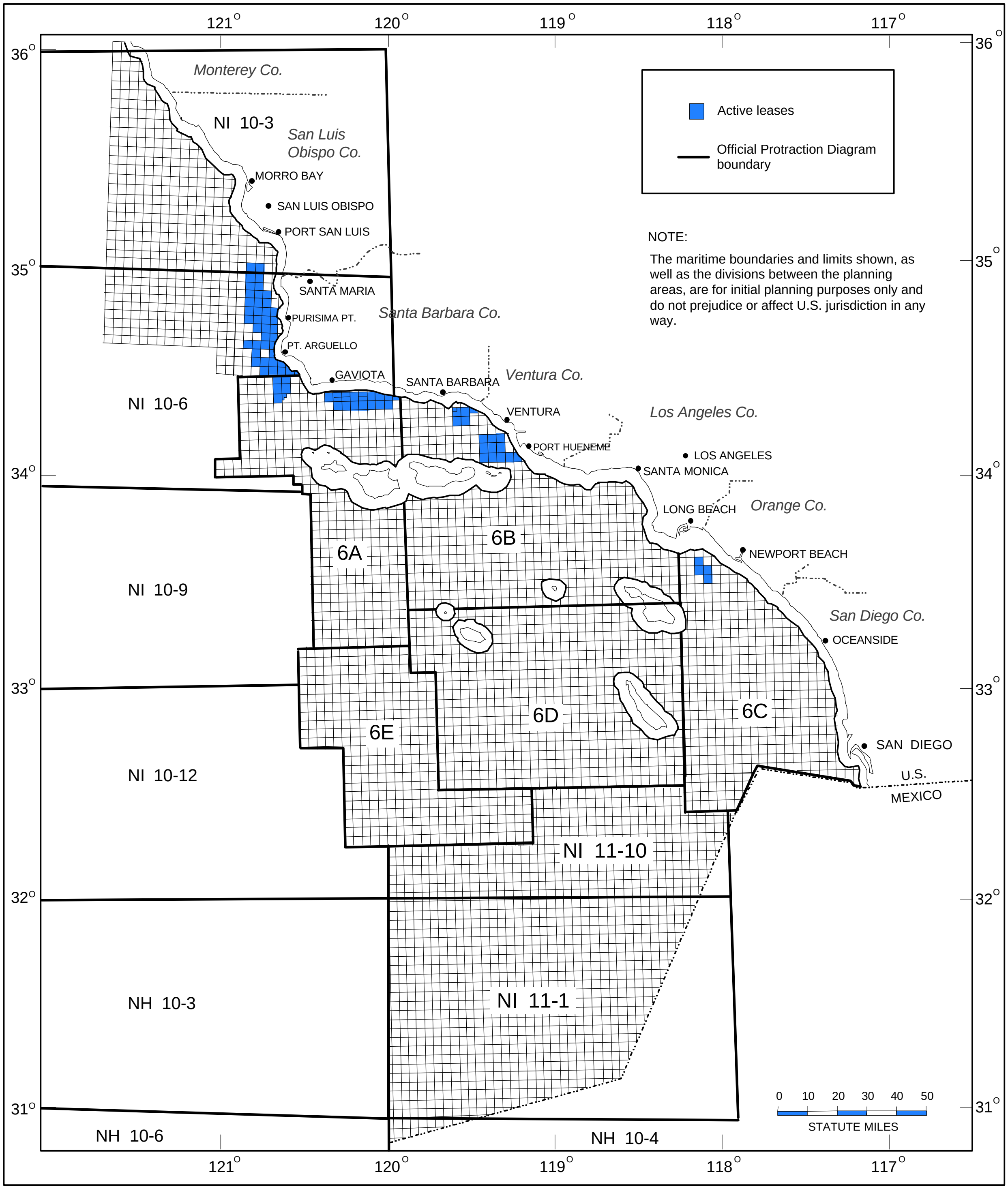
To confirm findings after the initial visual inspections, MMS inspectors examined each platform. In addition, in the interests of safety and environmental protection, MMS required operators to conduct Level I visual surveys of the platforms and to provide additional information concerning the earthquake's effects on OCS facilities. Although there were no indications that the seismic events reached platform design criteria levels, the MMS felt that formal Level I surveys would provide decisionmakers with valuable information regarding necessary repairs or preventive measures.

The Level I surveys found no indication of overloading or design deficiencies in the structural, electrical, or mechanical systems. Although the earthquake did cause some minor operational disruptions, there was no evidence of bent, buckled, damaged, or missing facility components from the seismic events. Although visual inspection of Platform Elly's 16-inch oil pipeline showed that some displacement had occurred, a



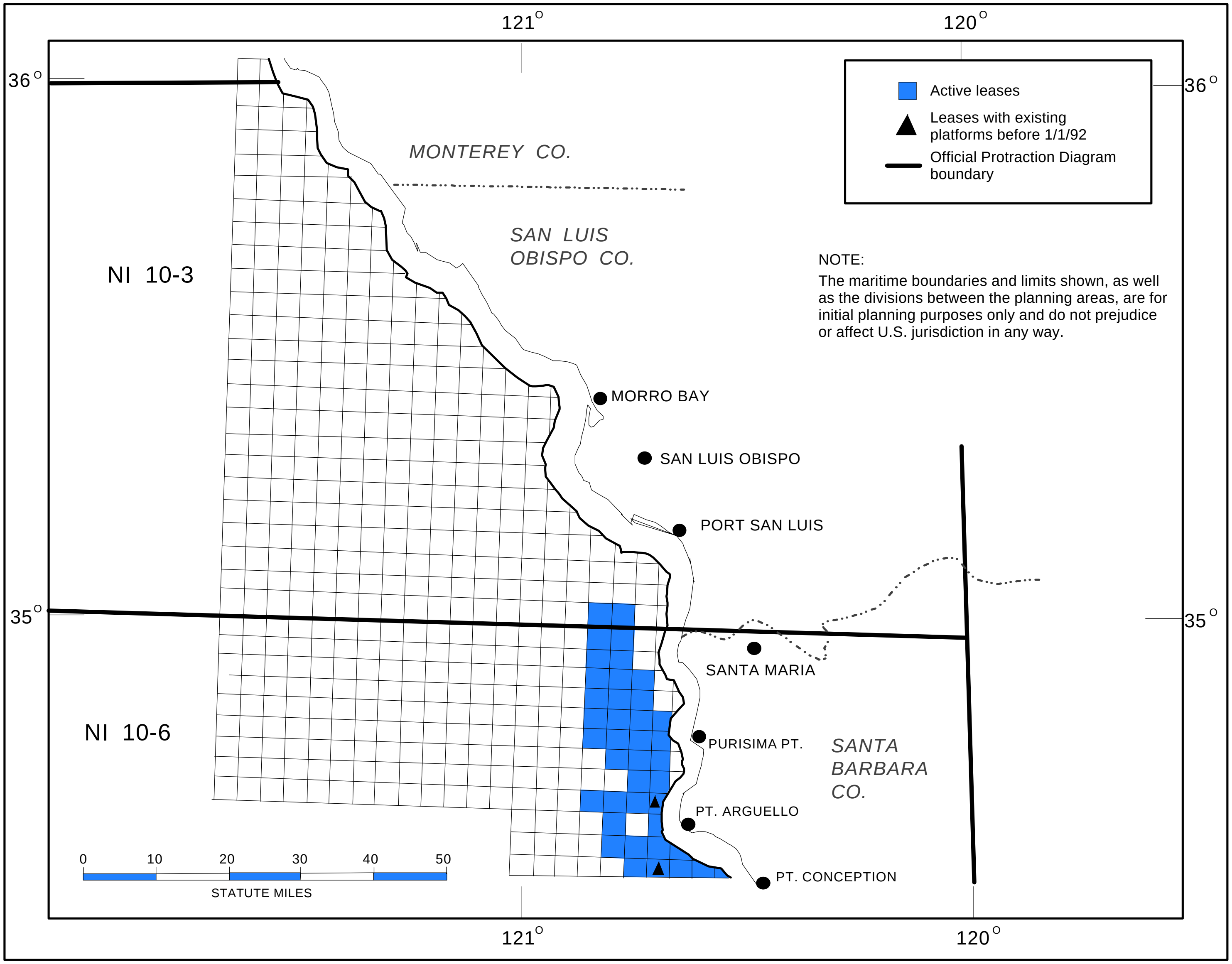
Source: Adapted from MMS Pacific source maps, 1994.

Figure 2.2-1. Pacific OCS Planning Areas, 1992-1994



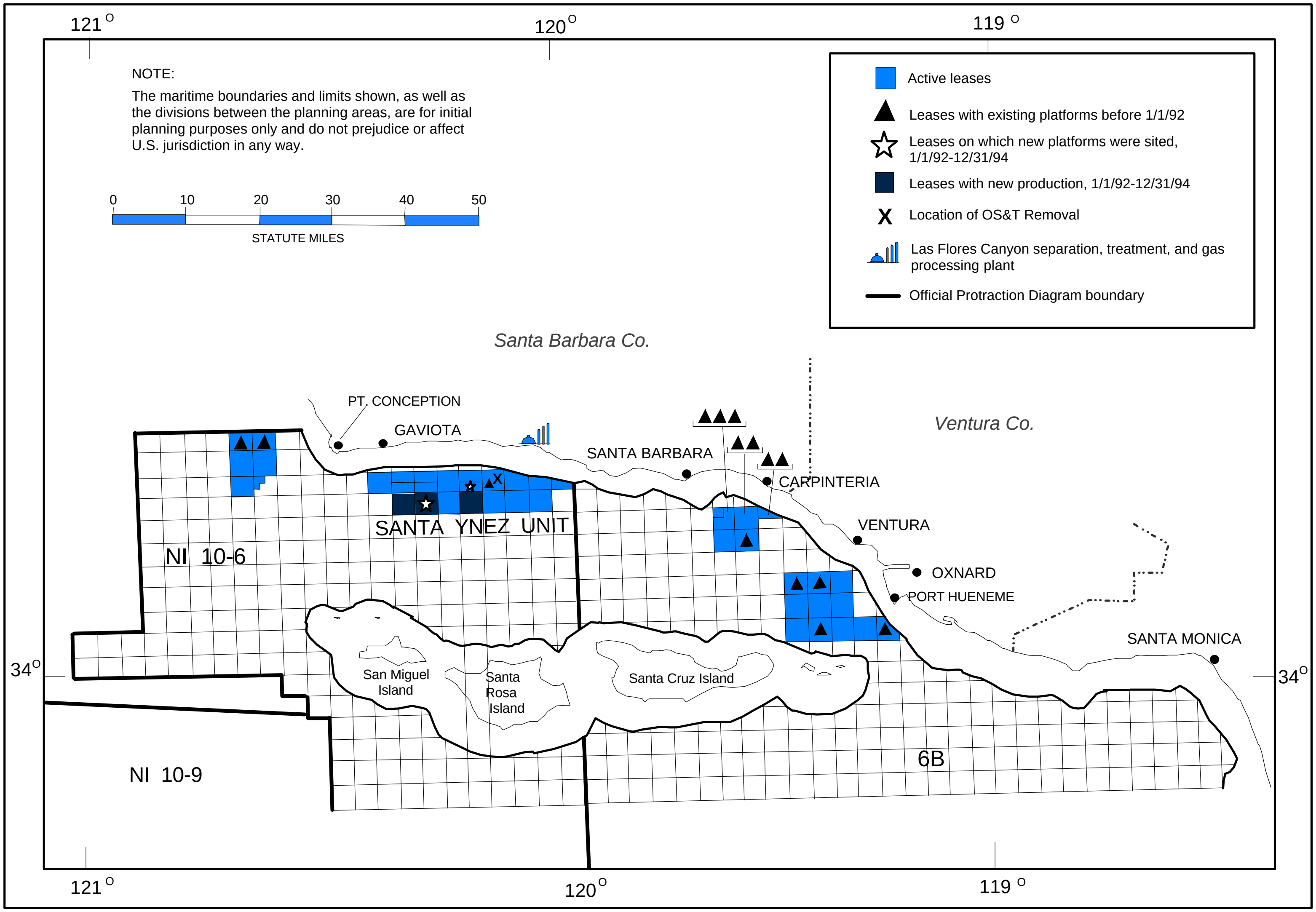
Source: Adapted from Pacific source maps, 1994.

Figure 2.2-2. Southern California Planning Area, Status of Leases, 1992-1994



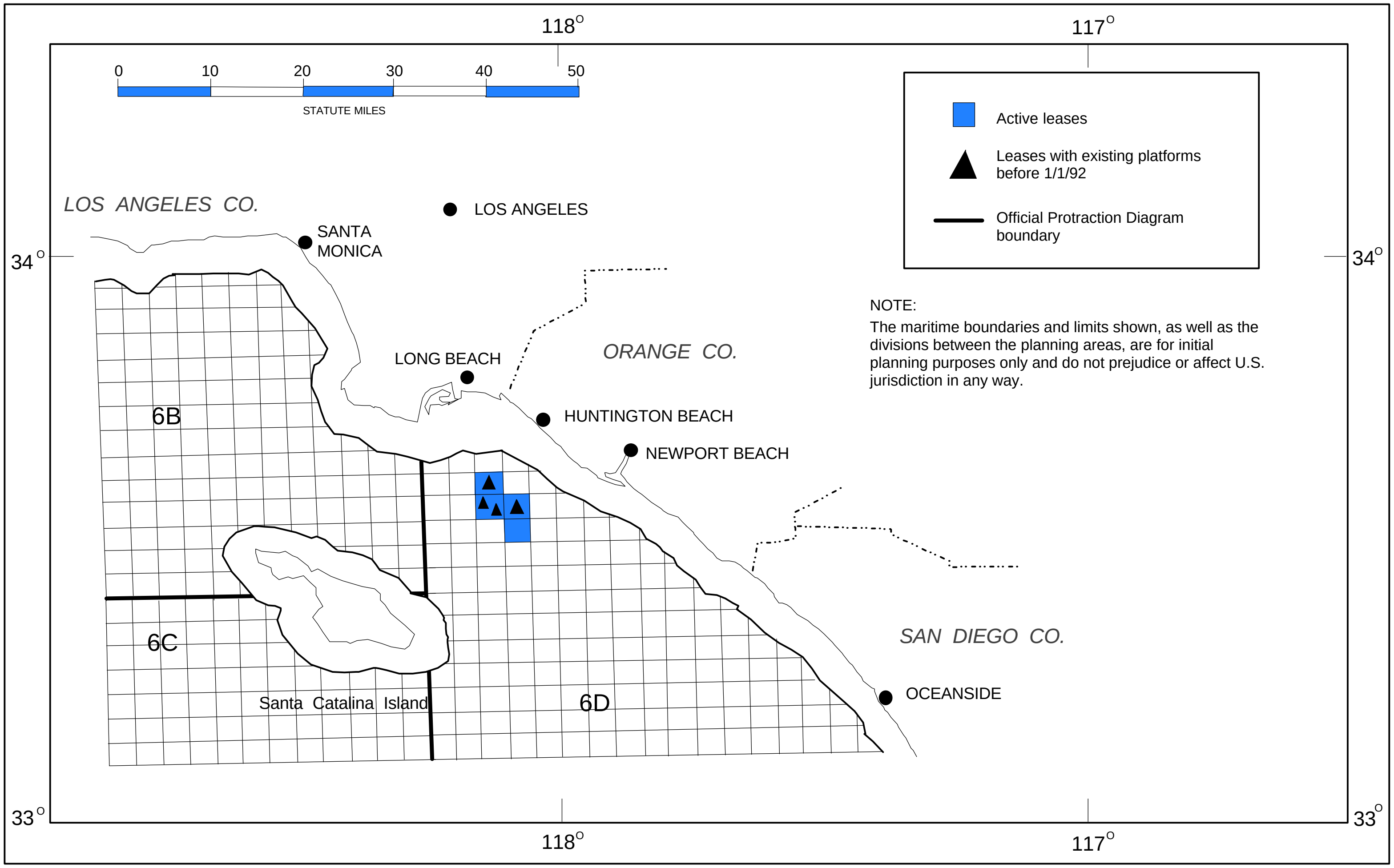
Source: Adapted from Pacific source maps, 1994.

Figure 2.2-3. Santa Maria Basin, Status of Leases, 1992-1994



Source: Adapted from Pacific source maps, 1994.

Figure 2.2-4. Santa Barbara Channel, Status of Leases, 1992-1994



Source: Adapted from Pacific source maps, 1994.

Figure 2.2-5. Long Beach Area, Status of Leases, 1992-1994 remotely operated vehicle(ROV) inspection found that the riser had not buckled, and a pressure test verified the integrity of the line. None of the Pacific OCS pipeline showed any indication of damage. Overall, all platforms, pipelines, and their respective safety systems performed well, as designed.

In June 1994, the MMS released its final post-earthquake seismic damage assessment report, *Northridge Earthquake Effects on Minerals Management Service Pacific Outer Continental Shelf Region Offshore Facilities* (MMS, 1994a). This report concluded that OCS platforms withstood the earthquake, with no structural damage. The MMS also believed that the lack of structural damage and minimal disruption of offshore operations from the earthquake were the result of proper platform design and operational procedures. Although OCS platforms are designed with careful consideration given to environmental conditions, there are currently no provisions governing platform seismic reassessment after installation.

Following the 1989 Loma Prieta earthquake, the MMS and the California State Lands Commission (CSLC) began investigating seismic reassessment of oil and natural gas structures located offshore southern California. The MMS/CSLC Seismic Reassessment Working Group was formed to address issues associated with reevaluating a platform's ability to withstand earthquakes. Draft regulations for the seismic reassessment of platforms in Federal waters offshore California have been drafted and are scheduled to be published in an upcoming *Federal Register*.

Several workshops concerning reassessment guidelines were held prior to the development of the draft regulations.

- In December 1992, an international workshop for industry, academia, policymakers, and other parties was held to discuss the state-of-the-art seismic design and reassessment procedures of offshore structures. Sponsors of the workshop included the California Institute of Technology, the U.S. Geological Survey, and the California Seismic Safety Commission.

- In November 1993, MMS/CSLC held a workshop on public policy issues related to the seismic reassessment of platforms offshore southern California.

- In December 1993, an international workshop was conducted to discuss the general reassessment of offshore structures under wave, ice, and seismic loading conditions.

In addition, to assist in developing reassessment indicators, MMS has contracted with Lawrence Livermore National Laboratories to develop a seismic hazards map for the eastern Santa Barbara Channel where older offshore platforms are located. This map will illustrate the expected level of ground shaking at platform sites from movement on the geologic faults affecting those sites.

Another MMS-supported research project is the Seafloor Earthquake Measurement System (SEMS) project, which was contracted with Sandia National Laboratories. [Note: Installation of SEMS offshore southern California was completed in July 1995.] Data collected from SEMS will provide input to the soil response models used in seismic reassessment of offshore platforms. In addition, SEMS data will assist in the development of the seismic hazards map.

2.2B Matters of Interest

For the period 1992-1994, the MMS Pacific regional office selected the following issues for discussion because of their particular interest to OCS stakeholders:

- air quality
- oil spills and response capabilities
- Santa Ynez Unit (SYU) expansion project
- drilling discharges
- Tri-County Forum
- California Offshore Oil and Gas Energy Resources Study
- approved exploration plan review process
- commercial fisheries

2.2B1 Air Quality

Emissions from all direct and support activities associated with OCS oil and natural gas operations (such as exploratory drilling, construction, development and production operations, and support craft activities) can affect air quality. Table 2.2-1 summarizes the estimated emissions from all OCS direct and support activities in the Pacific Region from 1992 through 1994.

Air quality monitoring studies conducted in the 1980's demonstrated that emissions from OCS development activities in the Santa Barbara Channel and related onshore facilities, such as oil or gas processing plants and marine terminals, contribute to ambient ozone levels in Santa Barbara and Ventura Counties (Haney, Fieber, and Chinkin, 1988; Haney, Souten, and Chinkin, 1987).

Ozone is formed in the atmosphere through a series of complex photochemical reactions involving NO_x and VOC. Meteorological conditions in the South Central Coast and South Coast Air Basins are particularly favorable for the formation of ozone, especially in the summer due to prevailing wind patterns, topography, and an abundance of solar radiation.

The Counties of Santa Barbara, Ventura, Los Angeles, and Orange are nonattainment for ozone (i.e., ozone concentrations exceed the Federal standard). The nonattainment classification is "extreme" for Los Angeles and Orange Counties, "severe" for Ventura County, and "moderate" for Santa Barbara County (40 CFR 81.305, July 1, 1994).

Table 2.2-1. Average Annual Estimated Emissions from OCS-Related Activities, Pacific Region, 1992 through 1994					
	Pollutant Emissions (tons)				
Activity	**NO_x**	**CO**	**SO_x**	**VOC**	**PM10**
Construction:					
Pipeline[1]	125	41	10	5	15
Platform[1]	35	26	7	5	8
Abandonment[2]	18	3	1	1	1
Development/Production[3]	1,327	712	336	782	89
Support Boats[3]	1,583	355	156	129	130
Total (tons/3 yrs.)	**3,157**	**1,137**	**511**	**921**	**243**
Total (tons/day)	**2.88**	**1.04**	**0.47**	**0.84**	**0.01**

[1] Estimates per Final Decision Document, Authority to Construct Permit 5651-01, Santa Barbara County Air Pollution Control District (APCD).
[2] Emission estimates per Exxon's Offshore Storage & Treatment Vessel Abandonment Plan, 1994.
[3] Permitted emissions compiled from Final Permits to Operate, South Coast Air Quality Management District, Ventura County APCD, Santa Barbara County APCD.

The Clean Air Act Amendments (CAAA) require States to implement measures that would result in the Federal ozone standard being achieved by the year 2010 for nonattainment areas classified "extreme," by the year 2005 for "severe" nonattainment areas, and by 1996 for "moderate" nonattainment areas. The plans being implemented by the counties would achieve reductions in NO_x and VOC emissions through additional control measures on industrial sources as well as through various transportation control measures.

The relative importance of OCS emissions with respect to the ozone problem can be ascertained by comparing the OCS emissions with emissions in adjacent onshore jurisdictions. Table 2.2-2 compares NO_x and VOC emissions from the OCS activities with those emissions from Santa Barbara County, Ventura County, and South Coast Air Quality Management District (AQMD) activities for 1992 through 1994. These OCS activity emissions are equal to about 8 percent and 2 percent, respectively, of the combined NO_x and VOC emissions from Santa Barbara and Ventura Counties, and they are equal to approximately 1 percent and 0.2 percent, respectively, of the total NO_x and VOC emissions from the South Coast AQMD.

In September 1992, the EPA promulgated regulations for emission sources on the OCS as required by the 1990 CAAA. For emission sources located within 25 miles of the nearest State seaward boundary, regulations (including permit requirements) are identical to those for facilities located in the nearest onshore jurisdiction.

Existing facilities had to meet local regulatory requirements by September 1994. To minimize emissions from facilities, Pacific OCS operators installed various types of pollution control technology and emission reduction measures, such as:

- use of low-sulfur fuel
- injection timing retard for diesel engines
- water injection
- waste-heat recovery
- inspection and maintenance programs

Table 2.2-2. Average Estimated Areawide Emissions, Pacific Region, 1992 through 1994

	Pollutant Emissions (tons/day)	
	NO_x	**VOC**
OCS Activities	8.6	2.5
Santa Barbara County[1]	40.4	51.0
Ventura County[2]	67.0	82.5
South Coast AQMD[3]	978.0	1,062

[1] Forecast base-case emissions for the year 1994 from the 1991 Santa Barbara County Air Quality Attainment Plan (Santa Barbara County APCD, 1991).
[2] Forecast baseline emissions for the year 1994 from the 1991 Ventura County Air Quality Management Plan (Ventura County APCD, 1991).
[3] Forecast baseline emissions for the year 1994 from the 1991 South Coast Air Basin Air Quality Management Plan (South Coast AQMD, 1991).

