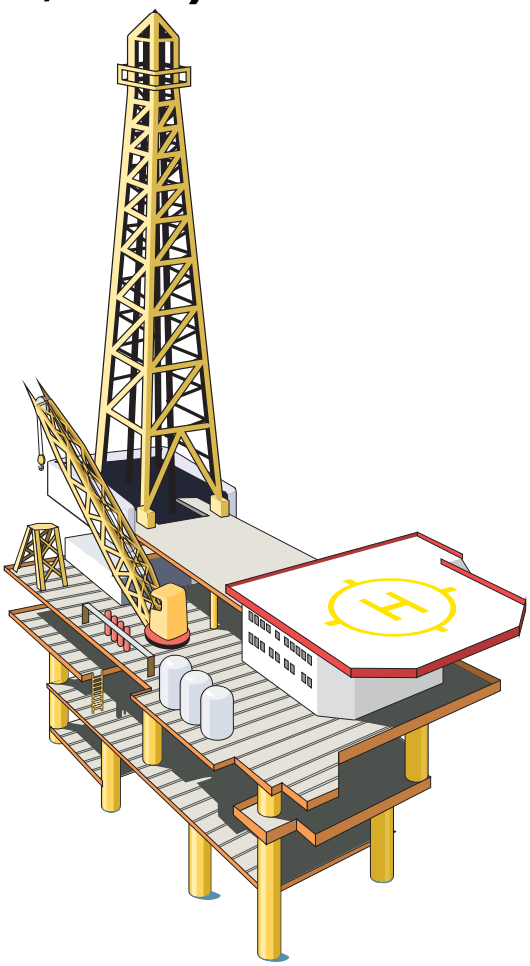
OCS Report
MMS 92-0073

Estimated Oil and Gas Reserves
Pacific Outer Continental Shelf

(as of December 31, 1991)



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

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by
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Office of Resource Evaluation

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

Camarillo
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Abbreviations

ACT . . . Actively Drilling
API . . . . American Petroleum Institute
°API . . . Oil Gravity
bbl . . . . Barrel of Oil (42 gallons)
Bcf . . . . Billion Cubic Feet of Gas
BOE . . . Barrels of Oil Equivalent
bpd . . . . Barrels per Day
cf . . . . . Cubic Feet
CFB . . . Cubic Feet per Barrel
CFR . . . Code of Federal Regulations
cp . . . . . Centipoise
DPP . . . Development and Production Plan
°F . . . . . Degrees Fahrenheit
GIW . . . Gas Injection Well
GLO . . . Gas Lift Oil Well
GOR . . . Gas/Oil Ratio
GSI . . . . Gas Well Shut-in
Mbbl . . . Thousand Barrels of Oil
MMbbl . Million Barrels of Oil
Mcf . . . . Thousand Cubic Feet of Gas
Mcfpd . . Thousand Cubic Feet of Gas per Day
MMcf . . Million Cubic Feet of Gas
md . . . . Millidarceys
MMS . . . Minerals Management Service
OCS . . . Outer Continental Shelf
OFR . . . Open File Report
OFSHR . Offshore
OSI . . . . Oil Well Shut-in
OS&T . . Offshore Storage and Treating Vessel
PA . . . . . Plugged and Abandoned
PGW . . . Producing Gas Well
POW . . . Producing Oil Well
ppm . . . Parts per Million
psia . . . . Pounds per Square Inch Absolute
psig . . . . Pounds per Square Inch Guage
RB . . . . Reservoir Barrel
SCF . . . Standard Cubic Feet
SPE . . . Society of Petroleum Engineers
STB . . . Stock Tank Barrel
SUSP . . Suspended (includes temporarily abandoned and inactive completions)
WDW . . Water Disposal Well
WIW . . . Water Injection Well
WSW . . Water Source Well

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Abstract

Proved reserves of oil[1] and gas[2] in the Pacific Outer Continental Shelf, offshore California, are estimated to be 894 million barrels and 1,503 billion cubic feet, respectively, as of December 31, 1991. These reserves are attributed to 13 fields. Original recoverable oil and gas reserves for these fields are estimated to be 1,420 million barrels and 2,083 billion cubic feet, respectively. Unproved reserves are estimated to be 570 million barrels of oil and 679 billion cubic feet of gas, in 25 fields.

Reserve estimates for 31 of the 38 fields were calculated using individual reservoir volumetric studies. Both decline-curve and volumetric analyses were used for the remaining seven. Over two-thirds of the original recoverable reserves and three-quarters of remaining reserves are attributed to reservoirs in the Monterey Formation.

Ten of the 38 fields were producing at yearend. Individual reserve estimates for each of these fields are herein presented for the first time. Production for 1991 amounted to 31.6 million barrels of oil and 52.4 billion cubic feet of gas, with average sale prices of $11.84 per barrel and $2.16 per thousand cubic feet. To date, 526 million barrels of oil and 580 billion cubic feet of gas have been produced from 10 fields.

[1] "Oil," as used in this report, includes crude oil and condensate

[2] "Gas," as used in this report, includes associated and nonassociated dry gas

Introduction

This report, which supersedes OCS Report MMS 91-0087 (Edwards, Sorensen, and Syms, 1991), presents estimates of original recoverable oil and gas reserves, cumulative production through 1991, and estimates of remaining reserves as of December 31, 1991, for the Pacific Outer Continental Shelf (OCS), offshore California. These estimates were completed in July 1992. The inclusion of field-specific reserves estimates in the annual update of this report is part of a Minerals Management Service (MMS) continuing program to provide a current inventory of oil and gas reserves for the Pacific OCS.

The estimates presented here were prepared by petroleum engineers, geologists, geophysicists, and other personnel from the MMS Pacific OCS Regional Office, Camarillo, California. Previous reports by Steven Wolfson and others were used as a basis for parts of this update. Contributions by James Galloway (stratigraphy), Tim Mac Gillvray (economics), and Dennis Tayman (computer graphics) were particularly important, and this report could not have been completed without their assistance.

Definition of Resource and Reserve Terminology

The MMS has standardized its definitions of resources (*Estimates of Undiscovered Conventional Oil and Gas Resources in the United States — A Part of the Nation's Energy Endowment*, U.S. Geological Survey and Minerals Management Service, 1989). The Society of Petroleum Engineers (SPE) has also adopted a standardized set of reserve categories and definitions (1987, p. 577-578). The definitions used within this report conform with both these sources. Figure 1 shows how resource and reserve definitions are related.

Undiscovered Resources -- Resources estimated from broad geologic knowledge or theory and existing outside of known fields or known accumulations are un-discovered resources. Undiscovered resources can exist in untested prospects on unleased acreage, or on undrilled leased acreage, or in known fields. In known fields, undiscovered resources occur in undiscovered pools that are controlled by distinctly separate structural features or stratigraphic conditions (U.S. Geological Survey and Minerals Management Service, 1989).

Discovered Resources -- Once leased acreage is drilled and is determined to contain oil or gas under Code of Federal Regulations (CFR) Title 30, Part 250, Subpart A, Section 11, Determination of Well Producibility (hereinafter referred to as 30 CFR 250.11), the lease is considered to have discovered resources. Discovered resources are the equivalent of identified resources as reported by Dolton and others (1981). Identified resources are resources whose location and quantity are known or are estimated from specific geologic or engineering evidence and include economic, marginally economic, and subeconomic components. Discovered resources can be further characterized as unproved or proved reserves, depending upon evidence of economic and geologic viability. Changing economic conditions and new geologic data and interpretations can result in reclassification of resources. The number of wells determined to be

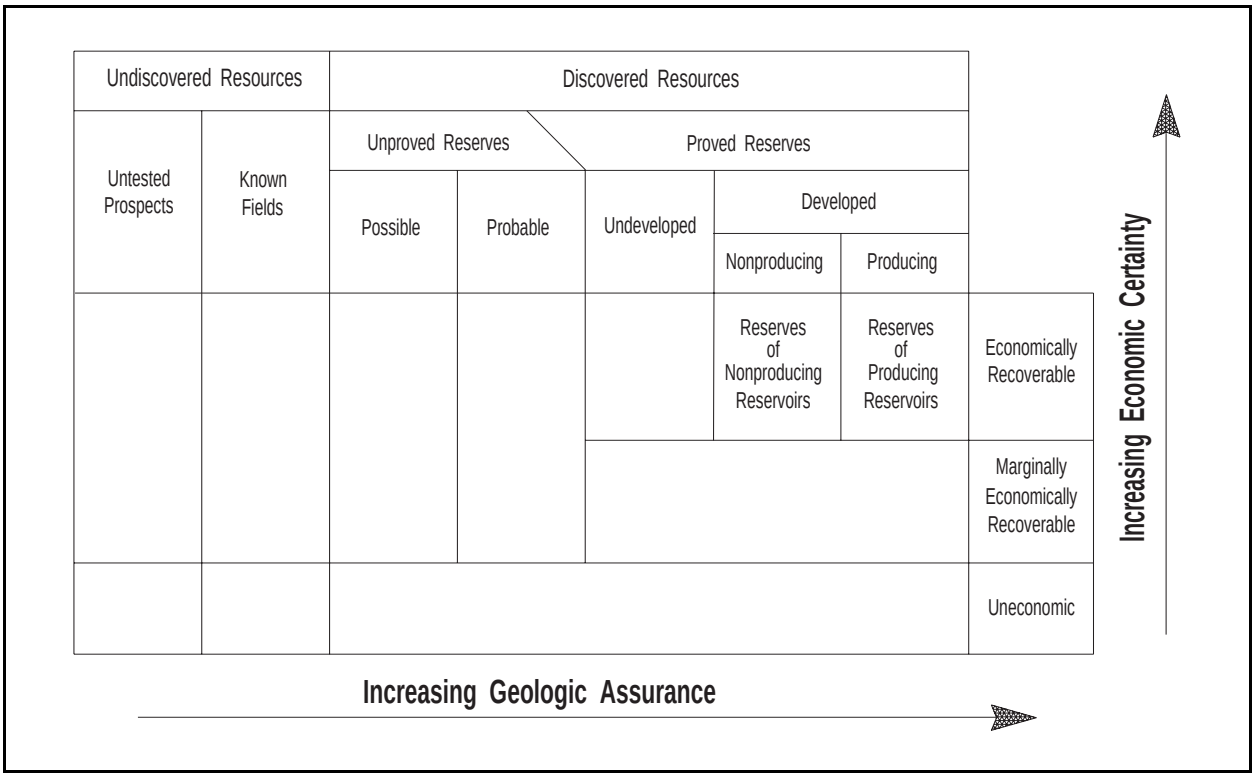

Figure 1. MMS petroleum reserve classification (modified from USGS and MMS, 1989; and SPE, 1987).

producible in accordance with 30 CFR 250.11 is shown in figure 2.

Unproved Reserves

After a lease qualifies under 30 CFR 250.11, the MMS Field Naming Committee reviews the new producible lease to assign it to an existing field or, if the lease is not associated with an established geologic structure, to a new field. Regardless of where the lease is assigned, the reserves associated with the lease are initially considered to be unproved reserves. Unproved reserves are based on geologic or engineering information similar to that used in estimates of proved reserves; but technical, contractual, economic, or regulatory uncertainties preclude such reserves being classified as proved.

Unproved reserves may be divided into two subclassifications, possible and probable, which are similarly based on the level of uncertainty.

Unproved Possible Reserves -- "Unproved possible reserves are less certain than unproved probable reserves and can be estimated with a low degree of certainty, which is insufficient to indicate whether they are more likely to be recovered than not. Reservoir characteristics are such that a reasonable doubt exists that the project will be commercial" (SPE, 1987). After a lease qualifies under 30 CFR 250.11, the reserves associated with the lease are initially classified as unproved possible.

Unproved Probable Reserves -- "Unproved probable reserves are less certain than proved reserves and can be estimated with a degree of certainty sufficient to indicate they are more likely to be recovered than

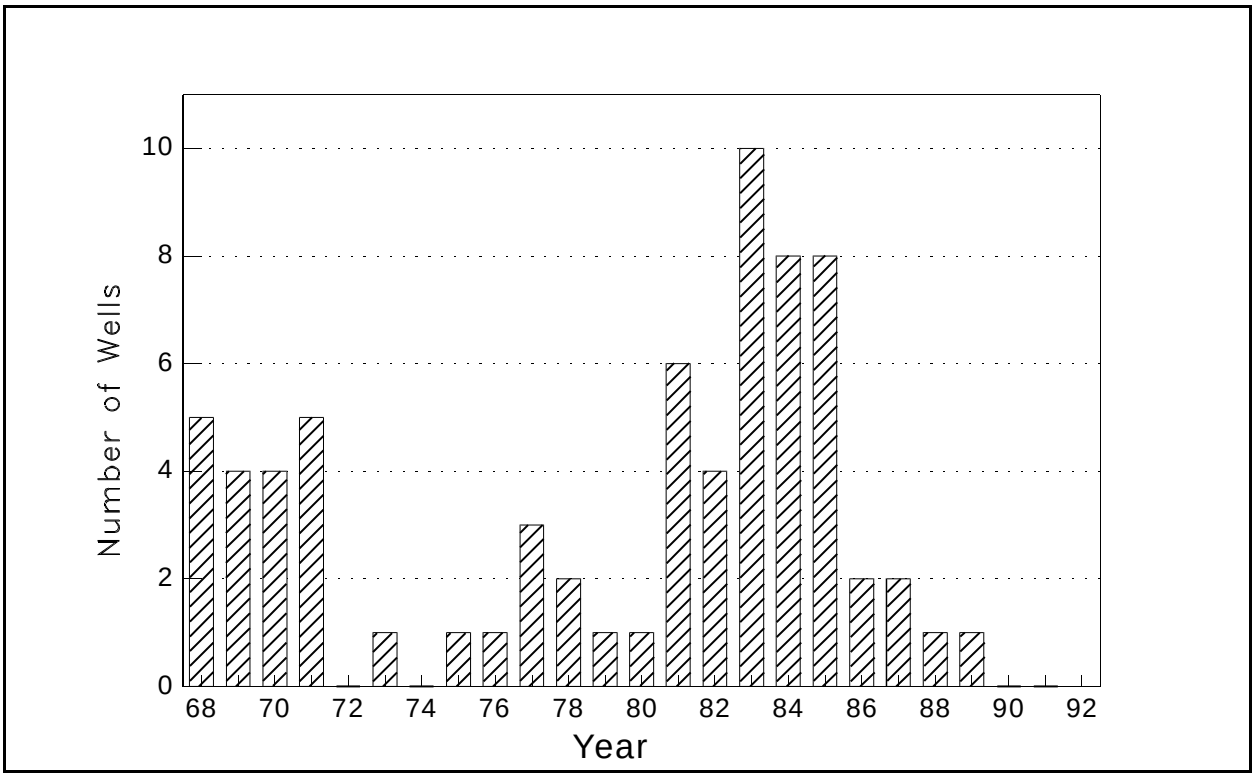

Figure 2. Wells determined to be producible in accordance with 30 CFR 250.11.

not" (SPE, 1987). Reserves in fields for which a schedule leading to a Development and Production Plan (DPP) has been submitted to the MMS have been classified as unproved probable.

Proved Reserves

"Proved reserves can be estimated with reasonable certainty to be recoverable under current economic conditions, such as prices and costs prevailing at the time of the estimate. Proved reserves must either have facilities that are operational at the time of the estimate to process and transport those reserves to market or a commitment or reasonable expectation to install such facilities in the future" (SPE, 1987). Proved reserves can be subdivided into undeveloped and developed.

Proved Undeveloped Reserves -- Reserves are classified proved undeveloped when a relatively large expenditure is required to install production and/or transportation facilities, a commitment by the operator is made, and a timeframe to begin production is established. Proved undeveloped reserves are reserves expected to be recovered from (1) yet undrilled wells, (2) deepening existing wells, or (3) existing wells for which a relatively large expenditure is required for recompletion.

Proved Developed Reserves -- "Reserves that are expected to be recovered from existing wells (including reserves behind pipe) are classified as proved developed reserves. Reserves are considered developed only after necessary production and transportation equipment have been installed or when the installation costs are relatively minor. Proved developed reserves are subcategorized as producing or

non-producing" (SPE, 1987). This distinction is made at the reservoir level and not at the field level.

Proved Developed Producing Reserves -- Once the first reservoir in a field begins production, the reservoir is considered to contain proved developed producing reserves, and the field is considered on production. If a reservoir had sustained production during the last year, it is considered to contain proved developed producing reserves.

Proved Developed Nonproducing Reserves -- Any developed reservoir in a developed field that has not produced or has not had sustained production during the past year is considered to contain proved developed nonproducing reserves. This category includes reserves contained in nonproducing reservoirs, contained reserves behind-pipe, and reservoirs awaiting well workovers or transportation facilities. A diagram of the reserves classification procedure is shown in figure 3.

Total Reserves -- Total reserves are the sum of proved and unproved reserves.

Original Recoverable Reserves -- The amount of oil and gas expected to be recovered from the original oil in place or the amount equal to the sum of cumulative production and remaining reserves is considered to be the original recoverable reserves.

Production Data -- The measured volumes of gross hydrocarbons reported to the MMS by Federal lessees and operators. Oil and gas volume measurements and reserves are corrected to reference standard conditions of 60° F and 14.73 psia. Continuously measured volumes from production platforms or leases are allocated to

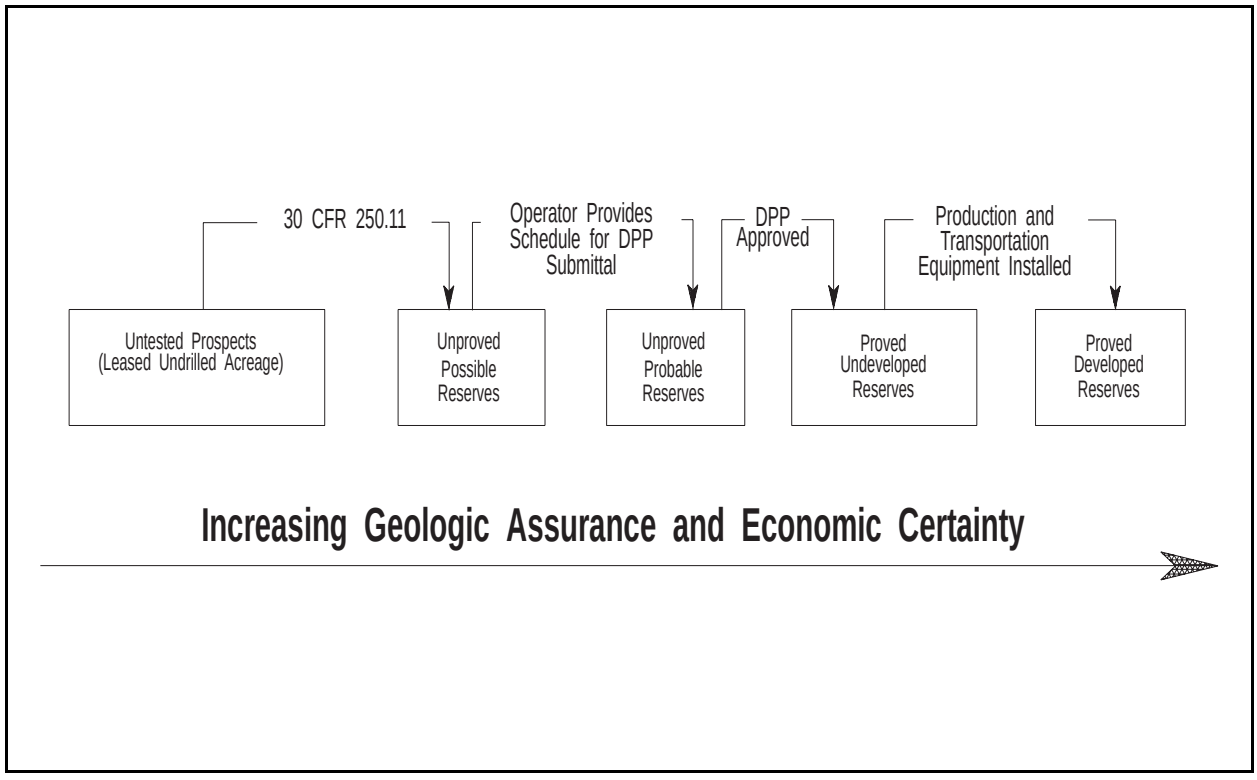

Figure 3. MMS Pacific OCS reserves classification procedure.

individual wells and reservoirs on the basis of periodic well tests. These procedures introduce approximations in both production and reserves data by reservoirs and by fields.

Methods Used for Estimating Reserves

Volumetric calculation -- For the volumetric calculation of reserves, the amount of original oil and gas in place is estimated from the bulk volume of the reservoir as mapped using data from boreholes and seismic profiles. Maps of net oil and gas sand thicknesses are generated with a computer mapping system, and the results are converted to bulk volume using the appropriate equations. Rock porosity and the amounts of water, oil, and gas in the pore space are interpreted from well logs and core analyses. The estimated amount of original oil and gas in place is converted to standard conditions by analyses of pressure, volume, and temperature relationships and by the use of standard correlations. The amount of the original oil and gas in place that can be recovered is estimated from information about the reservoir drive mechanism, well spacing, analog field recovery factors, and API recovery factor equations (Arps and others, 1967, p. 19-20).

Decline-curve analysis -- In the decline-curve analysis method, future production is estimated by extrapolating plots of production rates and fluid percentages versus time. The ultimate production is determined by adding cumulative past production to predicted future production.

Fields Reported

As of December 31, 1991, 38 fields in the Pacific OCS (figure 4) are recognized as containing reserves under the established criteria. Two of these fields are gas fields, 27 are oil fields, and 9 are combination oil and gas fields.

Thirteen fields were determined to have proved reserves of oil and/or gas. These 13 fields are San Miguel, Point Pedernales, Point Arguello, Pescado, Sacate, Hondo, Dos Cuadras, Pitas Point, Carpinteria Offshore, Santa Clara, Sockeye, Hueneme, and Beta (figure 4, Fields 2, 7, 11, 20, 21, 23, 29, 30, 31, 33, 34, 36, and 38). All of these fields, with the exception of Pescado, Sacate, and San Miguel, were producing at yearend. The remaining 25 fields were determined to have unproved reserves of oil and/or gas.

Reserve estimates for 7 of the producing fields were obtained from volumetric calculations and decline-curve analyses: Hondo, Dos Cuadras, Pitas Point, Carpinteria Offshore, Santa Clara, Hueneme, and Beta (figure 4, Fields 23, 29, 30, 31, 33, 36, and 38). Individual reservoirs in each field were grouped for volumetric calculations, while decline-curve analyses were made on lease-by-lease and platform bases. The 31 remaining fields (3 producing and 28 nonproducing) were studied on a reservoir-by-reservoir basis, and the reserve estimates were determined solely by the volumetric calculation method.

Individual nonaggregated estimates of the original recoverable and remaining reserves for each of the 10 producing oil and gas fields are being presented in this report for the first time (table 1). A summary of the exploration, development,

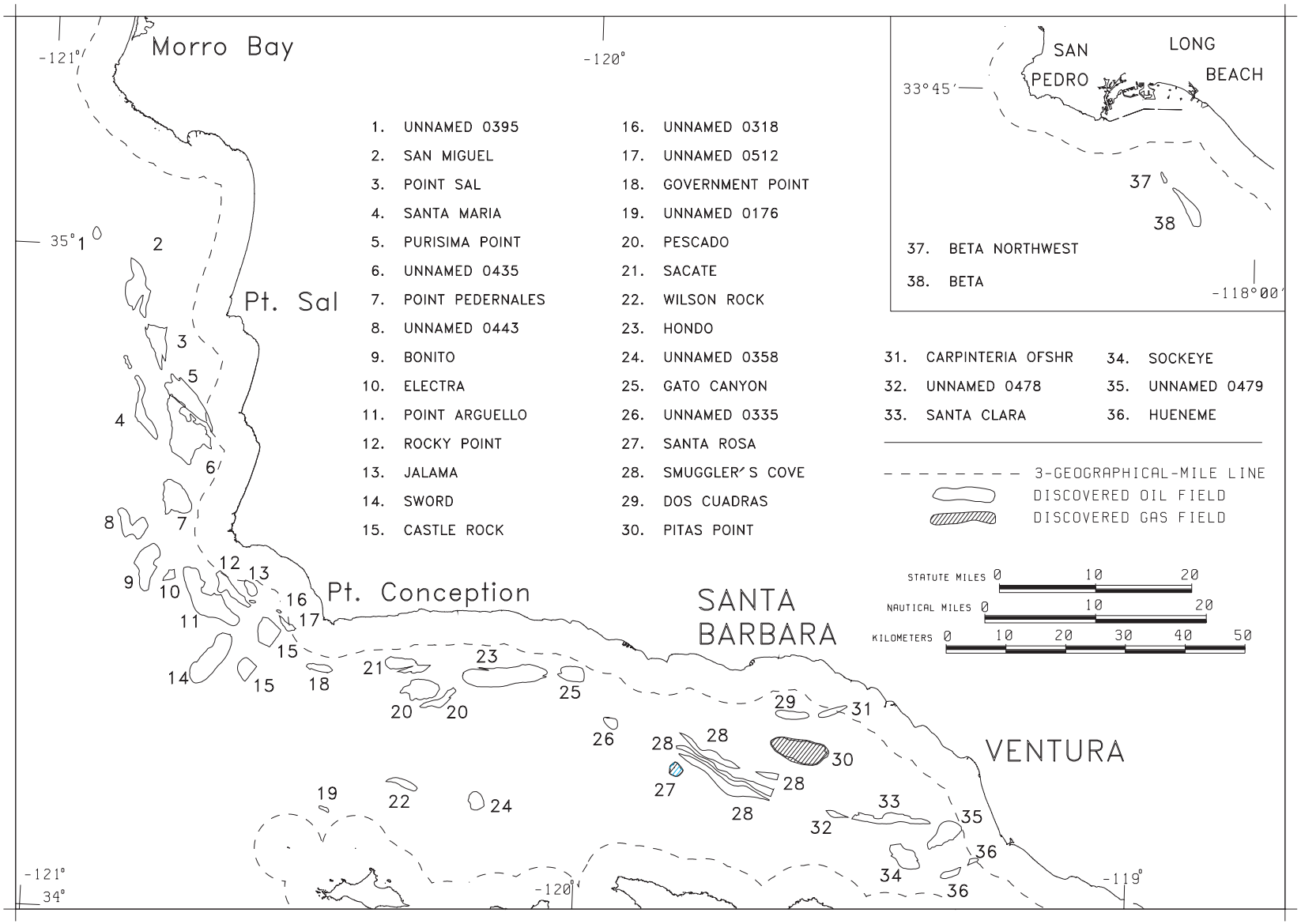

Figure 4. Recognized discoveries of federally controlled oil and gas fields in the Pacific OCS. (Dashed lines indicate 3-geographical mile boundary between State and Federal waters.)

Table 1. Production and estimated reserves of oil and gas for producing fields, Pacific OCS, December 31, 1992.

Field	Original Recoverable Reserves		Cumulative Production		1991 Annual Production		Remaining Reserves	
	Oil (MMbbl)	Gas (Bcf)	Oil (MMbbl)	Gas (Bcf)	Oil (MMbbl)	Gas (Bcf)	Oil (MMbbl)	Gas (Bcf)
Beta	120.62	28.73	55.25	18.78	4.58	1.50	65.37	9.95
Carpinteria	59.90	53.56	56.79	48.02	1.10	2.12	3.11	5.54
Dos Cuadras	243.80	119.80	222.97	107.98	3.13	2.36	20.83	11.82
Hondo	250.00	586.70	114.73	170.38	7.71	16.67	135.27	416.32
Hueneme	11.62	6.88	7.55	2.24	0.29	0.18	4.07	4.64
Pitas Point	0.22	236.60	0.15	151.97	0.01	15.79	0.07	84.63
Point Arguello	283.88	297.52	5.72	2.21	5.53	2.15	278.16	295.31
Point Pedernales	77.30	77.30	29.23	6.18	5.05	1.16	48.07	71.12
Santa Clara	70.02	114.19	25.35	51.97	1.95	2.81	44.67	62.22
Sockeye	49.46	105.33	8.15	20.48	2.27	7.67	41.31	84.84

and production history of each of the producing fields is also presented (appendices A through J).

Field Size Distribution

Figure 5 shows the field size distribution based on current estimated original recoverable reserves for 27 oil fields, 9 combination oil and gas fields, and 2 gas fields. Producing fields and nonproducing fields are distinguished in this figure. These 38 fields are located in three basins, offshore California. For comparison purposes, gas reserves are expressed in terms of barrels of oil equivalent on the basis of equivalent heating values (5,620 cubic feet of gas has the approximate heating value of one barrel of oil), hereinafter referred to as BOE.

Distribution of Reserves by Relative Age of Reservoir Rock

The reserves of the Pacific OCS can be divided into three groups based on the relative age of the reservoirs in which they exist. The three age groups of reservoir rocks are (1) Pre-Monterey: rocks older than the Monterey Formation (early Miocene age and older), (2) Monterey: rocks of the Monterey Formation (Miocene age), and (3) Post-Monterey: rocks younger than the Monterey Formation (late Miocene age and younger). The distribution of remaining reserves and estimated original recoverable reserves in BOE is illustrated in figure 6 and table 2.

Over two-thirds of the original recoverable reserves and over three-quarters of the remaining reserves are in Monterey Formation reservoirs.