New and modified emission sources are subject to stringent New Source Review requirements that apply to nonattainment areas. Pollution control measures must meet the Lowest Achievable Emission Rate requirements. Furthermore, emissions of NO_x and VOC must be offset at a greater than 1:1 ratio to achieve a net air quality benefit.

2.2B2 Oil Spills and Response Capabilities

From 1992 through 1994, there were 92 oil spills from Pacific OCS facilities. Three of these were greater than or equal to 1 bbl, with a total spillage of approximately 83 bbl (see table 2.2-3).

No oil from these spills contacted shore, and the MMS Pacific regional office received no reports that oil contacted marine life (mammals, birds, etc.). The lack of adverse environmental impact from these spills is due in part to several preventative measures, such as:

- stringent regulations covering OCS operational and environment safety

- continuous evaluation and improvement in the OCS facility's oil-spill response by the district office
- a highly organized oil-spill response infrastructure operating in southern California, the Pacific area with the largest number of OCS-related facilities

Table 2.2-3. Oil Spills Greater Than or Equal to 1 bbl from Pacific OCS Facilities, 1992 through 1994

Date	Location	Cause of Accident	Spillage (bbl)
1-17-94	Platform Hogan Camarillo District	Produced Water Treatment Facility Malfunction	3
5-25-94	Platform Hondo Camarillo District	Pump Failure	30
12-17-94	Platform Hogan Camarillo District	Pneumatic Control System Leakage	50

Source: MMS, Pacific Region, May 1995

Table 2.2-4. Oil Spills Measuring Less Than 1 bbl from Pacific OCS Facilities, by MMS District, 1992 through 1994

	Camarillo			Santa Maria			
Year	**Crude**	**Cond.**	**Other**	**Crude**	**Cond.**	**Other**	**Total**
1992	12	1	19	3	0	4	39
1993	7	0	19	3	0	3	32
1994	5	0	11	0	0	2	18
Total	**24**	**1**	**49**	**6**	**0**	**9**	**89**

Source: MMS, Pacific Region, May 1995

There are five mini-cooperatives (mini-co-ops) covering OCS facilities located in southern California. By pooling personnel and equipment, mini-co-ops provide closely situated platforms with a more effective primary oil-spill response system. Secondary response is provided by major co-ops such as Clean Seas or Clean Coastal Waters (Gebauer, 1993).

- Platforms Irene, Hidalgo, Harvest, and Hermosa, situated north of Point Conception, are covered for primary oil-spill response by *Mr. Clean III*, which is located at Platform Harvest as part of the Clean Seas Co-op. Secondary response is provided by *Mr. Clean I* in Avila Bay or *Mr. Clean II* in Santa Barbara.

- The SYU (Platforms Heritage, Harmony, Hondo, and the offshore storage and treatment vessel) provides its own primary response, with secondary response provided by *Mr. Clean II* in Santa Barbara.

- The Carpinteria mini-co-op (Platforms Habitat, Hogan, Houchin, Henry, Hillhouse, A, B, and C) provides its own primary response equipment, while secondary response comes from *Mr. Clean II* in Santa Barbara.

- The Ventura mini-co-op (Platforms Gina, Gilda, Gail, and Grace) supplies its own primary response, with secondary response provided by *Mr. Clean II* in Santa Barbara.

- The Beta Unit (Platforms Edith, Ellen, Elly, and Eureka) maintains primary response equipment on site, and secondary response is provided by Clean Coastal Waters located in Long Beach.

The MMS conducts unannounced oil-spill exercises at least quarterly for each mini-co-op, rotating among the facilities so that each facility is evaluated at least once a year. The major co-ops also participate in oil-spill exercises for each mini-co-op at least once a year. From 1992 through 1994, MMS annually conducted an unannounced oil-spill drill simulating a minor spill event for each OCS platform except for the SYU where three drills were conducted for the four platforms comprising the Unit. In addition, MMS conducted three major oil-spill drills during the period covered by this report: in 1992 on Platform Ellen (Camarillo District), in 1993 on Platform Gail (Camarillo District), and in 1994 on Platform Harvest (Santa Maria District).

The MMS conducts oil-spill exercises for the following reasons:

- to validate the operator's oil-spill contingency plan
- to test the operation of onsite oil-spill response equipment
- to evaluate the proficiency of the oil-spill response team in the following areas:
    — locating and shutting off the source of the spill when necessary
    — notifying company and agency personnel
    — coordinating the spill response effort
    — containing and recovering the oil
    — supervising the recovery

The oil-spill exercise begins when the MMS representative arrives at the platform unannounced. After determining that weather conditions and production operations are stable, the engineer provides the platform supervisor with a written scenario outlining the time, size, and cause of the spill. The size of the oil slick is estimated, and sorbent pads are thrown into the ocean to depict the "spill targets" and to show in which direction the slick is drifting. The platform supervisor responds to the spill scenario while the MMS official observes and evaluates the drill response.

After the cause of the spill is identified (with continuous focus on correcting it), the platform supervisor activates the onsite response team and arranges for the deployment of the onsite boom and skimming device. Usually a minimum of three vessels is involved, two to contain the spill and one to skim the oil. During the drill, the appropriate State and Federal agencies are notified. The MMS inspector reviews and verifies records of appropriate training of personnel, maintenance of oil-spill response equipment, and daily pollution inspections. Drills that do not satisfy the MMS representative are performed again at a later date.

In addition to MMS, other agencies have responsibilities to protect the marine environment from oil pollution and to plan for effective oil-spill response. The Oil Pollution Act of 1990 has tasked the U.S. Coast Guard (USCG) with oil-spill-related responsibilities including development of area contingency plans, oil-spill prevention and research, and implementation of a National Preparedness Response Exercise Program. The Regional Response Team's primary responsibility is to advise the "On-Scene Commander," usually a USCG representative, on environmental implications of an oil spill. The California Office of Oil Spill Prevention and Response (OSPR) is the primary responder to oil spills for the State of California.

In 1993, the MMS Pacific OCS regional office began developing a Memorandum of Agreement (MOA) with the OSPR to lay out general responsibilities, especially where agency responsibilities overlap. Other issues addressed in the MOA include information sharing, oil-spill response preparedness, oil-spill prevention, and regulatory enforcement. [Note: The MOA was signed in 1995.]

Within MMS, the MMS Intertidal Monitoring Program (MINT) team interacts closely with local oil-spill response organizations. With the OSPR and the National Oceanic and Atmospheric Administration’s Damage Assessment Center, the MINT team has co-sponsored a symposium to initiate scientific discussion on the development of standardized protocols for sampling rocky intertidal biota after an oil spill. Additionally, the MINT team has completed HAZWOPR training, which enables members to conduct rapid response intertidal assessments with agency and industry biologists.

2.2B3 Santa Ynez Unit Expansion Project

The SYU lies 3 to 9 miles offshore in OCS waters in the western end of the Santa Barbara Channel (fig. 2.2-4). The SYU includes 16 leases, covering approximately 76,000 acres, most of which were acquired by Exxon and its partners during OCS Lease Sale P-4 in 1968. Development drilling at Platform Hondo began in 1977. In 1982, Exxon submitted the SYU expansion proposal, which MMS approved in 1985, with subsequent revisions approved in 1988. The expansion project included:

- construction and emplacement of three additional platforms (and associated pipelines and power cables) and an onshore processing facility
- removal of the offshore storage and treatment vessel (OS&T)

In 1993, Exxon brought on line two additional platforms—Heritage and Harmony—to join Platform Hondo. Installation of another platform, Heather, is projected for 2001. Pipelines and power cables link the three SYU platforms to the Las Flores Canyon onshore facility where SYU crude oil is treated. Before installing the new platforms, Exxon transported production from Platform Hondo to the OS&T where it was treated to remove water and then stored until the crude was tankered to refineries in the Los Angeles area. In 1994, Exxon removed the OS&T (Gächter, 1994; MMS 1994b). Exxon currently produces approximately 100,000 bbl of oil per day from the three SYU platforms.

Construction and Emplacement/Installation of SYU Platform/Pipeline/Power Cables and Onshore Processing Facility: This phase of the SYU expansion project was completed ahead of schedule—a testament to the extensive joint Federal, State, and local coordination and cooperative efforts of approval and oversight of the pipeline and power cable installation. Coordination for the SYU expansion project began in 1983 with the preparation of the joint environmental impact statement/report by Federal, State, and local agencies. Regulatory agencies and Exxon cooperated to minimize the potential for controversy by meeting early and often to resolve issues.

A comprehensive environmental mitigation program was developed to address Federal, State, and local concerns. This program included a Marine Biology Impact Reduction and Mitigation Plan to cover issues related to the pipeline/power cable installation. While Exxon prepared this plan, all agencies worked together to develop a rigorous program that addressed their concerns. Required mitigation focused on the following measures:

- protection of hard-bottom features and kelp beds
- space-use conflicts with commercial fishing and fishing hazards
- protection of endangered species and marine mammals
- protection of air quality

At MMS's request, Exxon also developed the Environmental Mitigation Plan for Platform Construction. Some examples of the mitigation methods used are as follows.

- Pre- and post-construction biological surveys, surveys of hard-bottom areas by remotely operated vehicles (ROV’s), and detailed anchoring plans were required to avoid sensitive biological resources and potential archaeological sites.

- Fisheries preclusion zones, compensation programs, and special anchoring procedures were established to avoid conflicts with commercial fishing interests.

- A monitoring program was developed and implemented during the peak gray whale migration period to ensure that the whales would not be affected by installation and construction activities. The program was developed in cooperation with NMFS, the California Coastal Commission (CCC), Santa Barbara County, FWS, and MMS.

In 1989, Exxon installed the jackets for Platforms Heritage and Harmony in 1,075 and 1,198 feet of water, respectively, making them among the deepest conventional platforms in the world.

Between December 1991 and March 1992, Exxon installed five pipelines and five power cables between the two platforms and shore. During the offshore pipeline/power cable installation on the OCS, MMS inspectors conducted 2-3 inspections per week. The new pipelines and power cables link the SYU platforms to the Las Flores Canyon onshore facility. The use of dynamically positioned vessels to install the pipelines and cables reduced the number of anchor placements needed by 200-300 when compared to the use of conventionally anchored lay vessels. Reducing the number of anchor placements reduced the likelihood of potential conflicts with commercial trawl fisheries during and subsequent to the construction phase. Exxon completed the installation of the Platform Heritage and Harmony topsides in November 1992 and brought the platforms on line in 1993.

OS&T Removal: The OS&T was a converted 50,000-deadweight-ton oil tanker moored near Platform Hondo, approximately 20 miles west of the City of Santa Barbara (see fig. 2.2-4). A single anchor leg mooring (SALM) secured the OS&T to the seafloor at a water depth of approximately 490 feet. Three pipelines connected the SALM to Platform Hondo: a 6-inch fuel gas line, an 8-inch produced water line, and a 12-inch oil emulsion line (see fig. 2.2-6).

With the availability of the onshore processing facility at Las Flores Canyon, the OS&T was no longer needed and was slated for removal under the Santa Barbara County's final development permit for the SYU. The county also required Exxon to remove the OS&T and the SALM from the site within 1 year after initial production from Platforms Harmony and Heritage (other platforms associated with the SYU). In addition, MMS regulations require that any OCS oil and gas structures deemed unnecessary be removed and the location be cleared of all obstructions to other activities in the area (30 CFR 125.143). However, pipelines are allowed to be abandoned in place if they do not constitute a hazard to navigation or commercial fishing operations or do not unduly interfere with other uses of the OCS (30 CFR 250.156).

Under the OS&T Abandonment Plan, Exxon proposed to remove the OS&T, the SALM, and the SALM base, along with the portion of the power cable that was suspended above the seafloor by the submerged catenary buoy. The oil, gas, and water pipelines connecting Platform Hondo and the OS&T would be abandoned in place, with the exception of short segments near the SALM base. An in-depth MMS technical review of this plan was conducted. As part of this review, MMS sent the plan to 31 Federal, State, and local agencies; the Joint Oil/Fisheries Liaison Office; commercial fishermen; and other parties for review and comment. Based on extensive coordination and written communication received from these reviewers, a comprehensive mitigation program was developed to address OS&T removal concerns.

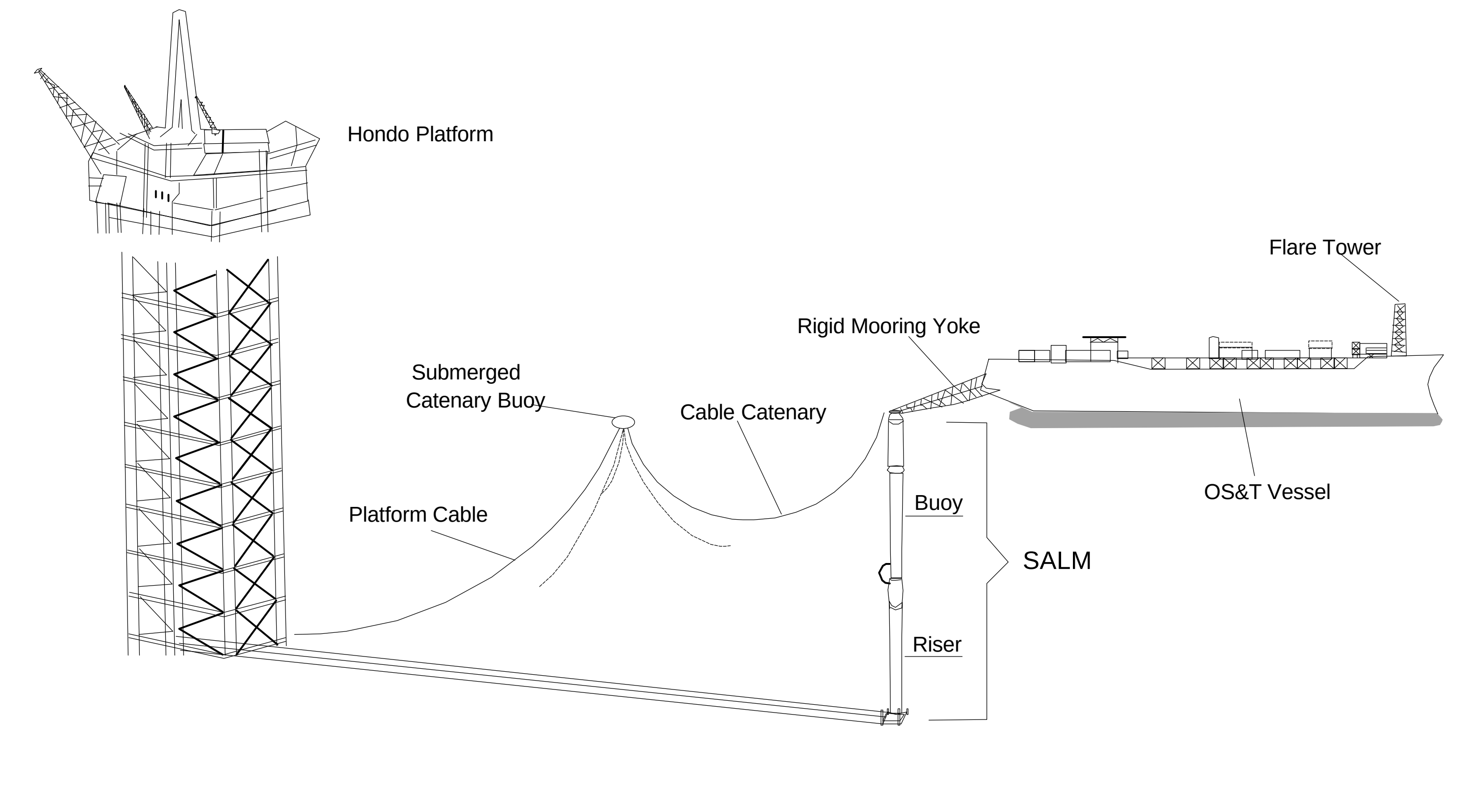


Figure 2.2-6. Offshore Storage and Treatment (OS&T) Abandonment Project Facilities Layout

The MMS in-depth review included an environmental review (MMS, 1994b), which focused on potential impacts to marine geology, air quality, marine water quality, marine biological resources, and commercial fishing. Based on its environmental review, MMS concluded that the proposed abandonment plan with additional mitigation would not significantly affect the quality of the human environment. This additional mitigation included the following requirements.

- Exxon would notify MMS by November 15 if abandonment activities were projected to extend past December 15, 1994, into the next gray whale migration period.

- Exxon would submit to MMS for review and approval a plan to cover, bury, or remove the power cable. Exxon would either (a) install a protective covering over the end of the power cable, (b) bury the exposed end of the power cable a minimum of 3 feet below the seafloor, or (c) completely remove the power cable.

- Exxon would submit a Location Clearance Plan to MMS for review and approval that included the following elements: (1) a high-resolution, side-scan sonar, reconnaissance survey to identify potential seafloor obstructions within the operational area of the OS&T, (2) deployment of an ROV to assess and remove oil- and natural gas-related obstructions, (3) a trawl test survey to verify that all oil- and natural gas-related obstructions to commercial trawling and other uses of the seabed had been cleared from the area.

The OS&T facility was successfully removed in accordance with the plans and procedures described in Exxon's OS&T Abandonment Plan and in compliance with all MMS requirements and conditions of approval. Under contract to Exxon, OPI International removed the OS&T vessel, the SALM, and portions of the associated pipelines and power cable between May 6 and July 9, 1994. The project included:

- disconnecting the OS&T vessel with its rigid mooring yoke from the SALM and towing it away
- disconnecting the SALM buoy and riser section from the SALM base, refloating, and towing them away
- cutting the six main piles and mono-pile, and removing the SALM base and subbase
- cutting the three Hondo/OS&T pipelines about 100 feet from the SALM base and removing the pipeline spool pieces
- plugging and covering the abandoned pipelines with flexible concrete mats
- cutting the power cable at the seafloor, burying its end 3 feet below the natural seafloor, and removing the cut section and submerged power cable buoy
- surveying the operational area around the SALM and recovering construction debris and oil- and natural gas-related obstructions on the seafloor

Prior to demobilizing from the site, OPI retrieved a large anchor that had been lost by one of the tankers that had moored at the OS&T as well as several other pieces of construction and operations-related debris in the immediate area of the OS&T. Additionally, consistent with Exxon's OS&T Location Clearance Plan, a side-scan sonar/ROV survey of the operational area was conducted during September and October 1994. Targets identified during the survey were investigated by an ROV, and oil- and natural gas-related debris (constituting a potential obstruction to commercial trawling and other uses of the seabed) was removed. [Note: During June and July 1995, test trawling operations were conducted to verify that the area was clear of all potential obstructions. There have been no reported net snags by commercial fishermen in the operational area since the project was completed.]

Benefits of the OS&T removal included the following (written commun. to Exxon dated April 25, 1994, signed by Thomas W. Dunaway, MMS Regional Supervisor, Operations and Safety, Pacific Region):

- reduction in the risk of a marine oil spill due to the elimination of (a) offshore oil storage in volumes up to 200,000 bbl, (b) oil transfer operations between the OS&T and tankers, and (c) approximately 35 tanker trips per year from the OS&T to Los Angeles, California
- increase in available commercial fishing grounds
- reduction in vessel traffic and improvement of visual quality

On June 3, 1994, removal of the OS&T was completed.

2.2B4 Drilling Discharges

The California OCS Monitoring Program (CAMP) was a series of studies to conduct long-term analysis of the cumulative effect of offshore drilling and production activities on the marine environment. The study area consisted of a portion of the continental shelf and the continental slope off southern California between Pt. Conception and Pt. Arguello.

The CAMP Phase I focused on baseline conditions of the long-term study sites for hard-bottom communities. Phase I's extensive reconnaissance study of soft-bottom and hard-bottom communities of the Santa Maria Basin and western Santa Barbara Channel provided the information base for Phase II.

During Phase II, from October 1986 through October 1990, monitoring studies were conducted at hard-bottom sites near Platform Hidalgo, and samples were collected near Platforms Harvest and Hermosa during predrilling, drilling, and postdrilling periods. Production drilling occurred at Platforms Hidalgo, Hermosa, and Harvest from January 1987 through January 1989.

During periods of drilling, analyses indicated increases in barium concentrations up to 40 percent and 300 percent, respectively, above background levels in the bottom sediments and suspended particles (Sciences Applications International Corporation [SAIC] and MEC, 1993). These increases were attributed to contributions of barite associated with drilling muds. Barium, in the chemical form associated with drilling muds, is essentially nontoxic to marine organisms, including embryos and larvae (NRC, 1983). Over time, the concentration levels of barium in the bottom sediments and suspended particles decreased. By the end of Phase II, barium concentrations in suspended particles had reached background levels, while concentrations in bottom sediments were slightly elevated due to the presence of residual barite particles (Steinhauer and Imamura, 1990).

Additionally, comparisons between pre- and postdischarge surveys indicated decreased abundances for 4 of the 22 taxa surveyed: sabellid polychaetes, *Halocynthia hilgendorfi*, *Caryophyllia* spp. and galatheid crabs. The study concluded that these decrease levels were likely due to a disruption of feeding, respiration, and/or postlarval survivorship due to burial rather than responses to toxicity (SAIC and MEC, 1993).

Phase III, from October 1991 to October 1992, continued the long-term monitoring and examined the physical and chemical processes that affect the natural and discharge-related variabilities in the biological communities. Phase III results showed that concentrations of chemical contaminants were at or near background concentrations for all those analyzed except for a small residual amount of barium. Additionally, there were no obvious residual effects on the hard-bottom communities (SAIC and MEC, 1993). The four taxa that experienced decreased abundances during Phase II did not exhibit any residual impacts. Other taxa were unaffected or, in some cases, showed increased settlement near the platforms. Results from both Phases II and III indicated that surface-generated waves usually did not cause resuspension at deeper bottom depths (e.g., 138 m) (SAIC and MEC, 1993). However, the potential for transport and resuspension is greater at shallower depths (105-119 m) (SAIC and MEC, 1993).

2.2B5 Tri-County Forum

The MMS has been working closely with local, State, and Federal regulators on issues concerning development and production from the 85 OCS leases located in the Pacific Region. An important vehicle in this intergovernmental coordination is the MMS/Tri-County Forum (Forum), a cooperative effort between the MMS and the Counties of Ventura, Santa Barbara, and San Luis Obispo.

The Forum was established in December 1990 to facilitate communication and coordination regarding OCS postlease issues of concern to the coastal counties. Other appropriate State and Federal agencies are invited to attend the meetings and are encouraged to express their interests and raise issues to the Forum. The MMS's overall objective in initiating the Forum was to improve the communication with local agencies regarding OCS exploration and development activities and to enable MMS to reach its goal of developing resources in a manner that all parties could support..

This open exchange of information and acknowledgment of the local government concerns and constraints has helped the permitting of postlease activities. For example, agreement between these parties in 1994 resulted in the adoption of a process for reviewing drilling proposals for exploration activities (plans) approved 3 or more years previous to the proposed activity (see *2.2B7 Approved Exploration Plan Review Process* for more information). This process provides the opportunity for MMS and the counties to jointly investigate and propose appropriate mitigation, which could be necessary because of changes to a plan or to the environmental considerations that may have occurred over the intervening years since the original plan was approved. This new process is expected to result in considerable savings to all parties, including OCS operators, by precluding litigation and coastal zone management appeals and by continuing to foster cooperative relations between regulators.