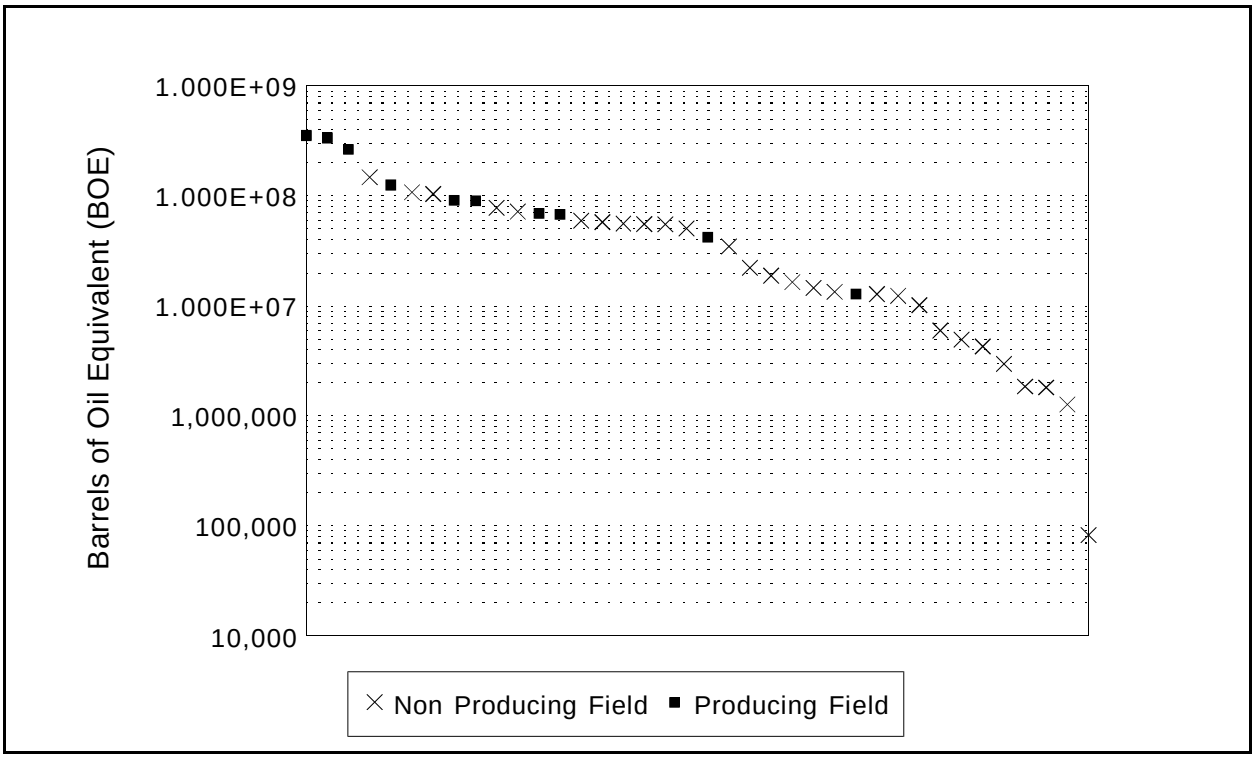

Figure 5. Size distribution of oil and gas fields.

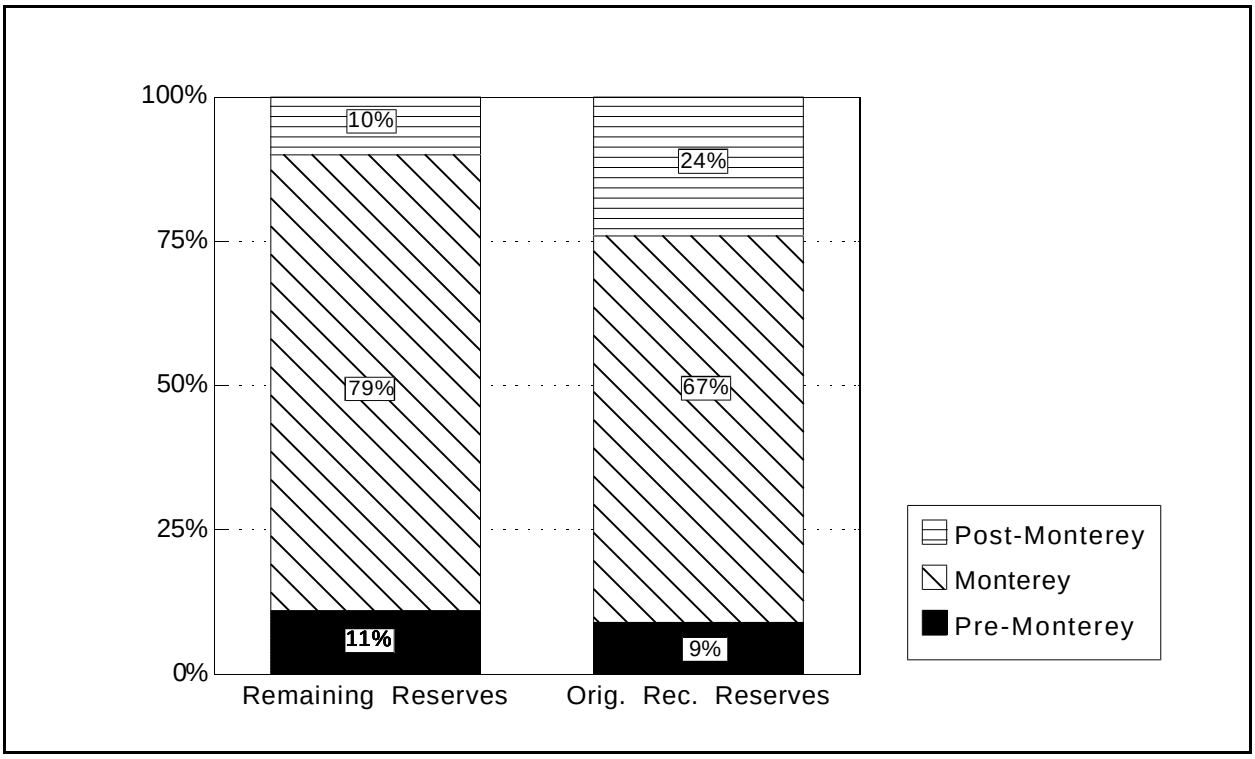

Figure 6. Remaining reserves and estimated original recoverable reserves (on a BOE basis) by reservoir age group.

Table 2. Geologic formations within each reservoir age group.

Reservoir Age Group	Geologic Formations	Estimated Original Recoverable Reserves* (MMbbl)	Remaining Reserves* (MMbbl)
Post-Monterey	Pico, Puente, "Repetto", Santa Margarita, Sisquoc	586	185
Monterey	Monterey	1,657	1,492
Pre-Monterey	Point Sal, Vaqueros, Topanga, Hueneme, Sespe/ Alegria, Gaviota, Sacate, Juncal (Camino Cielo), Jalama	222	202

*Barrels of oil equivalent

Six of the 10 producing fields have substantial reserves attributed to this formation (appendices D, E, G, H, I, and J), as do 22 of the 28 nonproducing fields. In 18 of the 28 nonproducing fields, all identified reserves are attributed to Monterey Formation reservoirs.

Changes in Reported Reserves

The current Pacific OCS aggregate estimates of proved, unproved, and total reserves of oil and gas are shown in table 3, for both original recoverable and remaining reserves. These estimates have been updated as additional information has become available. Past updates have caused both increases and decreases in estimates of original recoverable reserves (figure 7 and table 4). Variations in oil and gas production rates also affect estimates of remaining recoverable reserves (figure 8).

Current estimates of original recoverable reserves of oil and gas have increased, as compared with estimates published previously (table 5). This increase was sufficient to produce a net gain in remaining recoverable gas reserves at yearend. The increase in estimated original recoverable oil reserves was less than oil production during 1991, however, causing a net decrease in remaining recoverable oil reserves.

Status of Field Development

As of December 31, 1991, the primary drilling programs have been completed at 5 of the Pacific OCS fields: Dos Cuadras, Pitas Point, Carpinteria Offshore, Hueneme, and Beta (figure 4, Fields 29, 30, 31, 36, and 38). Of the 38 recognized fields, 10 were producing in December: Point Pedernales, Point Arguello, Hondo, Dos Cuadras, Pitas Point, Carpinteria Offshore, Santa Clara, Sockeye, Hueneme, and Beta (figure 4, Fields 7, 11, 23, 29, 30, 31, 33, 34, 36, and 38). A brief history of the exploration and development of each of these 10 fields is contained in the appendices to this report.

Table 3. Proved, unproved, and total oil and gas reserves for Pacific OCS, December 31, 1991

Reserves	Number of Fields	Original Recoverable Reserves		Cumulative Production		Annual Production		Remaining Reserves	
		Oil (MMbbl)	Gas (Bcf)	Oil (MMbbl)	Gas (Bcf)	Oil (MMbbl)	Gas (Bcf)	Oil (MMbbl)	Gas (Bcf)
Proved Reserves	13	1,420	2,083	526	580	32	52	894	1,503
Unproved Reserves	25	570	679	0	0	0	0	570	679

Table 4. Annual estimates of original recoverable reserves with source publication numbers.

Original Recoverable Reserves			
Year	Publication	Oil (MMbbl)	Gas (Bcf)
1976	OFR 78-384	829	1,530
1977	OFR 79-345	843	1,546
1978	OFR 80-477	875	1,665
1979	OFR 80-1042	920	1,845
1980	OFR 81-623	988	1,853
1981	OFR 82-37	1,082	1,847
1982	OFR 83-559	1,217	1,983
1983	MMS 84-0024	1,433	2,298
1984	MMS 85-0041	1,515	2,400
1985	MMS 86-0066	1,599	2,334
1986	MMS 87-0045	1,670	2,461
1987	MMS 88-0047	1,727	2,501
1988	MMS 89-0085	1,729	2,467
1989	MMS 90-0086	1,987	2,723

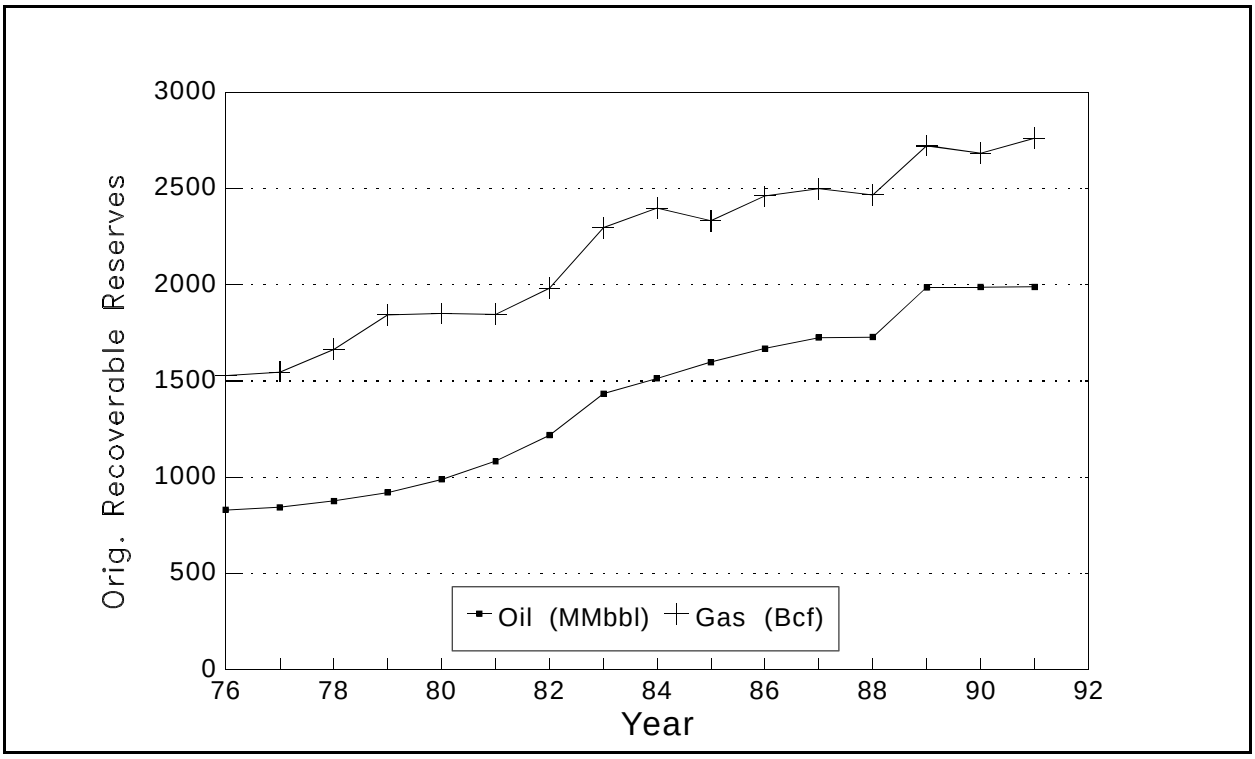

Figure 7. Annual estimates of original recoverable reserves from known fields.

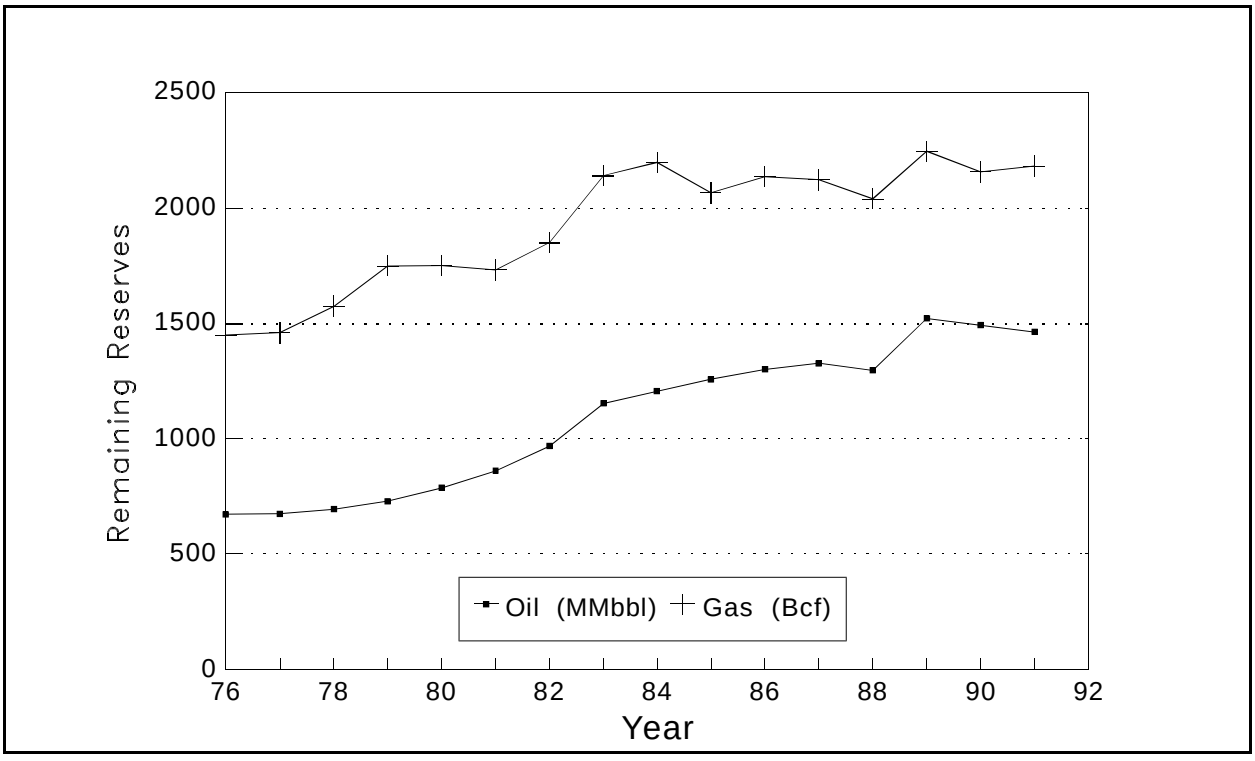

Figure 8. Annual estimates of remaining recoverable reserves from known fields.

Table 5. Changes in reported reserves and production, Pacific OCS, December 31, 1991.

Production and Reserves	Oil (MMbbl)	Gas (Bcf)
Original Recoverable Reserves:		
Estimated as of 12/31/91 (MMS 92-0073)	1,990	2,762
Estimated as of 12/31/90 (MMS 91-0087)	1,988	2,684
Change	+2	+78
Cumulative Production:		
Through 1991	526	580
Through 1990	494	528
Proved Reserves:		
Estimated as of 12/31/91 (MMS 92-0073)	894	1,503
Estimated as of 12/31/90 (MMS 91-0087)	923	1,478
Change	-29	+25
Total Reserves:		
Estimated as of 12/31/91 (MMS 92-0073)	1,464	2,182
Estimated as of 12/31/90 (MMS 91-0087)	1,493	2,157
Change	-29	+25

Additional exploratory and delineation wells are anticipated in many of the Pacific OCS fields to define productive limits and optimize oil and gas recovery further.

Five producing oil and gas fields in the Pacific OCS are undergoing fluid injection: Hondo, Dos Cuadras, Santa Clara, Hueneme, and Beta (figure 4, Fields 23, 29, 33, 36, and 38). Recovery beyond primary production is occurring or can be anticipated. One field, Hondo, is undergoing gas injection for reservoir pressure maintenance. Additional information on the enhanced recovery efforts at these fields is available in appendices A, C, D, E, and I.

Drilling History and Production Rates

There were 329 exploratory wells and 716 development wells spudded by yearend. For the second consecutive year, no exploratory wells were drilled in the Pacific OCS. Only 9 development wells and redrills were drilled during 1991, in four fields: Beta, Dos Cuadras, Pitas Point, and Point Pedernales (see appendices A, C, F, and H). Table 6 shows the yearend summary of the borehole status for all development wells. Drilled footage by year for all wells in the Pacific OCS is displayed in figure 9.

Annual oil and gas production from the Pacific OCS is shown in table 7. Production from the 10 fields that were producing during 1991 totaled 31.6 MMbbl of oil and 52.4 Bcf of gas (table 7 and figure 10). Cumulative production reached 526 MMbbl of oil and 580 Bcf of gas (table 7 and figure 11). Average daily production rates for each month during 1991 are shown in figure 12. Production data for each of the producing fields are available in the appendices to this report.

Table 6. Summary of development well borehole status.

Platform Name	POW	GLO	PGW	OSI	GSI	GIW	WIW	WDW	WSW	SUSP	PA	Total	ACT
A	39	0	0	8	0	0	3	0	0	0	15	65	0
B	35	0	0	9	0	0	4	0	0	0	21	69	0
C	25	0	0	1	0	0	5	0	0	0	0	31	0
Edith	16	0	0	2	0	0	0	0	0	2	1	21	0
Ellen	26	0	1	6	1	0	22	1	3	0	9	69	0
Eureka	29	0	0	0	0	0	15	0	0	0	1	45	0
Gail	10	3	0	1	0	0	0	0	0	0	0	14	0
Gilda	35	0	3	5	3	0	14	0	0	2	6	68	0
Gina	5	0	0	2	0	0	5	0	0	0	2	14	0
Grace	0	17	0	3	3	0	0	0	0	3	8	34	0
Habitat	0	0	15	0	3	0	0	0	0	2	1	21	0
Harvest	5	0	0	3	0	0	0	0	0	11	0	19	0
Henry	20	0	0	3	0	0	0	0	0	0	2	25	0
Hermosa	9	0	0	2	0	0	0	0	0	1	0	12	0
Hidalgo	4	1	0	1	0	0	0	0	0	1	0	7	0
Hillhouse	10	26	0	9	0	0	1	0	0	0	4	50	0
Hogan	8	5	0	18	0	2	0	3	0	0	14	50	0
Hondo	10	13	0	1	0	2	2	0	0	0	9	37	0
Houchin	13	5	0	14	0	0	0	0	0	1	10	43	0
Irene	2	11	0	5	0	0	0	0	0	1	3	22	0
Total	301	81	19	93	10	4	71	4	3	24	106	716	0

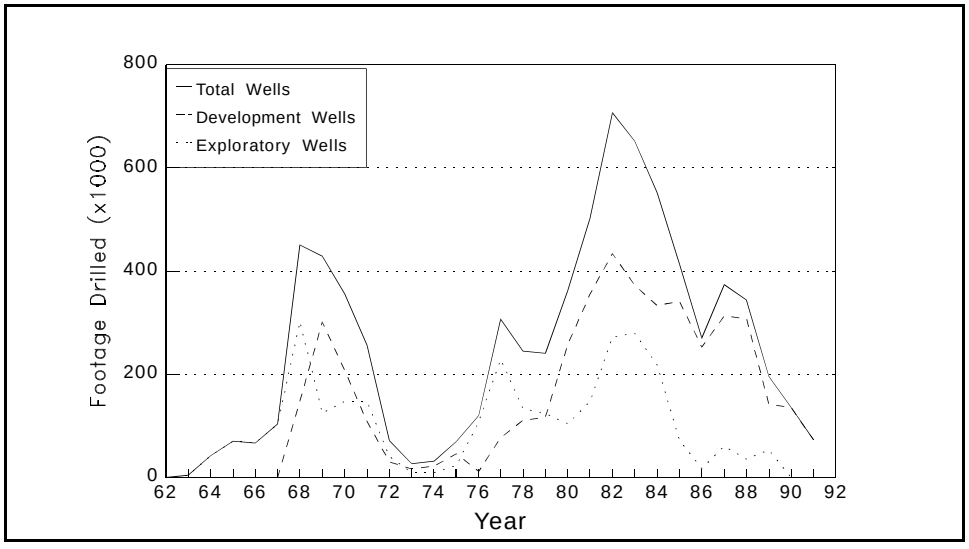

Figure 9. Annual drilled footage for wells in the Pacific OCS.

Table 7. Annual and cumulative production for the Pacific OCS.

Year	Annual Oil (bbl)	Cumulative Oil (bbl)	Annual Gas (Mcf)	Cumulative Gas (Mcf)
1968	2,076,160	2,076,160	1,237,180	1,237,180
1969	9,942,733	12,018,893	6,016,485	7,253,665
1970	25,035,171	37,054,064	13,757,148	21,010,813
1971	31,103,681	68,157,745	17,853,055	38,863,868
1972	22,562,566	90,720,311	12,546,915	51,410,783
1973	18,818,026	109,538,337	9,157,714	60,568,497
1974	16,784,100	126,322,437	7,234,937	67,803,434
1975	15,434,507	141,756,944	5,978,959	73,782,393
1976	13,977,436	155,734,380	5,533,258	79,315,651
1977	12,258,013	167,992,393	5,366,181	84,681,832
1978	11,979,674	179,972,067	5,193,985	89,875,817
1979	10,971,013	190,943,080	5,430,689	95,306,506
1980	10,118,614	201,061,694	5,771,792	101,078,298
1981	19,619,670	220,681,364	12,769,110	113,847,408
1982	28,471,665	249,153,029	17,814,958	131,662,366
1983	30,558,866	279,711,895	23,923,258	155,585,624
1984	30,500,506	310,212,401	45,912,435	201,498,059
1985	29,673,649	339,886,050	63,523,094	265,021,153
1986	28,779,936	368,665,986	57,989,035	323,010,188
1987	31,284,618	399,950,604	54,874,298	377,884,486
1988	31,529,776	431,480,380	49,132,759	427,017,245
1989	33,067,789	464,548,169	50,872,623	477,889,868
1990	29,885,271	494,310,184	49,950,216	527,796,524

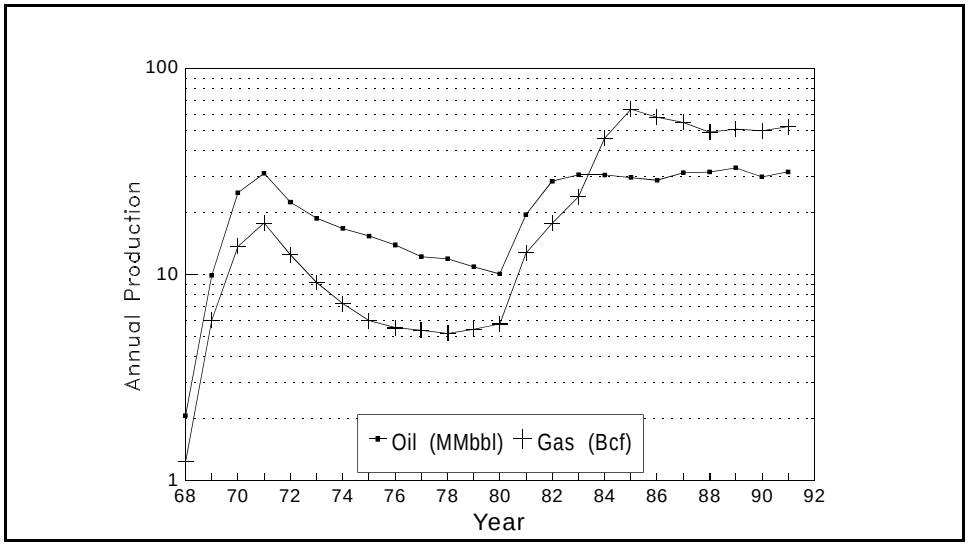

Figure 10. Annual production rates for the Pacific OCS.

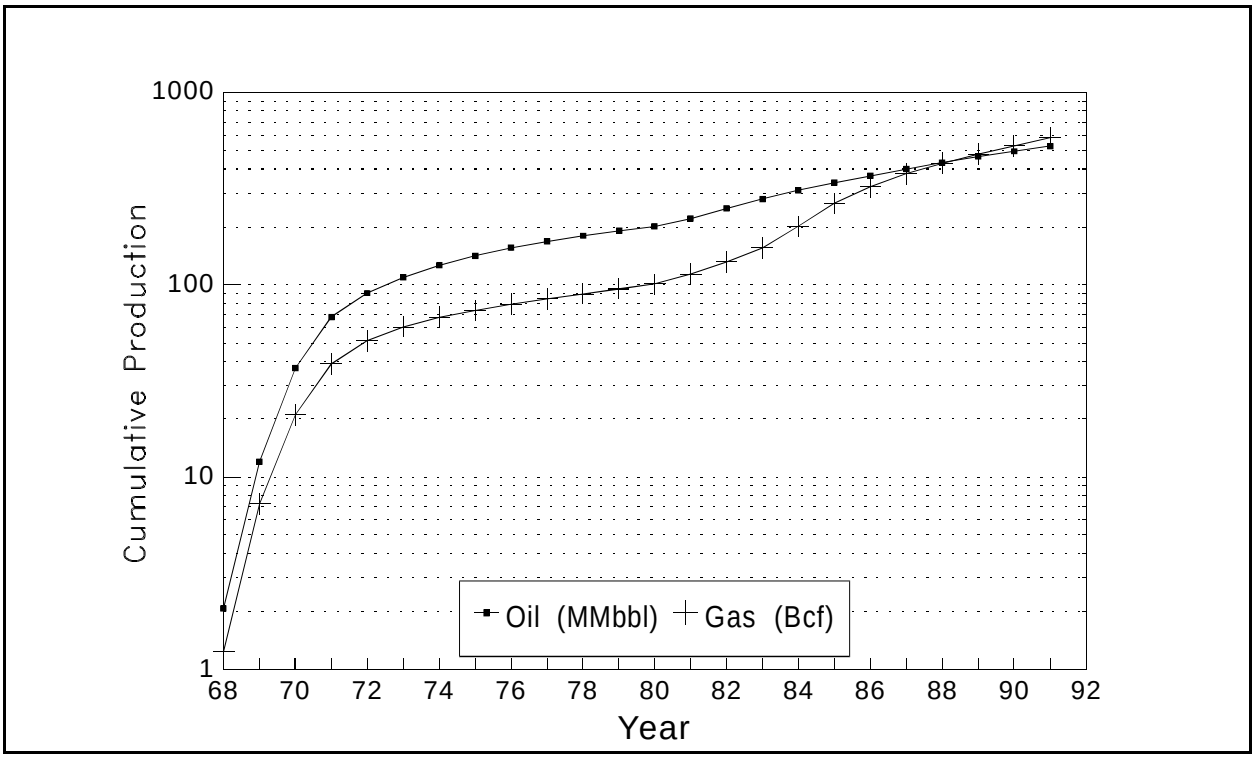

Figure 11. Cumulative production for the Pacific OCS.

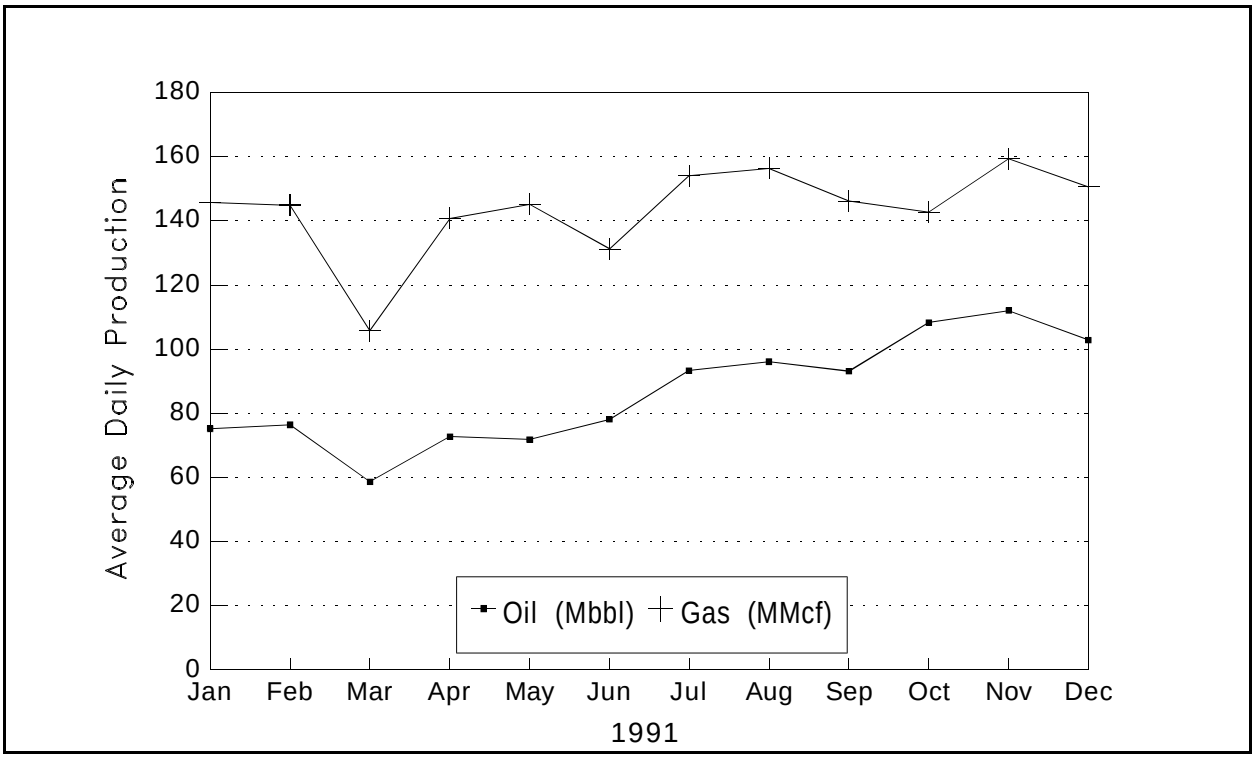

Figure 12. Average daily production rates for the Pacific OCS.