One of the Forum's major objectives was to determine cooperative ways to provide for production from the 42 undeveloped Pacific OCS leases—leases that are expected to yield perhaps a billion barrels of oil equivalent. Currently, production from the 43 producing OCS leases averages 180,000 bbl per day of oil and condensate and 155 million cubic feet of natural gas per day. The "Forum approach" has resulted in a cooperative relationship with all parties concerning OCS development, to the extent that, in comments received during the 1997-2002 5-year OCS program planning process, two of the three counties with the majority of OCS leases off their coasts have indicated a willingness to consider a limited expansion of leasing if the decisionmaking was shifted to the regional level and included a meaningful voice for local concerns and interests. To address the needs of the counties, the Forum identified the need for a study of California offshore oil and gas energy resources.

2.2B6 California Offshore Oil and Gas Energy Resources Study

Since the late 1890's, oil and natural gas development and production have occurred offshore southern California in the Federal OCS and in the California State Tideland waters. In the Santa Barbara Channel and Santa Maria Basin, there are 85 active OCS oil and natural gas tracts that were leased before 1992 (4 of which are off Long Beach). In addition, there are 39 oil and natural gas leases within the Tidelands (Steve Curran, CSLC, pers. commun., 1996).

Offshore oil and natural gas development in Ventura, Santa Barbara, and San Luis Obispo Counties (Tri-Counties) has a long history of controversy. To a large extent, the controversy centers around the ability of local and public agencies to deal with the cumulative onshore impacts associated with offshore development. These concerns have been communicated to MMS by the local county governments, the State government (Governor's office, the CCC, and the CSLC), and other commercial and recreational fishing industries in response to past lease sales and past exploration and development and production plans.

A major accomplishment of the MMS/Tri-County Forum (see section 2.2B5) is the *California Offshore Oil and Gas Energy Resources Study: A Joint Study of the Development Scenarios and Onshore Constraints in the Tri-County Area of San Luis Obispo, Santa Barbara, and Ventura* (COOGER). This study was conceived, in large part, by the Forum and was clarified through a series of working group meetings. The COOGER study is intended to evaluate, regionally and subregionally, the potential onshore effects of offshore oil and gas development from a “big picture” perspective. It will address existing and future onshore constraints associated with five possible levels of offshore oil and natural gas exploration and development from 1995 through 2015 by:

- providing information on potential development scenarios for the existing undeveloped offshore oil and natural gas leases
- analyzing the onshore constraints associated with the development of existing undeveloped offshore oil and natural gas leases

Under COOGER, the MMS has formed a Steering Committee and a Technical Management Team to broaden the scope of information and participation. The Team members include the MMS; CSLC; California Department of Conservation; CCC; Counties of San Luis Obispo, Santa Barbara and Ventura; Western States Petroleum Association; and lessees and operators of undeveloped oil and gas leases (Cal Resources LLC, Nuevo Energy Company, and Samedan Oil Corporation).

COOGER proceeds on the basis of the following assumptions.

- There is a market for petroleum products produced from the Tri-County study area.
- Discrete oil and natural gas fields will be considered within COOGER, and reserve estimates will be done on a field basis.
- Industry will endeavor to optimize both offshore and onshore production, processing, and transportation facilities.
- The Tri-County jurisdiction, along with the CCC, will endeavor to optimize onshore facilities as a means of minimizing adverse impacts.
- Geological and engineering data will be drawn from publicly available and proprietary sources. The MMS and CSLC will ensure that each company's proprietary data are protected. Ranges of values for reserve estimates and production rates will be used in the COOGER study.

[A contract for COOGER was awarded in February 1995 to Dames & Moore of Santa Barbara. The study will take 3 years and is co-funded by MMS and industry. This study includes public participation through workshops at key review periods. Additionally, the public is represented through membership of environmental and business community representatives on the Steering Committee. As such, this study exemplifies MMS’s philosophy that offshore resources are best managed in partnership with all key stakeholders.]

2.2B7 Approved Exploration Plan Review Process

In August 1994, the MMS Pacific Region initiated a new process to review previously approved Exploration Plans (EP’s)—the Approved Exploration Plan Review Process (AEPRP). This process applies only to MMS’s review of EP’s for the Pacific Region and does not address procedures that may be required by other agencies for permits related to proposed Pacific OCS exploratory drilling.

The AEPRP was developed by MMS in conjunction with Santa Barbara, San Luis Obispo, and Ventura Counties and the CCC through the MMS Tri-County Forum, and implements the MMS regulatory requirement found at 30 CFR 250.33(n)(1) for periodic reviews of approved EP's. In developing this process, MMS received input from other agencies and Pacific OCS lessees and operators. The MMS reviews an EP under this process when an operator intends to drill an exploratory well pursuant to an approved EP that is over 2 years old. The goals of the AEPRP are:

- to assess changes that may have occurred since MMS approved the EP, such as changes in exploratory project components and schedules, environmental conditions and impacts, mitigation measures, regulations, technology, or other pertinent information
- to ensure that concerns associated with these changes are resolved before exploratory drilling is approved
- to allow interested agencies an opportunity to participate in reviewing these changes

The Pacific OCS operator is required to annually provide MMS with general updated information on the intended schedules and procedures for exploratory drilling pursuant to an EP over the next 2-year period. The MMS shares this information with the other agencies to enable early coordination efforts to begin.

The AEPRP begins when the operator submits draft EP revisions to MMS for review. The MMS sends the EP revisions to the other agencies (see table 2.2-5), as appropriate, depending on the location of the proposed exploratory drilling.

The MMS and other agencies review the EP revisions and discuss them with the operator in detail. Then, in consultation, they decide if the EP revisions are complete or if there are any issues or concerns requiring further information and review. At that point, the AEPRP can proceed along one of two paths (see fig. 2.2-7): the "Short Path (A)" or the "Long Path (B)." In either case, MMS conducts an environmental analysis of the revisions prior to making a final decision.

The "Short Path" is an expedited process used when MMS, in consultation with the agencies, decides that the EP revisions as submitted are complete and that no additional information/review is required. The MMS notifies the agencies and operator of its decision and provides the agencies an opportunity to agree or disagree. If the agencies agree, MMS approves the revisions. If not, MMS holds a meeting to resolve any outstanding issues. Then MMS, in consultation with the agencies, decides if the issues are resolved or if further information/review is needed. The MMS approves the revisions if no additional information/review is needed. However, if more information/review is needed, the process proceeds along the "Long Path."

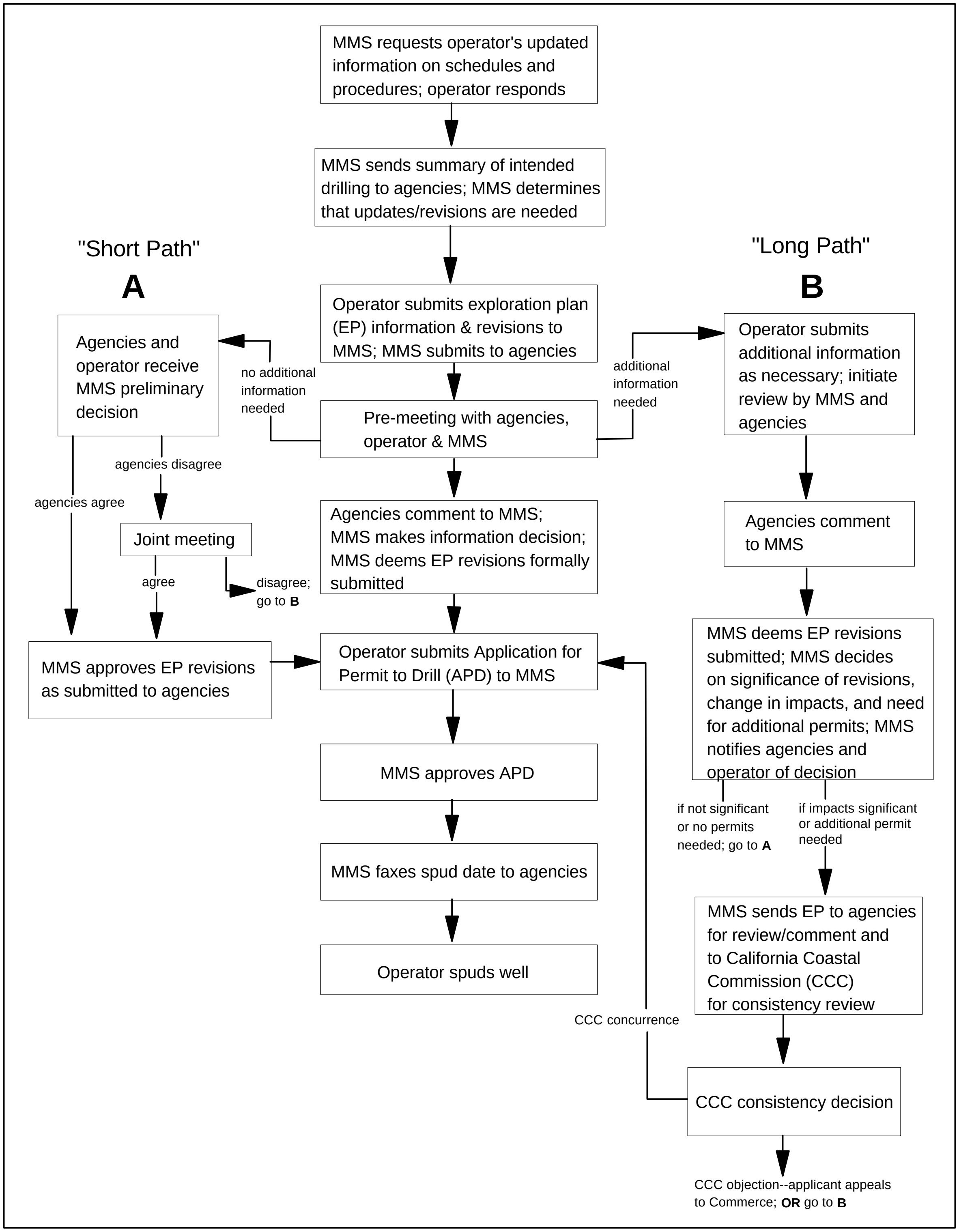


Figure 2.2-7. Approved Exploration Plan Review Process

The "Long Path's" initial steps are the same as those for the "Short Path." The MMS and the other agencies review the additional information submitted by the operator for up to 60 days. Then MMS, in consultation with the agencies, decides whether the EP revisions could result in a significant change in impacts previously identified or could require additional permits. If the decision is negative, the process returns to the "Short Path," where MMS notifies the agencies and operator and continues as described above.

Table 2.2-5. Other Agencies That Review Exploration Plan Revisions

Federal Agencies	State Agencies	Local Agencies/Governments	Other
Channel Islands National Marine Sanctuary	California Air Resources Board	San Luis Obispo County Air Pollution Control District	Joint Oil/Fisheries Liaison Office, Santa Barbara
Channel Islands National Park	California Coastal Commission	Santa Barbara County Air Pollution Control District	
Environmental Protection Agency	California Department of Conservation	Ventura County Air Pollution Control District	
National Marine Fisheries Service	California Department of Fish and Game	San Luis Obispo County Dept. of Planning and Building	
National Oceanic and Atmospheric Administration's (Office of Ocean and Coastal Resource Management)	California Division of Oil, Gas, and Geothermal Resources	Santa Barbara County, Energy Division	
Naval Air Weapons Center, Point Mugu	California Office of Oil Spill Prevention and Response	Ventura County, Planning Division	
U.S. Army Corps of Engineers	California State Lands Commission	Port of San Luis Harbor District	
U.S. Coast Guard		Oxnard Harbor District - Port of Hueneme	
U.S. Fish and Wildlife Service		Cities of Grover Beach, Santa Barbara, and Ventura	
U.S. Navy, San Diego		Cities of Arroyo Grande and Morro Bay	
Vandenberg Air Force Base		Cities of Pismo Beach and San Luis Obispo	
		Cities of Carpinteria, Oxnard, and Point Hueneme	

If the decision on impacts or permits is positive, the MMS initiates the consistency review process by deeming the EP revisions submitted and sending them to the agencies for further review and to the CCC for a consistency review. Within 30 days, the MMS, in consultation with the agencies approves, requires modifications, or disapproves the EP revisions. Within 3 months (with a possible 3-month extension) of the date it receives the EP revisions, the CCC either concurs with or objects to the operator's consistency certification. As with any other OCS plan, the MMS may not approve any application for permit to drill until one of the following occurs:

- consistency concurrence has been granted
- consistency concurrence has been presumed
- the State's consistency objection has been overruled by the Secretary of Commerce

2.2B8 Commercial Fisheries

The MMS requires OCS operators to conduct activities in a manner that would avoid undue interference with commercial fishing activities. The MMS has established mitigation measures to ensure this, such as notifying commercial fishermen about proposed activities, structures, or debris that might affect fishing operations. Conflicts between the fishing and oil industries are addressed and resolved by the Joint Oil/Fisheries Liaison Office and the Joint Oil/Fisheries Committee, which were established in 1983. Additionally, the California Sea Grant Extension Program publishes a monthly Oil and Gas Project Newsletter for Fishermen and Offshore Operators.

Some OCS-related activities and equipment, however, may cause damage or loss of commercial fishing gear and vessels. Service vessels also may damage or destroy fishing gear as the vessels traverse areas used for crab or lobster fishing, trap storage, longline fishing, or gill-net fishing. Under Title IV of the OCS Lands Act Amendments of 1978, commercial fishermen can file claims for compensation for fishing gear and vessel damage or loss caused by OCS oil and natural gas operations. The Fishermen's Contingency Fund compensates commercial fishermen for these economic losses. Table 2.2-6 summarizes fishermen's claims for such losses during 1992-1994.

Table 2.2-6. Fishermen's Contingency Fund Claims, Pacific Region, 1992 through 1994

Fiscal Year	Claims Received	Claims Paid	Amount Claimed	Amount Paid
1992	12	6	$57,351	$36,953
1993	4	2	$18,138	$8,208
1994	4	2	$67,183	$24,906
Total	**20**	**10**	**$142,672**	**$70,067**

Source: NMFS, February 1996

In addition, MMS has funded research on the effects of OCS activities on commercial fisheries. Centaur Associates (1981) conducted an extensive assessment of space-use conflicts between the fishing and petroleum industries, as discussed in our last report (Bornholdt and Lear, 1995). A more recent study (Imamura et al., 1993) is discussed below.

Effects of OCS Oil and Gas Production Platforms on Rocky Reef Fishes and Fisheries: The objective of this study (Imamura et al., 1993) was to examine potential effects of an offshore oil and natural gas production platform on fish assemblages by collecting preliminary data in three areas:

- spatial and short-term temporal variabilities in densities and species composition of fish assemblages at Platform Hidalgo
- variations in feeding habits of different fish species
- pathological and physiological conditions of fish in relation to chemical body burdens and a known contaminant source

The first aspect of the study was to compare the distribution and abundance of rockfish around Platform Hidalgo (located in 123 m of water and approximately 10 km southwest of Point Arguello) and at eight adjacent natural reefs. During July to October 1991, rockfish were surveyed and tagged, and the distribution and abundance of fish around Platform Hidalgo were monitored by scuba divers and by ROV photosurveys. Fish at the natural-reef sites were surveyed by ROV photosurveys and tagged with breakaway hook tags. Imamura et al. (1993), found the following.

- There were distinct differences in the fish assemblages between Platform Hidalgo and nearby reefs. Mid-water rockfish were dominant at Platform Hidalgo. Bottom-associated species, which were common at nearby natural reefs, were uncommon at the platform.

- It is hypothesized that Platform Hidalgo acts as a producer of fish populations by providing habitat for pelagic larvae to settle and grow prior to dispersing as juveniles—the study found that it was inhabited almost exclusively by juveniles. Had the pelagic larvae of these fish not encountered the platform, it is possible that many would have been lost through predation, starvation, or advection away from suitable natural reefs by currents.

- Among natural reefs, no statistical differences were found in rockfish population densities or community-level variables due to relief-height, depth, or proximity to the platform.

The second portion of the study examined variations in fish feeding habits by assessing:

- the best manner and time to catch rockfish with prey in their stomachs
- the optimum number of stomachs studied to adequately describe the range of prey for a species
- the similarity of prey and foraging activities between rockfish species in the Santa Maria Basin and rockfish found elsewhere

Fish were caught either using a commercial gill net or a hook-and-line method. When a rockfish is brought to the surface, it sometimes can't compensate rapidly enough for the decrease in pressure. The air in the swim bladder decompresses, resulting in swim bladder expansion which forces the fish's stomach to evert, spilling the prey contents. Both fishing methods were evaluated on their ability to prevent swimbladder expansion and the resulting stomach eversion. The swim bladders of some rockfish caught in gill nets were punctured to test if stomach eversion would be eliminated. Stomach contents were analyzed from fish caught at a variety of times and locations. The study results found that:

- Fish that were caught in gill nets and whose swim bladders were punctured were less likely to have everted stomachs.

- At least 20 prey-filled stomachs from fish caught during a variety of times and habitats must be examined to adequately analyze fish feeding habits.

- The feeding habits of vermillion rockfish (*Sebastes miniatus*) and yellowtail rockfish (*Sebastes flavidus*) near Platform Hidalgo differed from those previously reported elsewhere—the fish sampled near Platform Hidalgo consumed benthic-dwelling amphipods and polychaetes, whereas these species found elsewhere forage predominately in the water column on octopi, squids, and small fishes.

The third aspect of the study evaluated the pathological and physiological conditions of fish in relation to chemical body burdens and a known contaminant source. Because the natural petroleum seeps in the Santa Barbara Channel are a source of continuous hydrocarbon contamination away from the influence of intensive urban activity, they provide the opportunity to study chronic petroleum effects. For this phase of the study, the Isla Vista Petroleum Seep, located near Coal Oil Point in the Channel, was chosen because its environment resembles other shallow areas of the Channel.

In September 1990, rainbow and rubberlip surfperch were collected from Isla Vista and from two comparison areas (Naples Reef and Goleta Pier). Their organs were examined for biomarkers of hydrocarbon exposure and sublethal effects. The study found the following.

- Compounds fluorescing at wave lengths of naphthalene were significantly elevated in bile samples of rainbow surfperch (approx. 3X), but not rubberlip surfperch collected from the seep site.

- Compounds fluorescing at wavelengths of phenanthrene were significantly elevated in both species (approx. 2-3X) collected from the seep site. Both species also showed significantly elevated concentrations of P-450IA1 (an isozyme induced by exposure to hydrocarbons and PCS's) in hepatic microsomes (approx. 5X in rainbow surfperch and approx. 2X in rubberlip surfperch) relative to fish taken from the reference area.

- Histopathological lesions were documented in the gills, liver, and kidney of both species; however, total lesion scores were not significantly different between the two groups of rubberlip surfperch. Gill lesions were especially severe among rainbow surfperch collected from the seep site.

These interspecific differences in exposure and response are consistent with the greater reliance on benthic feeding and more limited migration noted of the rainbow surfperch.

Mariculture on the Platforms: One of the most successful mussel culture industries on the West Coast occurs on oil platforms in the Santa Barbara Channel. The platform jackets attract mussels, but their accumulated weight quickly becomes a hazard. Instead of paying to have the jackets cleaned regularly, some operators have the nuisance mussels harvested and marketed by a local entrepreneur. Currently, the harvest averages 20 tons/month for 10 months of the year. These mussels have been given a clean bill of health from California Health Services and, in fact, are preferred over mussels taken from nearshore areas. The business also includes oysters, scallops, and clams cultivated on the platforms.

Effects of Pacific OCS Structure Removal: Operations involved in installing or removing development structures may exclude fishermen from large areas (approx. 3 sq. mi.) around the structure. However, such temporary operations do not substantially increase the long-term or cumulative impacts on commercial fisheries.

From 1992 through 1994, there was one structure removed from the Pacific OCS. Under contract to Exxon, OPI International removed the OS&T vessel and associated structures between May 6 and July 9, 1994. Preliminary site-clearance surveys were performed, with final surveys scheduled for 1995. To minimize conflicts, Exxon was required to:

- submit an OS&T Location Clearance Plan, which included side-scan sonar, ROV assessment, clearance of obstructions, and trawl test verification of obstruction clearance.
- notify the appropriate agencies, including the Joint Oil/Fisheries Liaison Office, 30 days before starting the OS&T abandonment project and notify fishermen immediately after abandonment to announce the area open for fishing
- submit a vessel traffic scheme that follows the recommendations contained in the March 7, 1994, letter from the Joint Oil/Fisheries Liaison Office
- position anchors so as to minimize encroachment on trawling grounds between the OS&T and Platform Hondo
- retain responsibility for the abandoned pipelines and power cables on the lease and establish a claims procedure to reimburse commercial fishermen for verified claims

Twenty-five targets were identified by Exxon and MMS for trawl test verification during side-scan sonar and ROV investigation. All targets were trawled without any debris recovery or damage to the trawl gear. However, a trawl net was snagged and torn in one instance on what the trawl boat captain believed to have been rocks.

To further understand the effects of removing or decommissioning offshore oil and natural gas facilities in the Pacific Region, MMS and CSLC are working cooperatively to improve interagency coordination and planning. In 1994, these agencies sponsored a workshop entitled “Abandonment and Removal of Offshore Oil and Gas Facilities: Education and Information Transfer.” The purpose of this workshop was to bring together representatives from various Federal, State, and local agencies; the petroleum industry; commercial and recreational fishing associations; and environmental groups to disseminate information on removal and decommissioning planning and to discuss the technical and environmental issue concerns. Workshop topics ranged from the use of explosives during removal operations to the feasibility of converting facilities to artificial reefs.

One of the recommendations that emerged from the workshop was the need for the involved regulatory agencies to develop a consistent and streamlined permitting process for decommissioning and removing offshore oil and natural gas facilities. Presently, approvals for removal or decommissioning one of these facilities in the Pacific Region are required from not only MMS and the CSLC, but also a long list of Federal, State, and local agencies (such as U.S. Army Corps of Engineers, USCG, NMFS, the California Department of Fish and Game, county planning departments, air pollution control districts, and the CCC). Other interested parties include commercial and recreational fishing associations and environmental groups.

The CSLC/MMS interagency working group on decommissioning and removal of offshore facilities is one of several important cooperative efforts MMS has initiated to enhance dialogue and communication related to the OCS Program in the Pacific Region. Decommissioning and removal projects are likely to be prime candidates for future collaborative efforts. Contingent on economic conditions, it has been projected that as many as 10 platforms could be decommissioned and removed over the next 15 years.

2.3 Alaska Region

The Alaska Region is divided into 15 OCS planning areas (see fig 2.3-1). During 1992 through 1994, no Federal lease sales were held in the Alaska Region. In fact, over 680 OCS leases were relinquished; all remaining active OCS leases in the Alaska Region are found in the Beaufort Sea Planning Area (see fig 2.3-2). In fact, most of the OCS activities in the Alaska Region occurred in the Kuvlum Unit (table 2.3-1). However, the following postlease activities did occur from 1992 through 1994:

- 20 geological and geophysical exploration permits were issued
- 4 exploratory wells were drilled

Table 2.3-1. Alaska OCS Drilling History, 1992 through 1994

Sale	Well Name	Block	Operator	Spud Date	P&A[1] Date
87	Kuvlum #1	673	Arco Alaska, Inc.	8-22-92	10-13-92
87	Kuvlum #2	672	Arco Alaska, Inc.	7-28-93	8-28-93
87	Kuvlum #3	673	Arco Alaska, Inc.	9-9-93	10-5-93
124	Wild Weasel	760	Arco Alaska, Inc.	10-13-93	11-9-93

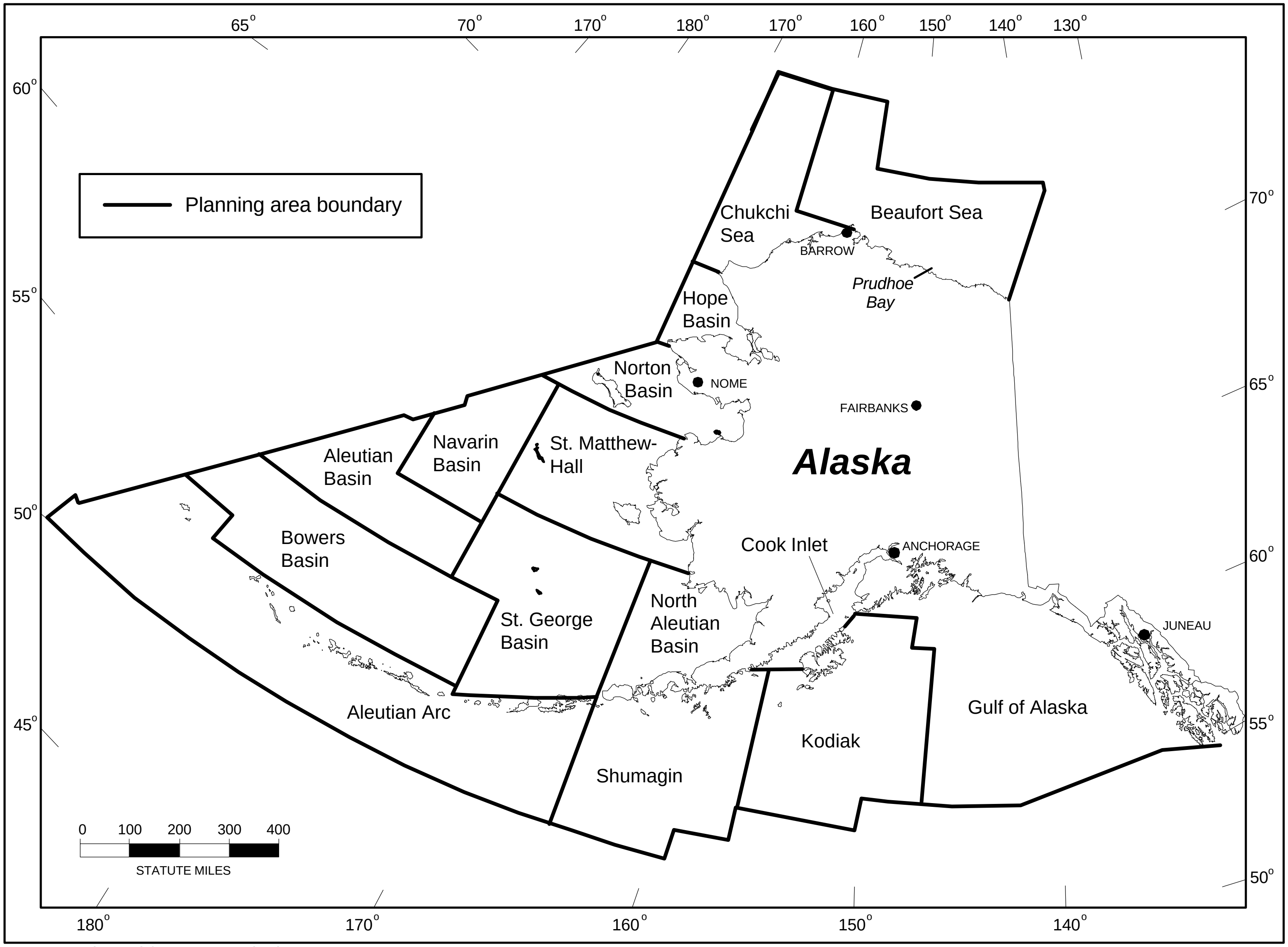
[1] Plugged and Abandoned Date
Source: MMS, Alaska OCS Region, April 1995

2.3A Special Topic—Kuvlum

As table 2.3-1 shows, most of the drilling activity during this report period was conducted in the Kuvlum Unit. This unit is located in the eastern portion of the Beaufort Sea Planning Area about 60 miles northeast of Prudhoe Bay and about 15 miles northeast of Point Brownlow, near the westernmost coastal portion of the Arctic National Wildlife Refuge (fig. 2.3-2). Kuvlum was unitized in 1993, making it the fourth unit in the Alaska OCS Region; the other three (Hammerhead, Northstar, and Sandpiper) are also in the Beaufort Sea Planning Area.

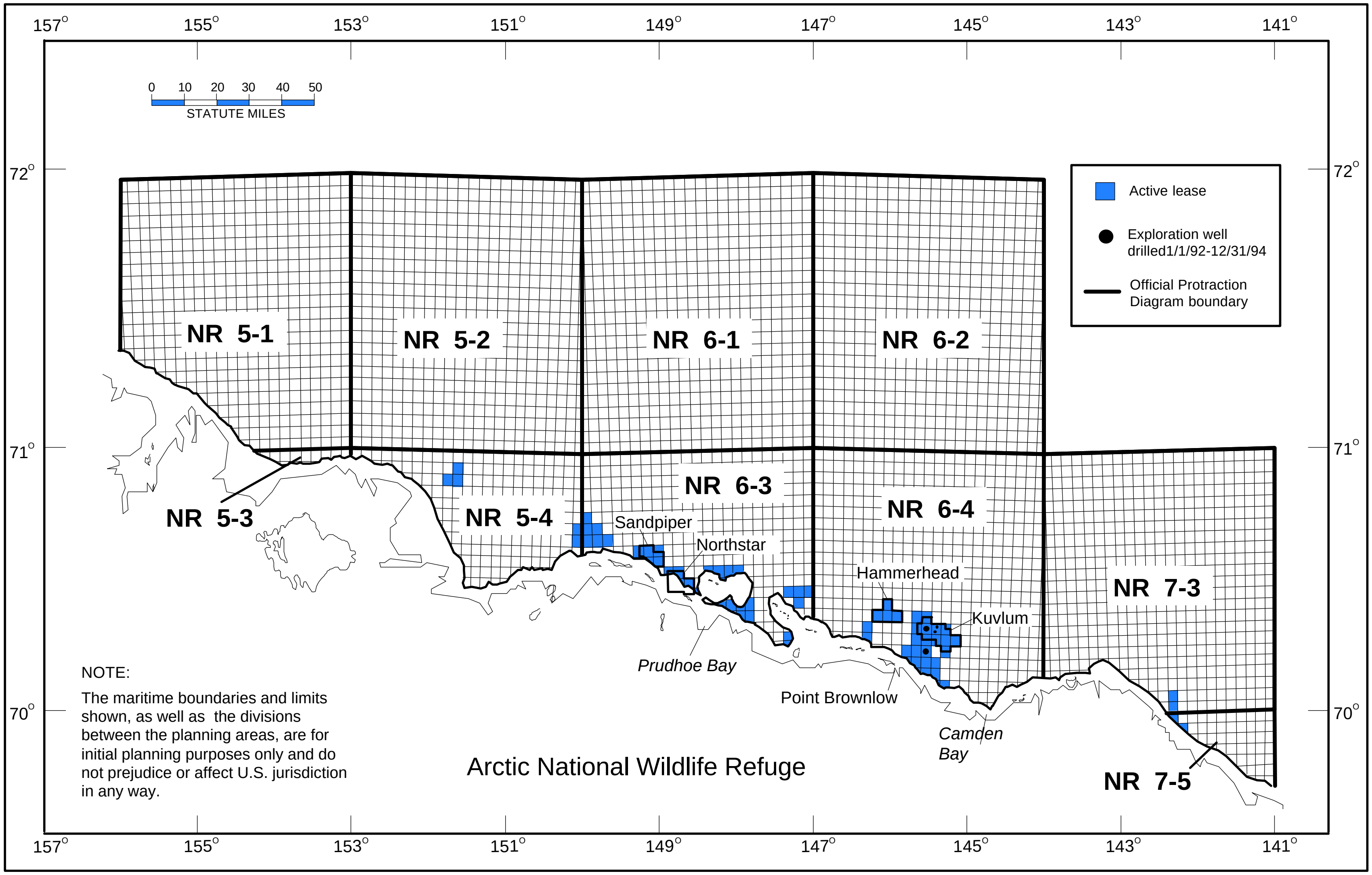
Before drilling began, the areas near the Kuvlum well sites were surveyed for special biological communities. The biological survey revealed that the seafloor area around the drill sites is frequently gouged by ice keels, and no diverse benthic communities were observed. However, the drill site was within the bowhead whale migration corridor. Therefore, a site-specific bowhead whale monitoring program was required by lease stipulation to determine the presence of bowhead whales during lease operations (see *2.3B2(b) Bowhead Whale Monitoring Program*).

To evaluate the production potential of the Kuvlum area, three exploratory wells were drilled during the open-water drilling seasons of 1992 and 1993. In August 1992, drilling operations on the first Kuvlum well commenced using the semisubmersible



Source: Adapted from MMS Alaska source maps, 1994.

Figure 2.3-1. Alaska OCS Planning Areas, 1992-1994



Source: Adapted from MMS Alaska source maps, 1994.

Figure 2.3-2. Beaufort Sea Planning Area, Status of Leases, 1992-1994

Kulluk, supported by four ice management vessels. The presence of heavy ice during the 1992 Kuvlum operations necessitated the use of ice breakers that unfortunately created unusually high levels of underwater noise. The well was plugged on October 14 and abandoned on October 15, 1992.

After evaluating the first well results, the lessees, ARCO (Alaska), Inc. and partners, petitioned the MMS to unitize the 12 leases, or portions thereof, that cover the Kuvlum Unit. In addition, they requested a Suspension of Production and Operations (30 CFR 250.10(a)(1)) for the unit. The MMS granted these requests on March 23, 1993, prior to the second year of exploratory drilling.

During the 1993 open-water season, two wells were drilled (Kuvlum #2—July 18-August 20; Kuvlum #3—September 9-October 5), and additional seismic data were collected to delineate the Kuvlum Unit until September 1 when seismic operations ceased. ARCO also conducted drilling operations at the Wild Weasel site (October 13-November 9) but abandoned the site on November 10, 1993. These three drilling operations again used the semi-submersible drilling barge *Kulluk*, supported by three ice-management vessels.

On August 11, 1993, the Alaska Eskimo Whaling Commission (AEWC) petitioned the Secretary of the Interior to suspend all permits issued to ARCO for oil and natural gas exploratory activities being conducted at Kuvlum. In addition, a second petition (signed by the AEWC; the Mayor of the North Slope Borough; and the Presidents of the Barrow, Kaktovik, and Nuiqsut Whaling Captains' Associations) asked the Secretary of the Interior to join a lawsuit filed in the U.S. District Court for the District of Columbia by the petitioners against NMFS and others. This lawsuit focused on the relationship of NMFS actions to ongoing oil exploration in the Beaufort Sea and to subsistence hunting of bowhead whales. Public testimony by Inupiat subsistence whalers (including Mr. Burton Rexford, AEWC President) reported that OCS operations displace the offshore bowhead whaling migration and that subsistence whalers must go farther offshore to find whales. Compounding this effect is the ensuing problem of having longer distances to tow a captured whale and, therefore, incurring possible spoilage of meat (Rexford, 1993).

The petitions addressed the MMS permits issued to ARCO for seismic and exploratory drilling operations at their Kuvlum Unit during the 1993 season. The plaintiffs contended that these activities would adversely affect the fall bowhead whale migration and the Eskimo subsistence hunting of bowhead whales.

On August 20, 1993, the plaintiffs filed a Motion for Preliminary Injunction and a Motion for Expedited Oral Hearing stating: "Only immediate injunctive relief can prevent imminent, irreparable harm to the subsistence hunt, and to the Eskimo hunters." On August 30, 1993, the Federal defendants filed their Memorandum Opposing Plaintiffs' Motion for Preliminary Injunction. On September 8, 1993, the court denied the plaintiffs' Motion for Preliminary Injunction and ordered the parties to inform the court within 45 days that the action was moot.

ARCO completed their seismic and exploratory drilling activities in the Kuvlum Unit in early November 1993.

As a result of Kuvlum's second-year drilling program, ARCO submitted documents in July 1994 to withdraw from the lease holdings, transferring them to Union Texas Petroleum. In January 1995, Union Texas Petroleum was approved as the succeeding operator for the Kuvlum Unit.

2.3B Matters of Interest

For the period of 1992-1994, the MMS Alaska regional office selected the following issues for discussion because they contain new scientific information, are of their particular interest to OCS stakeholders, or were cited as a cumulative effect of the OCS Program in our last report (Bornholdt and Lear, 1995):

- Cook Inlet water quality study
- bowhead whales
- subsistence and sociocultural effects

2.3B1 Cook Inlet Water Quality Study

During 1992-1994, there are 12 oil and natural gas production platforms operating in the State waters of Cook Inlet. For three decades, these platforms have been discharging drilling muds, cuttings, formation waters, and specialty chemicals such as biocides. In response to concerns expressed by the Public Awareness Committee for the Environment and others about the current and cumulative effects of oil and natural gas production discharges in Cook Inlet, MMS entered into a cooperative agreement with the University of Alaska (the Environment and Natural Resource Institute) to obtain information on the occurrence of petroleum hydrocarbons, trace metals, and naturally occurring radioactive materials in Cook Inlet.

The study was designed as a multipronged reconnaissance of the current status of contaminants. The major goals of the study were to ascertain the following:

- presence of hydrocarbon and trace metal contaminants in the water
- accumulation of contaminants in the sediments
- effects of current contaminant levels on sensitive animal life stages

Sampling sites were chosen within a variety of Cook Inlet environments: bays where fine-grained sediments indicate a depositional environment, bays in the vicinity of State production platforms in upper Cook Inlet, and bays near processing and transportation facilities in northern lower Cook Inlet. Many of the sediment sites within the study area were previously sampled by the Bureau of Land Management (BLM—the predecessor of the MMS) between 1976 and 1979. The recent study (Environment and Natural Resources Institute, 1995) selected various sites to determine whether or not hydrocarbons and trace metals have been accumulating in the sediments. In addition, water sampling sites were selected to investigate possible near-field contamination in current oil and gas development areas and possible far-field effects near Kachemak and Kamishak Bays.

Two research cruises were conducted during June 20-28 and August 16-September 4, 1993. The goal of these cruises was to occupy six to eight water chemistry stations and to take multiple samples of water, suspended sediments, and biota at 1-m depths during both high and low tides. Hydrographic casts were made for each station and, whenever possible, for points in between.

The physical, chemical, and bioassay results of the Cook Inlet Water Quality Study (Environment and Natural Resources Institute, 1995) showed that Cook Inlet had very low environmental concentrations of hydrocarbons and that the sediments and water were generally free from toxic components. The results also showed no immediate evidence of heavy metal pollution in Cook Inlet.

2.3B2 Bowhead Whales

The bowhead whale (*Balaena mysticetus*) gets its name from its huge, bow-shaped skull and the resulting bow-shaped intersection where the upper and lower jaws meet (Burns et al., 1993). Because it possesses a blubber layer thicker (43-50 cm) than that of any other animal, the bowhead has acclimated to living in the Chukchi and Beaufort Seas, where water temperatures average less than 0 degrees Celsius. In fact, the bowhead is the only baleen whale that has evolved to inhabit these seasonally ice-covered seas throughout the year.

The Bering-Chukchi-Beaufort population of the bowhead whale winters in the Bering Sea and spends summer in the Amundsen Gulf (off the coast of Canada). Migration occurs in pulses and is composed of groups of whales swimming together.

The bowhead whales' spring migration route begins in the northwestern Bering Sea, passes through the eastern Chukchi Sea along the coast of Alaska, then proceeds offshore across the central Beaufort Sea to the eastern Beaufort Sea. The whales migrate past the west end of St. Lawrence Island from late March through April and usually pass Point Barrow between mid-April and early June, arriving in the eastern Beaufort Sea as early as May. However, the timing of the spring migration seems to be influenced by annual differences in ice conditions (Burns et al., 1993).

The fall migration route begins in the eastern Beaufort Sea with whales passing through the central Beaufort Sea along the continental shelf, across the Chukchi Sea, and finally along the coast of the Chukchi Peninsula. Compared to the spring migration, this route brings the animals closer to the Alaskan north coast and is less restricted by ice. Fall migration begins in early September with the whales arriving in the northeastern Chukchi Sea by mid- to late September (Burns et al., 1993).

To ensure protection of bowhead whales, as required under the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973, MMS has funded numerous studies involving acquisition and analysis of marine mammal data. Since 1978, the biological opinions for OCS lease sales in the Arctic have recommended continuing studies of whale distribution and OCS-industry effects on bowhead whales (Treacy, 1993). These opinions also requested monitoring of bowhead whale presence during periods of geophysical exploration and drilling. From 1979 to 1987, the MMS/BLM funded annual monitoring of endangered whales in arctic waters under interagency agreements with the Naval Ocean Systems Center. Since 1987, MMS scientists have been conducting bowhead whale aerial surveys, the goals of which include:

- monitoring temporal and spatial trends in the distribution, relative abundance, habitat, and behaviors of endangered whales in arctic waters
- monitoring behaviors, swim directions, dive times, surfacing patterns, and tracklines of selected bowhead whales
- providing real-time data on the general progress of the fall migration across the Beaufort Sea for use in implementing seasonal drilling restrictions and limitations on exploration
- providing an objective wide-area context for management interpretation of the overall fall migration of bowhead whales and site-specific study results

To also protect the bowhead and other endangered whales, the MMS has developed certain stipulations and information to lessees (ITL). Stipulations are legally binding contractual provisions attached to OCS leases. An ITL is an advisory included in the Notice of Sale to alert lessees and operators of special concerns in or near a lease sale area.

For OCS leases in the Beaufort Sea Planning Area, an MMS stipulation requires that the site-specific effects of exploratory activities on bowhead whales must be monitored by industry, as stated below.

> The lessee shall conduct a site-specific monitoring program during exploratory drilling activities to determine when bowhead whales are present in the vicinity of lease operations and the extent of behavioral effects on bowhead whales due to these activities. The lessee shall provide its proposed monitoring plan to the Regional Supervisor, Field Operations, for review and approval no later then 60 days prior to commencement of drilling activities. Information obtained from this site-specific monitoring program shall be provided to the Regional Supervisor in accordance with the approved monitoring plan.

An ITL covering Beaufort Sea OCS lease sales advises lessees that, in consultation with NMFS and the State of Alaska, MMS will annually review information on endangered whales to determine whether existing mitigating measures adequately protect the whales from serious, irreparable, or immediate harm from oil exploration activities.

Recognizing the need to synthesize the extensive research work on the bowhead whale, the MMS invited those organizations that had sponsored/participated in such research to produce a single-volume reference book. This book is to be a scientifically authoritative reference that would serve the information needs of scientists, managers, and natural resource policymakers responsible for the bowhead and its habitat. Many organizations joined the MMS in sponsoring this effort: AEWC, American Petroleum Institute, Amoco Production Company, CANMAR U.S., Incorporation, Exxon Company USA, Fisheries and Oceans Canada, Indian and Northern Affairs Canada, North Slope Borough, Shell Western E&P Incorporated, Standard Alaska Production Company, Union Oil Company of California, and Western Geophysical Company.

In 1988, technically qualified representatives of these sponsors met to discuss the composition of this reference work. In 1993, The Society for Marine Mammalogy published *The Bowhead Whale* (Burns et al., 1993) as a Special Publication. The volume contains the work of over 35 contributing authors and discusses many topics, such as anatomy and physiology, behavior, foods and feeding ecology, distribution and movement, and subsistence and commercial whaling.

Below are discussions regarding continued efforts to learn more about bowhead whale behavior and how this mammal reacts to the presence of oil and gas activities.

(a) MMS Bowhead Whale Aerial Surveys

Broad-scale or cumulative effects on the distribution, abundance, and behavior of bowhead whales in the Beaufort Sea are monitored during each fall migration period under the MMS bowhead whale aerial survey program (Treacy, 1993; 1994; 1995). These surveys provide real-time data to MMS and NMFS on the progress of migration; these data are used to limit OCS exploratory activities. Comparisons of the bowhead whale migration routes provide information on potential long-term impacts of seismic exploration, drilling, and associated activities.

1992 MMS Surveys: During the fall 1992 MMS aerial surveys, general ice cover was moderately heavy. It was during this year that ARCO conducted drilling operations on its Kuvlum leases (see *2.3A. Special Topic—Kuvlum*). The fall 1992 aerial surveys resulted in 153 bowhead whale sightings (excluding repeated sightings), observing a total of 315 bowhead whales (Treacy, 1993). The initial sighting of bowhead whales occurred on August 31; half of the whales observed east of Cape Halkett (154° W. long.) were counted by September 20. During these surveys the estimated median (67.0 m) and mean (70.6 m) water depths for bowhead whale sightings were consistent with a previously noted trend for whales to be in deeper water during years of moderately heavy ice cover (Treacy, 1993). Most of the 1992 survey results were generally within the range of values from previous MMS-funded whale monitoring conducted during September and October (1979-1991) in the Beaufort Sea using similar survey methods (Treacy, 1993).

1993 MMS Surveys: During the fall 1993 MMS whale aerial surveys, general ice cover was extremely light—the mildest since fall surveys began in 1979. During this time, ARCO conducted drilling operations at the Kuvlum #2 and #3 sites and at the Wild Weasel

Prospect (see fig. 2.3-2). During these surveys, 235 sightings of bowhead whales were made (not counting repeated sightings), observing 353 bowhead whales—the second highest totals for project surveys conducted during 1987-1993 (Treacy, 1994). Bowhead whales were initially sighted on September 1, and half were counted by September 29. During these surveys, the estimated median (29.0 m) and mean (35.2 m) water depths for bowhead whale sightings were consistent with a previously noted trend for whales to be in shallower water during years of light ice cover (Treacy, 1994). Most of the 1993 survey results were generally within the range of values from previous MMS-funded whale monitoring conducted during September and October (1979-1992) in the Beaufort Sea using similar survey methods (Treacy, 1994).

1994 MMS Surveys: During the fall 1994 MMS aerial surveys, general ice cover in the Beaufort Sea was light, and no OCS drilling activity took place prior to the fall 1994 migration of whales. During these surveys, 105 sightings of bowhead whales were made (not counting repeated sightings), observing 204 bowhead whales—lower than average totals for previous project surveys conducted during 1987-1993 (Treacy, 1995). Bowhead whales were initially sighted on August 31, with half being counted by September 9. During these surveys, the estimated median (40.0 m) and mean (58.7 m) water depths for bowhead whale sights were consistent with a previously noted trend for whales to be in shallower water during years of light ice cover, (Treacy, 1995). Although the peak in the 1994 fall migration occurred earlier than that found in previous surveys (1987-1993), most of the 1994 survey results were generally within the range of values from previous whale monitoring (Treacy, 1995). This “early peak” is being analyzed for statistical significance and for comparison regarding industry activity, sighting conditions, etc.