Oil and Gas Sales Prices, Volumes, and Gravities

During 1991, ten of the 38 fields in the Pacific OCS produced oil and gas. Sales volumes of oil and gas produced from these fields totaled 31.6 MMbbl and 47.3 Bcf, respectively. The weighted average sale price during 1991 was $11.84 per barrel of oil, although the sale price in January exceeded $15.00 per barrel. The weighted average sale price of natural gas was $2.16 per thousand cubic feet.

Total sales of crude oil from each field during 1991 are shown in table 8. Sales of oil produced at Point Arguello Field began in June 1991. By December 1991, Point Arguello Field had become the second largest field in the Pacific OCS in terms of oil sales volumes. Hondo, Point Pedernales and Point Arguello fields account for almost 58 percent of all Pacific OCS crude oil sold.

Total sales of natural gas from each field during 1991 are shown in table 9. Pitas Point Field is the only producing gas field in the Pacific OCS, and produced more gas than any other single field. The amount of gas produced from Hondo Field is nearly as great, however, and the two fields account for over 67 percent of all Pacific OCS natural gas sold.

Almost 70 percent of Pacific OCS crude oil is below 20° API gravity (table 10). Oil produced from some reservoirs also contains substantial quantities of sulfur and metals. These factors have produced average prices for Pacific OCS crudes that are generally lower than the national average (figure 13).

Table 8. 1991 Crude oil sales for the Pacific OCS.

Field	Oil Sales Volume (MMbbl)	Percent of Total Sales
Hondo	7.75	24.52 %
Point Arguello	5.51	17.44 %
Point Pedernales	5.05	15.98 %
Beta	4.56	14.43 %
Dos Cuadras	3.12	9.91 %
Sockeye	2.27	7.18 %
Santa Clara	1.95	6.17 %
Carpinteria Offshore	1.09	3.45 %
Hueneme	0.29	0.92 %
Total	31.59	100.00 %

Table 9.. 1991 Natural gas sales for the Pacific OCS.

Field	Natural Gas Sales Volume (Bcf)	Percent of Total Sales
Pitas Point	15.8	33.4 %
Hondo	15.4	32.6 %
Sockeye	6.9	14.6 %
Santa Clara	2.5	5.4 %
Point Arguello	1.8	3.7 %
Dos Cuadras	1.7	3.6 %
Point Pedernales	1.2	2.5 %
Beta	1.0	2.1 %
Carpinteria Offshore	0.8	1.8 %
Hueneme	0.2	0.3 %
Total	47.3	100.00 %

Table 10. 1991 Crude oil sales by gravity (^{o} API).

Oil Gravity ^{o} API	Oil Sales Volume (MMbbl)	Percent of Total Sales
14^{o}	3.51	11.11 %
16^{o}	2.54	8.04 %
17^{o}	10.87	34.41 %
19^{o}	5.51	17.44 %
20^{o}	0.29	0.92 %
21^{o}	1.44	4.56 %
23^{o}	0.59	1.87 %
24^{o}	2.12	6.71 %
25^{o}	1.51	4.78 %
26^{o}	2.31	7.31 %
27^{o}/28^{o}	0.43	1.36 %
30^{o}/31^{o}	0.47	1.49 %

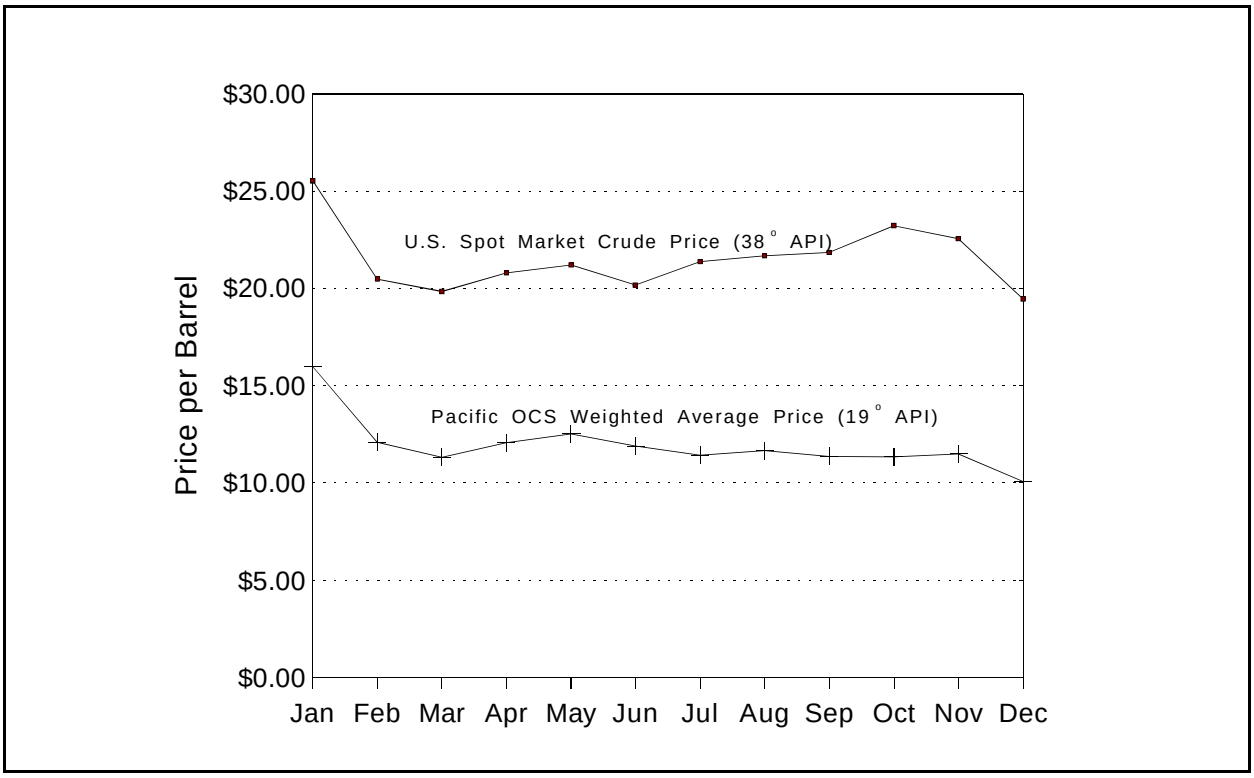

Figure 13. Average monthly crude oil price for Pacific OCS and Standard West Texas Crude (U.S. Spot Market).

Conclusions

As of December 31, 1991, the total original recoverable reserves in 38 fields in the Pacific OCS, offshore California, are estimated to be 1,990 MMbbl of oil and 2,762 Bcf of gas. The remaining proved reserves in 13 oil and gas fields are estimated to be 894 MMbbl of oil and 1,503 Bcf of gas. Remaining unproved reserves in 25 oil and gas fields in the Pacific OCS are estimated to be 570 MMbbl of oil and 679 Bcf of gas. Total remaining reserves have declined by 29 MMbbl of oil, and increased by 25 Bcf of gas, as compared to previously published estimates. Three-quarters of the remaining reserves in the Pacific OCS are attributed to reservoirs in the Monterey Formation.

Oil and gas were being produced from 20 platforms in 10 fields at yearend. Original recoverable gas reserves for the single producing gas field are estimated to be 236.6 Bcf, and remaining reserves are estimated to be 84.6 Bcf of gas. Estimated original recoverable reserves for the other 9 fields range from 11.6 MMbbl to 283.9 MMbbl of oil, and from 6.9 Bcf to 586.7 Bcf of gas. Estimated remaining reserves for these 9 fields range from 3.1 MMbbl to 278.2 MMbbl of oil, and from 4.6 Bcf to 416.3 Bcf of gas.

Oil and gas production during 1991 amounted to 31.6 MMbbl of oil and 52.4 Bcf of gas. Average oil and gas sale prices were $11.84 per barrel and $2.16 per thousand cubic feet, respectively. The weighted average oil sales gravity was 19° API. Cumulative production from fields in the Pacific OCS has climbed to 526 MMbbl of oil and 580 Bcf of gas since production began in 1968.

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Appendices: Producing Fields in the Pacific Outer Continental Shelf

The following appendices provide information on each of the 10 Pacific OCS fields that were producing at yearend. Each appendix provides a brief overview of the geology in the vicinity of each field; a summary of the field's leasing, exploration, development, and production history; and estimates of oil and gas reserves for each field.

The information in the appendices has been obtained primarily from MMS interpretations of geophysical, geological, and other data provided by lessees. Such interpretations form the basis of MMS oil and gas reserves estimates for each of the fields in the Pacific OCS.

Appendices: Producing Fields in the Pacific Outer Continental Shelf

Appendix A - BETA FIELD

SUMMARY

Beta Field is located on the San Pedro Shelf, approximately eight miles southwest of Huntington Beach, California. The field extends over Leases OCS-P 0296, 0300, 0301, and 0306. These four leases form the Beta Unit. Water depths in the area range from 161 feet at Platform Edith to 700 feet at Platform Eureka.

Production from Beta Field began in January 1981. A waterflood is in progress in the southern part of the field. Nearly 130 development wells have been drilled from three platforms on three leases; only four wells were completed or recompleted during 1991. All producing zones are within the Miocene Puente Formation.

Oil and gas production for 1991 reached 4,581,156 bbl and 1,499,285 Mcf, respectively. Produced oil averaged 14° API gravity. Cumulative production increased to 55.3 MMbbl oil and 18.8 Bcf gas. Current estimates of remaining reserves for the field are 65.4 MMbbl oil and 9.9 Bcf gas.

GEOLOGY

Beta Field is located within the Southwest Block of the Los Angeles Basin. The major structures within the field reflect the northwest-southeast trend of the nearby Palos Verdes (Harbor-Lasuen) Fault, as well as the Newport-Inglewood Fault Zone, which delimits the block to the northeast. Proximity to the Palos Verdes Fault has produced extensive faulting within the field (figures A-1 and A-2).

The oldest rocks located in the vicinity of Beta Field are the blueschists and metadiorites of the late Jurassic to early Cretaceous Catalina Schist. These metamorphic basement rocks were truncated by an unconformity upon which were deposited the marine sedimentary rocks of the middle to upper Miocene Puente Formation. The lower Puente Formation includes bathyal sandstones, siliceous shales, and carbonates that were deposited during the Mohnian stage. The lower Puente Formation is coeval with the Miocene Monterey Formation. The upper Puente Formation was deposited during the Delmontian stage (upper Miocene and possibly lower Pliocene), and consists of distal turbidite sands interbedded with bathyal shales.

The Pliocene section is composed of marine sediments deposited conformably on the Puente Formation. The lower Pliocene "Repetto" (lower Pico) Formation consists of lower bathyal sediments deposited during the Repettian stage. The formation includes interbedded sandstones, siltstones, shales, and claystones. The upper Pliocene Pico Formation conformably overlies the "Repetto" Formation. The unit is composed of middle to upper bathyal sandstones, claystones, and siltstones, and is truncated by an unconformity. The Pico Formation was deposited during the Venturian to early Wheelerian stages, and represents the uppermost Pliocene section in the area.

Above the unconformity are Quaternary marine and nonmarine sediments. These strata include sand and gravel channel deposits, siltstone, claystone, and marine shales. A type log for Beta Field is shown

in figure A-3.

Productive hydrocarbon reservoirs appear to be confined to rocks of Miocene age. The most prolific reservoirs have been found in the turbidite sands of the Delmontian section. Relatively minor amounts of heavy oil have also been produced from older Mohnian stage sedimentary rocks. Representative reservoir characteristics are shown in tables A-1 and A-2.

EXPLORATION AND DEVELOPMENT

The first coreholes located on what was to become the Federal Outer Continental Shelf were drilled in the vicinity of Beta Field in 1955. Most of the early coreholes penetrated less than 500 feet of sedimentary section, although some exceeded 5000 feet in depth. Stratigraphic coring in the area continued until 1965.

The four blocks containing Beta Field were leased during OCS Sale No. 35 in January 1976. A bidding group led by Standard Oil Company of California obtained Lease OCS-P 0296 for $105,177,888. Another group, led by Shell Oil Company, submitted high bids of $25,568,000 and $45,685,000 for Leases OCS-P 0300 and 0301, respectively. Standard Oil Company of California and Getty Oil Company acquired equal interests in Lease OCS-P 0306 for a bonus bid of $800,179.20.

The Beta Field discovery well was spudded in July 1976 and abandoned approximately three months later. The well, OCS-P 0301 No. 1, was drilled from the ODECO *Ocean Prospector* semisubmersible in 659 feet of water. Flow rates approached 500 barrels of 19.6° API gravity oil per day, with minor associated gas. An additional 21 exploration and delineation wells were later drilled on the four leases.

Development of the field began in 1980 with the installation of the Elly-Ellen platform complex by Shell California Production, Inc. The platforms are located in Lease OCS-P 0300, in approximately 260 feet of water. Platform Elly contains processing facilities; drilling is carried out from the adjacent 80-slot Platform Ellen. The first Beta Field development well was drilled from Platform Ellen in August 1980.

Two additional platforms have since been installed to produce oil and gas from Beta Field. Chevron U.S.A. Inc. installed 72-slot Platform Edith on Lease OCS-P 0296 in January 1983. The platform was set in 161 feet of water. Approximately 18 months later, Shell set 60-slot Platform Eureka in Lease OCS-P 0301 in 700 feet of water. Development drilling from the two platforms began in November 1983 and December 1984, respectively.

Beta Unit was formed in April 1983. The unit is composed of Leases OCS-P 0296, 0300, 0301, and 0306. Shell is the unit operator. In April 1989, Chevron transferred its interest in Leases OCS-P 0296 and 0306 to Union Oil Company of California. Union subsequently transferred its interest in Lease OCS-P 0306 to Shell Western E & P Inc., giving Shell a majority interest in three of the four leases forming Beta Unit.

Nearly 130 development wells have been drilled to date. Only 22 of the wells have been drilled from 72-slot Platform Edith. All producing wells use electric submersible or hydraulic rod pumps to produce heavy oil through gravel-packed completions.

Both Leases OCS-P 0300 and 0301 have been developed using a 5-spot waterflood, which was begun soon after production started. Water injection has helped

maintain reservoir pressure, and has slowed the decline in oil production rates. Water injection rates peaked in 1989 at an average daily rate of 36,458 bpd. Most injection wells are converted from producing oil wells. Well spacing is approximately 15 acres. No secondary recovery program has been initiated for Lease OCS-P 0296.

Three wells were drilled, and a fourth was recompleted at Beta Field during 1991. Other work included sand control repairs, packer changes, solvent stimulations, and almost 50 electric submersible pump changes. Platform Edith was shut down in June 1991 due to pipeline damage. Pipeline repairs were completed in October.

PRODUCTION AND RESERVES

Production from Beta Field began in January 1981, from Platform Ellen in Lease OCS-P 0300. Production from Platform Edith in adjoining Lease OCS-P 0296 began in January 1984, with production from Platform Eureka following approximately one year later. All producing zones are within the Miocene Puente Formation. Produced hydrocarbons are piped onshore to Shell's facility in Carson, California.

In May 1986 the monthly oil production from the field peaked at 645,412 bbl of approximately 14° API gravity oil. Five months later associated gas production reached a maximum of 253,504 Mcf. The decline in oil production between 1989 and 1990 was approximately 6 percent. Production data from the field are shown in figure A-4.

Volumetric and decline-curve analyses were used to calculate recoverable hydrocarbon reserves for Beta Field. Original recoverable oil and gas reserves are estimated to have been 120.6 MMbbl and 28.7 Bcf, respectively. Cumulative production reached 55.3 MMbbl oil and 18.8 Bcf gas in December 1991 (table A-3). Current estimates of remaining oil and gas reserves for the field are 65.4 MMbbl and 9.9 Bcf, respectively.

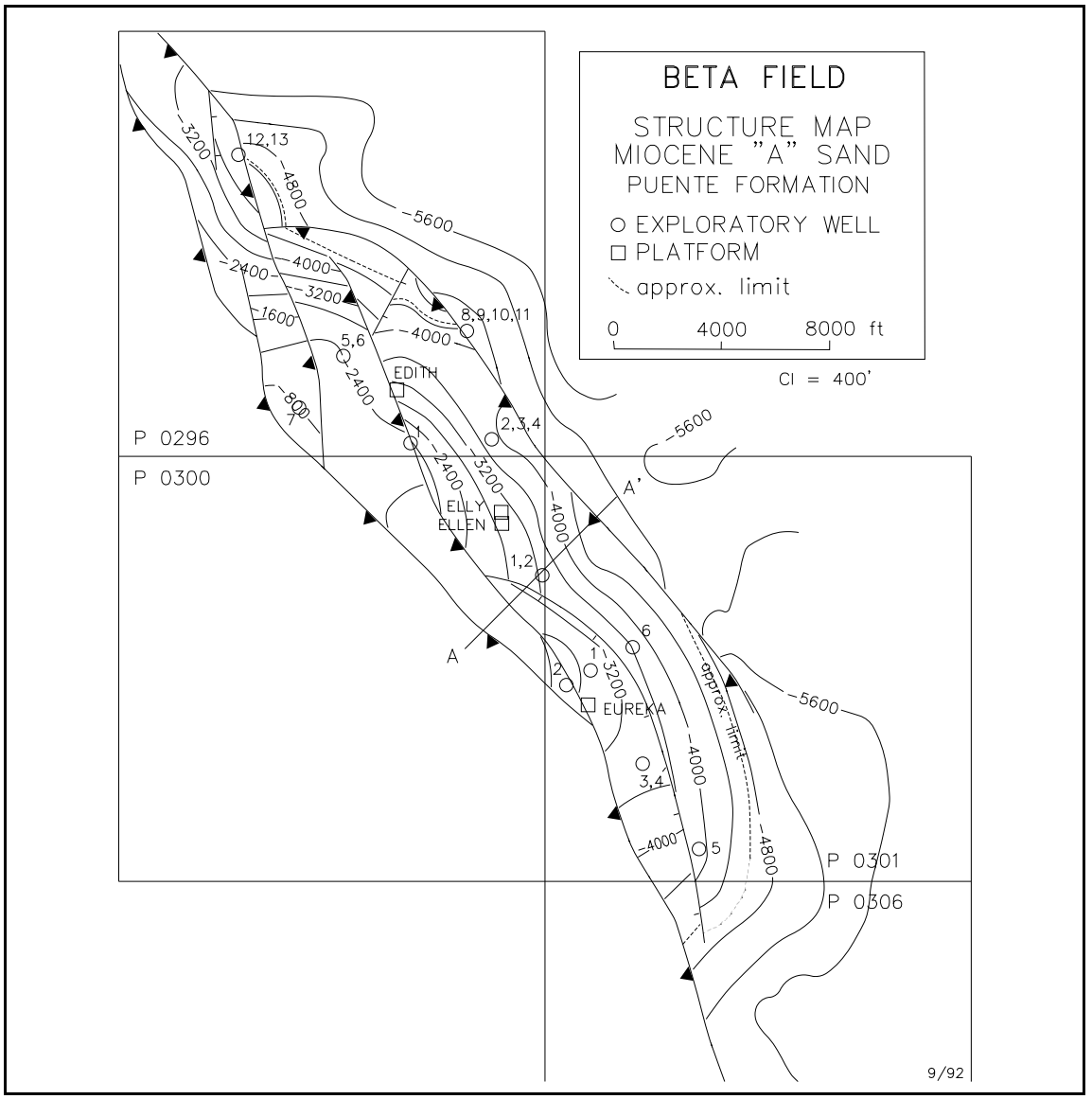

Figure A-1. Structure map of Beta Field.

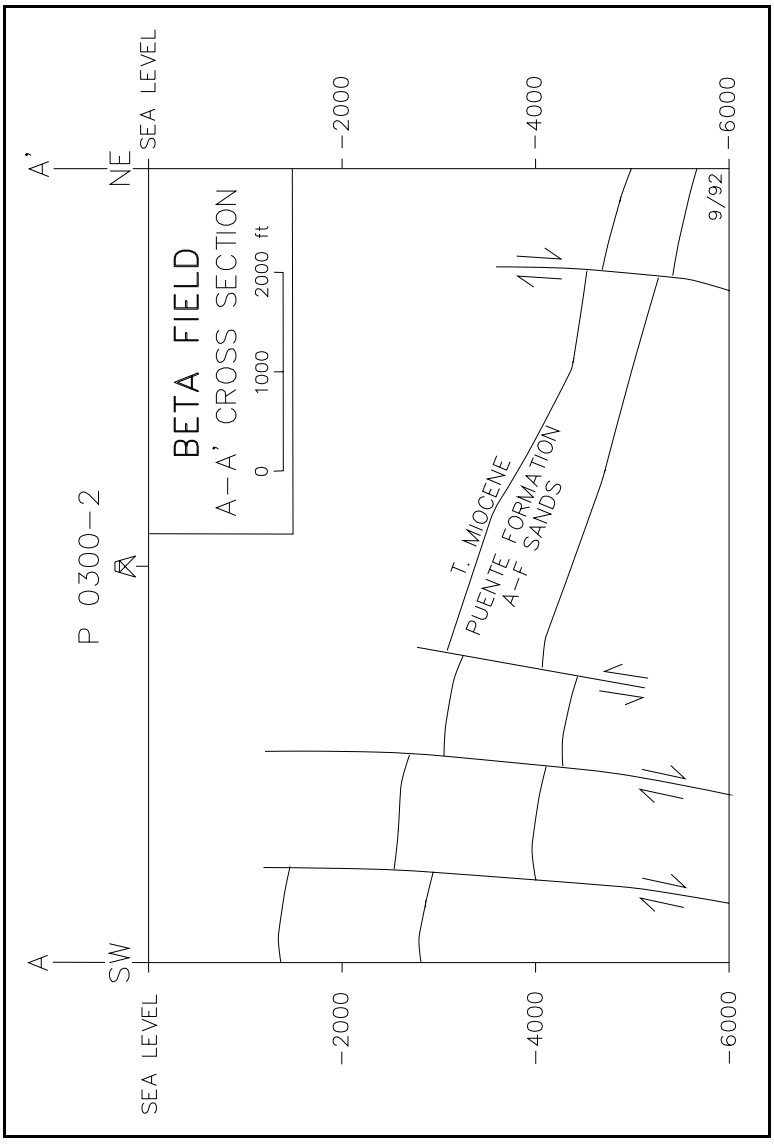

Figure A-2. Cross section through Beta Field.

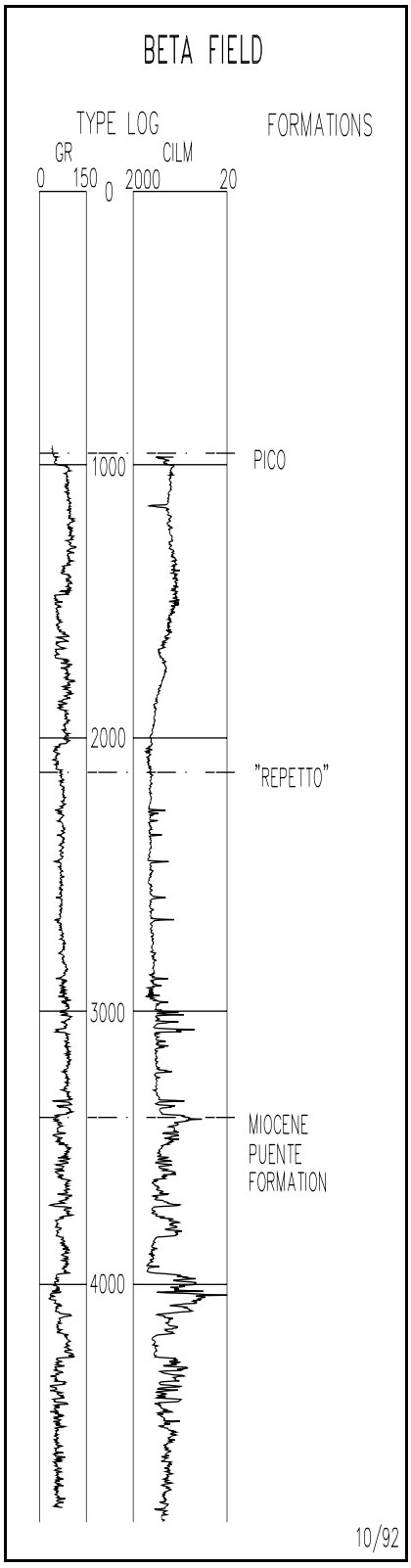

Figure A-3. Beta Field type log.

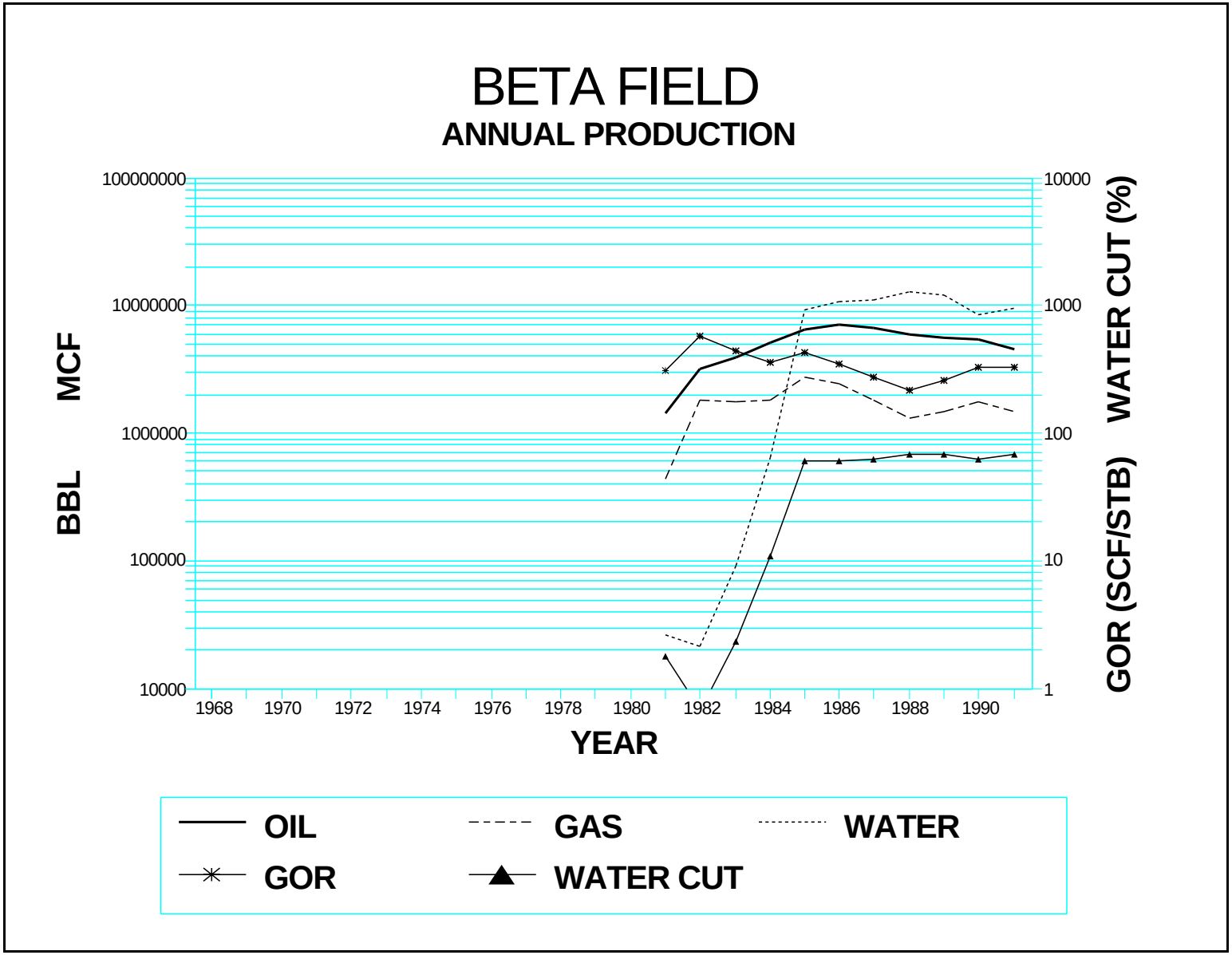

Figure A-4. Annual production from Beta Field.

Table A-1. Beta Field reservoir characteristics.

Beta Field	
Puente Reservoir Characteristics	
Average Depth	3,800 feet
Porosity	16-26 %
Permeability	10-300 md
Reservoir Temperature	140-175^{o} F
Original Reservoir Pressure	1,600 psig
Connate Water Saturation	30-75 %
Gross Sand Stratigraphic Thickness	1,425 feet
Net Sand Thickness	300-500 feet
Productive Area	1,675 acres
Gas Specific Gravity	0.66

Table A-2. Beta Field fluid characteristics

Beta Field	
Puente Reservoir Fluid Characteristics	
Average Oil Gravity	18^{o} API
Saturation Pressure	1,600 psig
Viscosity	10-1,000 cp
Initial Producing GOR	400 SCF/STB
Initial Oil Formation Volume Factor	1.115 RB/STB

Table A-3. Beta Field production.

Field: BETA

Year	Wells at Year End			Oil Production				Gas Production		Water Production			GOR
	Prod	Other	Total	Barrels	bpd	bpd/ Well	Cumulative Barrels	Mcf	Cumulative Mcf	Barrels	Cumulative Barrels	% Cut	CFB
1968													
1969													
1970													
1971													
1972													
1973													
1974													
1975													
1976													
1977													
1978													
1979													
1980													
1981	17	2	19	1,430,714	3,920	231	1,430,714	439,882	439,882	26,317	26,317	2	307
1982	36	7	43	3,186,503	8,730	243	4,617,217	1,834,412	2,274,294	21,339	47,656	1	576
1983	29	21	50	3,909,690	10,711	369	8,526,907	1,723,926	3,998,220	92,695	140,351	2	441
1984	42	28	70	5,165,427	14,152	337	13,692,334	1,830,477	5,828,697	636,738	777,089	11	354
1985	55	37	92	6,354,473	17,410	317	20,046,807	2,698,056	8,526,753	9,346,542	10,123,631	60	425
1986	56	53	109	7,040,164	19,288	344	27,086,971	2,444,898	10,971,651	10,580,933	20,704,564	60	347
1987	61	61	122	6,649,808	18,219	299	33,736,779	1,807,400	12,779,051	11,053,585	31,758,149	62	272
1988	60	62	122	5,999,643	16,437	274	39,736,422	1,308,617	14,087,668	12,657,210	44,415,359	68	218
1989	73	49	122	5,626,055	15,414	211	45,362,477	1,451,362	15,539,030	12,111,416	56,526,775	68	258
1990	72	51	123	5,307,730	14,542	202	50,670,207	1,739,146	17,278,176	8,403,346	64,930,121	61	328
1991	72	53	125	4,581,156	12,551	174	55,251,363	1,499,285	18,777,461	9,481,627	74,411,748	67	327

Appendix B - CARPINTERIA OFFSHORE FIELD (FEDERAL PORTION)

SUMMARY

Carpinteria Offshore Field is located in the eastern Santa Barbara Basin, about four miles south of Carpinteria, California. The field covers parts of Federal Leases OCS-P 0166 and 0240 and extends into State Leases PRC 3133 and 3150. Five platforms have been installed in Federal and State waters to develop the field. The water depth under the platforms on the Federal leases averages 163 feet.

The Federal portion of Carpinteria Offshore Field began producing in June 1968, about two years after production began in the State portion of the field. Almost 120 development wells and redrills have been drilled from the three Federal platforms to date. No wells were completed during 1991. Production is from sandstones of Pliocene age.

During 1991 the Federal portion of the field produced 1,098,928 bbl of oil and 2,117,939 Mcf of gas. Produced oil was approximately 24° API gravity. Cumulative production as of December 1991 totaled 56.8 MMbbl oil and 48.0 Bcf of gas. Remaining oil and gas reserves are estimated to be 3.1 MMbbl and 5.5 Bcf, respectively.

GEOLOGY

Carpinteria Offshore Field is located on the east-west oriented Rincon Trend, in the eastern Santa Barbara Basin. The discovery of Carpinteria Offshore Field can be directly related to the projection of this structural trend from producing onshore fields into State and Federal waters. The field is trapped within a easterly plunging anticline, and is divided into two major fault blocks by a major thrust fault that roughly parallels the anticlinal axis. Smaller normal and reverse faults also occur within the field (figures B-1 and B-2).

The oldest strata penetrated in the Federal portion of Carpinteria Offshore Field are the marine sedimentary rocks of the Miocene Monterey Formation. This formation consists of cherts, carbonates, sandstones, and shales. The marine claystones, siltstones, mudstones, and sandstones of the Miocene "Santa Margarita" (more properly, Sisquoc) Formation were deposited directly above the Monterey Formation. Above the Miocene sedimentary rocks is the Pliocene "Repetto" (lower Pico) Formation. This formation consists of interbedded deepwater clastics, and includes sandstones, siltstones, and mudstones. The sandstones were deposited by turbidity currents. A typical log from the field is shown in figure B-3.

Productive hydrocarbon reservoirs have been identified only in the "Repetto" Formation. The "Santa Margarita" and Monterey formations may have minor potential, as at nearby Dos Cuadras Field. A summary of producing reservoir characteristics is shown in tables B-1 and B-2.

EXPLORATION AND DEVELOPMENT

Numerous coreholes were drilled in the vicinity of Carpinteria Offshore Field between 1958 and 1966. These stratigraphic tests were allowed under joint Federal and State operating permits. Data

from some of the coreholes confirmed the presence of hydrocarbons and potential reservoirs in the area.

The "Sacs 3150" 1 well is considered to be the Carpinteria Offshore Field discovery well. The well was drilled in 1965 by Standard Oil Company of California from Platform Hope in State Lease PRC 3150. Initial flow rates exceeded 250 bpd of 26° API gravity oil. Following the discovery of the field in State tidelands, a drainage sale was held to lease the adjoining Federal acreage. In OCS Sale P3 in December 1966, Continental Oil Company, Cities Service Oil Company, and Phillips Petroleum Company acquired Lease OCS-P 0166. The winning bid was $21,189,000, or $10,618 per acre. At the time, the bonus bid was the highest ever received on a per acre basis for a Federal offshore lease.

In January 1967, Phillips was designated operator of Lease OCS-P 0166. Six expendable wells were drilled on the lease between February and September, five from the *Wodeco I* drillbarge and one from the *George F. Ferris* jackup. Platform Hogan was installed on Lease OCS-P 0166 in September 1967, in 154 feet of water. Development drilling from the 66-slot platform began the following year.

During OCS Sale P4 in February 1968, a bidding group consisting of The Superior Oil Company, Sunray DX Oil Company, Marathon Oil Company, and Sun Oil Company obtained Lease OCS-P 0240 with a high bid of $38,380,032. Sunray was designated lease operator. Twelve exploratory and delineation wells and redrills were drilled on the lease over the next nine years, targeting both the western end of Carpinteria Offshore Field and the eastern end of Dos Cuadras Field.

The second platform on the Federal portion of the field was installed in July 1968. Platform Houchin was set to the west of the first platform, in 163 feet of water. Drilling from the 60-slot platform began in January 1969, two days after the blowout at nearby Dos Cuadras Field. The blowout delayed the installation of 24-slot Platform Henry until August 1979. The platform was installed in 173 feet of water on Lease OCS-P 0240. The first well was spudded from Platform Henry in February 1980.

In February 1991, Signal Hill Service, Inc. became the sole interest holder in Lease OCS-P 0166 and designated Pacific Operators, Inc. as the lease operator. The same month, Union Oil Company of California acquired interests in Lease OCS-P 0240 held by Oryx Energy Company (formerly Sun Oil Company and Sunray DX Oil Company), and was designated lease operator.

To date, 118 wells and redrills have been drilled from the three platforms on Leases OCS-P 0166 and 0240. Development wells employ gravel-packed completions. Gas lift, rod pumps, and electric submersible pumps are used for artificial lift.

No wells were completed during 1991, although there were three workovers. Two workovers involved conversions from gas lift to rod pump, and one was an acid stimulation. Produced gas has been reinjected since 1985, but has failed to maintain reservoir pressure or improve oil recovery. Reservoir pressure has declined approximately 78 percent from its initial value. The lease operators are currently evaluating behind-pipe reserves and waterflood potential, which could extend the productive life of the field.

PRODUCTION AND RESERVES

Production from the Federal portion of Carpinteria Offshore Field began in June 1968, from Platform Hogan in Lease OCS-P 0166. All production has been from "Repetto" Formation reservoirs. Produced oil is piped onshore for processing at Chevron's Carpinteria, Mobil's Rincon, and Phillips' La Conchita facilities.

In August 1969 the daily average oil production from the Federal portion of the field reached a maximum of 27,899 bpd from 52 wells on two platforms. Associated gas production peaked two months later at 21,758 Mcfpd. The startup of production from Platform Henry in May 1980 had no long-term effect on declining production rates. The average yearly decline in oil production from 1985 through 1991 was 11 percent. Oil and gas production data for Carpinteria Offshore Field are shown in figure B-4.

Volumetric and decline-curve analyses have been used to calculate recoverable hydrocarbon reserves for Carpinteria Offshore Field. Original recoverable oil and gas reserves in the Federal portion of the field are estimated to have been 59.9 MMbbl and 53.6 Bcf, respectively. Cumulative production reached 56.8 MMbbl and 48.0 Bcf in December 1991 (table B-3), with remaining reserves for the field estimated to be 3.1 MMbbl of oil and 5.5 Bcf of gas.

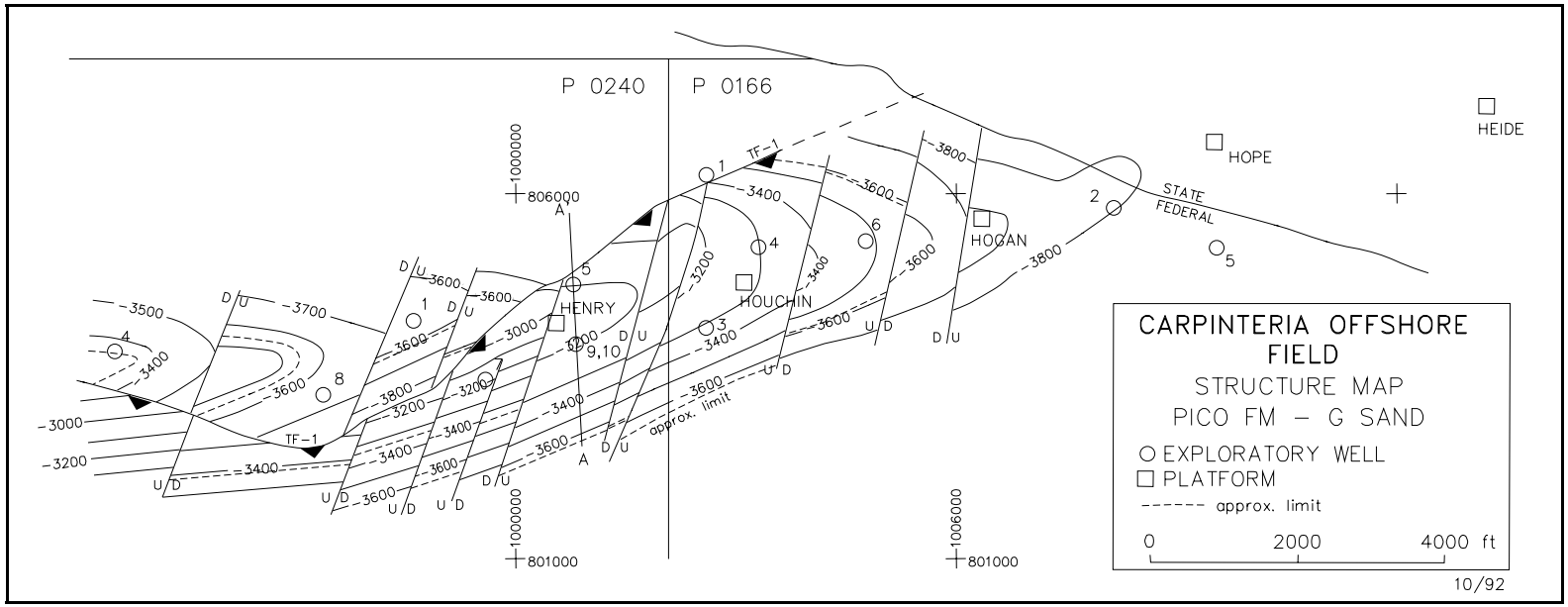

Figure B-1. Structure map of Carpinteria Offshore Field.

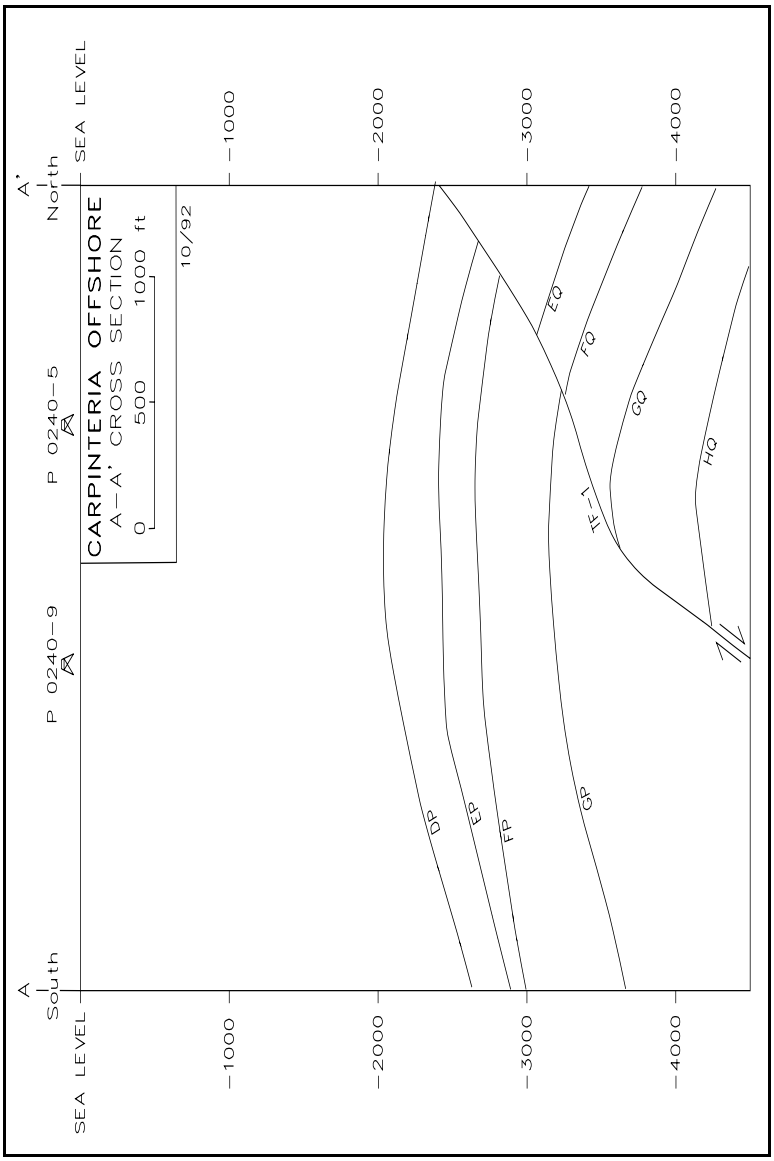

Figure B-2. Cross section through Carpinteria Offshore Field.

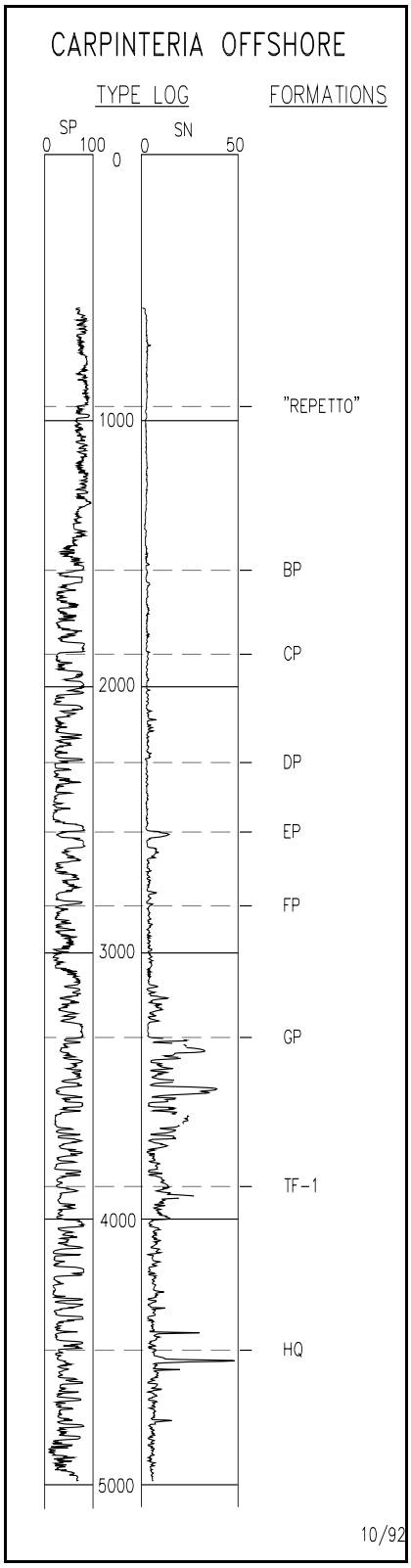

Figure B-3. Carpinteria Offshore Field type log.

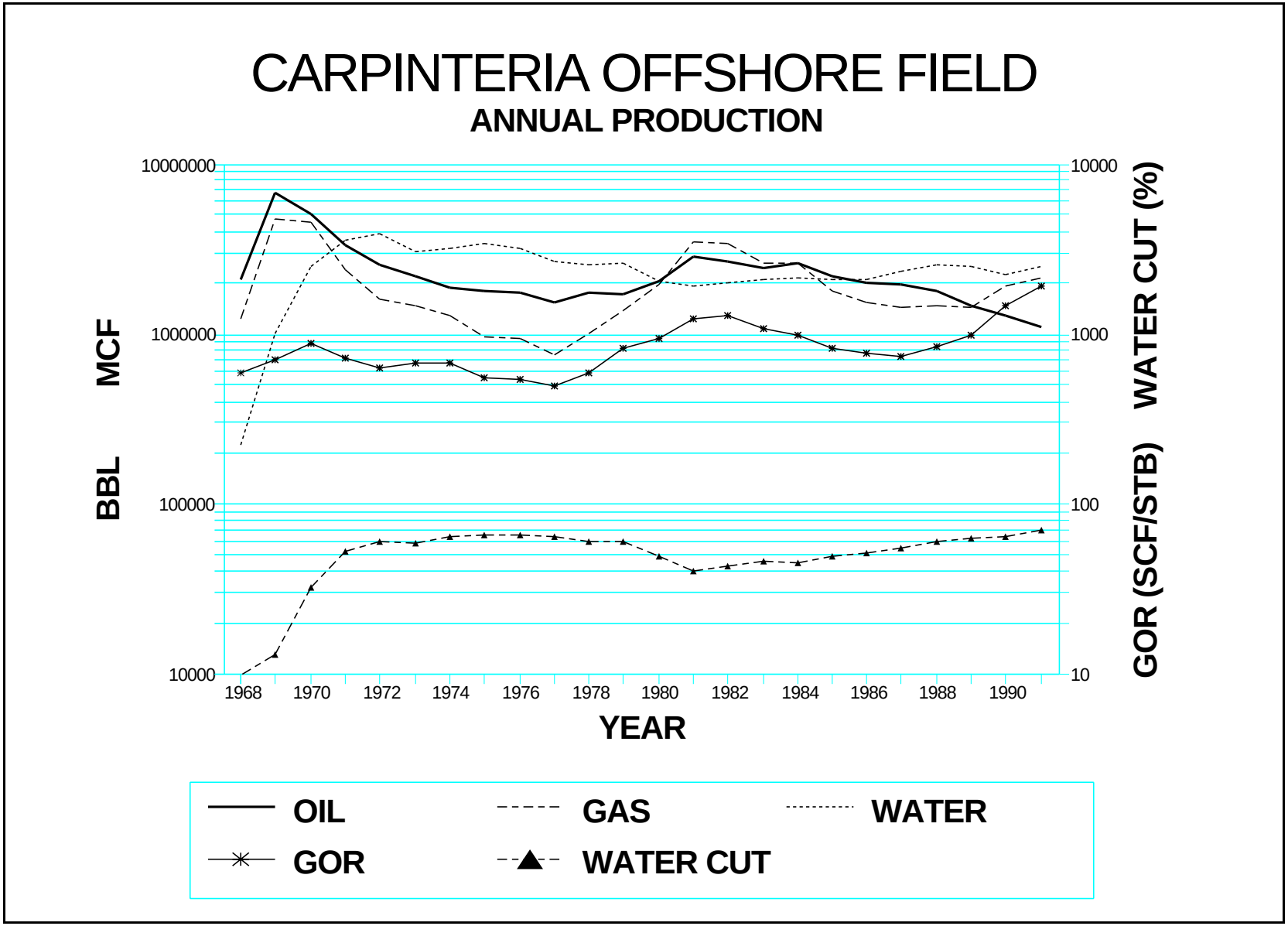

Figure B-4. Annual production from Carpinteria Offshore Field.

Table B-1. Carpinteria Offshore Field reservoir characteristics.

Carpinteria Offshore Field	
Repetto Reservoir Characteristics	
Average Depth	3,300 feet
Porosity	15-39 %
Permeability	1-2,200 md
Reservoir Temperature	125^{o} F
Original Reservoir Pressure	1,510 psig
Connate Water Saturation	31-37%
Gross Sand Stratigraphic Thickness	1,760 feet
Net Sand Thickness	1,000-1,150 feet
Productive Area	350 acres
Gas Specific Gravity	0.69

Table B-2. Carpinteria Offshore Field fluid characteristics.

Carpinteria Offshore Field	
Repetto Reservoir Fluid Characteristics	
Average Oil Gravity	25.5^{o} API
Saturation Pressure	1,250 psig
Viscosity	3.5-7.0 cp
Initial Producing GOR	418 SCF/STB
Initial Oil Formation Volume Factor	1.150 RB/STB

Table B-3. Carpinteria Offshore Field production.

Field: CARPINTERIA OFFSHORE

Year	Wells at Year End			Oil Production				Gas Production		Water Production			GOR
	Prod	Other	Total	Barrels	bpd	bpd/ Well	Cumulative Barrels	Mcf	Cumulative Mcf	Barrels	Cumulative Barrels	% Cut	CFB
1968	22	2	24	2,076,160	7,577	344	2,076,160	1,237,180	1,237,180	223,710	223,710	10	596
1969	50	11	61	6,777,575	18,569	371	8,853,735	4,749,410	5,986,590	1,001,128	1,224,838	13	701
1970	56	5	61	5,150,584	14,111	252	14,004,319	4,560,809	10,547,399	2,466,343	3,691,181	32	885
1971	52	9	61	3,350,709	9,180	177	17,355,028	2,369,370	12,916,769	3,568,159	7,259,340	52	707
1972	48	13	61	2,561,740	7,018	146	19,916,768	1,601,050	14,517,819	3,846,057	11,105,397	60	625
1973	50	11	61	2,189,447	5,998	120	22,106,215	1,473,994	15,991,813	3,039,889	14,145,286	58	673
1974	43	18	61	1,871,072	5,126	119	23,977,287	1,274,487	17,266,300	3,191,954	17,337,240	63	681
1975	49	12	61	1,761,459	4,826	98	25,738,746	962,700	18,229,000	3,390,346	20,727,586	66	547
1976	44	17	61	1,730,742	4,742	108	27,469,488	927,578	19,156,578	3,215,611	23,943,197	65	536
1977	44	20	64	1,515,153	4,151	94	28,984,641	753,030	19,909,608	2,633,962	26,577,159	63	497
1978	50	21	71	1,731,326	4,743	95	30,715,967	1,006,202	20,915,810	2,554,969	29,132,128	60	581
1979	53	25	78	1,701,918	4,663	88	32,417,885	1,382,941	22,298,751	2,599,424	31,731,552	60	813
1980	57	37	94	2,053,230	5,625	99	34,471,115	1,946,976	24,245,727	2,011,244	33,742,796	49	948
1981	71	35	106	2,882,311	7,897	111	37,353,426	3,516,878	27,762,605	1,897,066	35,639,862	40	1,220
1982	70	40	110	2,680,681	7,344	105	40,034,107	3,386,187	31,148,792	2,002,677	37,642,539	43	1,263
1983	69	41	110	2,406,911	6,594	96	42,441,018	2,573,115	33,721,907	2,100,231	39,742,770	47	1,069
1984	67	43	110	2,592,472	7,103	106	45,033,490	2,590,665	36,312,572	2,124,177	41,866,947	45	999
1985	67	43	110	2,201,984	6,033	90	47,235,474	1,804,769	38,117,341	2,089,768	43,956,715	49	820
1986	64	46	110	1,983,683	5,435	85	49,219,157	1,524,822	39,642,163	2,097,473	46,054,188	51	769
1987	65	45	110	1,948,965	5,340	82	51,168,122	1,433,077	41,075,240	2,334,025	48,388,213	54	735
1988	65	45	110	1,765,259	4,836	74	52,933,381	1,484,487	42,559,727	2,548,498	50,936,711	59	841
1989	62	48	110	1,470,411	4,029	65	54,403,792	1,432,217	43,991,944	2,490,650	53,427,361	63	974
1990	60	50	110	1,288,980	3,531	59	55,692,772	1,911,822	45,903,766	2,223,675	55,651,036	63	1,483
1991	51	59	110	1,098,928	3,011	59	56,791,700	2,117,939	48,021,705	2,499,669	58,150,705	69	1,927

Appendix C - DOS CUADRAS FIELD

SUMMARY

Dos Cuadras Field is located in the eastern Santa Barbara Basin, approximately six miles southwest of Carpinteria, California. Four platforms have been installed to develop the field, which extends over Leases OCS-P 0240 and 0241. The water depth under the platforms averages 190 feet.

Dos Cuadras Field began producing oil and gas in March 1969. Water injection within the field began in 1971, and a polymer flood was active in Lease OCS-P 0241 from 1986 through 1990. Over 200 development wells and redrills have been drilled to date. Three of the four wells completed during 1991 featured horizontal completions. Reservoirs of Miocene and Pliocene age have contributed to production.

Oil and gas production during 1991 totaled 3,126,274 bbl and 2,358,087 Mcf, respectively. Produced oil averaged 26° API gravity. Cumulative production as of December 1991 reached 223.0 MMbbl oil and 108.0 Bcf gas. Current estimates of remaining oil and gas reserves are 20.8 MMbbl and 11.8 Bcf, respectively.

GEOLOGY

Dos Cuadras Field is located on the Rincon Trend, a major east-west oriented structural feature in the eastern Santa Barbara Basin. A number of producing fields, including Carpinteria Offshore Field, were discovered along this trend prior to the leasing and discovery of Dos Cuadras Field. The anticline containing the field is divided into two major fault blocks by a major thrust fault, which roughly parallels the axis of the anticline. Smaller normal faults trending northeast-southwest also exist within the field (figures C-1 and C-2).

The oldest strata penetrated in Dos Cuadras Field are the cherts, carbonates, and siliceous, diatomaceous, and phosphatic shales of the Monterey Formation. These sediments are of marine origin and were deposited during the middle to late Miocene. Younger Miocene rocks in the area include the deep marine claystones, siltstones, diatomaceous mudstones, and fine-grained sandstones of the "Santa Margarita" (more properly, Sisquoc) Formation.

Above the Miocene sedimentary rocks are the marine clastics of the Pliocene "Repetto" (lower Pico) Formation. This formation consists of interbedded deep-water mudstones, siltstones, and sandstones. The sandstones are considered to be turbidity current deposits. A typical log from Dos Cuadras Field is displayed in figure C-3.

Productive hydrocarbon reservoirs have been identified in the "Repetto" and "Santa Margarita" formations. The sands in the "Repetto" Formation form the principal reservoirs in the field. There may be some potential for hydrocarbon production from the Monterey Formation. A summary of reservoir characteristics is presented in tables C-1 and C-2.

EXPLORATION AND DEVELOPMENT

From 1957 to 1965, a number of coreholes were drilled under joint Federal and State

operating permits in the vicinity of Dos Cuadras Field. The coreholes were drilled to obtain stratigraphic information, and confirmed the presence of hydrocarbons and reservoirs in the area.

Dos Cuadras Field lies within two blocks that were leased during OCS Sale P4, in February 1968. A bidding group consisting of The Superior Oil Company, Sunray DX Oil Company, Marathon Oil Company, and Sun Oil Company obtained Lease OCS-P 0240 with a high bid of $38,380,032. Gulf Oil Corporation, Mobil Oil Corporation, Texaco Inc., and Union Oil Company of California acquired equal interests in adjacent Lease OCS-P 0241 with a bonus bid of $61,418,000.

Union spudded the Dos Cuadras Field discovery well in March 1968. The OCS-P 0241 No. 2 well was drilled from the *Wodeco I* drillbarge in 188 feet of water. Drill stem tests of sands in the "Repetto" Formation flowed oil and gas at rates of approximately 2100 bpd and 300 Mcfpd, respectively. Later the same year, Sunray spudded the first well on neighboring Lease OCS-P 0240. A total of 17 exploratory and delineation wells and redrills have been drilled on the two leases to date.

Union installed the first platform in Dos Cuadras Field, 57-slot Platform A, in September 1968. The installation of 63-slot Platform B followed in November of the same year. Both platforms are located in Lease OCS-P 0241 in approximately 190 feet of water.

The first Dos Cuadras Field development well was spudded from Platform A in November 1968. In January 1969 the fifth well drilled from the platform blew out. Over a period of 12 days, reservoir fluids escaped up the borehole to near surface rocks, and then through fractures to the seafloor. The blowout was killed in February 1969.

Sun set Platform Hillhouse on neighboring Lease OCS-P 0240 in November 1969. The 60-slot platform was placed in approximately 190 feet of water. As a result of the blowout at Platform A, the installation of Union's 60-slot Platform C was delayed until February 1977. The platform was eventually set in 192 feet of water, near the west end of the field in Lease OCS-P 0241.

A total of 215 wells and redrills has been drilled from the four platforms; 22 of these wells employed dual completions. Although most wells completed to date have employed gravel-packed completions, slotted and prepacked liners have seen increasing use. Artificial lift is provided by gas lift and electric submersible pumps, both of which are being replaced by progressive cavity pumps.

A peripheral waterflood was initiated at the field in January 1985 in response to a 45 percent drop in reservoir pressure. Water injection rates peaked in July 1985 at 25,770 bpd. A polymer flood of selected reservoirs in Lease OCS-P 0241 began in early 1986. Although polymer injection systems were installed on all three platforms on the lease, the tertiary recovery effort was abandoned in August 1990.

In February 1991, Union Oil Company of California acquired a major interest in Lease OCS-P 0240. As a result, Union has become the designated operator of both leases containing Dos Cuadras Field. Four wells were completed during 1991, including three horizontal wells drilled from Platform C. Other work performed during the year included two workovers

and 90 pump changes.