(b) Kuvlum Site-Specific Bowhead Whale Monitoring Program

The Industry Site-Specific Bowhead Whale-Monitoring Program is a precautionary or mitigation measure that requires oil industry contractors to monitor bowhead whale presence and behavior by using underwater acoustic arrays and aerial survey grids surrounding exploratory seismic and drilling operations.

Because ARCO engaged in OCS-related activities during the 1992 and 1993 fall bowhead whale migration, it was required by the MMS to execute a site-specific monitoring program for each year. No industry site-specific monitoring was required during the 1994 fall migration because no OCS-related activities that could disrupt the migration took place.

1992 ARCO Monitoring Program: On behalf of ARCO, the Coastal and Offshore Pacific Corporation developed and executed the site-specific monitoring program for the 1992 Kuvlum exploratory well (Kuvlum #1), which included four core elements (Brewer et al., 1993):

- aerial surveys
- surface observations
- passive acoustics
- physical acoustics

Thirty-five dedicated ***aerial survey*** flights were completed from September 8 through October 16, 1992. During these flights, a total of 49 bowhead whales were observed, with the sightings per effort and numbers of bowhead whales being similar to previous aerial surveys in the Beaufort Sea (Brewer et al., 1993). The monitoring report characterized the whale migration as occurring in three pulses through the Kuvlum area, with the primary pulse occurring September 17-28. All of the whales sighted appeared to move toward the north of the drilling project as they passed within about 30 km of the drilling location, although one bowhead was observed approximately 23 km from an ice breaker (Brewer et. al., 1993).

During the aerial surveys, eight omnidirectional sonobuoys were deployed to record animal calls, ambient noise levels, and industrial sounds. Approximately 3,800 bowhead whales, beluga whales, and seals were detected on approximately 6 hours of sonobuoy tape recordings (Brewer et. al., 1993). The monitoring report found that calling peaked when the bowhead whales were approximately 32 km from the OCS activity, about the same distance that whales were observed moving north around the drilling activity.

From September 5 through 30, 1992, ***surface observations*** of marine mammals and the operational characteristics of the *Kulluk* and associated support fleet were collected up to 12 times during the daylight hours. A total of 290 observation periods (15 minutes per period) were completed aboard the *Kulluk*, with no bowhead whales being sighted; however, 31 seals, 60 polar bears, and one Arctic fox were sighted (Brewer et. al., 1993).

Unfortunately, the ***passive acoustic*** array, based on bottom mounted acoustic sensors and an electro-optic data transmission cable, could not be deployed because of the heavy ice conditions in the area.

The ***physical acoustic*** program element, based on calibrated digital acoustic tape recordings of underwater sounds, was designed to:

- characterize sound production of the *Kulluk* and its support vessels
- calculate the acoustic source levels produced by the *Kulluk* and its support fleet
- calculate the acoustic loss characteristics of the drilling area
- measure the ambient noise level in areas where industrial sounds were not present
- determine the maximum distance at which industrial sounds could be measured
- determine industrial sound levels where bowhead whales were sighted during aerial surveys

The monitoring report revealed that sounds from the semi-submersible drilling barge *Kulluk* and from the support fleet could be detected at ranges up to 41 km from the Kuvlum #1 site. The sound levels recorded from the sonobuoys were much lower than would have been calculated by the transmission loss model for the area around the drilling site. It is believed that these lower levels were due to the heavy, grounded ice floes located to the west, north, and east of the drilling site (Brewer et. al., 1993). During one of the sonobuoy recording efforts, the aerial survey airplane (*Commander FL 680*) flew directly over the sonobuoy as it was transmitting acoustic data back to the airplane. Analysis found that this acoustic source level was less than one half as high as the source level published for a common aerial survey airplane (*DeHaviland Twin Otter*). This indicates that the *Commander FL 680* could fly at one half the altitude of the *Twin Otter* and produce the same sound level at the sea surface—an important consideration when designing aerial surveys for acoustically sensitive organisms such as marine mammals (Brewer et. al., 1993).

The combined presence of moderate to heavy ice conditions throughout the monitoring area and of the occurrence of industrial activity during the 1992 monitoring program makes it difficult to determine if the ice or the industrial activity, or both, caused the bowhead whales to migrate north of the project. However, the monitoring report concluded that the presence of ice alone did not determine the observed whale distribution. Based on available information, the MMS cannot eliminate the industrial activity as a source for the observed, although apparently unusual, shift in distribution of bowhead whales in the Kuvlum #1 monitoring area (Brewer et al., 1993). However, this shift appeared to be temporary, because the distribution of whales observed west of the drilling activity was dispersed, not clumped as when the whales were within 30 km of the drilling site (Brewer et al., 1993).

1993 ARCO Monitoring Program: During the 1993 drilling season, environmental conditions in the Kuvlum project area, especially with regard to sea ice, were very different from those encountered in 1992. Whereas 1992 was characterized by moderate to heavy sea-ice conditions, 1993 was sea-ice free after August 31. On behalf of ARCO, the Coastal and Offshore Pacific Corporation developed and executed the site-specific monitoring plan for the 1993 Kuvlum area exploratory wells (Hall et al., 1994). The monitoring program included three elements:

- aerial surveys
- surface observations
- physical acoustics

From August 17 through October 12, 1993, a total of 52 aircraft flights were made: 32 survey fights and 20 acoustic flights. ***Aerial survey*** programs made 330 sightings, observing 377 bowhead whales in the Kuvlum monitoring area. The report indicated that the whale distribution fell within the parameters of previously recorded fall migration distributions and that migration was likely underway in the Camden Bay area during the time of the surveys (Hall et al., 1994).

Surface observations from the drilling unit and from seismic and icebreaker vessels during the 1993 Kuvlum site-specific monitoring program sighted a total of 31 bowhead whales over a period of 13 sightings. These bowhead whales were much closer to the drilling unit and support vessels than those observed during the aerial surveys. The closest observed positions of a bowhead whale to the industrial source were an estimated 175 m from the seismic vessel *Western Aleutian* and an estimated 400 m from the barge *Kulluk*. These positions are similar to the surface observer sightings made during 1989 and 1990 OCS-related activities (Hall et al., 1994).

The ***physical acoustic*** program revealed that project noise sources tainted ambient noise levels at ranges over 100 km east of the Kuvlum monitoring site. Mean one-third octave band levels of 105dB re $1\mu Pa^2$ were measured for bands 20 through 30 (100Hz to 1kHz), with levels dropping off above band 30 (Hall et al., 1994). The report concluded that "offshore drilling operations in Camden Bay composed of similar equipment, and operating in similar water depths, as the Kuvlum projects in 1993, will ensonify the inshore Beaufort Sea marine environment with detectable industrial sounds from Harrison Bay to the Canadian border".

The 1993 monitoring report indicated that under similar open-water conditions, the 1993 distribution of bowhead whales in western Camden Bay was not significantly different from those for 1989 and 1990—years characterized by open-water conditions during the bowhead whale migration and during which substantial industrial activity took place. According to Hall et al. (1994), it appears that the 1993 bowhead whale distribution fell within the parameters of previously recorded fall migration distributions, given the results of the statistical analyses and the evidence from aerial survey sighting distributions.

As stated previously, no OCS-related activities capable of disrupting bowhead whale migration occurred during 1994; therefore, no industry site-specific monitoring was required.

Conclusion: According to the MMS aerial survey results, bowhead whale fall migrations for 1992, 1993, and 1994 exhibited patterns found in previous MMS aerial surveys conducted during years of respective ice conditions. From 1992 through 1994, the Kuvlum site-specific monitoring programs found indications of local and temporary bowhead whale avoidance near some OCS exploration activities in the Beaufort Sea. However, whether this displacement was due to natural conditions (heavy ice) or industrial activity is unclear. Overall, the MMS found no evidence of serious, irreparable, or immediate harm to the bowhead whales from OCS-related activities during 1992-1994 (i.e., cumulative effects, such as delay or displacement of the entire migration, or lethal effects).

2.3B3 Subsistence

"Subsistence uses" are those traditional Alaskan uses of fish, wildlife, and vegetation for personal, family, and community needs that are accorded priority in State and Federal law. Some examples include the harvesting of wildlife for domestic consumption and for use in traditional forms of trade and barter, and the use of by-products from such harvests (i.e., walrus ivory, whale baleen, or caribou hides) in the manufacture of traditional arts and crafts for sale. Some types of harvests that are not given subsistence priority include commercial salmon harvests, harvests for sale of salmon meat, and such "wasteful" harvests as the taking of walrus solely for its ivory.

Subsistence also has a cultural sense. Many Native Alaskans express identity through convictions based on the harvest, distribution, and sharing of wild resources. This importance goes beyond the significant role of subsistence food in the local diet to include many of the shared activities and values that help hold Alaska's rural communities together (Stephen R. Braund and Associates, 1993a, b).

The subsistence hunting of bowhead whales occurs at Barrow (during spring and fall), Nuiqsut (during fall), and Kaktovik (during fall). The bowhead whale is the Inupiat’s most culturally important subsistence resource. Bowhead whaling strengthens family and community ties and the sense of a common Inupiat heritage, culture, and way of life (MMS, 1996c). It is the experience of many Alaskan Natives that OCS support vessels and platforms near the subsistence-harvest area disrupt bowhead subsistence hunting.

> Loud noises drive the animals away. . . . We know where whales can be found; when the oil industry comes into the area, the whales aren’t there. It is not the ice; it is the noise (B. Rexford, Minutes of Hearing on Kuvlum Letter of Authorization [LOA], 1993).
>
> It takes longer to tow a whale back to the village when it must be taken further away than usual, which means, more of the meat is spoiled [describing impacts when oil industry activities drive subsistence hunting outside of normal whaling areas] (J. Kaleak, Minutes of Hearing on Kuvlum LOA, 1993).
>
> The impacts of seismic are what we know as a fact. We’re always asked to prove our knowledge and never industry. More credit must be given to the knowledge we have collected over many, many years (E. Itta, Minutes of Hearing on Kuvlum LOA, 1993).

In addition to the traditional knowledge learned during public hearings, MMS obtains information from various research sources. During 1992 through 1994, two MMS-funded sociocultural studies were completed: (1) *An Investigation of the Sociocultural Consequences of Outer Continental Shelf Development in Alaska* and (2) *Social Indicators Study of Alaskan Coastal Villages*. An overview of each study is found below.

(a) An Investigation of the Sociocultural Consequences of Outer Continental Shelf Development in Alaska

Through a cooperative agreement with MMS, the Alaska Department of Fish and Game (ADFG) initiated a 3-year study (ADFG, 1995). Although the primary objective of the study was to investigate the social/cultural consequences of Alaskan OCS development, the consequences of the 1989 non-OCS oil spill from the *Exxon Valdez* became its major focus.

The study communities in the various areas affected by the *Exxon Valdez* oil spill included Chenega Bay, Cordova, Tatitlek, and Valdez (Prince William Sound); Kenai, Nanwalek, Port Graham, and Seldovia (Cook Inlet); Akhiok, Karluk, Kodiak, Larsen Bay, Old

Harbor, Ouzinkie, and Port Lions (Kodiak Island Borough); and Chignik Bay and Chignik Lake (Lake and Peninsula Borough).

The Arctic communities of Kotzebue, Kaktovik, Kivalina, and Nuiqsut were added as control sites to strengthen application of the findings to sociocultural change issues related to development of the Alaskan OCS.

The ADFG collected study data in three rounds of voluntary, face-to-face interviews using:

- the “harvest survey questionnaire,” which collected data on household demography, involvement in the cash economy, resource harvests and uses, and assessment of changes in subsistence harvest and use patterns

- the “social effects questionnaire,” which addressed changes in social and community organizations that could be affected by OCS development

The social effects survey effort was halted in Kaktovik after 6 days, following a request from the mayor; however, the report findings concerning OCS activities from the remaining Arctic communities included the following (ADFG, 1995):

- Most Kotzebue respondents believed that search for and development of offshore oil and natural gas would decrease the amount of wildlife available for harvest. Of the respondents, 47.5 percent did not think that industry could clean up a small oil spill (< 1,000 bbl), and 69.7 percent did not think that industry could clean up a large spill (≥100,000 bbl). Approximately 62.0 percent of respondents believed that more jobs would be created for local people, while 29.3 percent did not.

- Respondents in Kivalina agreed that exploration and development of offshore oil and natural gas would decrease the amount of fish and wildlife available for harvest. A majority of respondents (52.5%) did not believe industry could clean up a small oil spill, and 72.1 percent responded negatively when asked if industry could clean up a large spill. Only 36.1 percent of the responders believed that more local jobs would be created from offshore exploration and development.

- In Nuiqsut, 66.0 percent of respondents were not in favor of OCS exploration or development, citing concerns about adverse impacts to harvesting activities and disruption of resource migration patterns. However, about 10.0 percent said they would be in favor of these activities if they were done carefully. Sixty percent of the respondents did not believe that industry could effectively clean up a small oil spill, and 80.0 percent did not believe industry could clean up a large spill. Additionally, nearly half of Nuiqsut respondents (48.3%) believed that OCS development would make more jobs available to community residents.

Other report findings include:

- During the 3 study years, virtually every household in all 21 study communities used at least one kind of wild resource. A majority of the community populations either hunted, fished, or gathered wild resources. There were no discernible differences between larger, predominantly non-Native communities and the Alaska Native villages in terms of involvement in harvesting activities.

- A geographic pattern to sociocultural impacts was found—impacts were greater to those communities closest to the non-OCS related *Exxon Valdez* oil spill and lessened with distance from Prince William Sound.

- Prespill norms for subsistence harvest levels were either approached or matched in all communities located in the non-OCS related *Exxon Valdez* oil spill area except in the severely impacted communities of Tatitlek, Chenga Bay, and Ouzinkie, where harvest levels remained below prespill averages.

- There was a shift in the explanations given for why the *Exxon Valdez* spill caused reductions in community resource uses. In 1989, a majority of households experiencing reduction in resource use cited fear of oil contamination as the main reason; whereas in 1993, decreased resource population levels were blamed for reduced use.

- The cultural importance of subsistence to the Alaska Native communities and the injuries that this culture had suffered were not yet acknowledged by the judicial process.

(b) Social Indicators Study of Alaskan Coastal Villages

In 1987, on behalf of MMS, the Human Relations Area Files, Inc. began an analysis of contemporary life in 31 Alaskan villages located between Kaktovik on the coast of the Beaufort Sea and Kodiak City on Kodiak Island south of the Alaskan Peninsula. The study's objective was to develop two sets of indicators that (1) would be sensitive to social and economic change and (2) could be used to monitor conditions among villagers throughout coastal Alaska. The rationale behind developing social indicators was that subsets of those indicators could be used to monitor Alaskan villages and determine whether oil-related activities were affecting them (Jorgensen, 1994).

To determine if and to what extent oil-related factors contribute to changes in Alaskan villages, the MMS requested that special attention be paid to distinguishing differences between:

- Natives and non-Natives
- villages with and without well-developed infrastructures/services
- OCS oil-related activities and other activities that may affect village organization, life, economies, and politics

While developing the indicator system, the researchers noticed that two indicators stood out among all surveyed villages:

- differences between traditional customs and Western customs in village life
- differences between a dependency model of economic development and a Western model of capitalist development

The study reported that elements representing traditional activities of Native life (Eskimo, Aleut, and Athapaskan) are:

- communitarian acts and sentiments (e.g., active interests in community affairs and sharing resources and meals with relatives)
- participation in hunting, fishing, and other extraction activities (individually or with relatives/friends)

The study found that traditional customs continued to be practiced in large, complex, multi-ethnic villages as well as small, simple, more homogeneous ones. However, the study could not determine whether some traditional practices decrease among Natives during periods of high employment and increase during periods of economic distress (Jorgensen, 1994). The strongest contrast in the traditional custom and activities was found between Native and non-Natives (Jorgensen, 1994):

> [That a] person is not a Native is the best indicator that they do not engage in subsistence-extraction activities, that subsistence foods were not eaten in the previous 2 days, that subsistence foods constitute small proportions of the annual diet, that few meals are eaten with relatives in other households, and that ties with persons in other villages are satisfactory or less than satisfactory.

The study reported that elements of a Western model of capitalist development show that:

- individuals develop knowledge and skills, and work hard to earn monetary rewards
- individuals delay gratification to maximize benefits that will accrue from those resources
- individuals invest some of the benefits into the education of their children so that those children will also acquire skills and knowledge, work hard, and invest the proceeds from that work

The study notes that the passage of the Alaska Natives Claim Settlement Act, with its mandatory requirements to establish regional and village for-profit shareholder corporations, assumed that for local and regional economies to flourish, shareholders would have to behave like any successful shareholder in a for-profit corporation. This means that resources must be economized to maximize benefits which, Jorgensen (1994) claims, do not complement the traditional Native practices of sharing goods, labor, and cash. Although the study revealed that Natives followed a traditional communitarian ethic rather than the Western ethic, several indicators showed that the Western model is gaining practitioners, such as:

- increases in Native educational attainment, months of employment, and income
- decreases in household sizes and household types as income, etc., increases
- decreases in the frequency of travel to visit friends and relatives in distant communities
- decreases in the total subsistence activities in which respondents engage

Conclusion: One impact of OCS activities in the Alaska Region, as documented by ADFG (1995), was continued stress associated with the arctic residents' consistent concerns regarding oil and natural gas impacts to their culture and traditional lifestyles (e.g., decreased wildlife, disruption of resource migration patterns, and insufficient recognition of the cultural importance of subsistence by the judicial system). Although direct losses of subsistence resources resulting from OCS operations in the Beaufort Sea were reported to the Federal Government during public hearings, no declines in subsistence harvest levels due to OCS oil-related activities were actually documented.

2.4 Atlantic Region

In October 1994, MMS closed the Atlantic OCS regional office and transferred responsibilities for the four OCS planning areas in the Atlantic OCS—North Atlantic, Mid-Atlantic, South Atlantic, and Straits of Florida (fig. 2.4-1)—to the GOM regional office. Although no OCS-related activities occurred in the Atlantic OCS during the 3 years covered by this report, there were existing leases—the one of major concern during this time being the Manteo Prospect.

2.4A Special Topic—Manteo Prospect Block 467

In 1981, MMS issued 47 leases as a result of Atlantic OCS Lease Sale 56. Nineteen blocks from this sale (including Block 467 leased by Mobil Exploration and Production U.S. Inc. [Mobil]) and two blocks subsequently leased from Atlantic OCS Lease Sale 78 became the 21-block Manteo Prospect (fig. 2.4-2), which is located approximately 39 miles offshore North Carolina.

In the summer of 1988, Mobil notified MMS and North Carolina of its intention to submit an EP covering the Manteo Prospect. In response, North Carolina requested that an environmental impact statement be prepared to satisfy its needs for information and analysis on the effects from OCS exploration activities offshore North Carolina.

After 11 months of negotiations, North Carolina, MMS, and Mobil signed a Memorandum of Understanding that stipulated, among other things, that MMS prepare an environmental report to assess the environmental impacts of activities outlined in Mobil's draft EP. This environmental report would also assess potential OCS oil and natural gas activities in the area of Block 467. In addition, MMS agreed to issue a suspension of operations for leases in the Manteo Prospect that would soon expire. The final environmental report was completed in August 1990.

In August 1990, Mobil submitted to MMS its final EP proposing to drill a single well on Block 467. Because the proposed drilling activity would result in the discharge of clay muds and rock cuttings from the borehole, Mobil was required to obtain an EPA-issued NPDES permit to discharge this material and other waste streams at the site. However, the proposed activities did not commence because of subsequent State consistency decisions and congressional action.

In July and November 1990, respectively, North Carolina objected to Mobil's consistency certifications for the NPDES permit and the EP. The State decided that Mobil had failed to provide adequate information to address four specific criteria in the North Carolina coastal management program: risks to fish spawning areas, potential damage to areas of high biological/recreational importance, placement of structures in geologically hazardous or biologically sensitive areas, and potential wildlife destruction. Subsequently, Mobil filed appeals with DOC requesting Secretarial override of the State's consistency objections. In its September 1994 final decision regarding the Mobil appeals, DOC did not override

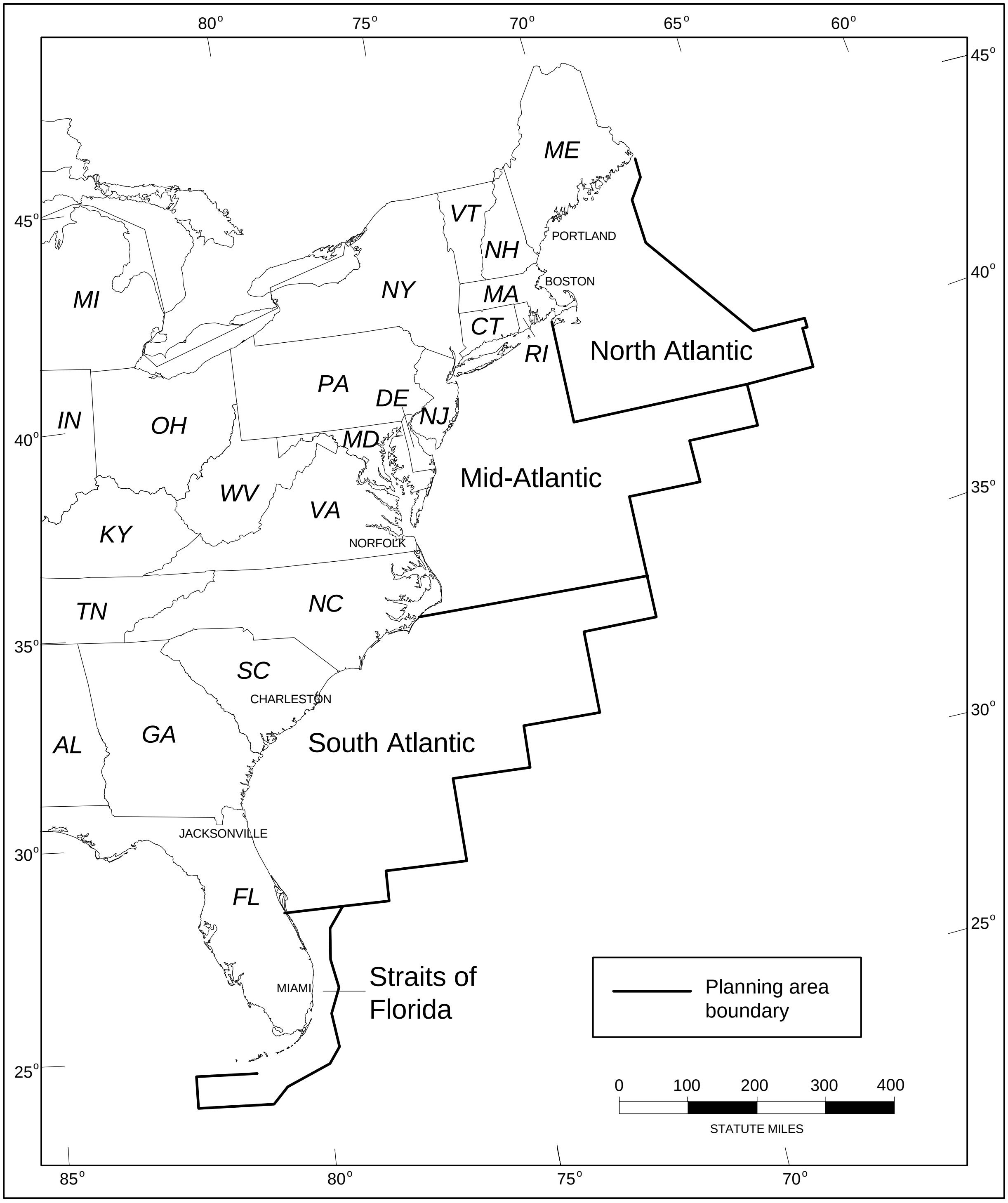


Figure 2.4-1. Atlantic OCS Planning Areas, 1992-1994

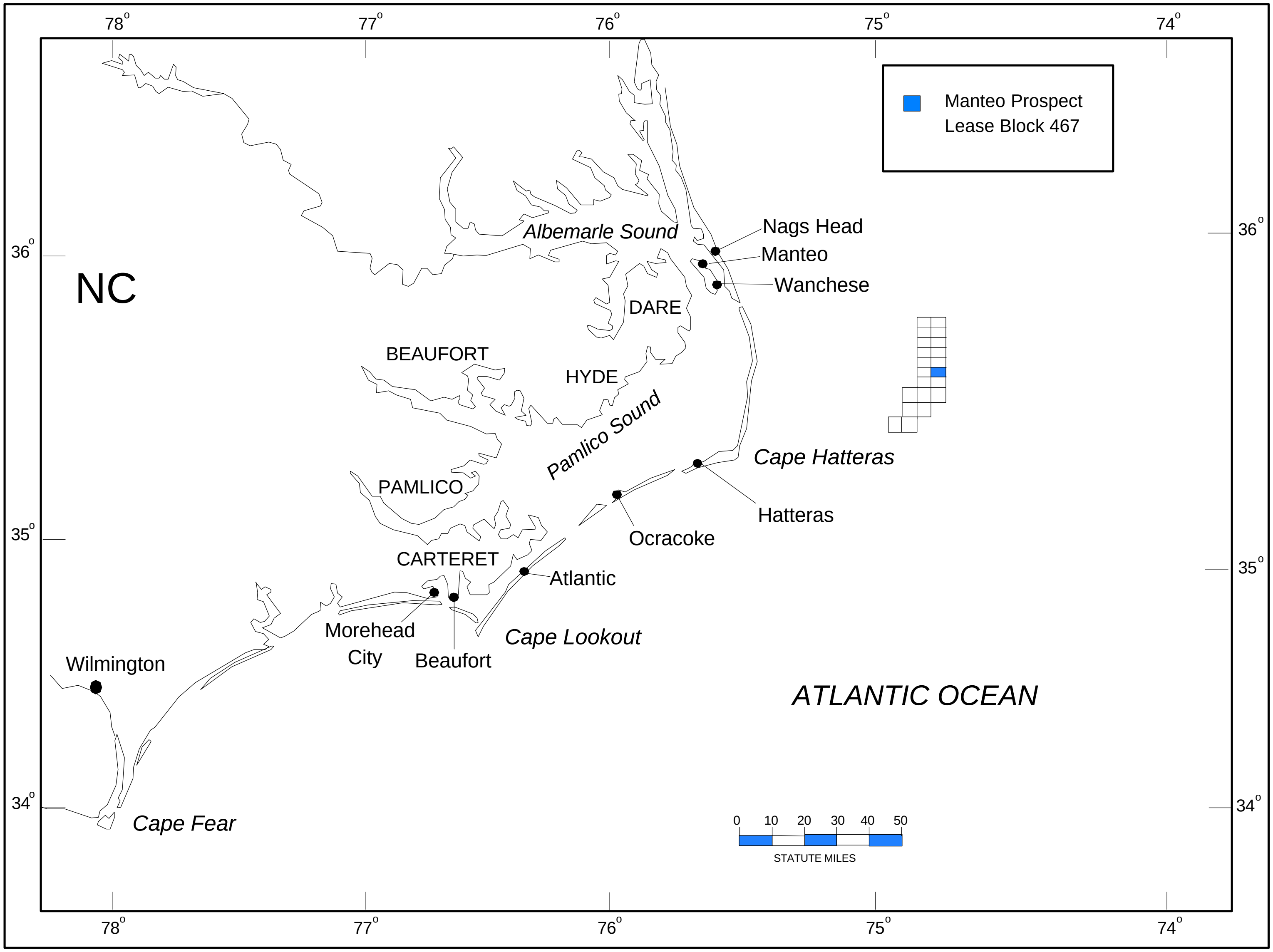


Figure 2.4-2. Location of Manteo Prospect

North Carolina's consistency objections on either Mobil's proposed EP or proposed discharges.

A major congressional action relevant to this issue occurred on August 18, 1990. On that date, the Oil Pollution Act of 1990 (OPA 90) was signed into law. Under OPA 90, the Outer Banks Protection Act prohibited the Secretary of the Interior from proceeding with actions associated with OCS oil and natural gas resources offshore North Carolina. This prohibition was mandated to remain in effect until the latter of October 1, 1991, or 45 days of continuous congressional session following the submission of a Secretarial report. In addition, OPA 90 established the North Carolina Environmental Sciences Review Panel (ESRP), whose main purpose was to submit to the Secretary of the Interior findings and recommendations assessing the adequacy of the available physical oceanographic, ecological, and socioeconomic information. Additionally, the ESRP was to identify other information deemed essential for the Secretary to carry out his OCSLAA responsibilities. In its January 1992 report, the ESRP recommended that MMS complete the following:

- a limited bottom survey of the proposed Manteo drilling site to provide information on the geographic extent of the "unusual benthic community" offshore North Carolina
- socioeconomic studies including a base-case characterization analysis, community studies, an aesthetic and perceptual issue analysis, an infrastructure issue analysis, and a socioeconomic monitoring study

In April 1992, the Secretary of the Interior submitted his report to Congress. In his report, he confirmed that

> . . . in spite of the scientific data gaps identified by the ESRP, the information that currently exists is adequate to allow me to make a reasoned decision about the activities presently proposed to take place offshore North Carolina . . . . I have decided to fund and conduct the socioeconomic studies prior to drilling the first exploratory well. The geographical extent of the biological communities in the vicinity of the well site will also be determined prior to approving any drilling activities.

The Secretary also reported that

> . . . since the ESRP requests for these limited socioeconomic and biological studies are reasonable from a scientific perspective and will undoubtedly add to our information base, I will not issue a permit, approve the exploration plan, or allow any drilling until the studies have been completed.

The studies recommended by the ESRP (the benthic study and the socioeconomic study) are discussed below.

2.4A1 Manteo Benthic Study

Benthic Study of the Continental Slope off Cape Hatteras, North Carolina (Diaz et. al., 1993), a study established under a cooperative agreement with the Virginia Institute of Marine Science, was developed to acquire additional knowledge of the unusual benthic communities surrounding Manteo Block 467, and to determine whether more than 5 percent of these communities would be covered by the drilling muds and cuttings resulting from Mobil's proposed exploratory drilling. Specifically, the study had the following objectives: (1) to survey the seafloor and to define the unusual benthic community in the vicinity of the proposed Manteo drill site, (2) to use the Offshore Operators' Committee (OOC) model to estimate the area between the 300-m and 1,500-m isobaths that could be covered by the deposition of drilling discharges, and (3) to use the results of the OOC model and the seafloor survey analyses to estimate the percentage of the benthic community that would be potentially impacted by the deposition of drilling discharges.

The study area's physical habitat was found to experience high rates of sediment instability, accumulation, and flux. Distribution of the infaunal and megafaunal communities was characterized as patchy but widespread, and covered a 50-km area at water depths ranging from 600 m to 1,500 m. Of the various infaunal species collected, the predominant ones were: oligochaetes (*Limnodriloides medioporus* and *Tubificoides intermedius*) and polychaetes (*Scalibregma inflatum*, *Aricidea quadrilobata*, *Cossura* spp., and *Tharyx kirkegaardi*). Four species dominated the megafaunal community: foraminifera (*Bathysiphon filiformis*), eelpouts (*Lycenchelys verrilli* and *Lycodes atlanticus*), witch flounder (*Glyptocephalus cynoglossus*), and anemone (*Actinauge verrilli*). Diaz et al. (1993) found that these communities were well adapted to the dynamic nature of the physical environment.

Diaz et al. (1993) concluded the following:

- The unusual benthic community is distributed widely throughout the study area.
- Nearly 12 km^2 of seafloor would receive as little as 0.1 micron covering of drilling discharges from the proposed exploratory well on Manteo Lease Block 467, resulting in only about 2.4 percent of the unusual benthic community being impacted.
- More sediment is deposited by natural processes than would be by the proposed exploratory drilling.

2.4A2 Manteo Socioeconomic Study

Coastal North Carolina Socioeconomic Study (Maiolo et al., 1993), a cooperative agreement with East Carolina University, was designed to gather, analyze, and disseminate information about socioeconomic and sociocultural conditions along the North Carolina coastal area that could be affected by exploratory drilling at the Manteo Prospect. Study information will be used by Federal, State, county, and local governments to plan for potential OCS-related activities and to provide a basis for monitoring and assessing changes in the event that OCS activities are initiated offshore North Carolina.

In response to the ESRP recommendations, Maiolo et al. (1993) provided: (1) a base-case characterization of selected counties; (2) detailed sociocultural studies of communities most likely to be affected by OCS development; (3) a study of the perceptions of environmental conditions, issues, and values held by potentially affected populations; (4) infrastructure studies in potentially affected communities; and (5) a comprehensive monitoring system of socioeconomic variables.

(a) Base-Case Characterization

Five counties located along the North Carolina coastal/sound regions were analyzed: Dare, Hyde, Carteret, Beaufort, and Pamlico. These communities were chosen because they were considered to represent communities that could be impacted by OCS activities on the Manteo Prospect. Some of the general characterizations of these counties were reported as follows:

- Counties in the study area were sparsely populated, with the main population centers located in resort towns.
- Ethnic diversity varied considerably within the five counties, with Euro-Americans and African-Americans representing the two main ethnic groups.
- Annual population fluctuations were influenced by tourism- and recreation-related seasonal populations, resulting in an increase in seasonal housing units.
- Dare County median family income was 8 percent higher than the State's ($34,000), while the other counties were slightly lower than the State level.
- Similar to most of the State, unemployment levels in the counties were low except in Hyde County where the county unemployment was almost double the State's.
- The economy of Carteret County was the most diverse with fishing, tourism, military facilities, and manufacturing industries.
- Unlike State trends, three of the counties (Hyde, Beaufort, and Pamlico) had expenditures greater than their revenues.
- Most of the communities studied were unincorporated, placing the burden of governmental services directly on the county.
- Commercial uses of the rivers, sounds, and ocean were widespread in the counties studied.

(b) Sociocultural Studies of Communities

Seven communities (near large tracts of Federal land proximate to the Manteo Prospect) that had potential for impacts from OCS activity were studied: Wanchese, Nags Head, Hatteras, Ocracoke, Atlantic, Beaufort, and Morehead City. This study component examined several variables to gain insight into how these communities function socially, economically, culturally, and politically (Maiolo et al., 1993).

The three communities of Dare County and their social and cultural climates are summarized below.

- **Wanchese:** economy reflects trends in commercial fisheries; relatively closed social system.

- **Nags Head:** dramatic seasonal population change due to tourism; ongoing disputes between seasonal recreational fishing and commercial fishing.

- **Hatteras:** combination of commercial- and tourism-oriented economies; ongoing disputes between commercial and recreational fishing.

In Hyde County, only one community was studied; its characteristics are listed below.

- **Ocracoke:** combination of long-time commercial-oriented and newer tourism-oriented economy; restricted access social system (where ancestry plays a role of importance); inconsistent land-use issues due to lack of zoning restrictions.

Carteret County encompassed three of the communities studied. Their sociocultural backgrounds are as follows.

- **Atlantic:** relatively isolated in geographic and social terms; fishing is an economic mainstay.

- **Beaufort and Morehead City:** larger permanent populations than other communities studied; more urbanized, tourism-oriented, but diversified economy.

(c) Aesthetic and Perceptual Issues Studies

Maiolo et al. (1993) investigated the residents' views on three principal perceptions: (1) the qualities/attributes that make their area a desirable place to live; (2) the uses of the environment; and (3) the potential sources of change to the area.

Residents of the communities studied in Dare County had the following perceptions.

- **Wanchese:** view commercial fishing-related enterprises as the most common uses of the local environment; believe that jetty construction will improve the capability of the local fleet; have reverence for forces of nature and respect for fishermen; view their own community as hard working fishermen and supporting families; perceive stricter fishing regulations as having a negative effect on the community.

- **Nags Head:** believe surffishing, followed by sunbathing and surfing, is the most common use of the local environment; believe that hurricanes and overdevelopment have the greatest potential to change the community; believe in mitigating negative impacts of development and preserving the natural beauty of the area.

- **Hatteras:** believe that commercial fishing and tourist activities (the primary economic sectors) are the most common uses of the environment; consider hurricanes and overdevelopment to have the greatest potential to change the community; value the beauty and power of the natural environment; highly value the ability to survive adverse North Carolina climates.

Residents of the one Hyde County community studied had the following views:

- **Ocracoke:** believe commercial fishing (although small) and recreational activities are common uses of the environment; view overdevelopment as an important source of change; value the beautiful island environment.

Residents in the three Carteret County communities that were studied held the following beliefs:

- **Atlantic:** view commercial fishing as the most common use of the natural surroundings; believe that community life revolves around the commercial fishery; cite farm runoff, sewage problems, and red tide as the most important factors of change; value small town atmosphere and family ties; value the environment more as a source of subsistence or commercial products than as a source of natural beauty.

- **Beaufort:** believe boating, sunbathing, and commercial fishing are common uses of the environment; value environment for recreational and commercial possibilities; believe overdevelopment and poor natural resource management have the greatest potential for change; highly value natural beauty.

- **Morehead City:** believe offshore recreational fishing, followed by boating and commercial fishing, is the most common use of the environment; view hurricanes, relaxation of environmental regulations, and overdevelopment as the primary sources of change; value their proximity to the ocean and sounds.

(d) Infrastructure Studies

This study component of Maiolo et al. (1993) reported on the status of the physical (bridges, roads, etc.) and service (local and regional government, social and medical services, etc.) factors of the community infrastructure. In general, the infrastructure of populated coastal areas is more developed than that of less-populated inland rural areas—mainly due to local government goals of fostering tourism, as seen in Dare and Carteret Counties. The study reported the following findings:

- Bridges, ferries, and other transportation-related infrastructures have been central in opening up coastal areas to tourism.
- Four of the five counties studied have significantly more secondary than primary roads—the exception is Dare County, which has over 50 percent more miles of primary than secondary roads.
- Beaufort and Carteret Counties had the greatest amount of public school expenditures, while Hyde County had the least.
- The rural and relatively isolated nature of an area impaired delivery of local government services.

(e) Socioeconomic Monitoring

Maiolo et al. (1993) identified a number of socioeconomic variables (demographic, economic, infrastructure, and sociocultural) that should be considered for monitoring purposes at the county and community levels. The demographic variables included total population, percent of persons 65 years of age or older, ethnicity, percent of owner-occupied units, and number of units available for seasonal use. Among the economic variables identified were changes in property values, tourism-generated revenue, and commercial fisheries landings and values. Some of the infrastructure variables addressed were educational facilities, use of social services, marine facilities, water-related and sewer system-related problems, and land-use patterns. Several sociocultural variables were also identified, such as social stratification, perceptions about physical changes to the community and the environment, and lifestyle/intracommunity variations.

The data collected by this study show that the socioeconomic systems of this North Carolina coastal area are heavily dependent upon use of marine resources and access to a maritime environment perceived as relatively pristine. The data also show that the character of these needs varies considerably depending on the mix of a community's or region's reliance on tourism, commercial or recreational fisheries, military activity, or other income sources.

Conclusion: The two Manteo studies (Diaz et al., 1993; Maiolo et al., 1993) responded in full to the recommendations of the ESRP (to complete a bottom survey of the drilling site and to document the socioeconomic and sociocultural aspects of potentially affected populations before exploration is permitted). The information collected by these studies will provide a means for monitoring and measuring change in the study area if OCS activity in North Carolina goes forward.

3.0 OCS Marine Minerals Program

The Outer Continental Shelf (OCS) is an important potential source of minerals for industrial, agricultural, consumer, and national security purposes. In addition to managing OCS oil and natural gas resources, the Minerals Management Service (MMS) also manages, through its Office of International Activities and Marine Minerals (INTERMAR), the following valuable, nonenergy marine minerals on the OCS.

- Cobalt, which is used in industries such as medicine, aerospace, paint, ceramics, and tires, is critical to national security.

- Manganese, which provides strength and hardness in steel, is used in batteries, bricks, glass, and paints.

- Heavy minerals, including titanium and chromite, are used by the aerospace and automobile industries and for other applications including medical, electrical, and high-temperature applications; and even precious minerals including gold and platinum.

- Phosphorites are used extensively in agriculture and pharmaceuticals.

- Sand and gravel, which are important for creating and preserving our infrastructure, are used for beach renourishment and glassmaking, among other purposes.

Currently, the program is focused on managing exploration and development activities for Federal offshore sand, gravel, and shell resources found on the OCS. A substantial portion of the U.S. coastline is considered to be severely eroding. Sand nourishment has generally replaced construction of seawalls and other hard structures as the preferred method of forestalling beach erosion. As a result, sand management has become a significant issue for many coastal States, particularly along the mid- and south-Atlantic and the Gulf coasts. For example, dredging farther from shore, beyond the active wave base, may afford protection from further erosional impacts, which can be caused by nearshore dredging.

Federal OCS sand is needed to support shoreline protection, beach restoration, and coastal wetlands protection projects. This need is increasing as land-based and nearshore sand resources in certain coastal areas are becoming depleted or unavailable for environmental reasons. Likewise, there is a growing demand for OCS sand, gravel, and shell resources for construction and road base materials.

In 1994, P.L. 103-426 (Negotiated Agreements for OCS Sand, Gravel, and Shell Resources), which amends the Outer Continental Shelf Lands Act sections 8(k) and 20(a), was signed into law. This new law authorizes the Secretary of the Interior, through MMS, to negotiate agreements for use of OCS sand, gravel and shell resources in projects undertaken by Federal, State, or local governments for shore protection, beach or coastal wetlands restoration, or other construction projects that are wholly or partially funded or authorized, by the Federal Government. (Access to OCS hard minerals for purposes other than those specified under P.L. 103-426 is managed through the competitive bidding process.) The MMS does not promote any particular approach for managing coastal erosion; rather, it assists States that choose to use offshore sand for coastal restoration.

In carrying out a negotiated agreement, MMS may assess a fee (when appropriate) based on the value of the OCS resources and the public interest served by their development. However, a fee cannot be directly or indirectly assessed against any Federal Agency. In determining the value to the public, MMS may consider the public costs and benefits of both extracting the resources and their ultimate end-use.

Once MMS receives a request for OCS sand, gravel, or shell resources and the necessary supporting information, it determines the project's eligibility under P.L. 103-426. Once eligibility is established, the conditions of the negotiated agreement are developed at a mutually acceptable time and location to all parties involved. Information requirements, National Environmental Policy Act (NEPA) considerations, terms and conditions, and other relevant subjects are addressed during the negotiation process. Successful negotiations conclude with a written legal agreement, such as a memorandum of agreement, a noncompetitive lease, or both, depending on the parties involved.

Coastal States and local communities are generally supportive of the MMS sand and gravel program and, in light of diminishing coastal and nearshore resources, recognize the need for access to OCS sand for beach nourishment and coastal restoration. [During the time period covered by this report, the following agreements with MMS were being pursued by coastal States and by the U.S. Department of the Navy; however, they were completed at a later date.]

- A negotiated agreement was completed with the City of Jacksonville/Duval County, Florida, to use sand from a borrow site 7 miles offshore to renourish several local beaches. A stipulation was attached to that agreement requiring that a benthic repopulation study be conducted for the actual borrow area. (This study is presently underway.)

- The Governor of Louisiana has requested initiation of the negotiated agreement process for use of OCS sand from the Ship Shoal area for barrier island restoration. (Currently, MMS, Louisiana, and the National Marine Fisheries Service are partners in preparing an environmental impact statement to support future decisions associated with restoring several barrier islands in the Terrebonne-Barataria Basins of coastal Louisiana.)

- The Navy and MMS entered into a memoranda of agreement to use OCS sand from Sandbridge Shoal, offshore Virginia, to renourish a portion of the Federal beach at the Fleet Combat Training Center at Dam Neck near Virginia Beach. The approximately 800,000 cubic yards of sand requested will protect some existing buildings and structures that lie just off the beachfront.

- Plans were being made for a negotiated agreement to use OCS sand to renourish Surfside and Garden City beaches in South Carolina.

- The National Park Service initiated the planning process to renourish a portion of Assateague Island in Maryland using sand from an OCS borrow site. (The MMS and the U.S. Army Corps of Engineers are presently coordinating during the preparation of required NEPA documents.)

With the passage of P.L. 103-426, the MMS anticipates an increase in requests for negotiated agreements. A wide range of qualified projects could emerge, including those congressionally authorized (U.S. Army Corps of Engineers and State/local nonfederal sponsors), federally sponsored, or State/locally sponsored. In addition, requests for OCS sand, gravel, and shell resources via competitive bidding could emerge as OCS mining activities become more commonplace.

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Appendix A: Administration of the OCS Program

The MMS Regulatory Program

The Minerals Management Service (MMS) administers the provisions of the Outer Continental Shelf Lands Act Amendment (OCSLAA) through regulations found at Title 30 of the Code of Federal Regulations (CFR) Parts 200-243, 250-282, and 290. These regulations govern leasing, exploration, prospecting, and production operations of oil, natural gas, sulphur, and strategic minerals on the Outer Continental Shelf (OCS). In addition to regulating prelease and postlease operations on the OCS, these provisions allow for:

- public participation in leasing and postlease processes, including the review by and coordination with State governments
- consideration of State coastal zone management (CZM) programs
- solicitation of public information concerning proposed lease sales through a Call for Information and Nominations
- comments on environmental impact statements (EIS's)

These regulations also provide for consultation with appropriate Federal and State agencies to develop measures for mitigating adverse effects on the environment.

The MMS consults formally and informally with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS) on the effects of MMS-administered oil and natural gas activities on endangered and threatened species under their respective jurisdictions. These consultations, conducted under Section 7 of the Endangered Species Act, may result in suggestions and recommendations promoting the conservation of listed and candidate species. They also may identify operational or other "reasonable and prudent" alternatives that preclude the likelihood of jeopardizing the continued existence of listed species or adversely modifying their critical habitats. The MMS pays close attention to these alternatives and recommendations when developing mandatory lease-sale stipulations and discretionary Information to Lessees clauses. The alternatives may also necessitate area-specific Notices to Lessees and Operators (NTL's) and special conditions in approved exploration plans (EP's) and development and production plans (DPP's). In all cases, the intent of these NTL's is to eliminate or minimize the adverse effects of oil and natural gas operations on endangered and threatened species.

The regulations under 30 CFR 250.33 require industry to submit to MMS an EP that includes measures to protect the environment. The MMS reviews the EP, analyzes the environmental effects, and determines appropriate mitigation before approving the plan.

Additionally, regulations under 30 CFR 250.34 require industry to submit a DPP before development can occur. The MMS approves the DPP, if appropriate, taking into account environmental, technical, and economic considerations. Many other elements of offshore operations are covered in MMS regulations that reflect the mandates of the OCSLAA.

For the Central and Western Gulf of Mexico (GOM), MMS uses a three-step analytical procedure (30 CFR 250.44-46) to evaluate potential air quality emissions and to determine whether air quality standards will be met at the shoreline during offshore oil and natural gas activities. For areas outside the Central and Western GOM, the Environmental Protection Agency (EPA) requires that the corresponding onshore regulations apply to pollution sources located within 25 miles offshore (40 CFR Part 55).