PRODUCTION AND RESERVES

Production from Dos Cuadras Field began in March 1969. Only one well has produced from the "Santa Margarita" Formation, with almost all production coming from "Repetto" Formation reservoirs. Produced hydrocarbons from Dos Cuadras Field are piped onshore for processing at Mobil's Rincon facility.

In July 1970 the daily average oil production from the field reached a maximum of 80,878 bpd from 66 wells on three platforms. Associated gas production peaked a month later at 48,672 Mcfpd. The decline of oil and gas production since 1970 was only briefly alleviated by the startup of production from Platform C in August 1977. Oil and gas production data for Dos Cuadras Field are shown in figure C-4.

Volumetric and decline-curve analyses have been used to calculate recoverable hydrocarbon reserves for Dos Cuadras Field. Original recoverable oil and gas reserves are estimated to have been 243.8 MMbbl and 119.8 Bcf, respectively. Cumulative production climbed to 223.0 MMbbl and 108.0 Bcf in December 1991 (table C-3), with remaining reserves for the field estimated to be 20.8 MMbbl of oil and 11.8 Bcf of gas.

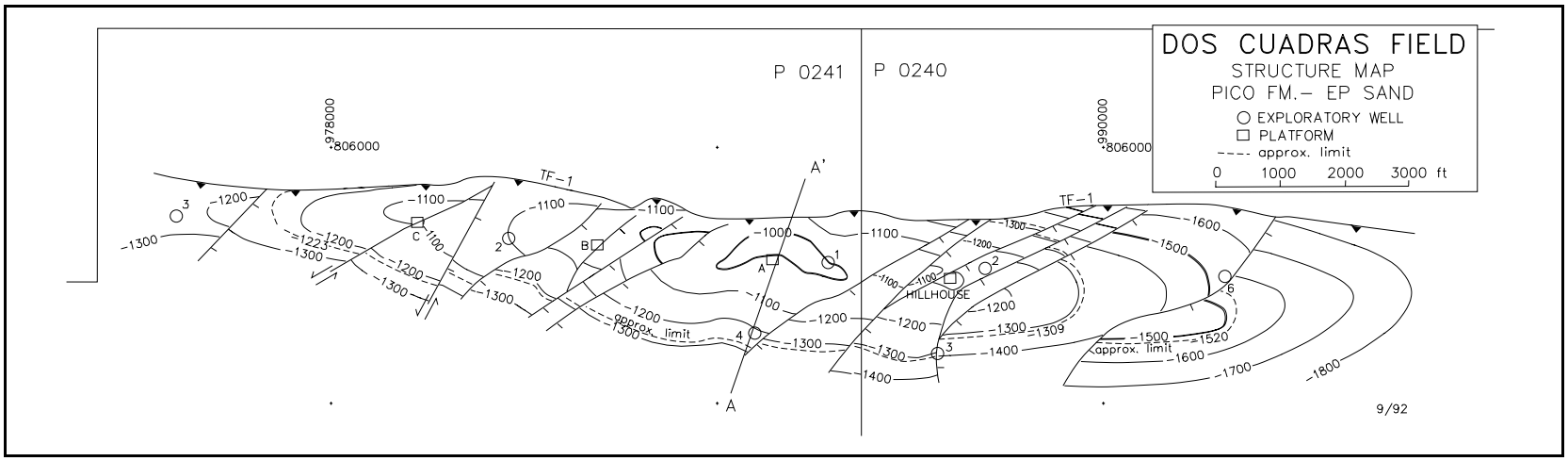

Figure C-1. Structure map of Dos Cuadras Field.

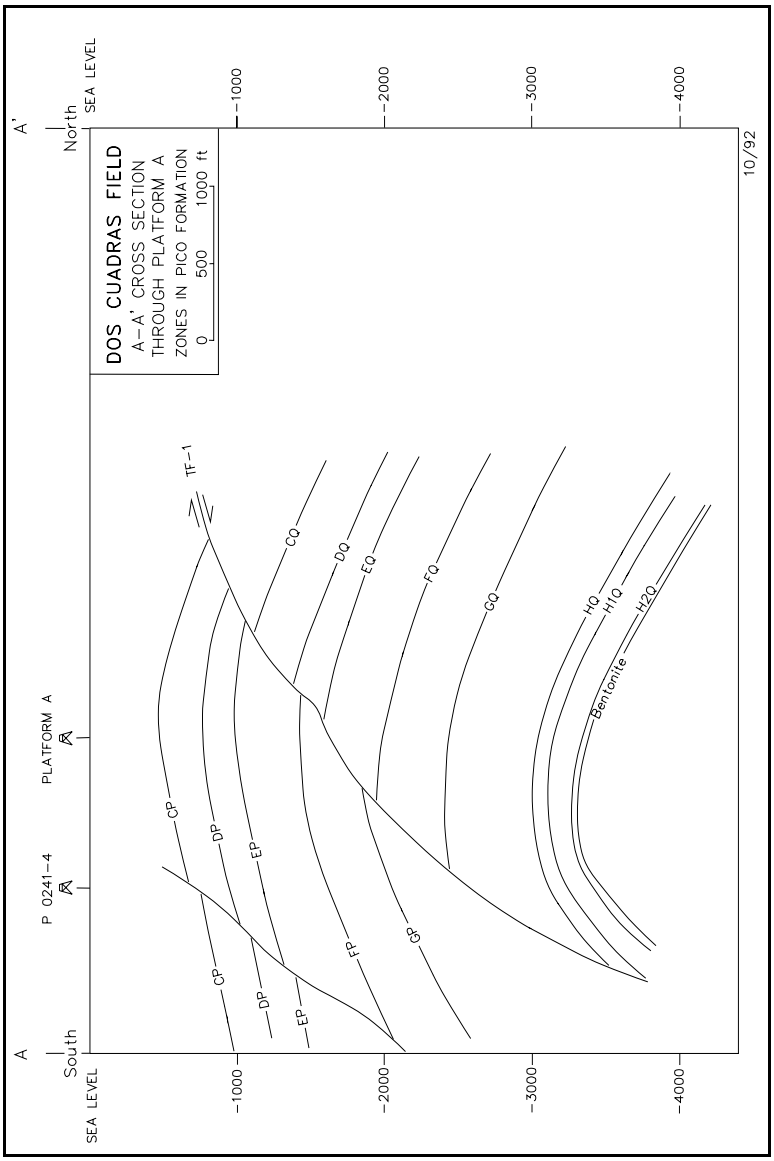

Figure C-2. Cross section through Dos Cuadras Field.

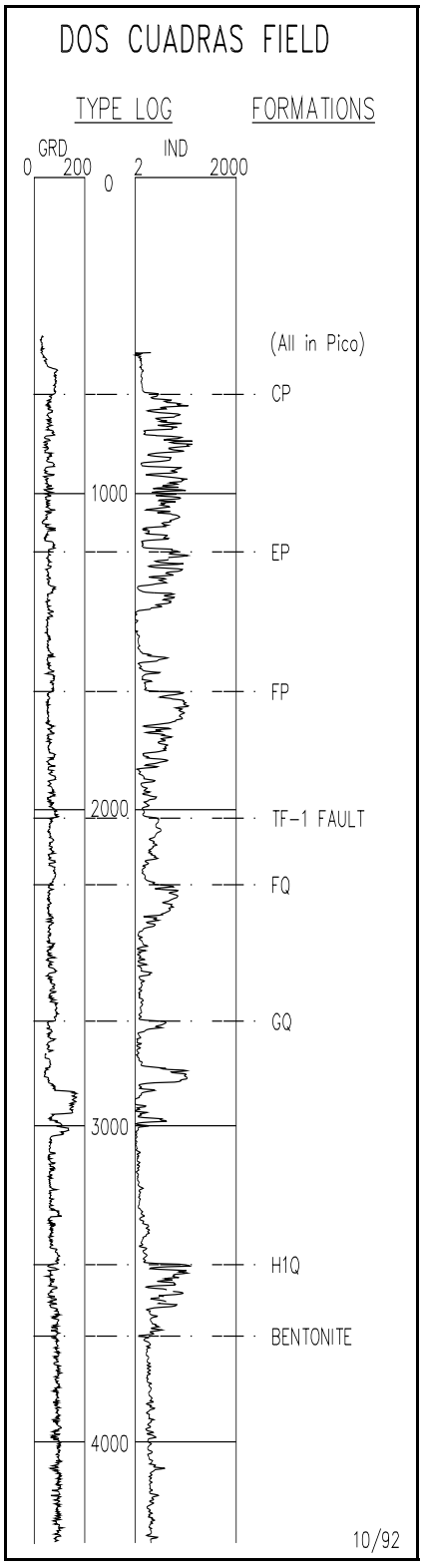

Figure C-3. Dos Cuadras Field type log.

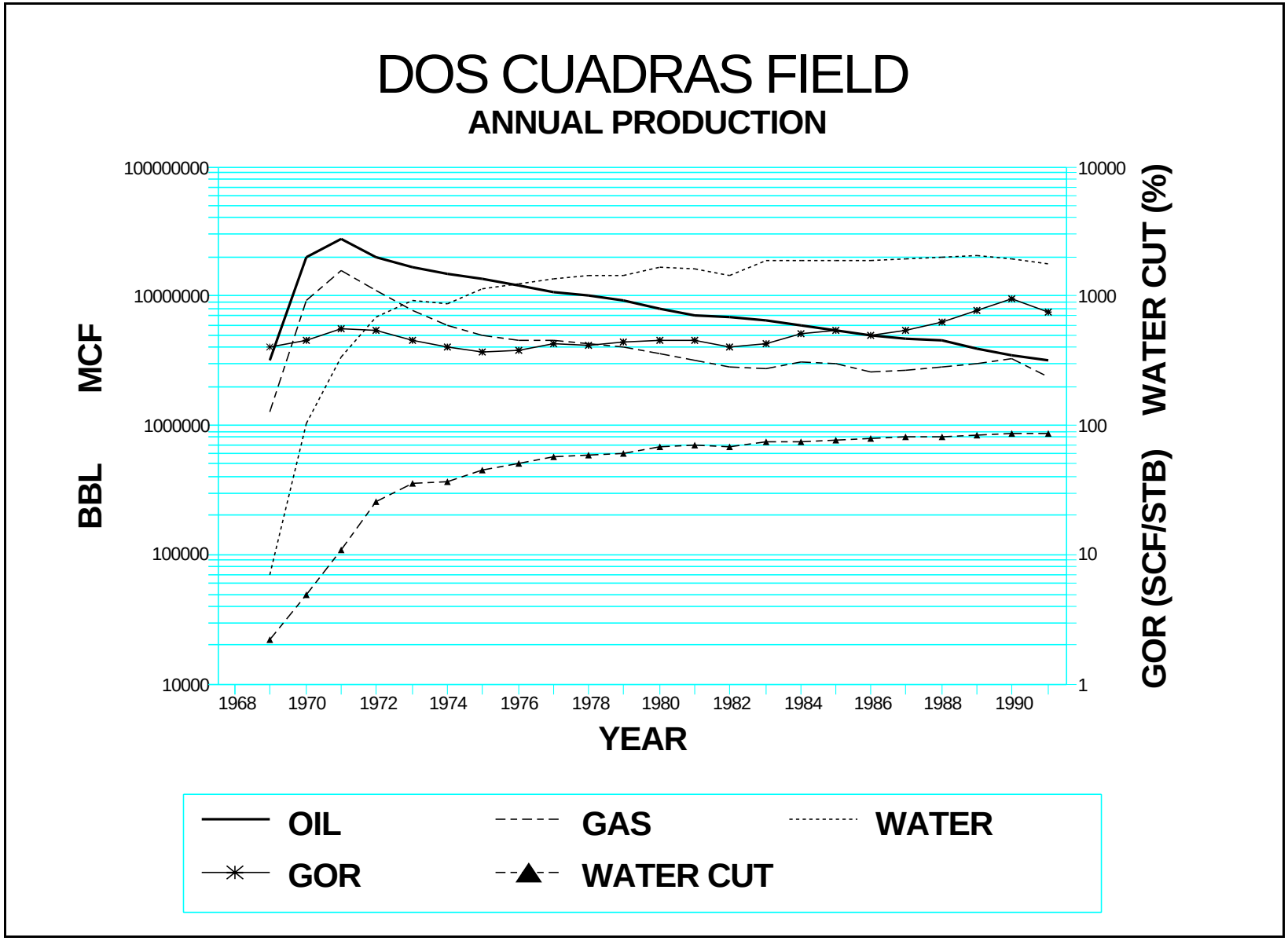

Figure C-4. Annual production from Dos Cuadras Field.

Table C-1. Dos Cuadras Field reservoir characteristics.

Dos Cuadras Field	
Repetto Reservoir Characteristics	
Average Depth	1,600 feet
Porosity	15-40 %
Permeability	50-1,000 md
Reservoir Temperature	101° F
Original Reservoir Pressure	750 psig
Connate Water Saturation	19-30 %
Gross Sand Stratigraphic Thickness	1,980 feet
Net Sand Thickness	100-1,048 feet
Productive Area	4,935 acres
Gas Specific Gravity	0.82

Table C-2. Dos Cuadras Field fluid characteristics.

Dos Cuadras Field	
Repetto Reservoir Fluid Characteristics	
Average Oil Gravity	25° API
Saturation Pressure	750 psig
Viscosity	12-26 cp
Initial Producing GOR	181 SCF/STB
Initial Oil Formation Volume Factor	1.07 RB/STB

Table C-3. Dos Cuadras Field production.

Field: DOS CUADRAS

Year	Wells at Year End			Oil Production				Gas Production		Water Production			GOR
	Prod	Other	Total	Barrels	bpd	bpd/ Well	Cumulative Barrels	Mcf	Cumulative Mcf	Barrels	Cumulative Barrels	% Cut	CFB
1968													
1969	30	5	35	3,165,158	13,025	434	3,165,158	1,267,075	1,267,075	70,988	70,988	2	400
1970	94	9	103	19,884,587	54,478	580	23,049,745	9,196,339	10,463,414	1,040,144	1,111,132	5	462
1971	126	5	131	27,752,972	76,036	603	50,802,717	15,483,685	25,947,099	3,347,117	4,458,249	11	558
1972	128	11	139	20,000,826	54,797	428	70,803,543	10,945,865	36,892,964	6,887,816	11,346,065	26	547
1973	122	22	143	16,628,579	45,558	373	87,432,122	7,683,720	44,576,684	9,127,444	20,473,509	35	462
1974	122	29	151	14,913,028	40,858	335	102,345,150	5,960,450	50,537,134	8,667,069	29,140,578	37	400
1975	124	35	159	13,673,048	37,460	302	116,018,198	5,016,259	55,553,393	11,240,594	40,381,172	45	367
1976	124	40	164	12,246,694	33,553	271	128,264,892	4,605,680	60,159,073	12,415,592	52,796,764	50	376
1977	144	44	188	10,742,860	29,432	204	139,007,752	4,613,151	64,772,224	13,523,775	66,320,539	56	429
1978	142	51	193	10,248,348	28,078	198	149,256,100	4,187,783	68,960,007	14,514,034	80,834,573	59	409
1979	146	54	200	9,269,095	25,395	174	158,525,195	4,047,748	73,007,755	14,145,647	94,980,220	60	437
1980	142	59	201	7,957,223	21,801	154	166,482,418	3,621,939	76,629,694	16,529,535	111,509,755	68	455
1981	142	60	202	7,018,865	19,230	135	173,501,283	3,142,232	79,771,926	16,172,994	127,682,749	70	448
1982	139	63	202	6,902,302	18,910	136	180,403,585	2,801,138	82,573,064	14,486,077	142,168,826	68	406
1983	139	65	204	6,356,346	17,415	125	186,759,931	2,680,409	85,253,473	18,276,832	160,445,658	74	422
1984	142	63	205	5,991,632	16,415	116	192,751,563	3,094,789	88,348,262	18,761,154	179,206,812	76	517
1985	142	63	205	5,483,142	15,022	106	198,234,705	2,920,032	91,268,294	18,449,120	197,655,932	77	533
1986	141	64	205	5,063,866	13,874	98	203,298,571	2,557,080	93,825,374	18,664,721	216,320,653	79	505
1987	142	64	206	4,744,370	12,998	92	208,042,941	2,617,391	96,442,765	19,254,912	235,575,565	80	552
1988	141	67	208	4,475,647	12,262	87	212,518,588	2,828,441	99,271,206	20,350,594	255,926,159	82	632
1989	136	72	208	3,893,869	10,668	78	216,412,457	3,043,822	102,315,028	20,613,713	276,539,872	84	782
1990	137	74	211	3,433,544	9,407	69	219,846,001	3,302,959	105,617,987	19,336,497	295,876,369	85	962
1991	135	79	214	3,126,274	8,565	63	222,972,275	2,358,087	107,976,074	17,610,369	313,486,738	85	754

Appendix D - HONDO FIELD

SUMMARY

Hondo Field is located in the western Santa Barbara Basin approximately eight miles southeast of Gaviota, California. The field covers parts of Leases OCS-P 0180, 0181, 0187, 0188, 0190, 0191, 0329 and 0461, all of which are in the Santa Ynez Unit. Water depths over the field range from less than 1,200 to approximately 1,600 feet, with 28-slot Platform Hondo set just north of the field in Lease OCS-P 0188 in 842 feet of water.

Oil and gas production from Hondo Field began in April 1981. A total of 37 development wells and redrills has been drilled to date. No wells were completed during 1991. Approximately 95 percent of produced oil is from fractured reservoirs in the Miocene Monterey Formation. Miocene and Oligocene sandstone reservoirs also contribute to production totals.

Platform Harmony is under construction in Lease OCS-P 0190 in 1,200 feet of water. The 60-slot platform is being installed to develop the western portion of the field. Development drilling from the new platform is expected to start in the third quarter of 1993, with production anticipated in early 1994.

Production during 1991 totaled 7,710,793 bbl of oil and 16,666,503 Mcf of gas. Produced oil averaged 21° API gravity. Cumulative production reached 114.7 MMbbl of oil and 170.4 Bcf of gas. Estimated remaining oil and gas reserves for the field are 135.3 MMbbl and 416.3 Bcf, respectively.

GEOLOGY

The geologic structures of the Hondo Field area exhibit the general east-west trend of the Transverse Ranges physiographic province. The anticline that provides structural closure for most of the field follows this trend, as do the two principal faults. One of the faults is a high-angle reverse fault with nearly 2,000 feet of vertical displacement. The other is apparently a scissors fault, with reverse motion to the west and normal motion to the east. These faults form part of a system defining the northern margin of the basin that contains the Santa Barbara Channel. Numerous smaller normal and reverse faults also occur within the field area (figures D-1 and D-2).

The oldest strata penetrated within Hondo Field are Eocene marine sedimentary rocks. This Eocene section begins with the Ulatisian to Narizian Matilija Formation, which consists primarily of neritic to bathyal sandstones and siltstones. The bathyal shales of the Narizian Cozy Dell Formation overlie the Matilija Formation. Above this shale unit are the upper bathyal sandstones of the Narizian Sacate Formation. The Sacate sandstones tend to be more porous and permeable than the Matilija sandstones.

The Gaviota Formation was deposited during the Refugian stage, which spans the Eocene-Oligocene boundary. This formation includes bathyal to neritic shales, siltstones, and sandstones. These sandstones are thin to massive and

somewhat better sorted than the older sands. Above the Gaviota Formation, sandstones and shales of the Oligocene Sespe and Alegria formations interfinger across the field. The Sespe Formation is nonmarine in origin and includes thin to thick sandstones interbedded with shales. This formation interfingers with the shallow marine sandstones of the Alegria Formation, which are generally better sorted and less lenticular. The Sespe Formation thins to the west, and only the Alegria Formation is present west of the field. The Eocene and Oligocene rocks at Hondo Field are analogous to rocks of the Great Valley Sequence in the San Joaquin Valley.

The basal transgressive Vaqueros Sandstone marks the onset of Neogene deposition in the Santa Barbara Basin. This shallow marine sand varies in thickness from 20 to 110 feet within the field and was deposited unconformably above the Sespe or Alegria Formation. Conformably overlying the Vaqueros Sandstone is the lower Miocene Rincon Formation, which consists of a deepening-upwards sequence of outer neritic to upper bathyal shales and sandstones. The sandstones are discontinuous and are limited to the upper two-thirds of the formation. A bentonite bed that has been arbitrarily picked as the top of the Rincon Formation may be the coeval with the Tranquillon Volcanics identified onshore.

Lying directly above the Rincon Formation is the middle to upper Miocene Monterey Formation. At Hondo Field this formation is informally subdivided into a lower sandstone/shale zone and an upper biogenic silica/carbonate zone. The lower zone contains lenticular, fine-grained sandstones deposited as deep sea fan sediments. That part of the lower zone that was deposited during the Relizian stage has lithologic and stratigraphic affinities to the Point Sal Formation of the Santa Maria Basin and to the upper Rincon Formation in other parts of the Santa Barbara Basin. The upper zone is a complex of fractured deep-water sedimentary rocks that include laminated chert, shale, siltstone, and carbonates.

The top of the Monterey Formation is gradational with the base of the late Miocene to early Pliocene Sisquoc Formation. The amount of biogenic silica decreases within the Sisquoc Formation, which contains more terrigenous material. Thin carbonates are also common in the formation. Younger Pliocene sediments are represented by the Pico and "Repetto" (lower Pico) formations, which consist of a shallowing upwards sequence of bathyal sandstones, siltstones, and mudstones. A type log for Hondo Field is shown in figure D-3.

Hydrocarbon reservoirs are apparently present throughout the stratigraphic section. Gas and oil reservoirs have been found in the Sacate Formation at nearby fields. The Gaviota, Sespe-Alegria, and Vaqueros formations are all currently producing light oil with associated gas. Well log data indicate some potential for oil and gas production from the Rincon Formation. Some tests of the lower Monterey sandstone/shale unit produced significant quantities of high gravity oil and gas. Fractured reservoirs within the upper Monterey formation have proven to be prolific producers of heavy oil. Gas caps have also formed within this zone and may extend into the Sisquoc Formation through

vertical fractures. Tests of the Pico Formation were unsuccessful, but some potential is indicated by mudlog shows and well log analysis. Reservoir characteristics are summarized in tables D-1 through D-4.

EXPLORATION AND DEVELOPMENT

Exploration for hydrocarbons in the vicinity of Hondo Field was prompted, at least in part, by the discovery of large oil and gas fields in nearby State tidelands. A stratigraphic coring program conducted under joint Federal and State operating permits provided additional data. At least 12 coreholes were drilled in the area prior to the first Federal lease sale in the western Santa Barbara Basin.

The eight blocks containing Hondo Field were leased during three OCS lease sales. Leases OCS-P 0180, 0181, 0187, 0188, 0190 and 0191 were all leased during OCS Sale P4, in February 1968. Lease OCS-P 0329 was leased eleven years later, in June 1979, in OCS Sale No. 48. The last of the eight blocks, Lease OCS-P 0461, was leased during OCS Sale No. 68 in June 1982. Exxon Corporation (formerly Humble Oil & Refining Company) is the sole interest holder in each of the leases except Lease OCS-P 0191, in which Chevron U.S.A. Inc. holds a minority interest. High bids for the leases totaled $91,389,447, with individual high bids ranging from $213,811 to $27,831,142.

The Hondo Field discovery well, OCS-P 0188 No. 2, was spudded in February 1969. The well was drilled from the *Bluewater II* semisubmersible in 1,005 feet of water. Drill stem tests of the Monterey and other formations produced oil and gas at combined rates of about 1,700 bpd and 1,200 Mcfpd. The Monterey Formation was tested successfully in 14 other expendable wells and redrills that were drilled on the Hondo Field leases. The last exploratory well was plugged and abandoned in February 1983.

The discoveries in the northwestern Santa Barbara Basin prompted the creation of the Santa Ynez Unit in November 1970. The unit initially contained 18 leases, including all of the Hondo Field leases acquired by Exxon during OCS Sale P4. Exxon was designated as unit operator. Since 1970, two additional leases overlying parts of the Hondo Field have been added to the Santa Ynez Unit.

Exxon installed Platform Hondo on Lease OCS-P 0188 in June 1976. The platform was located just north of Hondo Field in 842 feet of water, a world record water depth at the time. In September 1977 the first development well was directionally drilled from the 28-slot platform. Production was delayed until April 1981, when Exxon obtained approval for processing produced hydrocarbons aboard an Offshore Storage and Treating (OS&T) vessel.

To date, 37 development wells and redrills have been drilled to date, into four of the leases in the eastern portion of Hondo Field. Producing oil wells use perforated completions and are converted to gas lift as flow rates decline. Only one well has been completed as a producing gas well. Several of the wells have featured dual completions.

A waterflood pilot project was begun at Hondo Field in 1987 with the conversion of a single well to inject water into a fractured

Monterey Formation reservoir. Water injection rates peaked in February 1988 at an average of 9,952 bpd. The project has helped control the pressure decline within the affected reservoir. Some produced gas is also reinjected at Hondo Field.

No wells have been completed or recompleted at Hondo Field since 1990. Work completed during 1991 included tubing repairs and acid stimulations.

Additional perforations were also added to two wells producing from Monterey Formation reservoirs.

PRODUCTION AND RESERVES

Hondo Field went on production in April 1981. About 95 percent of the production to date has been approximately 17° API gravity oil from fractured Monterey Formation reservoirs. Sandstone reservoirs in the older Vaqueros, Sespe-Alegria, and Gaviota formations have produced approximately 31° API gravity oil. Produced oil averages 21° API gravity after blending of the two crudes.

Produced oil is processed on the OS&T, and then shipped by tanker to refineries. When production begins from Platform Harmony sometime in 1994, all oil from the field will move onshore by pipeline to Exxon's Las Flores Canyon facility.

Oil production from Platform Hondo peaked in August 1984, when 18 oil wells contributed to an average daily rate of 41,613 bpd. Gas production rates peaked in March 1989 with an average of 70,353 Mcfpd (figure D-4). Oil production has been declining since 1984 at an average rate of 8 percent per year.

Volumetric and decline-curve analyses were used to calculate recoverable hydrocarbon reserves for Hondo Field. Original recoverable reserves of oil and gas are estimated to have been 250 MMbbl and 586.7 Bcf, respectively. Cumulative production as of December 1991 reached 114.7 MMbbl of oil and 170.4 Bcf of gas (table D-5). Estimated remaining oil and gas reserves for the field are 135.3 MMbbl and 416.3 Bcf, respectively.

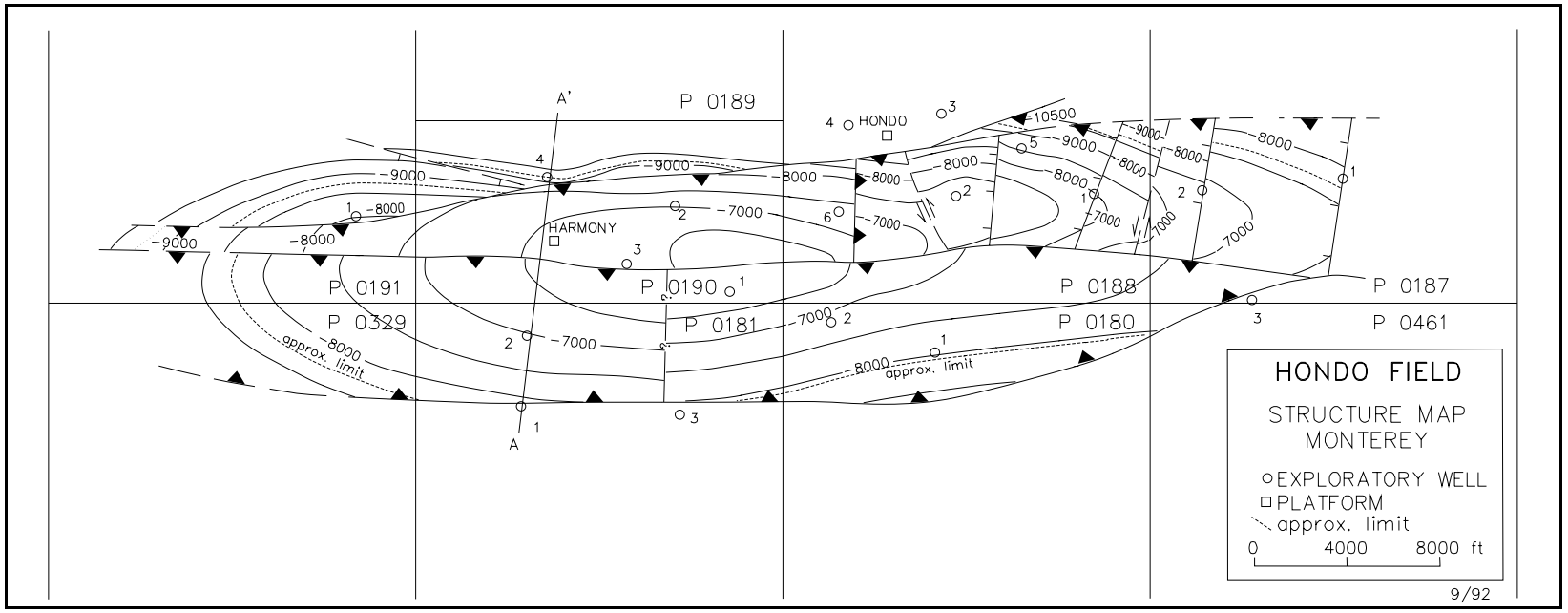

Figure D-1. Structure map of Hondo Field.

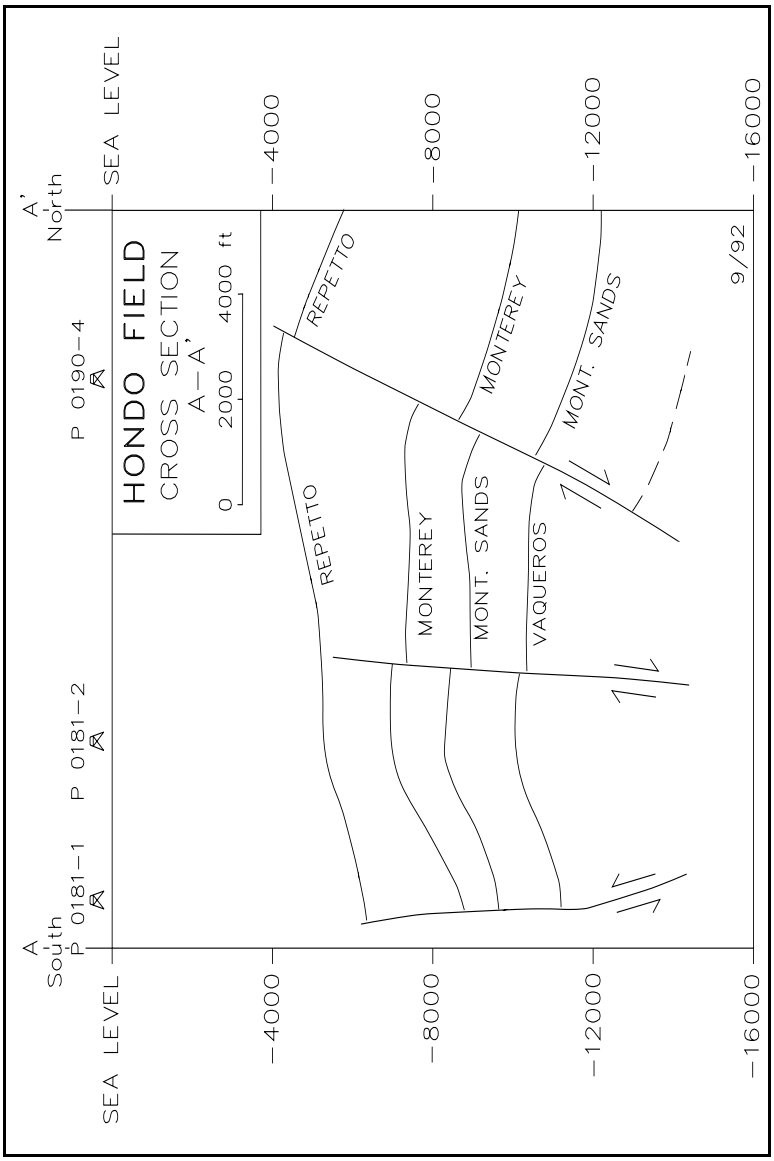

Figure D-2. Cross section through Hondo Field.

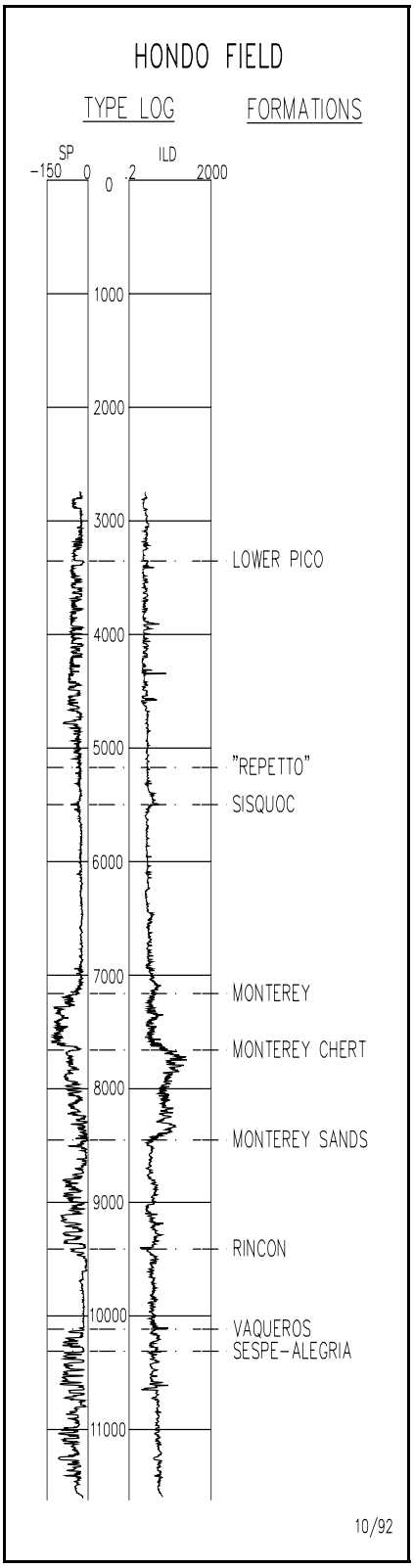

Figure D-3. Hondo Field type log.

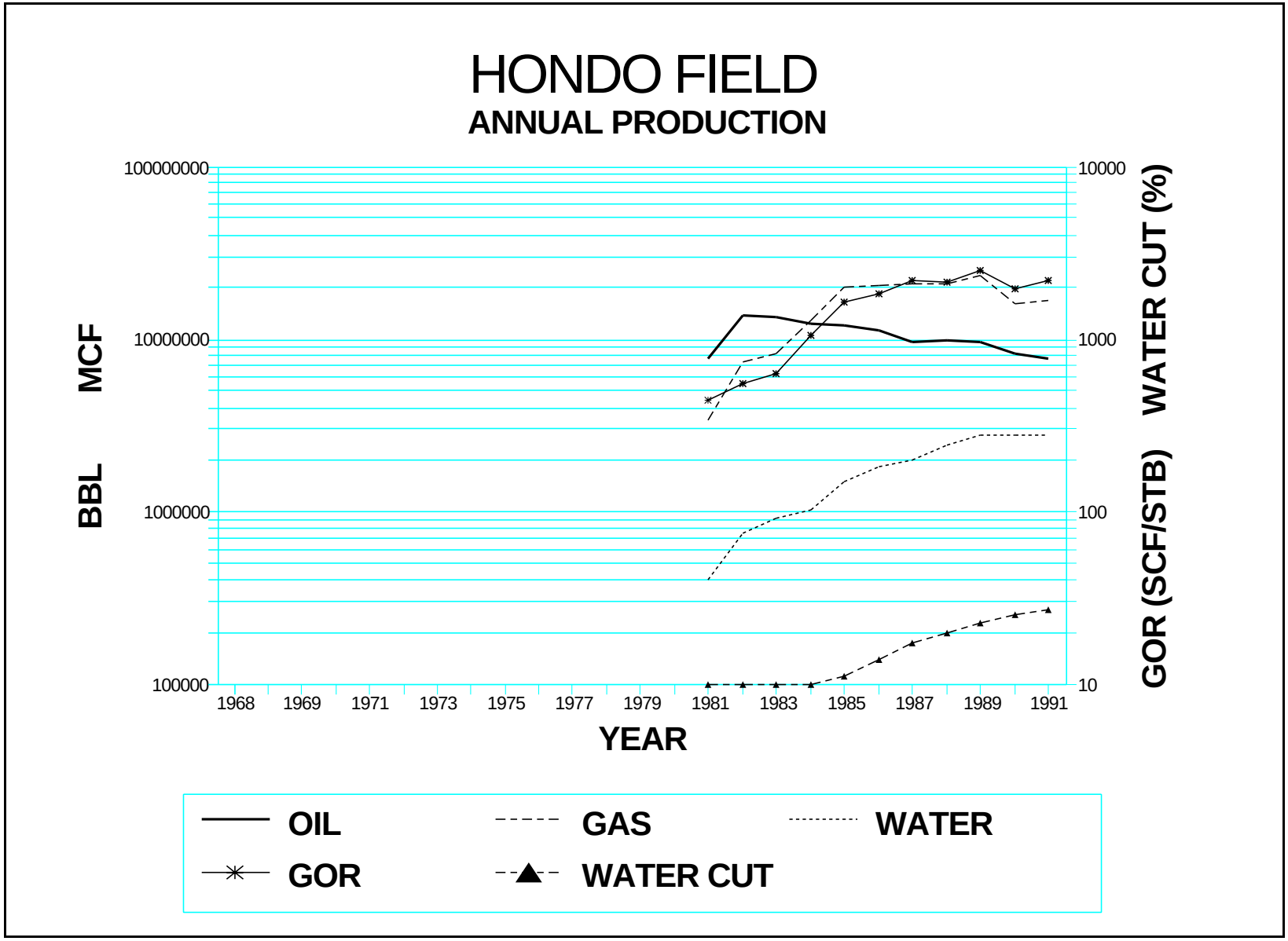

Figure D-4. Annual production from Hondo Field.

Table D-1. Hondo Field Monterey reservoir characteristics.

Hondo Field	
Monterey Reservoir Characteristics	
Average Depth	8,500 feet
Porosity	9-23 %
Permeability	0.1-1,700 md
Reservoir Temperature	215^{o} F
Original Reservoir Pressure	3,315 psig
Connate Water Saturation	10-55 %
Gross Pay Thickness	1,300 feet
Net Pay Thickness	33-730 feet
Productive Area	5,350 acres
Gas Specific Gravity	0.88

Table D-2. Hondo Field Monterey fluid characteristics.

Hondo Field	
Monterey Reservoir Fluid Characteristics	
Average Oil Gravity	17^{o} API
Saturation Pressure	2,500 psig
Viscosity	4.8 cp
Initial Producing GOR	400 SCF/STB
Initial Oil Formation Volume Factor	1.20 RB/STB

Table D-3. Hondo Field sandstone reservoir characteristics.

Hondo Field	
Vaqueros/Sespe Reservoir Characteristics	
Average Depth	10,000 feet
Porosity	10-35 %
Permeability	10-1,500 md
Reservoir Temperature	250° F
Original Reservoir Pressure	5,323 psig
Connate Water Saturation	15-50 %
Gross Sand Stratigraphic Thickness	455-730 feet
Net Sand Thickness	112-478 feet
Productive Area	500-600 acres
Gas Specific Gravity	0.73

Table D-4. Hondo Field sandstone fluid characteristics.

Hondo Field	
Vaqueros/Sespe Reservoir Fluid Characteristics	
Average Oil Gravity	35.1° API
Saturation Pressure	4,965 psig
Viscosity	0.17 cp
Initial Producing GOR	185 SCF/STB
Initial Oil Formation Volume Factor	2.11 RB/STB

Table D-5. Hondo Field production.

Field: HONDO

Year	Wells at Year End			Oil Production				Gas Production		Water Production			GOR
	Prod	Other	Total	Barrels	bpd	bpd/ Well	Cumulative Barrels	Mcf	Cumulative Mcf	Barrels	Cumulative Barrels	% Cut	CFB
1968													
1969													
1969													
1970													
1971													
1972													
1973													
1974													
1975													
1976													
1977													
1978													
1979													
1980													
1981	14	5	19	7,716,627	25,384	1,813	7,716,627	3,383,015	3,383,015	396,794	396,794	10	438
1982	16	8	24	13,485,307	36,946	2,309	21,201,934	7,345,181	10,728,196	745,908	1,142,702	10	545
1983	14	13	27	13,263,867	36,339	2,596	34,465,801	8,271,975	19,000,171	913,240	2,055,942	10	624
1984	21	7	28	12,248,595	33,558	1,598	46,714,396	12,970,639	31,970,810	1,023,815	3,079,757	10	1,059
1985	20	9	29	12,004,058	32,888	1,644	58,718,454	19,723,924	51,694,734	1,511,045	4,590,802	11	1,643
1986	22	8	30	11,100,854	30,413	1,382	69,819,308	20,405,357	72,100,091	1,794,380	6,385,182	14	1,838
1987	20	11	31	9,586,503	26,264	1,313	79,405,811	20,999,243	93,099,334	1,980,558	8,365,740	17	2,191
1988	22	12	34	9,889,837	27,095	1,232	89,295,648	21,034,222	114,133,556	2,413,714	10,779,454	20	2,127
1989	21	14	35	9,519,054	26,080	1,242	98,814,702	23,431,882	137,565,438	2,768,674	13,548,128	23	2,462
1990	22	14	36	8,211,684	22,498	1,023	107,026,386	16,142,530	153,707,968	2,762,785	16,310,913	25	1,966
1991	23	13	36	7,710,793	21,125	918	114,737,179	16,666,503	170,374,471	2,792,272	19,103,185	27	2,161

Appendix E - HUENEME FIELD

SUMMARY

Hueneme Field is located in the eastern Santa Barbara Basin, approximately four miles southwest of Port Hueneme, California. Most of the field is in Federal Leases OCS-P 0202 and 0203, although the field's eastern end apparently extends into State Lease PRC 3945. The Federal leases are included in the Point Hueneme Unit. Water depths in the area range from less than 100 to over 800 feet, with the single 15-slot platform set in 96 feet of water.

Oil and gas production from Hueneme Field began in February 1982. A peripheral waterflood was begun at about the same time. Fourteen development wells have been drilled to date but no wells have been drilled since 1988. Production is from heavy oil reservoirs in Oligocene and Miocene sands.

Oil and gas production for calendar year 1991 was 287,223 bbl and 176,272 Mcf, respectively. Produced oil averaged 14^{o} API gravity. In December 1991 cumulative production reached 7.6 MMbbl and 2.2 Bcf, with remaining reserves in the sandstone reservoirs estimated to be 4.1 MMbbl oil and 4.6 Bcf gas.

GEOLOGY

The geologic structural trend in the Hueneme Field area is northeast-southwest, in contrast to the general east-west trend of other major structures in the basin. The anticlinal feature containing the field may form part of an offshore extension of the Oxnard Trend. The anticline is bounded to the south by the Hueneme Fault, a major, high-angle reverse fault, and is broken by a series of smaller faults and shallow saddles (figures E-1 and E-2).

The strata penetrated in the Hueneme Field area range in age from Oligocene to Pliocene and consist primarily of marine sedimentary rocks. Nonmarine sediments formed the Oligocene Sespe Formation, which is comprised of interbedded sandstones, claystones, and shales. In the Hueneme Field area this formation is truncated by a basal Miocene unconformity.

The Miocene section includes the Hueneme Sand, which was deposited above the unconformity. This unit consists of relatively course-grained, well-sorted, massive sands that were deposited in a shallow marine environment. Conformably overlying the Hueneme Sand are the claystones, mudstones, siltstones, and sandstones of the Rincon(?) Formation ("Relizian Shale"). The middle to upper Miocene section is dominated by the Monterey Formation. The lithology of this formation is rather complex and includes laminated cherts, siltstones, phosphatic shales, and carbonates. The uppermost Miocene sediments in the area are the marine siltstones and diatomaceous shales, which have been informally assigned to the Sisquoc Formation.

Rocks younger than Miocene age are represented primarily by the Pliocene Pico and "Repetto" (lower Pico) formations. The "Repetto" Formation conformably overlies the Miocene Sisquoc Formation. The Pico and "Repetto" formations both include interbedded marine sandstones, claystones,

and siltstones. A type log for Hueneme Field is shown in figure E-3.

Hydrocarbon reservoirs are found in four distinct zones within the field. The sandstones of the upper Sespe Formation contain low gravity oil, as does the superjacent Hueneme Sand. Gas reservoirs have formed in fractured intervals of the Monterey Formation, apparently without associated oil. The Pico Formation also includes a massive tar-impregnated sandstone that appears analogous to the productive Vaca Sands at the nearby Oxnard Field. Reservoir characteristics are summarized in tables E-1 and E-2.

EXPLORATION AND DEVELOPMENT

Two deep coreholes were drilled in the vicinity of Hueneme Field in 1964 and 1965. One was drilled in the State tidelands, and the other was drilled in Federal waters under a joint Federal and State permit. These coreholes confirmed the presence of potential hydrocarbon reservoirs in the area.

The two blocks containing the bulk of Hueneme Field were leased during OCS Sale P4, in February 1968. Mobil Oil Corporation and Union Oil Company of California acquired equal interests in Leases OCS-P 0202 and 0203 for bonus bids of $1,012,000 and $5,567,000, respectively. Mobil was designated operator for both leases.

The Hueneme Field discovery well, OCS-P 0202 1A, was spudded in January 1969 from the *Wodeco I* drillbarge in 97 feet of water. Flow rates from this well approached 1,100 bpd of 15.8° API gravity oil from the Hueneme and Sespe reservoirs. Another test produced approximately 2,200 Mcfpd of gas from a fractured Monterey Formation reservoir. Mobil drilled eight more wells or redrills on the two Federal leases between 1969 and 1975. Initial development plans proposed completing a number of these wells as production or injection wells, but all nine were eventually plugged and abandoned.

Union later assumed Mobil's interest in the Federal leases, and installed Platform Gina in December 1980. The platform is located in 96 feet of water, just north of the surface location of the discovery well in Lease OCS-P 0202. A total of 12 water injection and production wells were drilled on this lease from the 15-slot platform between 1981 and 1983, establishing production from the Hueneme and Sespe oil reservoirs.

In late 1984 and early 1985, two wells were drilled from the semisubmersible *Diamond M. Falcon* operating in 812 feet of water. The second well, OCS-P 0203 No. 6, flowed 440 bpd of 15.6° API oil from the Sespe and Hueneme sands and over 5,800 Mcfpd of gas from the Monterey Formation. These wells proved the productive potential of the west end of the anticline in Lease OCS-P 0203.

The Point Hueneme Unit was established in February 1988 and includes Federal Leases OCS-P 0202, 0203, and 0479. Two additional wells have subsequently been drilled from Platform Gina, one of which established production from Lease OCS-P 0203. The western portion of the field in Lease OCS-P 0203 contains most of the field's remaining oil reserves. Up to three slots were also originally allocated to develop the eastern portion of the field, which extends into State waters. Economic considerations have apparently prevented the operator of State Lease PRC 3945 from initiating such development.

Fourteen wells and redrills have been drilled from Platform Gina to date. All production wells use gravel pack completions to commingle production from Hueneme and Sespe Formation sands. Two of the producing wells initially flowed oil at commercial rates, but all currently employ electric submersible pumps.

A reservoir pressure maintenance program using peripheral water injection wells was begun in January 1985, commencing with the second well drilled from Platform Gina. Five of the 14 development wells drilled to date are water injection wells. Water injection rates peaked in March 1990 at 8,413 bpd. Reservoir pressure has declined at an average rate of only 1.3 percent per year since the beginning of the waterflood.

No wells have been completed at Hueneme Field since 1988. In May 1991 Platform Gina was shut down following damage to the production pipeline. Repairs were completed in October, and the platform was returned to production. Plans are under way to install additional hydrogen sulfide treating equipment on the platform, and the operator is also evaluating a potential polymer flood of the field.

PRODUCTION AND RESERVES

Production from Hueneme Field began in February 1982 with the completion of Well OCS-P 0202 H-1 from Platform Gina. Reservoirs in the Sespe Formation and Hueneme Sand are currently producing. Produced hydrocarbons are piped onshore for processing at the operator's Mandalay Beach facility.

In March 1983 the daily average production peaked at 4,672 bpd of approximately 15° API gravity oil from six producing oil wells. Associated gas production reached a maximum of 38,150 Mcfpd in October 1983. Both oil and gas production have since declined significantly (figure E-4).

Hueneme Field may contain undeveloped commercial hydrocarbon reservoirs. Drill stem tests of the Miocene Monterey Formation have produced gas at rates approaching 6,000 Mcfpd. Production from this gas reservoir has not yet begun.

Recoverable hydrocarbon reserves for Hueneme Field have been calculated using volumetric and decline-curve analyses. Original recoverable oil and gas reserves are estimated to have been 11.6 MMbbl and 6.9 Bcf, respectively. Cumulative production reached 7.6 MMbbl and 2.2 Bcf in December 1991 (table E-3), with remaining reserves for the field estimated to be 4.1 MMbbl of oil and 4.6 Bcf of gas.

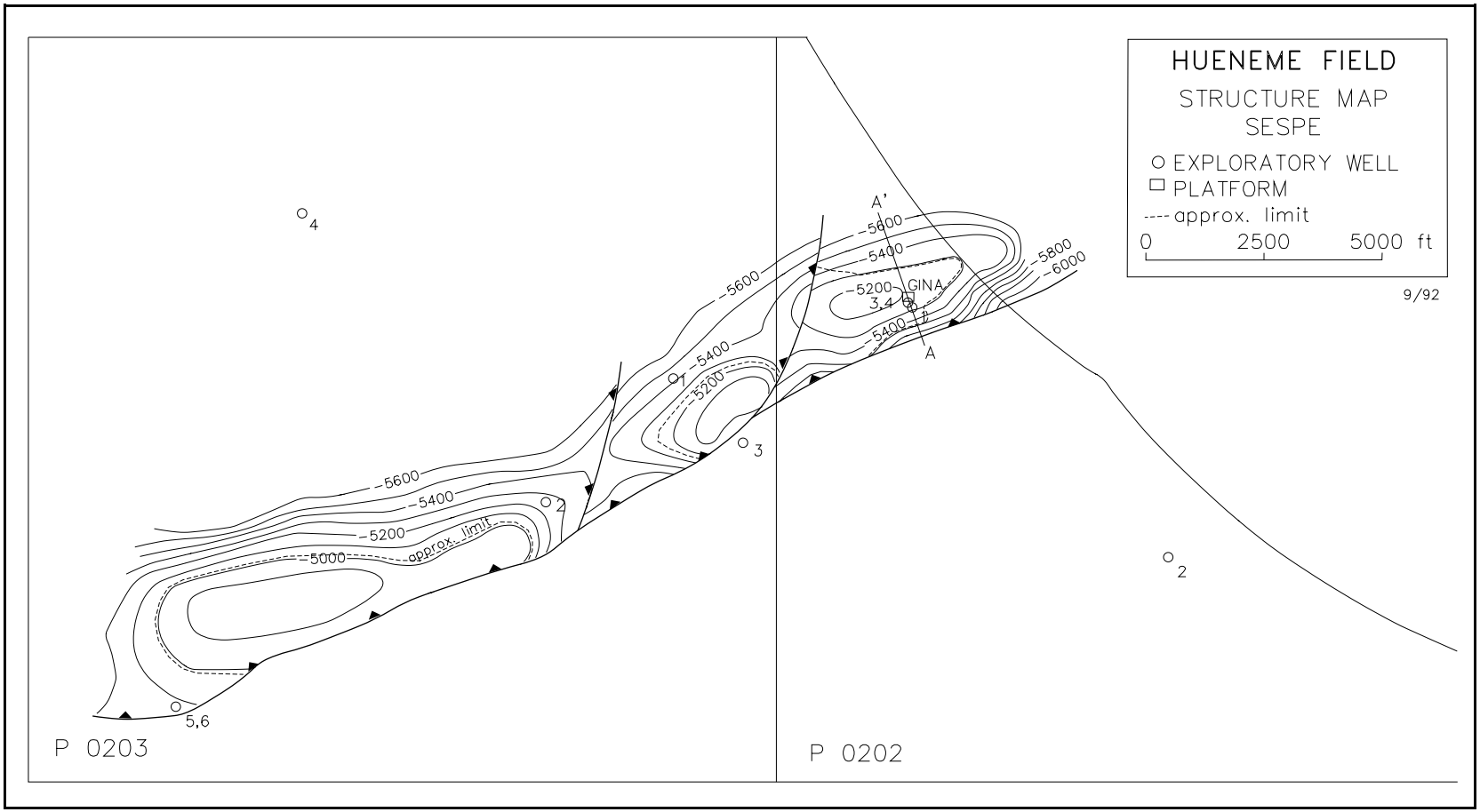

Figure E-1. Structure map of Hueneme Field.

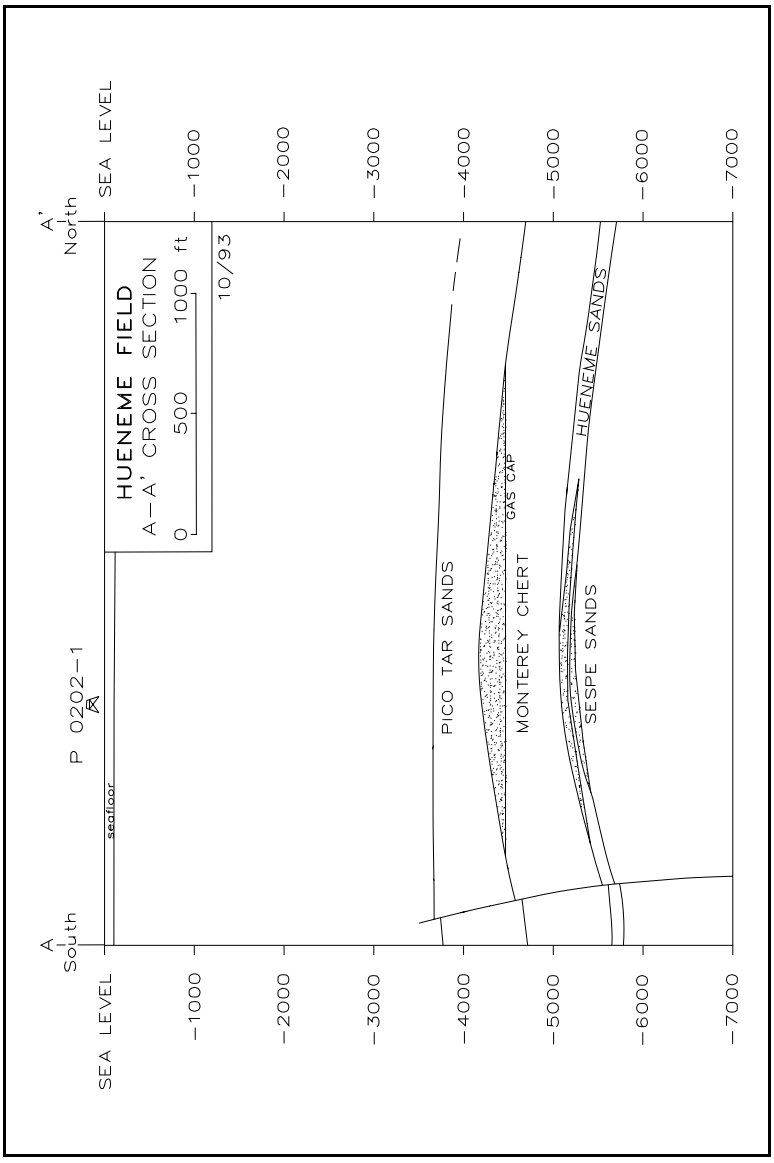

Figure E-2. Cross section through Hueneme Field.

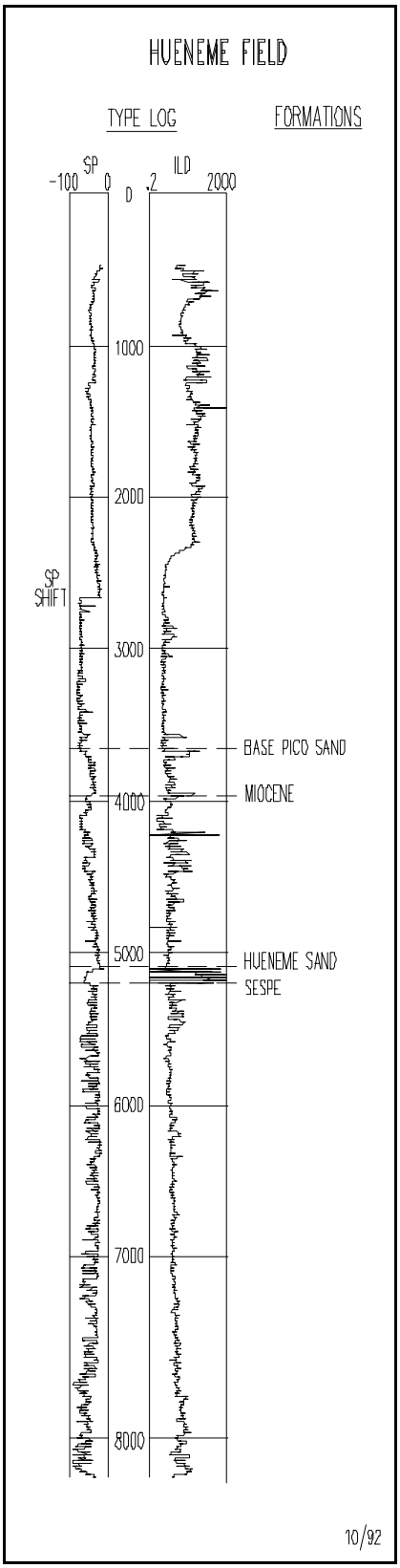

Figure E-3. Hueneme Field type log.

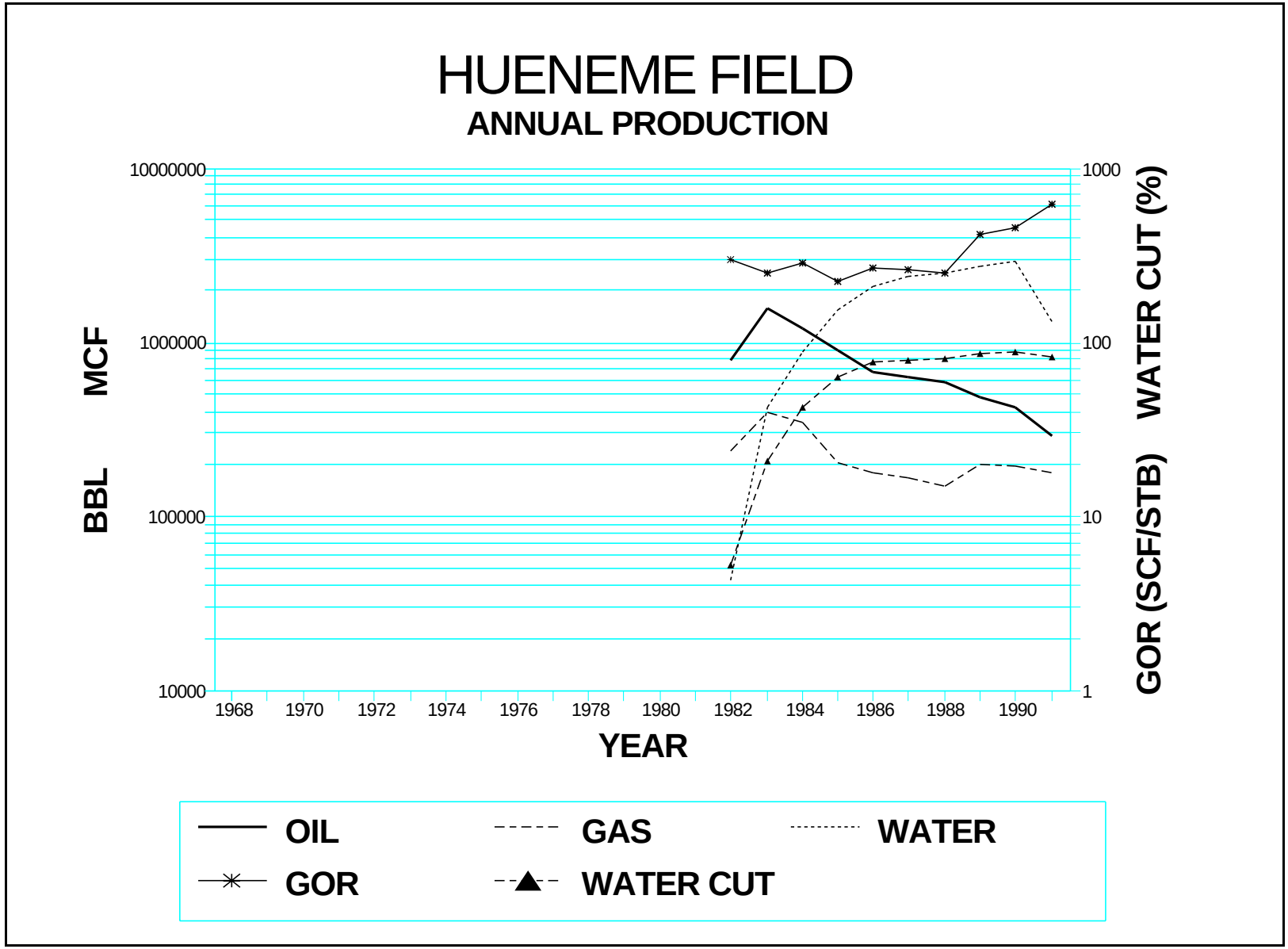

Figure E-4. Annual production from Hueneme Field.