Regulations under 30 CFR Part 251 contain the requirements for prelease geological and geophysical (G&G) exploration for oil, natural gas, and sulphur resources on the OCS as well as G&G scientific research. These regulations prescribe the following:

- cases where a permit or the filing of a notice is required to conduct G&G activities on the OCS
- operating procedures for conducting exploration
- requirements for disclosing data and information
- requirements for inspection and selection of data and information
- conditions for reimbursing permittees for certain costs
- other conditions under which activities shall be conducted

Similar regulations under 30 CFR Part 280 address prospecting activities for minerals other than oil, natural gas, and sulphur. Many Federal departments and agencies, besides the U.S. Department of the Interior (DOI), regulate specific aspects of OCS operations. For example, the EPA regulates waste discharges; the U.S. Department of Transportation (DOT) regulates occupational safety and health, the reporting and containment of oil spills, and the design of certain pipelines and mobile offshore drilling units; and the U.S. Department of the Army, Corps of Engineers, regulates the placement of structures in navigable waters. Also, affected States review EP's and DPP's for consistency with their CZM programs.

Stipulations

Special stipulations, which are legally binding contractual provisions, often are attached to OCS oil and natural gas leases in response to concerns of MMS, coastal States, fishing groups, Federal agencies, and others. For example, the stipulations may require the following:

- biological surveys of sensitive seafloor habitats
- special environmental training for operational personnel
- special waste-discharge procedures
- special operating procedures near military bases or their zones of activity

Notices to Lessees and Operators

The NTL's quickly notify operators within a particular OCS Region about changes in MMS administrative practices or procedures for complying with rules, regulations, and lease stipulations. Also, NTL's are issued to clarify requirements that are already established.

Conditions of Approval

Often, conditions are attached to approved permits, such as applications for permit to drill. These conditions can range from administrative matters (such as required frequency of reports) to technical or environmental conditions (such as requirements for the disposal of drilling muds). In all cases, they are specific conditions that amplify or explain a requirement in the regulation or lease stipulation.

Offshore Inspection and Compliance Program

The OCSLAA authorizes and requires MMS to inspect oil and natural gas operations and to schedule annual onsite inspections of each OCS facility subject to any environmental or safety regulation. This annual inspection examines all safety equipment designed to prevent blowouts, fires, spills, or other major accidents. In addition, the OCSLAA requires MMS to conduct periodic inspections to ensure compliance with environmental and safety regulations without any advance notice to the operators of such facilities. (See also *2.2B2 Oil Spills and Response Capabilities*.)

The MMS performs these inspections using a national checklist called the Potential Incident of Noncompliance List. This list is a compilation of yes/no questions derived from all regulated safety and environmental requirements and is divided into the following sections:

- drilling
- environmental
- general
- pipeline
- production
- production measurement
- hydrogen sulfide
- site security requirements

Upon detecting a violation, MMS issues an Incident of Noncompliance (INC) to the operator and uses one of two main enforcement actions (warning or shut-in), depending on the severity of the violation. If the violation is not severe or threatening, a warning INC is issued. The warning INC must be corrected within a certain amount of time. For violations that threaten the safety of the facility or the environment, a shut-in INC is issued. The shut-in may be for a single component (a portion of the facility) or the entire facility. The violation must be corrected before the operator is allowed to continue the activity in question.

Passage of the Oil Pollution Act of 1990 restored and expanded MMS's authority to impose penalties for regulatory violations that constitute a serious hazard to safety or the environment. [For additional information, see *Appendix B. Nonroutine Events*.] Under this augmented authority, the MMS can assess a civil penalty in cases where a failure to comply with applicable regulations resulted in a threat of serious, irreparable, or immediate harm or damage, without first providing notice and time for corrective action. Since 1990, the MMS used its civil penalty authority in 59 cases to initiate and assess fines.

Coordination with Federal Agencies, State Agencies, and Local Governments

Coordination with other governmental agencies occurs both formally and informally. Formal mechanisms exist through compliance with the many laws that govern the OCS. Leasing and operating activities on the OCS are also subject to the requirements of some 30 Federal laws administered by numerous Federal departments and agencies. Among these laws are the following:

- The National Environmental Policy Act of 1969 establishes requirements for preparing environmental assessments and EIS's for major Federal actions that could significantly affect the quality of the human, marine, or socioeconomic environment.

- The Marine Mammal Protection Act of 1972 provides for protection of marine mammals. It also allows for the incidental, but not intentional, taking of depleted as well as nondepleted marine mammals. The incidental taking of marine mammals is permitted by U.S. citizens under a Letter of Authorization from the appropriate trust agency—the NMFS or the FWS.

- The Coastal Zone Management Act provides for State review of OCS lease sales, EP's, and DPP's that affect the land and water uses and resources of the coastal zone. This Act requires consistency, to the maximum extent practicable, of Federal activities with federally approved CZM plans.

- The Endangered Species Act of 1973 requires that Federal agencies ensure that their actions are not likely to jeopardize the continued existence of any threatened or endangered species.

- The Federal Water Pollution Control Act (commonly known as the Clean Water Act) requires that pollutants generated by OCS operations and discharged into U.S. waters comply with the limitations and restrictions included in a National Pollutant Discharge Elimination System permit.

- The Oil Pollution Act of 1990 expanded MMS's authority to impose penalties for regulatory violations, raised the level of financial responsibility for offshore facilities from $35 million to $150 million, and expanded the coverage from facilities on the OCS to offshore facilities "in, on or under navigable waters."

- The Ports and Waterways Safety Act protects navigational safety.

- The Deepwater Port Act of 1974 requires DOT to regulate ports and terminals handling oil for transportation.

- The National Historic Preservation Act requires that MMS consider the effects of its leasing and permitting actions on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places. This Act also requires that the Advisory Council on Historic Preservation be given a reasonable opportunity to comment on these undertakings.

- The Clean Air Act Amendments of 1990 establish Federal jurisdiction over air quality issues—DOI regulates the OCS in the Western and Central GOM, and EPA regulates the remaining OCS areas.

In addition, the following sections of the OCSLAA require coordination with affected States.

- Section 8(g) requires coordination between DOI and coastal States whenever a leasing proposal includes lands within 3 miles of State waters.

- Section 18 requires significant participation of affected States, Federal agencies, and the public during the development of a 5-year leasing program.

- Section 19 provides the framework for coordination and consultation with affected States and local governments for each proposed lease sale.

- Section 26 requires the Secretary of the Interior to provide the affected States with indexes and summaries of data to aid them in planning for the onshore impacts of OCS natural gas and oil activities.

The OCS Advisory Board, established in 1975, advises the Secretary and other DOI officers in performing discretionary functions of the OCSLAA. The OCSLAA requires that the DOI consult with affected States and other interested parties on all aspects of leasing, exploration, development, and protection of OCS resources. The Advisory Board provides a formal mechanism for this consultation. It directly influences the program by providing a unique forum for conflict resolution and policy development for this critical national energy program. The OCS Advisory Board was renamed the Minerals Management Advisory Board in 1994 to enable it to address royalty-related issues. The Board is composed of the following groups.

- The OCS Policy Committee advises the Secretary on the national policy implications of managing OCS resources.
- The Gulf of Mexico Offshore Advisory Committee advises the MMS Regional Director, Alaska Region, on all aspects of OCS development.
- The OCS Scientific Committee:
  - — advises MMS on the feasibility, appropriateness, and scientific value of the Environmental Studies Program (ESP);

- reviews the information produced by the ESP and may recommend changes in ESP's scope, direction, or emphasis; and
- reflects, through its membership, a balance of scientific and technical disciplines considered important to the management of the ESP.

- The Royalty Policy Committee advises the MMS on royalty management and other mineral-related policies.

Appendix B: Activities Associated with OCS Exploration, Development, and Production

Geological and Geophysical Investigations

Under the authority of Title 30 Code of Federal Regulations (CFR) Part 251, the Minerals Management Service (MMS) issues permits for prelease exploration surveys of mineral resources and for scientific research on the Outer Continental Shelf (OCS). These activities include geophysical surveys (gravity, magnetic, seismic, electrical, sidescan sonar, etc.) and geological investigations (bottom sampling, coring, test drilling operations, etc.).

Geophysical Surveying

Geophysical survey data provide information on how the physical properties of the earth's upper crust vary vertically and laterally beneath large areas of the OCS.

Gravity surveys measure the earth's gravity field to obtain information on large-scale geological features beneath the OCS (e.g., the presence of large sedimentary basins and the measurement of the average density of a rock formation). Similarly, aerial magnetic surveys measure the earth's magnetic field to detect anomalies that may reveal geological features of economic or other interest.

The common depth point seismic method determines the subsea geology by using travel time of seismic waves generated from a source and reflected from different subsurface geologic strata. These surveys provide more detailed information on the subsea distribution of sediment layers and geological boundaries, and better resolution of the subsurface geology.

In a typical two-dimensional (2-D) OCS seismic survey, seismic sources (sound wave generators) are towed behind a ship. A streamer (2 to 3 miles in length) consisting of a cable and arrays of pressure-sensitive hydrophones is towed farther behind the ship. Seismic waves generated by the energy source reflect off the subsea strata and structures through the water column where they are detected by the hydrophones. Electrical signals generated by the hydrophones are then transmitted to the survey ship where total travel times and other properties of the seismic signals, such as amplitude and phase, are recorded digitally on magnetic tape. After initial field data processing aboard ship and more extensive processing onshore, these seismic profiles (vertical cross sections) are interpreted to identify structural features that may act as potential hydrocarbon traps (e.g., sediments that are arched, folded, faulted, or intruded by diapirs—such as salt) and are also used to map potential mineral reservoirs and source rocks.

Additionally, characteristics of seismic sections are used to identify stratigraphic traps, such as changes in the sediment grain size or locations where porous rock containing hydrocarbons thins out horizontally between layers of impermeable rock to block the route of fluids. Seismic sections also can provide information on the thickness of the various sediment strata and on drilling depths to prospective subbottom locations.

The evolution of three-dimensional (3-D) seismology, in conjunction with interactive computer work stations, has made it possible to more accurately locate in three dimensions and to assess quantitatively the potential for oil and natural gas accumulations on the OCS. This type of survey produces 3-D cross sectional representations (somewhat like cubes) of data. Compared to a 2-D survey, a 3-D survey uses more hydrophone streamers, collects and processes significantly greater amounts of data, and incurs higher costs.

The 3-D seismology was used initially during lease operations to locate additional "pay zones," drilling targets, in the Gulf of Mexico. Currently, it is also used extensively to decide on whether or where to drill, and whether to properly deplete producing reservoirs. For reservoir geophysics and modeling, the 3-D seismic survey is the most common and effective geophysical tool used to determine faults, structures, stratigraphic features, extent and continuity of reservoirs, and volume estimates. For exploration of salt structures, processed 3-D seismic information can better locate and define these structures and, in many cases, can provide information not available from 2-D seismic surveys. Perhaps most importantly, 3-D seismic information allows for more precise location of hydrocarbons, which usually results in fewer exploration, delineation, and development wells being drilled and, consequently, less pollution and reduced project costs. Use of 3-D data improves assessment of fair-market value and aids accurate assessment of undiscovered resources and quantification of natural gas and oil reserves.

Other OCS geophysical methods include electrical surveys, which measure natural and artificially induced electrical fields, and sidescan sonar, which maps seafloor physiographic features (e.g., sand waves, rock outcrops, and mud slides) and manmade features (e.g., pipelines, shipwrecks, ordnance, and cables).

Geological Sampling and Continental Offshore Stratigraphic Test (COST) Wells

Methods to gather physical samples or other bottom data useful for engineering and geological purposes are divided into three types: bottom sampling, core and shallow drilling operations, and deep stratigraphic drilling operations.

Bottom samples are collected by dropping a weighted tube to the ocean floor and recovering it with a wire line. Bottom samples provide the information necessary to determine engineering properties and the basic scientific information on the bottom sediments.

Core and shallow drilling operations are conducted to obtain information (such as the lithology and geological age of the sediments), engineering properties, and shallow stratigraphic correlations. Pursuant to 30 CFR Part 251, core and shallow test drilling can penetrate into no more than 50 feet of consolidated rock or 300 feet of unconsolidated rock in the sea bottom without permits.

Deep stratigraphic drilling operations or COST wells use rotary or core drills to penetrate more than 50 feet into consolidated rock or more than 300 feet into unconsolidated sediments. These holes are drilled to obtain information on regional geology and exploratory drilling conditions, as opposed to other wells that are drilled to find oil and natural gas.

A geological permit for mineral exploration or a permit or notice for scientific research is required from MMS before geological surveys can be conducted on the OCS. A geological permit for prelease geological exploration or scientific research, an approved application for permit to drill, and a geophysical permit, if necessary, are required for COST wells.

Exploration Phase

Exploration Plan

The OCS lessee bases exploration decisions on the estimated hydrocarbon potential, the availability of rigs, and various economic and environmental factors. The lessee conducts preliminary activities (such as geological and geophysical, archaeological, cultural, and biological surveys) to acquire information needed to prepare an exploration plan (EP)—a detailed description of the proposed exploratory activities.

The EP and its supporting documentation are submitted to MMS for approval. This documentation includes the oil-spill contingency plan (OSCP), a description of onshore/offshore support facilities and activities, and an environmental analysis. Upon receiving the EP, the MMS reviews it for completeness and conformity with regulations. After deeming the EP complete, MMS has 30 days to approve or disapprove it. If not complete, the EP is returned to the lessee for additional information.

The MMS conducts a technical and environmental review of the EP (in adherence with National Environmental Policy Act [NEPA] regulations). As shown in figure B-1, the EP is forwarded for comment to Governors of affected States, State agencies, and other Federal agencies, including the Fish and Wildlife Service (FWS), the National Marine Fisheries Service (NMFS), the Environmental Protection Agency (EPA), the Army Corps of Engineers (COE), and the U.S. Coast Guard (USCG). A State's review also includes a coastal zone consistency review pursuant to the Coastal Zone Management Act (CZMA)—activities described in an approved EP cannot be permitted until State coastal zone consistency concurrence is received or conclusively presumed. By the end of the 30-day period, the MMS must inform the lessee of its decision to approve or disapprove the EP.

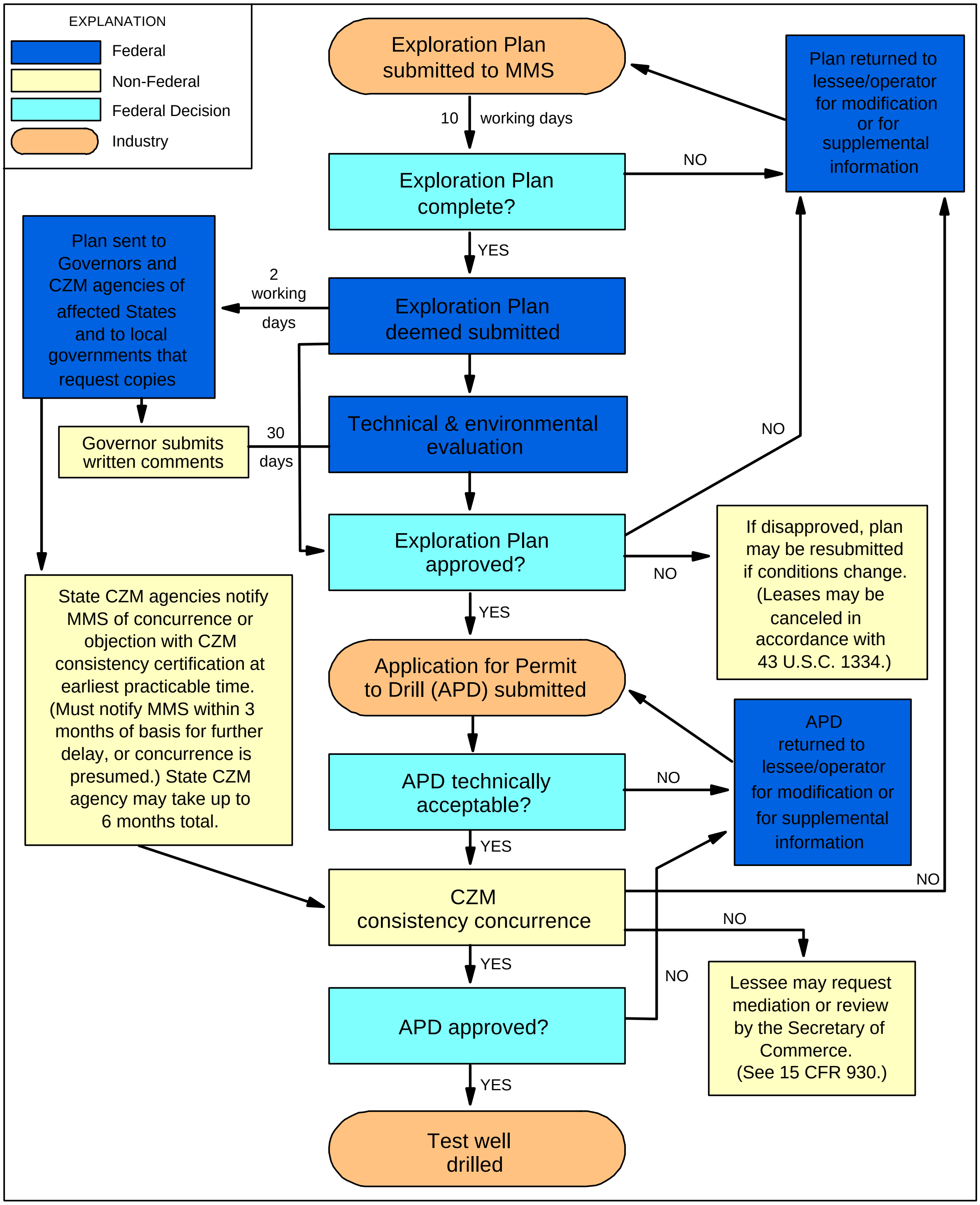

Figure B-1. Exploration Plan Approval Process

An EP is disapproved for the following reasons (30 CFR 250.33):

- The proposed activities would cause serious harm or damage to life (including marine life); property; minerals; national security or defense; or the marine, coastal, or human environment.
- The activities could not be modified to avoid such harm.

If an EP is approved, and before any drilling can commence, the lessee must submit and receive approval for an application for permit to drill (APD) for each well. The APD describes in extensive detail the drilling program, the blowout prevention system, the casing, the cementing, and the drilling mud program. The MMS reviews the APD and frequently attaches to it "conditions of approval" that amplify or explain items in the MMS regulations or that specify procedures that are unique to the well site. The MMS cannot approve the APD until the affected State's coastal zone consistency concurrence is received or conclusively presumed.

Additionally, the lessee must obtain permits from other Federal agencies before drilling can begin. Such permits address navigational aids and certification of mobil offshore drilling units (USCG), platform sitings in navigable waters (COE), and effluent discharges (EPA).

Rig Emplacement and Artificial Islands

During the exploration phase, the lessee drills one or more wells from a drilling unit to determine whether the lease area contains commercial quantities of natural gas or oil. Drilling units used in oil and natural gas operations in the marine environment can generally be classified as follows:

(1) Mobile (Floating) Units

- *Drillships* are self-propelled vessels with a hole through the hull to allow drilling operations. Some vessels with dynamic positioning capability use thrusters rather than anchors to maintain their position over the drilling site.

- *Semisubmersible rigs* are towed (some are self-powered) to the drill site, partially submerged, then moored with lines and anchors extending out a mile or slightly more. Some semisubmersibles have dynamic positioning capabilities and do not require anchors.

- *Drilling barges* are similar to drillships but are not self-propelled.

(2) Mobile Bottom-Founded Units

- *Jack-up rigs* have a hull and deck supported by retractable legs. These legs are retracted while the rig is being towed, and then are lowered to rest on the seafloor at the drill site. Once the legs are firmly positioned on the seafloor, the hull is jacked up to the appropriate height, and the deck level is adjusted.

- The *submersible drilling unit* includes several hull compartments (which are flooded to submerge the unit) and rests on the seafloor.

- *Artificial islands* (gravel or ice) or specially designed units (concrete islands and mobile arctic caissons) are employed for drilling wells offshore the arctic areas of Alaska. During the winter, construction materials for artificial islands (usually sand and gravel) are transported over ice and unloaded at the desired location to form the island. During ice-free periods, islands are constructed by dredging material from the sea bottom and delivering it to the construction site by barge or pipeline. An advancement in the island building technique involves pumping sand and gravel into a caisson. This method results in less disturbance to the area where the gravel is collected and a considerable savings in material.

Exploration Drilling

Regardless of the type of drilling rig used, the exploration drilling methods are similar. A drilling derrick is located on the vessel, rig, or island. A drill bit is attached to a hollow drill pipe and rotated by an engine or an electric motor. Rotating the drill bit fractures the subsurface rock into chips (cuttings). As the drilling progresses, drilling fluids are circulated through the drill pipe and drill bit for the following reasons:

- to remove cuttings from the bottom of the hole
- to lubricate the drill string
- to provide hydrostatic pressure to prevent the flow of formation fluids into the wellbore
- to support and seal the sides of the well

Although in some cases drilling muds and cuttings are barged ashore, usually they are discharged directly from the drilling rig in accordance with limitations in the EPA-issued National Pollutant Discharge Elimination System (NPDES) permit.

As drilling progresses, the sides of the hole are supported by installing steel casing. Blowout preventers are attached to the casing to close off the well in an emergency situation, such as an unexpected change in well pressure.

Generally, an exploratory well takes from 1 to 6 months to drill. Once exploratory drilling results are known, the lessee generally plugs the well and moves the drilling equipment to a new site.

Development and Production Phase

Development and Production Plan

When a natural gas or oil reservoir is discovered and its extent is determined through delineation drilling, the lessee begins the development and production phase of operations. The lessee prepares a development and production plan (DPP)—a detailed description of and schedule for proposed development and production activities. The DPP and its supporting documentation are submitted to the MMS for approval. This documentation includes an OSCP, a list of proposed environmental safeguards, an assessment of environmental effects, and a report on offshore/onshore support facilities.

After receiving the DPP, the MMS reviews it for completeness. After the MMS deems the DPP complete, the technical review process begins. If deemed incomplete, the DPP is returned to the lessee for additional information.

The MMS conducts a technical and environmental review of the DPP (in adherence with NEPA regulations). As shown in figure B-2, the DPP is forwarded for comment to Governors of affected States, State agencies, and other Federal agencies (including the FWS, NMFS, EPA, COE, USCG). A State's review also includes a coastal zone consistency review pursuant to the CZMA—activities described in an approved DPP cannot be permitted until State coastal zone consistency concurrence is received or conclusively presumed. In addition, the MMS Regional Supervisor makes the DPP available for public review and comment. If an environmental impact statement (EIS) is not warranted, the MMS must inform the lessee of its decision by the end of a 120-day period. Under the OCS Lands Act Amendments (OCSLAA), at least one DPP in each frontier area must be declared a major Federal action, and MMS must prepare an EIS.

A DPP is disapproved if MMS determines any of the following applies (30 CFR 250.34):

- The lessee failed to demonstrate compliance with applicable Federal laws and regulations.
- The State's concurrence has not been received or conclusively presumed, or the State objected to the consistency certification, and the Secretary of Commerce does not authorize the activity pursuant to the CZMA.
- The proposed activities threaten national security or national defense.
- Exceptional circumstances exist, such as exceptional geological conditions, exceptional resource values, or probable serious harm to environmental resources.