Table E-1. Hueneme Field reservoir characteristics.

Hueneme Field	
Hueneme/Sespe Reservoir Characteristics	
Average Depth	5,101 feet
Porosity	12-40 %
Permeability	1-1,500 md
Reservoir Temperature	148° F
Original Reservoir Pressure	2,350 psig
Connate Water Saturation	20-40 %
Gross Sand Stratigraphic Thickness	750 feet
Net Sand Thickness	150-250 feet
Productive Area	990 acres
Gas Specific Gravity	0.573

Table E-2. Hueneme Field fluid characteristics.

Hueneme Field	
Hueneme/Sespe Reservoir Fluid Characteristics	
Average Oil Gravity	14.5° API
Saturation Pressure	2,175 psig
Viscosity	28-48 cp
Initial Producing GOR	188 SCF/STB
Initial Oil Formation Volume Factor	1.09 RB/STB

Table E-3. Hueneme Field production.

Field: HUENEME

Year	Wells at Year End			Oil Production				Gas Production		Water Production			GOR
	Prod	Other	Total	Barrels	bpd	bpd/ Well	Cumulative Barrels	Mcf	Cumulative Mcf	Barrels	Cumulative Barrels	% Cut	CFB
1968													
1969													
1970													
1971													
1972													
1973													
1974													
1975													
1976													
1977													
1978													
1979													
1980													
1981													
1982	5	4	9	782,964	2,337	467	782,964	234,409	234,409	42,745	42,745	5	299
1983	6	5	11	1,575,189	4,316	719	2,358,153	394,350	628,759	417,686	460,431	21	250
1984	6	5	11	1,206,462	3,305	551	3,564,615	347,068	975,827	868,344	1,328,775	42	288
1985	6	5	11	902,312	2,472	412	4,466,927	201,812	1,177,639	1,529,953	2,858,728	63	224
1986	6	5	11	664,001	1,819	303	5,130,928	178,251	1,355,890	2,085,290	4,944,018	76	268
1987	6	5	11	635,327	1,741	290	5,766,255	165,418	1,521,308	2,388,702	7,332,720	79	260
1988	6	7	13	595,325	1,631	272	6,361,580	148,847	1,670,155	2,463,593	9,796,313	81	250
1989	7	6	13	483,097	1,324	189	6,844,677	197,612	1,867,767	2,716,352	12,512,665	85	409
1990	7	6	13	419,371	1,149	164	7,264,048	192,469	2,060,236	2,923,541	15,436,206	87	459
1991	5	8	13	287,223	787	157	7,551,271	176,272	2,236,508	1,321,904	16,758,110	82	614

Appendix F - PITAS POINT FIELD

SUMMARY

Pitas Point Field is located in the eastern Santa Barbara Basin, approximately nine miles south of Carpinteria, California. The field covers portions of Leases OCS-P 0233, 0234, and 0346. All three leases are included in the Pitas Point Unit. Water depths approach 300 feet in the vicinity of the single, 24-slot platform.

Pitas Point Field is the only producing gas field on the Pacific OCS. Gas production from the field began in December 1983. To date 21 development wells and redrills have been drilled; only 1 new well was completed during 1991. Production is from sands of Pliocene age.

Production of gas and condensate during 1991 totaled 15,791,734 Mcf and 13,507 bbl, respectively. Produced petroleum liquids averaged 38° API gravity. Cumulative production reached 152.0 Bcf of gas and 155.0 Mbbl of condensate by December 1991. Remaining gas and condensate reserves are estimated to be 84.6 Bcf and 68.0 Mbbl, respectively.

GEOLOGY

The geologic structures in the vicinity of Pitas Point Field follow the general east-west trend of most major structures in the eastern Santa Barbara Basin. The anticline containing the field is located within a larger structural depression between the Rincon Trend to the north and the Montalvo (Twelve Mile) Trend to the south. The Pitas Point and Oak Ridge Faults are located just north and south of the field, respectively (figures F-1 and F-2).

The oldest strata penetrated in Pitas Point Field are the marine sedimentary rocks of the middle to late Miocene Monterey Formation. This formation consists of cherts, sandstones, carbonates, and siliceous, calcareous, or phosphatic shales. The uppermost Miocene rocks in the area are the marine sandstones, siltstones, and shales of the Sisquoc Formation.

Rocks younger than Miocene age include the Pliocene Pico and "Repetto" (lower Pico) formations. These formations are similar lithologically and consist of interbedded marine shales, claystones, siltstones, and sandstones. A thin veneer of Quaternary-aged sediments was deposited discontinuously above the Pico Formation. A type log for the field is displayed in figure F-3.

Productive hydrocarbon reservoirs have been identified in the Pico and "Repetto" formations. Sandstones in both the Pico and "Repetto" formations form gas reservoirs, and some of the deeper "Repetto" Formation sands contain oil. A summary of reservoir characteristics is presented in tables F-1 and F-2.

EXPLORATION AND DEVELOPMENT

Prior to the issuance of the first Federal leases in the Santa Barbara Channel, at least four stratigraphic coreholes were drilled in the vicinity of Pitas Point Field. Only one was drilled to a depth of greater than 500 feet. All of the coreholes were drilled between 1958 and 1965 under joint Federal and State operating permits.

The blocks containing Pitas Point Field were leased during two OCS lease sales, in

February 1968 and in June 1979. In OCS Sale P4 in 1968, Gulf Oil Corporation, Mobil Oil Corporation, Texaco Inc., and Union Oil Company of California acquired equal interests in Leases OCS-P 0233 and 0234 with bonus bids of $4,038,000 and $56,378,000, respectively. Humble Oil & Refining Company obtained adjoining Lease OCS-P 0235 with a high bid of $45,262,080.

Texaco spudded the Pitas Point Field discovery well in March 1968. The OCS-P 0234 No. 1 well was drilled from the drillship *Glomar II* in 293 feet of water. Drill stem tests of sands in the "Repetto" Formation produced oil and gas at relatively low rates.

Later the same year, Humble Oil & Refining Company drilled two wells on neighboring Lease OCS-P 0235. Neither well was tested, and both were eventually plugged and abandoned. The lease was relinquished in December 1969.

Texaco continued to drill expendable wells in Lease OCS-P 0234. One of these wells, OCS-P 0234 No. 3, was the deepest drilled on the Pacific OCS, reaching a total depth of 18,318 feet. The next well to be drilled, OCS-P 0234 No. 4, tested gas at a rate approaching 20,000 Mcfpd. By the time of OCS Sale No. 48 in June 1979, a total of six wells had been drilled in the lease.

One of the blocks available during OCS Sale No. 48 was relinquished Lease OCS-P 0235, which had been held by Humble. Texaco Inc. and Union Oil Company of California acquired the block, now named Lease OCS-P 0346, for a bonus bid of $31,727,001.60. Texaco drilled one more well on neighboring Lease OCS-P 0234 in 1980, bringing the total number of exploratory and delineation wells in the vicinity of Pitas Point Field to nine.

Texaco installed Platform Habitat on Lease OCS-P 0234 in October 1981. The 24-slot platform was set in 290 feet of water. Development drilling began three months later, with the spudding of Well OCS-P 0234 A-1.

A total of 21 wells and redrills have been drilled from Platform Habitat to date, 2 of which were completed in Lease OCS-P 0346. Ten of the 21 wells feature dual completions. Only 1 well was drilled during 1991, and minor workovers were performed on 3 other wells.

PRODUCTION AND RESERVES

Commercial gas production from Pitas Point Field began in December 1983. All production to date has been from reservoirs in the Pico and "Repetto" formations. Produced gas is piped to Mobil's processing facility at Rincon, California.

In January 1985 the daily average gas production peaked at 102,566 Mcfpd, from 10 producing wells. Condensate production peaked one month later at 113 bpd. Gas and condensate production from the field have since declined by more than 50 percent. Production data for the field are displayed in figure F-4.

Volumetric and decline-curve analyses have been used to calculate hydrocarbon reserves for Pitas Point Field. Original recoverable gas and condensate reserves are estimated to have been 236.6 Bcf and 223.0 Mbbl, respectively. Cumulative production reached 152.0 Bcf gas and 155.0 Mbbl condensate in December 1991 (table F-3). Remaining reserves for the field are estimated to be 84.6 Bcf gas and 68.0 Mbbl condensate.

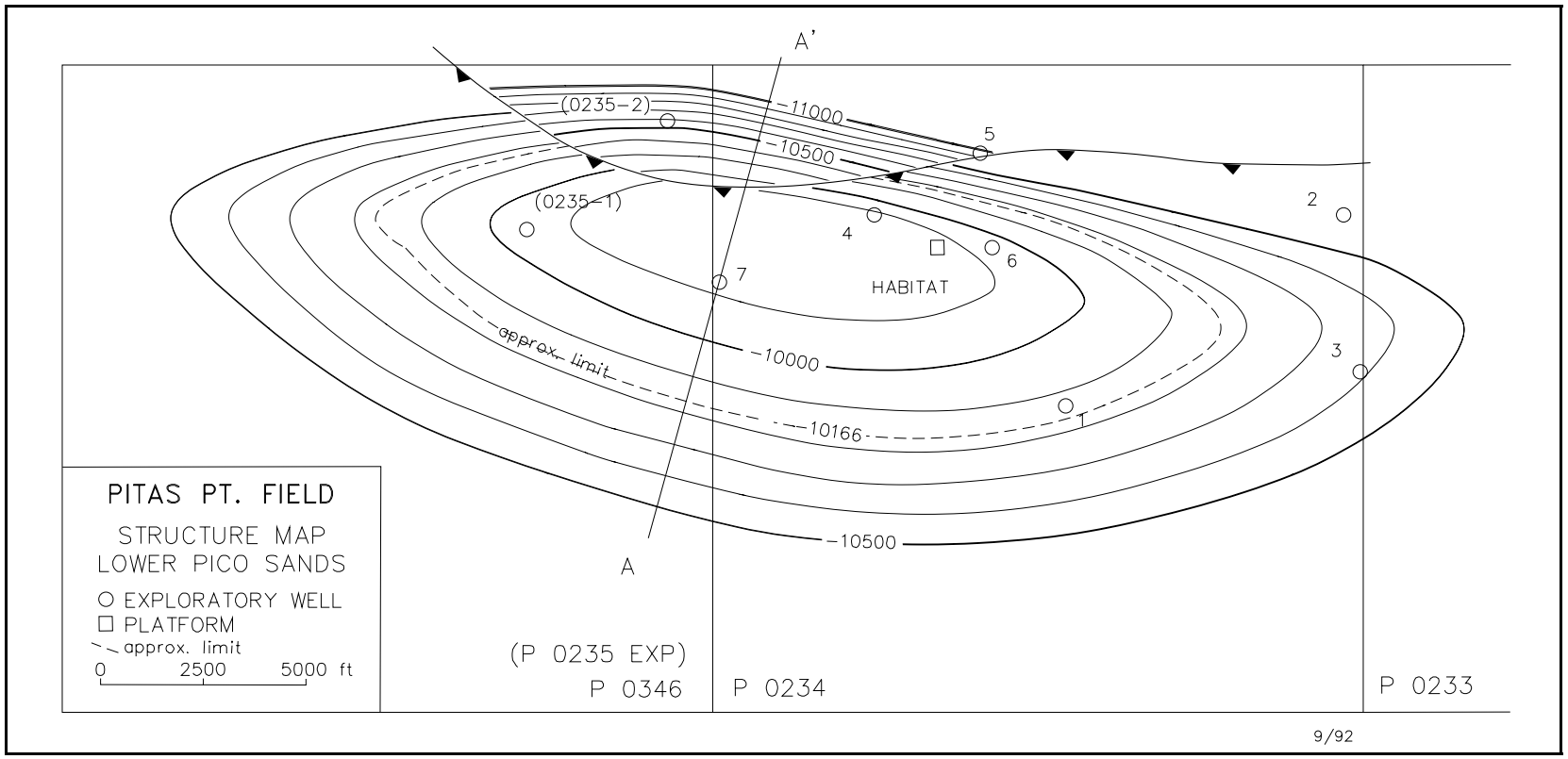

Figure F-1. Structure map of Pitas Point Field.

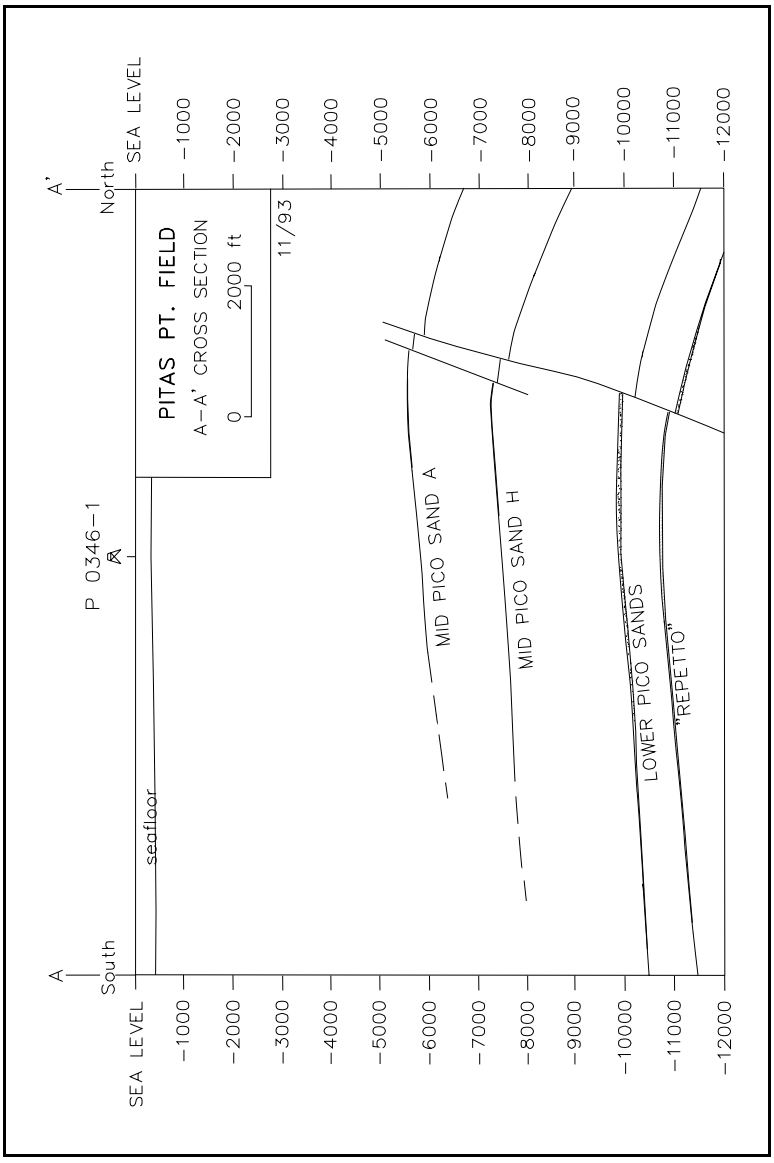

Figure F-2. Cross section through Pitas Point Field.

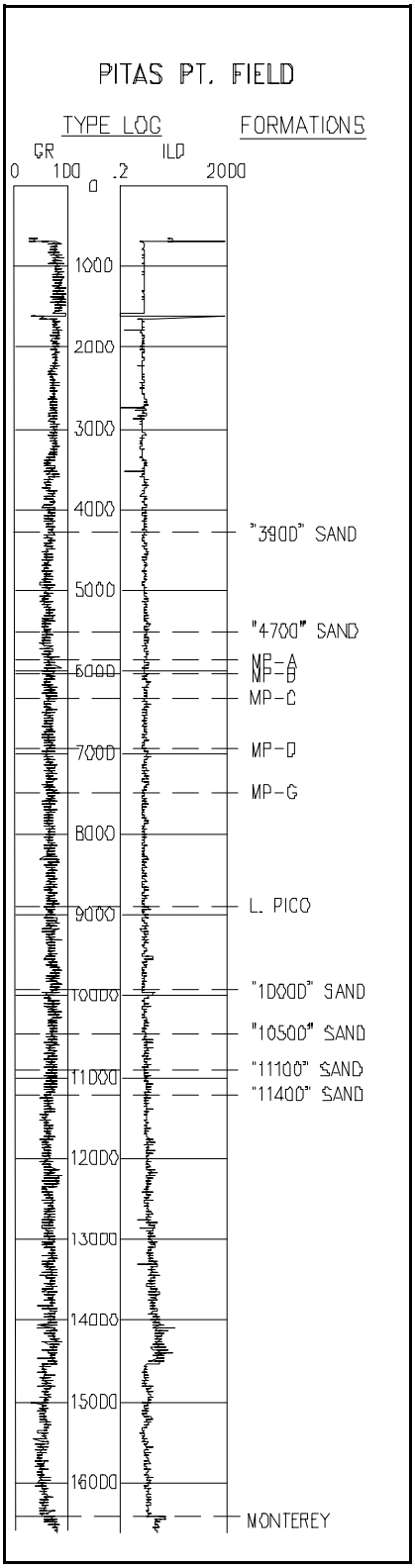

Figure F-3. Pitas Point Field type log.

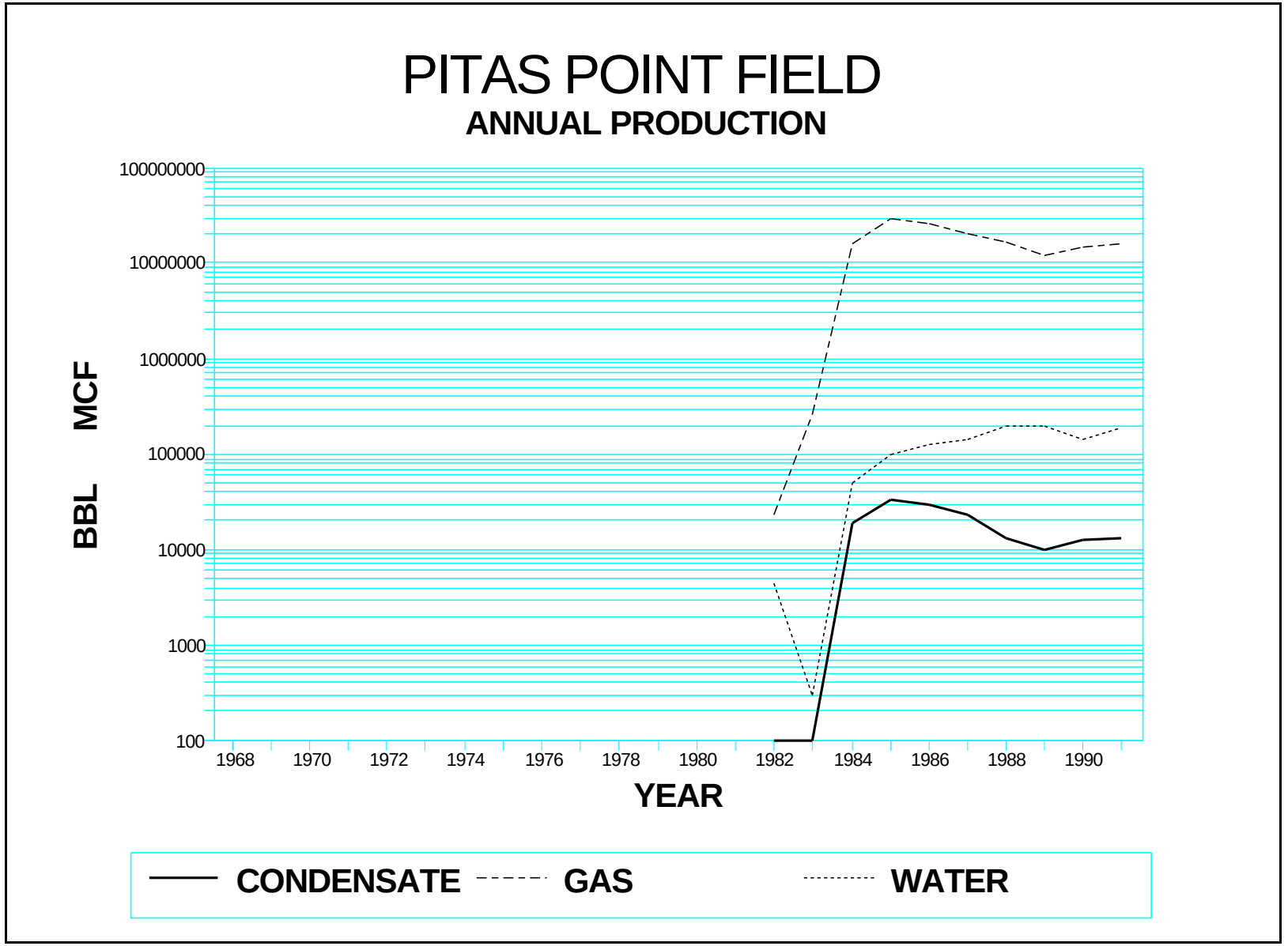

Figure F-4. Annual production from Pitas Point Field.

Table F-1. Pitas Point Field reservoir characteristics.

Pitas Point Field	
Lower Pico/"Repetto" Reservoir Characteristics	
Average Depth	11,100 feet
Porosity	15-18 %
Permeability	1-20 md
Reservoir Temperature	215^{o} F
Original Reservoir Pressure	5,817 psig
Connate Water Saturation	61-77 %
Gross Sand Stratigraphic Thickness	300 feet
Net Sand Thickness	65-150 feet
Productive Area	2,000 acres

Table F-2. Pitas Point Field fluid characteristics.

Pitas Point Field	
Lower Pico/"Repetto" Reservoir Fluid Characteristics	
Gas Specific Gravity	0.57
Viscosity	0.025 cp
Initial Prod. Condensate Gas Ratio	1.3 bbl/MMcf
Initial Gas Formation Volume Factor	0.00354 cf/SCF

Table F-3. Pitas Point Field production.

Field: PITAS POINT

Year	Wells at Year End			Gas Production				Condensate Production		Water Production			Yield
	Prod	Other	Total	Mcf	Mcf/Day	Mcf/Day/ Well	Cumulative Mcf	Barrels	Cumulative Barrels	Barrels	Cumulative Barrels	% Cut	B/MMCF
1968													
1969													
1970													
1971													
1972													
1973													
1974													
1975													
1976													
1977													
1978													
1979													
1980													
1981													
1982				22,680			22,680	0	0	4,329	4,329	100	0
1983	4	4	8	261,123	8,704	2,176	283,803	0	0	298	4,627	100	0
1984	10	1	11	15,876,559	43,497	4,350	16,160,362	18,831	18,831	50,371	54,998	73	0
1985	11	2	13	29,898,809	81,915	7,447	46,059,171	33,885	52,716	100,478	155,476	75	0
1986	13	3	16	25,750,123	70,548	5,427	71,809,294	29,343	82,059	121,726	277,202	81	0
1987	12	4	16	20,737,828	56,816	4,735	92,547,122	23,771	105,830	140,492	417,694	86	0
1988	10	6	16	16,688,425	45,722	4,572	109,235,547	13,329	119,159	196,865	614,559	94	0
1989	9	7	16	12,119,847	33,205	3,689	121,355,394	9,784	128,943	195,737	810,296	95	0
1990	15	4	19	14,828,643	40,626	2,708	136,184,037	12,537	141,480	140,011	950,307	92	0
1991	15	5	20	15,791,734	43,265	2,884	151,975,771	13,507	154,987	190,386	1,140,693	93	0

Note: 1982 figures represent test production

Appendix G - POINT ARGUELLO FIELD

SUMMARY

Point Arguello Field is located in the southern part of the offshore Santa Maria Basin, near the convergence of the Santa Maria and Santa Barbara basins. The field is approximately six miles southwest of Point Arguello, California, and covers parts of Leases OCS-P 0315, 0316, 0320, 0447, 0450, and 0451. Water depths over the field range from approximately 400 to over 1,100 feet, with 430 feet of water at Platform Hidalgo and over 600 feet near Platforms Harvest and Hermosa.

Point Arguello Field began producing oil and associated gas in May 1991. A total of 38 development wells has been drilled, only 26 of which have been completed. No wells were drilled or completed during 1991. All production is from fractured reservoirs in the Miocene Monterey Formation.

Production for calendar year 1991 totaled 5,532,709 bbl of oil (averaging 19° API gravity) and 2,145,192 Mcf of gas. Cumulative production reached 5.7 MMbbl of oil and 2.2 Bcf of gas. Estimated remaining oil and gas reserves for the field are 278.2 MMbbl and 295.3 Bcf, respectively.

GEOLOGY

Point Arguello Field formed north of the "Amberjack High," a Mesozoic basement flexure at the convergence of the north-south trending Santa Maria Basin and the east-west trending Santa Barbara Basin. These major regional trends are reflected in the orientation of the faulted anticlines that contain the field. The major structures trend northwest-southeast in the northern part of the field, changing to an east-west orientation in the southernmost part of the field (figures G-1 and G-2).

The stratigraphic section at Point Arguello Field includes rocks ranging in age from Cretaceous to Holocene. The oldest strata present are the shales and sandstones of the Cretaceous Jalama Formation. A significant unconformity exists between the Mesozoic and Neogene sections, marked by the absence of rocks of Paleogene age.

The oldest Neogene rocks present in the area are the lower Miocene Tranquillon Volcanics. Lying disconformably above the Tranquillon Volcanics is the lower to middle Miocene Point Sal Formation. This formation is composed primarily of Relizian mudstones and dolostones, which are coeval with the rocks of the Rincon Formation in the Santa Barbara Basin.

Conformably overlying the Point Sal Formation are the rocks of the middle to late Miocene Monterey Formation. This formation includes bathyal siltstones, cherts, and dolostones, as well as siliceous and porcellaneous shales. Away from the structural high the Monterey Formation rests conformably on the Point Sal Formation. On the flank of the "Amberjack High," however, the Monterey Formation apparently was deposited directly on the Cretaceous strata, and the Point Sal Formation is absent.

Above the Monterey Formation is the late Miocene to early Pliocene Sisquoc (or "Santa Margarita") Formation. This formation consists of middle to upper

bathyal shales, claystones, and diatomaceous mudstones. Younger Pliocene sedimentary rocks include the upper bathyal mudstones, siltstones, and sandstones of the Foxen Formation. Paleontological data indicate that the contact between the Sisquoc and Foxen formations may be paraconformable. Pleistocene and Holocene sediments in the area are composed largely of silts and gravels. A type log for the field is shown in figure G-3.

Hydrocarbon reservoirs have been identified throughout the stratigraphic section. Drill stem tests of the Sisquoc and Monterey formations produced oil at commercial rates. Although most of these tests recovered heavy oil, some of the Monterey Formation reservoirs produced oil with API gravities in the 29-33° range. Tests of the Foxen Formation produced gas, and a test over the Point Sal and Jalama formations produced significant quantities of oil. Representative reservoir characteristics are summarized in tables G-1 and G-2.

EXPLORATION AND DEVELOPMENT

The blocks in which Point Arguello Field is located were leased during two different OCS lease sales, in June 1979 and in May 1981. In OCS Sale No. 48, a bidding group led by Texaco Inc. acquired Lease OCS-P 0315 for $35,294,949.60. Another group of firms, which included Chevron U.S.A. Inc. and Phillips Petroleum Company, obtained Lease OCS-P 0316 for a bonus bid of $36,569,421.30. Lease OCS-P 0320 was the final Point Arguello Field block to be leased during the first sale. The lease went to a group of bidders led by Conoco Inc. for a bonus bid of $1,208,800.

Chevron spudded the Point Arguello Field discovery well in November 1980. The well, OCS-P 0316 No. 1, was drilled from the drillship *Glomar Atlantic* in 635 feet of water. Drill stem tests of the Monterey Formation flowed 12-19° API gravity oil at rates in excess of 8,500 bpd. The pre-Monterey sedimentary rocks were also tested, and produced approximately 2,000 bpd of 13° API gravity oil.

The discovery of Point Arguello Field prompted higher bidding for nearby blocks offered in OCS Sale No. 53. Chevron U.S.A. Inc. and Phillips Petroleum Company obtained equal interests in Leases OCS-P 0447, 0450, and 0451 with high bids of $31,276,800, $333,596,200, and $168,485,750, respectively. The bonus bid for Lease OCS-P 0450 was the highest ever submitted for a lease in Federal waters.