As with an EP, when the MMS approves the DPP and before any drilling can commence, the lessee must submit and receive approval for an APD for each well. [In the Central and Western GOM Planning Areas, DPP’s are not required. In these areas, the lessee submits a development opeations coordination document (see 30 CFR 250.34(d)(1) and (2) and definiton of Eastern GOM at 30 CFR 250.2 (definition).]

Platform Emplacement

Development and production activities entail installation of a platform or other production system (e.g., artificial island). Usually, offshore development and production activities are conducted on fixed-leg platforms, which form an above-water, stable working area. Platforms consist of a deck (or decks)—where drilling, production, and other activities occur—supported by legs and cross members that rest on pilings driven into the sea bottom. Platform legs are constructed onshore, barged to the final location, and sunk into position. Pilings are driven through the legs to secure the base; then the upper working structure is welded on. A production platform accommodates from 1 to 100 production and injection wells and remains in place for the life of the reservoir or field, usually over 30 years.

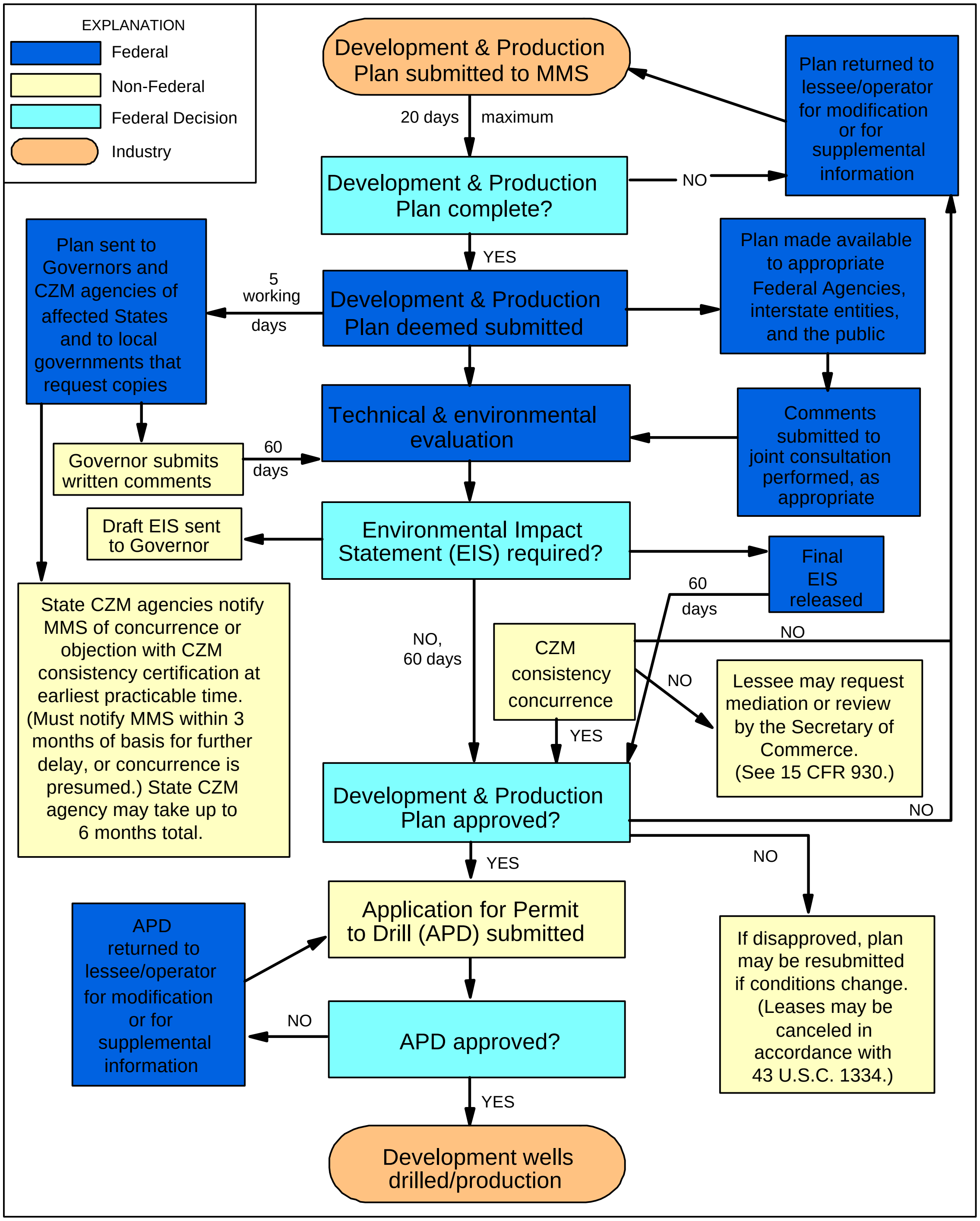

Figure B-2. Development and Production Plan Approval Process

In addition to the platform installation, onshore support facilities must be constructed if not already existing. Such facilities include storage yards, pipelines, marine terminals, and processing plants. These facilities also require MMS approval.

Production Drilling

Once a platform is installed, several wells are drilled to develop the surrounding area. On the OCS, as many as 67 wells have been drilled from a single platform; however, the average number is slightly more than 4—this average is highly influenced by the smaller number of wells per platform in the Gulf of Mexico. The drilling procedures are similar to those discussed above in the section on exploration.

Drilling and production involve many activities that could result in undesirable discharges or emissions. Some of these activities and the resulting discharges or emissions are discussed below.

- Transportation aspects related to OCS oil and natural gas activities include the conveyance of natural gas and oil to onshore processing facilities by pipeline, shuttle tankers, or barges; and the transport of supplies, services, and personnel by boats and helicopters.

- During the production life of a field, the lessee conducts well workover or repair operations to maintain a high production level. Such operations usually require MMS approval.

- Formation water is produced along with oil during petroleum production. Formation fluid is derived from water that became trapped within sediment pore spaces when the sediments were deposited. The amount of this produced water depends on the method of production, field characteristics, and location. As the volume of oil and natural gas production from a reservoir decline, the amount of produced water increases. Produced water must be disposed of according to the limitations of the EPA-issued NPDES permit.

- Naturally occurring radioactive material exists in some formation waters. Radioactive elements and their daughter products, such as radium 226 (RA^{226}) and radium 228 (RA^{228}), can be leached from formations by reservoir fluids and transported to the surface with produced water, oil, and gas. Radium isotopes comprise over 90 percent of the total radioactivity in formation waters (Laul et al., 1985; Snavely, 1989).

- Other wastewaters (e.g., sanitary and domestic waste, deck drainage, cooling water, and desalinization-unit discharges) are treated as required and are discharged in accordance with the NPDES permit.

- Air quality emissions from OCS facilities result from combustion, evaporation, or venting of hydrocarbons. Commonly used equipment that generate air emissions are diesel-powered generators and pumps. Operational emissions in the offshore environment are generally low-level, constant, and long-termed. The types of emitted air pollutants include nitrogen oxides, carbon monoxide, sulphur oxides, total suspended particulates, and volatile organic compounds. Ozone is not emitted directly by any source but is formed during a photochemical reaction in the atmosphere involving volatile organic compounds and nitrogen oxides.

Throughout the drilling and production phases, the MMS inspects the operations to ensure regulatory compliance. This inspection further ensures operational safety and pollution prevention. The MMS also requires that drilling personnel involved with well control attend MMS-certified training.

Pipeline Construction

Installation of subsea pipelines is a short-term (days) activity for a particular location but may cover extensive space (miles). There are several types of vessels used for offshore pipelaying operations. The most common is the pipelaying barge on which the pipe sections are welded together and laid in a continuous string from the center or side of the barge. Newer variations to the pipelaying barge include semisubmersible vessels, ship-shaped vessels, and reel barges (which use reels of pipe rather than welded straight sections). Pipelines are placed in trenches to protect them from the forces of water currents and wave action in shallow water and to minimize impacts on fish trawling activities. In the surf and beach zone, pipelines are pulled into a prepared trench and covered to restore the area to its original configuration. Pipelines coming ashore and crossing wetlands use specialized technologies including single ditch, double ditch, and flotation canal methods.

Platform Removal

Once platforms are no longer useful, they are removed, the wells are plugged, and the surrounding seafloor is cleared of obstructions. Current technology available for platform removal includes bulk explosives, shaped explosive charges, mechanical cutters, and underwater arc cutters. The use of bulk explosive charges has been the most common procedure (about 90 percent). Under this method, the pilings of the platform are blown off below the seafloor, and the platform is loaded onto barges for transportation away from the site.

Nonroutine Events

For purposes of this report, an OCS-related oil spill refers to an accidental release of crude oil or condensate originating from an OCS-related activity.

All crude oils contain a combination of hydrocarbon and nonhydrocarbon components; the relative proportions of these components determine the oil's toxicity. The hydrocarbon components usually make up the major portion of the crude oil—some crude oils are more than 95 percent hydrocarbons (Kallio, 1976; National Research Council, 1985). The principal classes of hydrocarbons found in crude oil are alkanes, cycloalkanes, and aromatic hydrocarbons. Nonhydrocarbon components of crude oil include sulfur, nitrogen, oxygen, and a variety of trace metals.

The chemical and physical properties of spilled oil change with time. The rate of change depends on the initial chemical composition of the oil and on the processes of "weathering" or aging. Generally, the longer spilled oil is weathered, the fewer ecologically damaging constituents it will contain. Weathering tends to reduce the toxicity of spilled oil because many of its acutely toxic components are lost through evaporation, dissolution, or degradation from photo-oxidation and microbial activity. The impacts caused by heavily weathered oil (tars and resins) are generally related to physical rather than chemical properties.

With or without fires, oil spills (including diesel fuels) and blowouts (uncontrolled flows of oil, natural gas, or other well fluids into the atmosphere) emit pollutants. These accidental emissions can include hydrocarbons, hydrogen sulfide, nitrogen oxides, carbon monoxide, sulphur oxides, and total suspended particulates.

Tables B-1 and B-2 show the annual number of oil spills from Federal OCS facilities for 1992 through 1994 that were greater than 1 barrel (bbl).

Table B-1. Number and Volume of OCS-Related Oil Spills Greater Than 1 bbl, 1992-1994

Year	Gulf of Mexico OCS			Pacific OCS			OCS Volume
	> 1-	> 50	Volume	> 1-50	> 50	Volume	
1992	29	2	2,336	0	0	0	2,336
1993	24	0	147	0	0	0	147
1994	20	4	4,851	3	0	83	4,934
Total	**73**	**6**	**7,334**	**3**	**0**	**83**	**7,417**

Source: Adapted from *Federal Offshore Statistics: 1994* (MMS, 1996a)

Table B-2. Offshore Oil Spills of 1,000 bbl or Greater from Federal OCS Facilities and Operations, 1992 through 1994

Year	Location	Cause of Accident	Spillage (bbl)
1992	South Pelto (Gulf of Mexico)	Hurricane damage to pipeline	2,000
1994	Ship Shoal (Gulf of Mexico)	Trawler damage to pipeline	4,533

Source: Adapted from *Federal Offshore Statistics: 1994* (MMS, 1996a)

Oil Pollution Act of 1990: Title III of OCSLAA required lessees/owners/operators of offshore facilities to establish and maintain proof that they can pay the costs (at a level of $35 million) of cleanup and damages caused by oil spills from their facilities. The oil-spill financial responsibility program, created under OCSLAA, was administered by USCG.

In the wake of the *Exxon Valdez* oil spill of 1989, Congress enacted the Oil Pollution Act of 1990 (OPA). The Offshore Responsibilities Section of OPA requires evidence of $150 million in financial responsibility from responsible parties regardless of the degree of risk posed by an offshore facility. Although OPA replaced Title III of OCSLAA, it provided that existing financial responsibility under OCSLA ($35 million) would continue in effect until new regulations were promulgated under OPA.

In 1991, the President signed Executive Order 12777 implementing OPA and assigned the responsiblity for all offshore facilities (State and Federal) to the U.S. Department of the Interior (DOI). In turn, DOI delegated these responsibilities to MMS. Prior to passage of E.O 12777, MMS had jurisdiction for spill prevention and response plans on the OCS only; this was the first time that MMS has had responsibility in State waters.

In an effort to implement the Offshore Responsibilities Section of the OPA, MMS published an Advance Notice of Proposed Rulemaking (ANPR) in August 1993 to alert the affected parties of potential economic impacts of the law on a wide range of facilities and industries. The MMS extended the comment period twice and held five public workshops across the country. As the preliminary step in rulemaking, the ANPR enabled the agency to collect information necessary to construct the proposed rule. Specifically, the ANPR requested information from the public on the potential effects of (1) extending the financial responsibility program from facilities on the OCS to facilities "in, on, or under navigable waters of the United States" and (2) raising the level of evidence required to be demonstrated from $35 million to $150 million. Until MMS develops final regulations to implement the expanded requirement of OPA, the program for offshore facilities developed by USCG will be continued at a level of $35 million for facilities on the OCS.

After receiving almost 2,000 comments and over 100 letters from Members of Congress representing 40 States, the DOI Assistant Secretary asked the OCS Policy Committee to form a subcommittee to recommend ways to implement the law—protecting the environment and ensuring availability of oil-spill cleanup funds—without causing severe economic damages. Presentation of their recommendations are due in the spring of 1995.

In an effort to further define each agency's jurisdictions under OPA, the EPA, DOT, and MMS have developed a memorandum of understanding (MOU). The MOU, which became effective on February 3, 1994, allocates responsibilities for oil-spill prevention and control, response planning, and response equipment inspection for offshore facilities. These responsibilities are shared among four Federal Agencies: EPA, USCG, DOT's Research and Special Programs Administration, and MMS. The responsibilities were allocated based on the locations of the facilities being regulated. The EPA is responsible for *nontransportation-related facilities* located landward of the coastline.

The USCG and DOT's Research and Special Program Administration handles *transportation-related facilities* (including pipeline) located landward of the coastline. The MMS is responsible for facilities (including pipeline) located *seaward* of the coastline. Division of these responsibilities avoids the possibility of overlapping efforts among the four Federal agencies.

Appendix C: Ongoing MMS-Funded Environmental Studies, 1992-1994

The Minerals Management Service (MMS) Environmental Studies Program supports the Outer Continental Shelf (OCS) Program by providing decisionmakers with information needed to predict, assess, and manage impacts from OCS-related activities in the offshore and nearshore areas. Studies provide information on the status of the environment (human, marine, and socioeconomic) and on the ways and extent the OCS activities can potentially impact the environment and coastal areas. The following table lists the studies that were funded by the MMS during the period covered by this report (1992-1994).

Table C-1. List of MMS-Funded Environmental Studies, 1992-1994

MMS Region	Title of Study	Contractor
Alaska	Fishery Oceanography in Areas of Oil and Gas Development Activities: Offshore Chukchi Sea	University of Alaska
Alaska	Spotted Seals In Kasegaluk Lagoon	Alaska - Department of Fish and Game
Alaska	North Slope Social and Subsistence Data Analysis	William E. Nebesky
Alaska	Fisheries Data Retrieval System	University of Alaska
Alaska	Alaska Marine Mammal Tissue Archival Project	U.S. National Biological Service
Alaska	Breeding Biology of Seabirds on the Barren Islands, Alaska	University of Washington
Alaska	Adsorption and Decomposition of Hydrocarbons	University of Alaska, Fairbanks
Alaska	Kachemak Bay Study	University of Alaska, Fairbanks
Alaska	Testing Conceptual Models of Marine Trophic Dynamics Using Carbon and Nitrogen Stable Isotope Ratios	University of Alaska, Fairbanks
Alaska	North Slope Amphidromy Assessment	University of Alaska, Fairbanks
Alaska	Intertidal and Subtidal Effects of Pollution—Assessment of Top-Trophic Predictors as Bioindicators	University of Alaska, Fairbanks
Alaska	Microbial Degradation of Aromatic Hydrocarbons in Marine Sediments	University of Alaska, Fairbanks
Alaska	Circulation on the Northcentral Chukchi Sea Shelf	University of Alaska, Fairbanks
Alaska	Juvenile Flatfish Habitat in the Kachemak Bay: Pilot Study	University of Alaska, Fairbanks
Alaska	Winter Circulation Processes in the Northeast Chukchi Sea	University of Alaska, Fairbanks
Alaska	Analysis of 1990 Census Data	University of Alaska, Anchorage

MMS Region	Title of Study	Contractor
Alaska	Northern Marine Ecosystem Management Workshop Conference	University of Washington
Atlantic	Physical Oceanography Field Study of the Straits of Florida	Science Applications International Corp.
Atlantic	Abundance and Distribution of Sea Turtles off North Carolina	Virginia Institute of Marine Science
Atlantic	A Review of Physical Oceanography of the Cape Hatteras, North Carolina, Area	Science Applications International Corp.
Atlantic	North Carolina Science Panel	Panel
Atlantic	Social Analysis Study for North Carolina	East Carolina University
Atlantic	Seafloor Survey in the Vicinity of the Manteo Prospect Offshore North Carolina	Virginia Institute of Marine Science
Atlantic	Deep Sea Research CD-ROM	Virginia Institute of Marine Science
Gulf of Mexico	Long-Term Assessment of the Oil Spill At Bahia Las Minas Panama	Bulletin of Marine Science
Gulf of Mexico	Long-Term Assessment of the Oil Spill At Bahia Las Minas Panama	Jovanovich, Ltd.
Gulf of Mexico	Hydrographic Survey of Northwest Gulf of Mexico	Texas A&M University
Gulf of Mexico	Gulf of Mexico Data Buoy Study	NOAA - National Data Buoy Center
Gulf of Mexico	Mississippi River Plume Hydrographic Study—LATEX B	Louisiana State University
Gulf of Mexico	Drifter Study in the Missippi River Plume	Louisiana State University
Gulf of Mexico	Cruises on the Flower Garden Banks	Sea Hoss Inc.
Gulf of Mexico	Quality Review Board —Gulf of Mexico Air Quality Study	Environmental Protection Agency
Gulf of Mexico	Coastal and Environmental Analysis Program	Jackson State University
Gulf of Mexico	Modeling Integrated Companies	Louisiana State University
Gulf of Mexico	Wave Climate Modeling and Evaluation Relative to Sand Mining on Ship Shoal, Offshore Louisiana, for Coastal and Barrier Island Restoration	Louisiana State University
Gulf of Mexico	Socioeconomic Determinants	Louisiana State University
Gulf of Mexico	Seasonal and Spacial Variation in the Biomass and Size Frequency Distribution of Fishes Associated with Oil and Gas Platforms	Louisiana State University
Gulf of Mexico	Assessment of PAH Composition of Diesel Fuel Sorbed to Marine Sediments and Their Toxicity to Aquatic Foodwebs	Louisiana State University
Gulf of Mexico	Biodegradation of Aromatic Heterocycles From Petroleum, Produced Water, and Pyrogenic Sources in Marine Sediment	Louisiana State University
Gulf of Mexico	Bioremediation of Spilled Hydrocarbons: The Selection and Survival of Introduced Bacterial Species	Louisiana State University
Gulf of Mexico	A Pressure Gauge and Moored CTD Array in the Lousiana Coastal Current	Louisiana State University
Gulf of Mexico	The Environmental and Safety Risks of Increasing Activity by Independents on the Federal OCS	Louisiana State University

MMS Region	Title of Study	Contractor
Gulf of Mexico	Effects of Offshore Oil and Gas Development: A Current Awareness Bibliography	Louisiana State University
Gulf of Mexico	CMI-LSU: Ecological Overview of Continental Slope	Louisiana State University
Gulf of Mexico	CMI-LSU: Role of Bottom Sediment Redox-Chemistry Near Oil Production Facilities on Sequester/Release/Degradation of Metals, etc.	Louisiana State University
Gulf of Mexico	CMI-LSU: PAH Sub-Lethal Chronic Toxicity Tests	Louisiana State University
Gulf of Mexico	CMI-LSU: A Numerical Model Study of the GOM Under Present and Past Condiions	Louisiana State University
Gulf of Mexico	CMI-LSU: Management Proposal	Louisiana State University
Gulf of Mexico	CMI-LSU: Coastal Marine Modeling	Louisiana State University
Gulf of Mexico	CMI-LSU: Overwater Dispersion Characteristics of SO_2 From Energy Production in the Gulf of Mexico	Louisiana State University
Gulf of Mexico	CMI-LSU: Digital High Resolution Acoustic Data Acquisition for Improved Benthic Habitat/Geohazard Evaluation and Classification of Chemosynthetic Communities	Louisiana State University
Gulf of Mexico	CMI-LSU: Development of Bioremediation for Oil-Spill Cleanup in Coastal Wetlands	Louisiana State University
Gulf of Mexico	CMI-LSU: Development and Characterization of Sea Anemones as Bio-indicators of Offshore Resource Exploitation and Environmental Impact	Louisiana State University
Gulf of Mexico	CMI-LSU: Effects of Simultaneous Exposure to Petroleum Hydrocarbons, Hyposia, and Prior Exposure on Tolerance and Sublethal Responses of Marine Mammal	Louisiana State University
Gulf of Mexico	CMI-LSU: Gulf-wide Information System Development	Louisiana State University
Gulf of Mexico	Flower Garden Banks Monitoring Study	Continental Shelf Associates, Inc.
Gulf of Mexico	Coastal Mississippi Hydrographic Data Project	Gulf Coast Research Lab
Gulf of Mexico	Northeastern Gulf of Mexico Satellite Imagery Study	University of Florida
Gulf of Mexico	Marine Debris Investigation Padre Island National Seashore, Texas	U.S. National Park Service
Gulf of Mexico	Measurements of SO_2 and NO_x and Surface Meteorology in the Northeast Gulf of Mexico	Louisiana State University-coastal Studies Institute
Headquarters	Oil Following Drifter Development and Applications	Multiple
Headquarters	Risk Assessment Model Verification Study	Technocean, Inc.
Headquarters	Near Surface Circulation and Mixed Layer Experiment	Office of Naval Research
Headquarters	Maryland Geological and Delaware Geological Surveys Cooperative Offshore Sand Resources Study	MD and DE Geological Surveys
Headquarters	Investigation of Sand Shoals on the Inner Shelf of Virginia Relative to the Potential For Aggregate Mining	Virginia Institute of Marine Science
Pacific	Potential Social and Economic Effects of OCS Oil and Gas Activities on Oregon and Washington Indian Tribes	Central Washington University
Pacific	Long Term Chronic Effects—University Initiative	University of California, Santa Barbara

MMS Region	Title of Study	Contractor
Pacific	Taxonomic Atlas of the Santa Maria Basin Fauna	Science Applications International Corp.
Pacific	Updated Inventory of Biological Resources, Southern California, Santa Barbara	University of California, Santa Barbara
Pacific	Southern California Bight Circulation Study: Santa Barbara Channel/Santa Maria Basin Circulation Study—Phase II	University of California, San Diego
Pacific	Monitoring: Assessment of Long Term Changes in Biological Communities In the Santa Maria Basin—Phase III	Science Applications International Corp.
Pacific	Monitoring: Assessment of Long-Term Changes in Biological Communities—Phase III	Naval Civil Engineering Laboratory
Pacific	Disturbance of Deep Water Reef Communities by Exploratory Oil and Gas Operations	Mec Analytical Systems, Inc.
Pacific	Santa Barbara Channel Socioeconomic Study	University of California, Santa Barbara
Pacific	MMS Intertidal Team (MINT) Studies	Minerals Management Service- Pacific
Pacific	CMI-UCSB: Administrative Support for Initial Start-up of CMI	University of California, Santa Barbara

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 **Royalty Management Program** 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.