Texaco spudded Well OCS-P 0315 No. 1 about four months after OCS Sale No. 53. Drill stem tests of the Monterey Formation produced 14-22° API gravity oil at rates approaching 20,000 bpd. Another well, Chevron's OCS-P 0450 No. 1, penetrated light oil reservoirs in the Monterey and Point Sal formations. Aggregate flow rates of the approximately 33° API gravity crude exceeded 2,400 bpd. A total of 14 exploratory and delineation wells has been drilled on the Point Arguello Field leases to date.

Texaco set Platform Harvest in June 1985. The 50-slot platform is located near the northern edge of Lease OCS-P 0315 in 675 feet of water. Chevron continued the development of the field with the installation of 48-slot Platform Hermosa on Lease OCS-P 0316, and 56-slot Platform Hidalgo on Lease OCS-P 0450. Platform Hermosa was set first, in October 1985, in water 603 feet deep. Installation of Platform Hidalgo followed about nine

months later, in 430 feet of water.

Development drilling in Point Arguello Field began in November 1986 with the spudding of Well OCS-P 0315 A-1 from Platform Harvest. Development drilling in the Chevron leases began in 1987. To date, 39 wells have been drilled from the three platforms, including 1 exploratory well drilled from Platform Hermosa into Lease OCS-P 0451. No wells have been drilled within the field since 1990. All producing wells use perforated completions and are producing without artificial lift.

Regulatory difficulties delayed startup of production from Point Arguello Field until May 1991. Workovers and acid stimulations were performed on 5 wells during the year. Several pressure buildup and interference tests were also conducted. The operators are evaluating the feasibility of reinjecting produced gas, which averages over 7,000 ppm hydrogen sulfide.

PRODUCTION AND RESERVES

Since production from Point Arguello Field began in May 1991, no more than 23 development wells have produced during any single month. Production has so far been limited to fractured reservoirs in the Monterey Formation. Produced hydrocarbons are piped onshore for processing at the operator's Gaviota plant and marine terminal. Due to local concerns about tanker traffic in the Santa Barbara Channel, the oil is piped 300 miles north to San Francisco, where it is loaded into tankers for the 400 mile trip south to refineries in the Los Angeles area.

Oil production for the last seven months of 1991 averaged 26,466 bpd of approximately 19° API gravity oil. Average daily gas production during the same period was 8,934 Mcfpd. Production is continuing at an artificially constrained rate, due to disagreements between the operators and state and local government agencies (figure G-4).

Oil and gas reserves for Point Arguello Field have been calculated using volumetric analyses. Original recoverable reserves are estimated to have been 283.9 MMbbl of oil and 297.5 Bcf of gas. Cumulative production as of December 1991 was 5.7 MMbbl of oil and 2.2 Bcf of gas (table G-3). Estimated remaining oil and gas reserves for the field are 278.2 MMbbl and 295.3 Bcf, respectively.

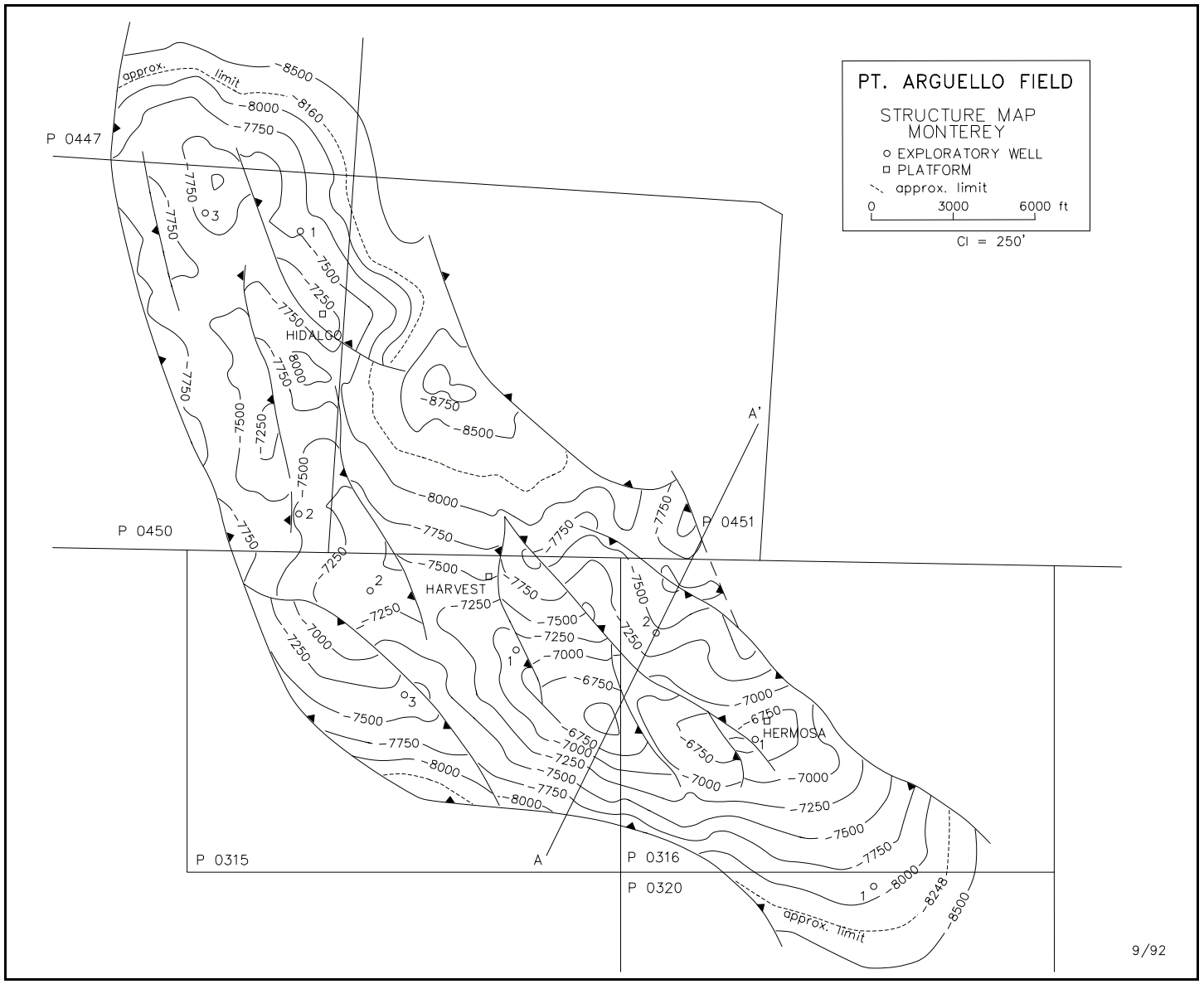

Figure G-1. Structure map of Point Arguello Field.

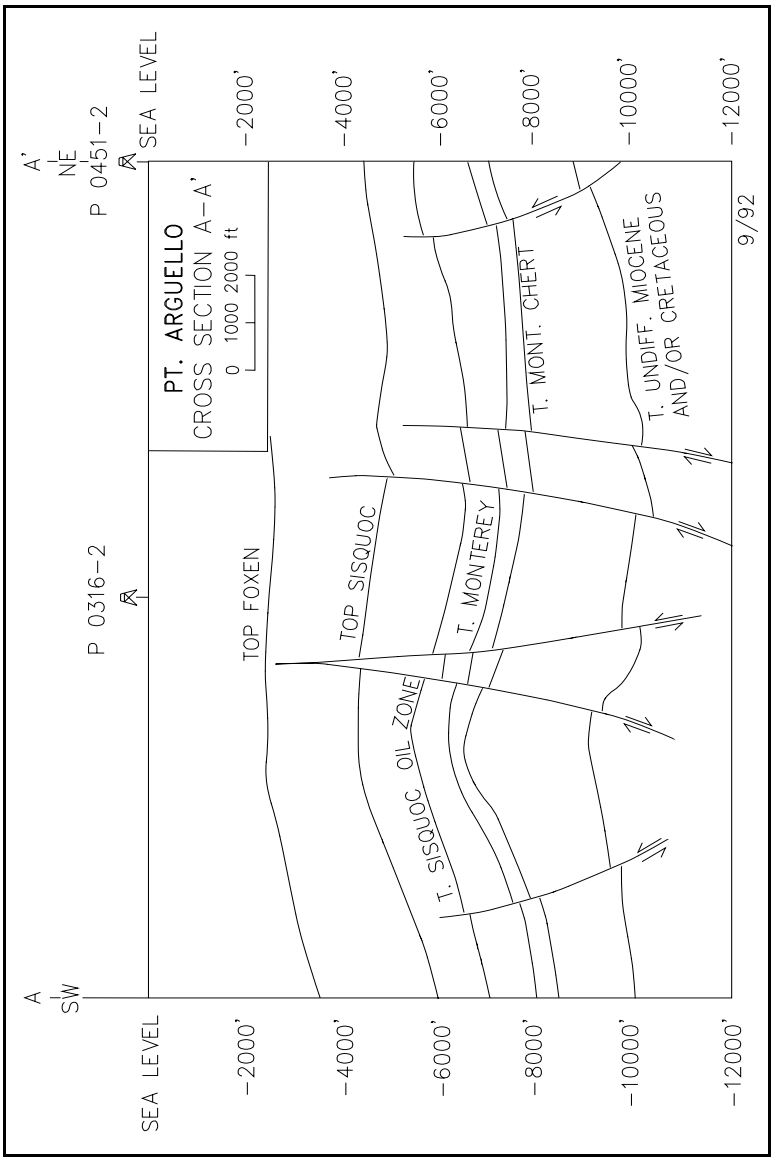

Figure G-2. Cross section through Point Arguello Field.

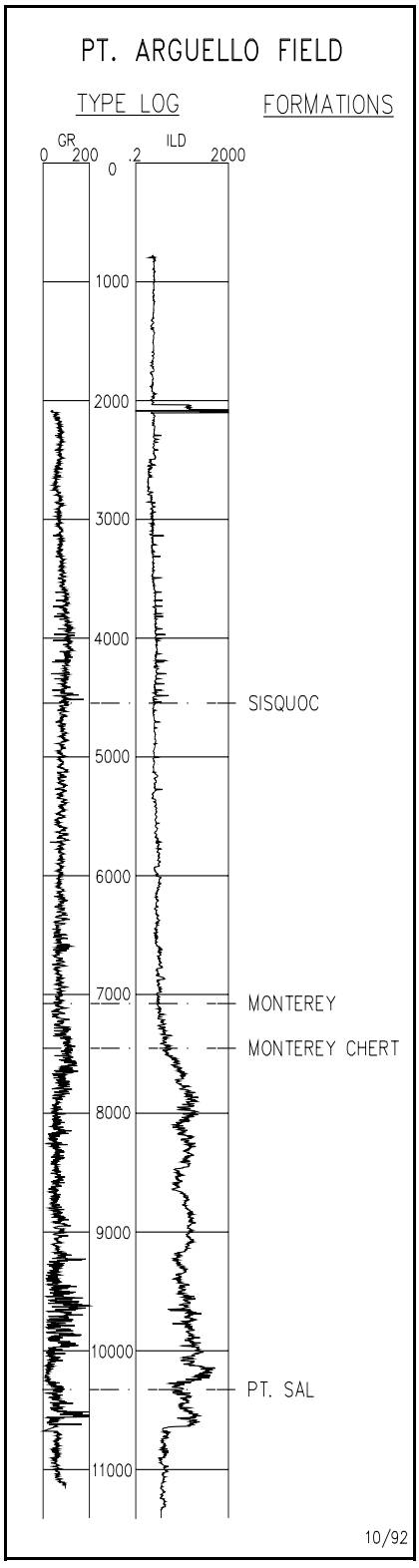

Figure G-3. Point Arguello Field type log.

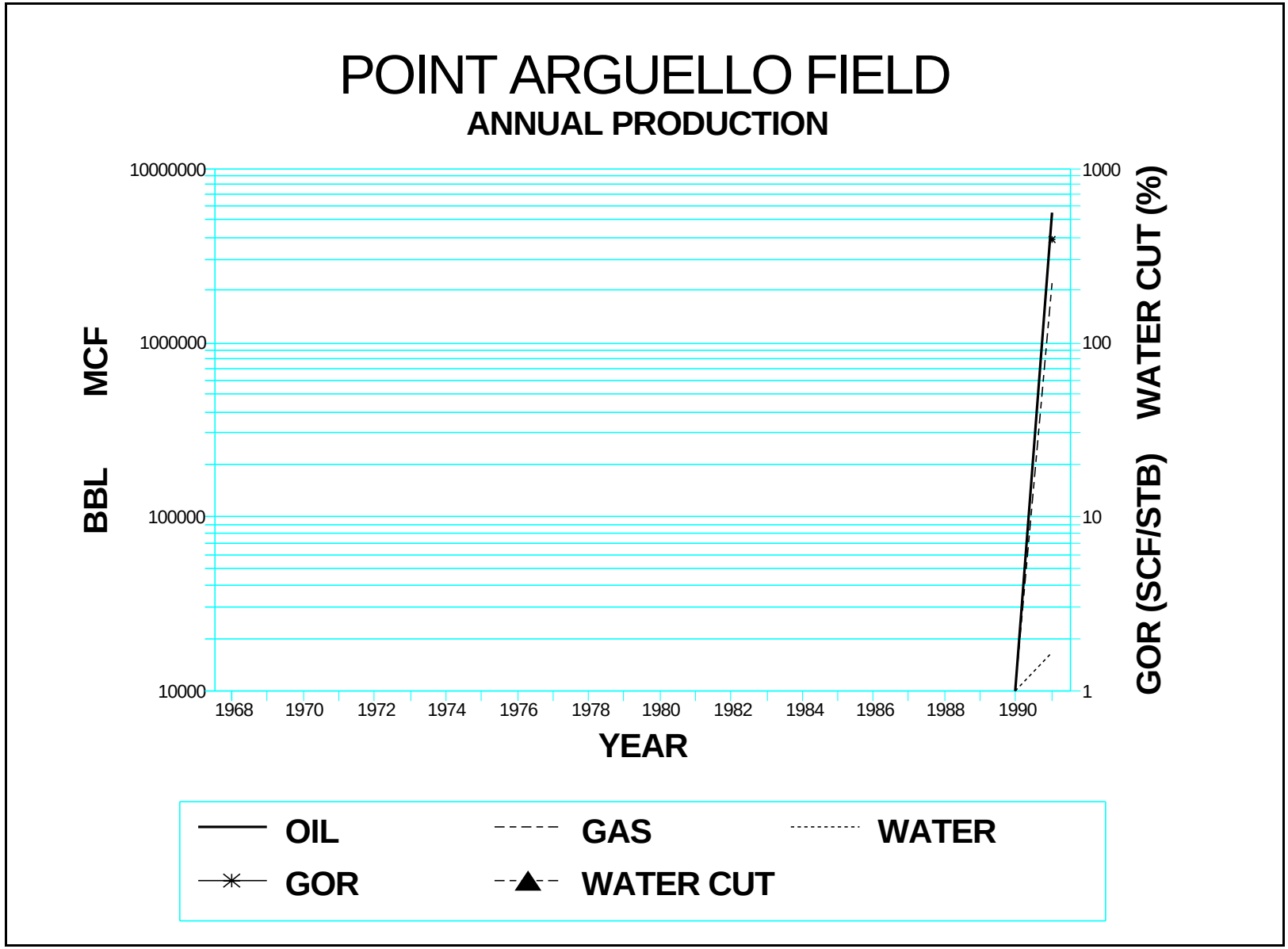

Figure G-4. Annual production from Point Arguello Field.

Table G-1. Point Arguello Field reservoir characteristics.

Point Arguello Field	
Monterey Reservoir Characteristics	
Average Depth	7,800 feet
Porosity	10-11 %
Permeability	1-3,000 md
Reservoir Temperature	240^{o} F
Original Reservoir Pressure	3,385 psig
Connate Water Saturation	50-60 %
Gross Pay Thickness	1,000 feet
Net Pay Thickness	200-400 feet
Productive Area	8,652 acres
Gas Specific Gravity	0.66

Table G-2. Point Arguello Field fluid characteristics.

Point Arguello Field	
Monterey Reservoir Fluid Characteristics	
Average Oil Gravity	18^{o} API
Saturation Pressure	2,785 psig
Viscosity	3-10 cp
Initial Producing GOR	400 SCF/STB
Initial Oil Formation Volume Factor	1.25 RB/STB

Table G-3. Point Arguello Field production.

Field: POINT ARGUELLO

Year	Wells at Year End			Oil Production				Gas Production		Water Production			GOR
	Prod	Other	Total	Barrels	bpd	bpd/ Well	Cumulative Barrels	Mcf	Cumulative Mcf	Barrels	Cumulative Barrels	% Cut	CFB
1968													
1969													
1970													
1971													
1972													
1973													
1974													
1975													
1976													
1977													
1978													
1979													
1980													
1981													
1982				20,966			20,966	7,347	7,347	3,155	3,155	13	350
1983				1,277			22,243	0	7,347	0	3,155	0	0
1984							22,243		7,347		3,155		
1985							22,243		7,347		3,155		
1986							22,243		7,347		3,155		
1987				183,272			205,515	68,790	76,137	301	3,456	0.16	375
1988							205,515		76,137		3,456		
1989							205,515		76,137		3,456		
1990							205,515		76,137		3,456		
1991	19	6	25	5,533,358	26,101	1,374	5,738,873	2,145,201	2,221,338	16,459	19,915	0.30	388

Note: 1982, 1983, 1987 figures represent test production

Appendix H - POINT PEDERNALES FIELD

SUMMARY

Point Pedernales Field is located in the southern Santa Maria Basin, approximately six miles west of Point Pedernales, California. The field is in the Point Pedernales Unit, and covers parts of Leases OCS-P 0437, 0438, 0440, and 0441. Water depths over the field range from less than 200 to approximately 500 feet, with the single, 72-slot platform set in 242 feet of water.

Oil and gas production from the field began in April 1987. A total of 22 development wells and redrills has been drilled, of which 3 were completed during 1991. All production is from fractured reservoirs in the Miocene Monterey Formation.

Production for calendar year 1991 totaled 5,047,112 bbl of approximately 17° API gravity oil and 1,160,819 Mcf of gas. Cumulative production reached 29.2 MMbbl and 6.2 Bcf. Estimated remaining oil and gas reserves for the field are 48.1 MMbbl and 71.1 Bcf, respectively.

GEOLOGY

The geologic structures of the Point Pedernales Field area exhibit the general northwest-southeast trend of the Coast Ranges physiographic province. The anticline that provides structural closure for the field follows this trend, as does a prominent strike-slip fault system, which divides the field into two major blocks. Numerous smaller normal and reverse faults also occur within the field area, some subparallel to the major fault system and others almost perpendicular to it (figures H-1 and H-2).

The oldest strata penetrated in the vicinity of Point Pedernales Field are the metasediments of the Jurassic Franciscan Formation. Sedimentary rocks of Cretaceous age are also present locally, deposited above the unconformity truncating the metamorphic basement. The Espada(?) and Jalama Formations, when present, consist primarily of marine sandstones, siltstones, and shales.

The oldest Miocene(?) strata present are the reworked volcaniclastics of the nonmarine to shallow marine Lospe Formation. The lower Miocene Point Sal Formation may also be present in the area, because rocks of similar age and lithology have been penetrated in wells immediately south of the field. Within Point Pedernales Field, the complex of deep-water sedimentary rocks known as the Monterey Formation was deposited directly on older Miocene or Mesozoic rocks. This formation dates to the middle to upper Miocene and includes laminated chert, shale, siltstone, and carbonates. Thick dolomite members are locally prominent.

Above the Monterey Formation are the marine shales, claystones, and diatomaceous mudstones of the upper Miocene to lower Pliocene Sisquoc Formation. Pliocene sedimentary rocks also include the Foxen Formation, which is composed of marine sandstones, siltstones, and mudstones. The upper part of the Foxen Formation is sometimes referred to as the Careaga Sandstone. The shallow marine sands and conglomerates of the Plio-Pleistocene Paso Robles Formation are also present, but are commonly quite thin.

A type log for Point Pedernales Field is shown in figure H-3.

Hydrocarbon reservoirs are apparently present throughout the stratigraphic section. A test of the Franciscan basement in the discovery well produced measurable quantities of oil. The Cretaceous sedimentary rocks produced significant quantities of low gravity oil in another exploratory well. Tests of a combined Cretaceous through lower Miocene interval have also produced minor amounts of gas and heavy oil. Fractured zones within the Monterey Formation form the most prolific reservoirs. The Sisquoc Formation has produced minor amounts of gas during drill stem tests, as has the Foxen Formation, which also generated prominent oil shows on some mudlogs. Reservoir characteristics for current producing zones are shown in tables H-1 and H-2.

EXPLORATION AND DEVELOPMENT

The four blocks containing Point Pedernales Field were leased during OCS Sale No. 53 in May 1981. A group of firms led by Amoco Production Company and Atlantic Richfield Company acquired Lease OCS-P 0437 for $7,140,000. Exxon Corporation obtained Leases OCS-P 0438 and 0440 for bonus bids of $3,412,000 and $37,358,000, respectively. Gulf Oil Corporation, The Superior Oil Company, and Union Oil Company of California acquired equal interests in Lease OCS-P 0441 with a high bid of $70,742,905.20.

The Point Pedernales Field discovery well, OCS-P 0441 No. 1, was spudded in November 1982. The well was drilled from the semisubmersible *Diamond M. General* in 264 feet of water. Aggregate flow rates exceeded 9,200 bpd of approximately 16° API gravity oil. Five additional exploratory and delineation wells were drilled on the four leases. All except OCS-P 0437 No. 1 found hydrocarbons in significant quantities.

Union set 72-slot Platform Irene in August 1985. The platform is located near the surface location of the second well on Lease OCS-P 0441, in 242 feet of water. In September 1986, the Point Pedernales Unit was formed. The unit initially contained Leases OCS-P 0440 and 0441 and portions of Leases OCS-P 0437, 0438, 0444 and 0510. Lease OCS-P 0510 has since been relinquished. Union is the designated unit operator.

Development drilling from Platform Irene began in April 1986. To date, 22 development wells and redrills have been drilled, including a number of horizontal wells. Two wells and one redrill were completed during 1991, as were six workovers. All completed wells have used gas lift or electric submersible pumps to produce oil through perforated completions. Plans to install a platform on Lease OCS-P 0440 have been abandoned due to the success of extended reach drilling from Platform Irene.

PRODUCTION AND RESERVES

Point Pedernales Field went on production in April 1987. Although 22 wells and redrills have been drilled to date, no more than 15 have produced during any single month. Production has been limited to fractured Monterey Formation reservoirs. Produced hydrocarbons are piped onshore for processing through the operator's Lompoc and Battles plants.

Oil production peaked in August 1987, when 8 development wells contributed to a monthly average of 23,572 bpd of

approximately 16° API gravity oil. Approximately two years later, average daily gas production reached a maximum of 5,622 Mcfpd. Since 1989, oil production has declined at an average yearly rate of about 16 percent (figure H-4).

Recoverable hydrocarbon reserves for Point Pedernales Field have been calculated using volumetric analyses. Original recoverable reserves of oil and gas are estimated to have been 77.3 MMbbl and 77.3 Bcf, respectively. Cumulative production as of December 1991 was 29.2 MMbbl oil and 6.2 Bcf gas (table H-3). Estimated remaining oil and gas reserves for the field are 48.1 MMbbl and 71.1 Bcf, respectively.

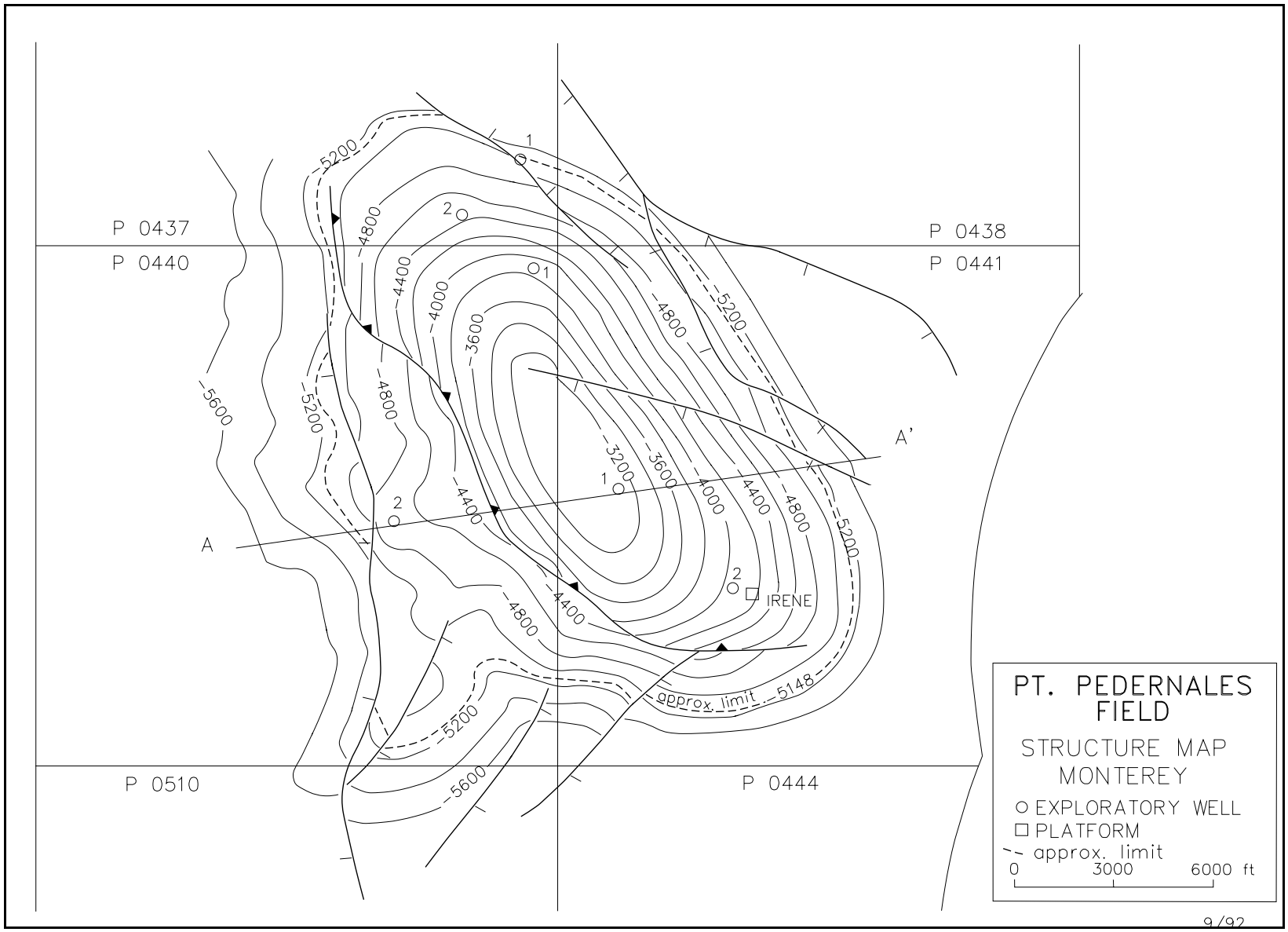

Figure H-1. Structure map of Point Pedernales Field.

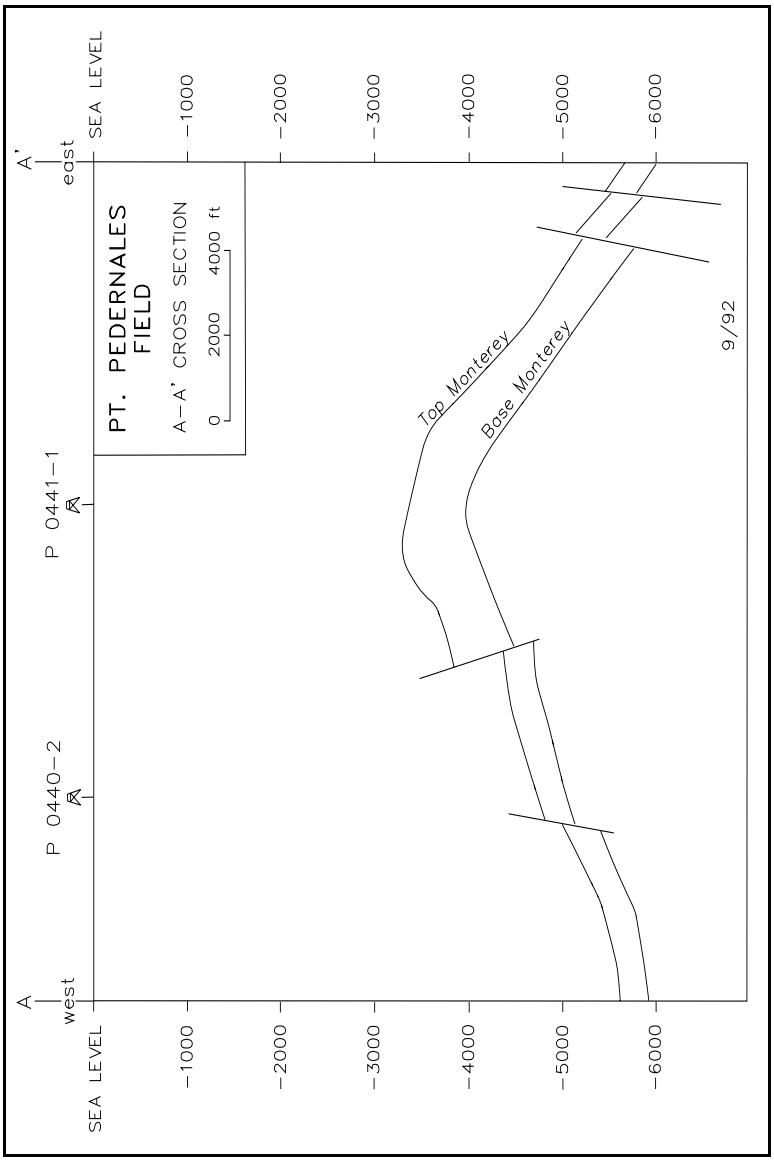

Figure H-2. Cross section through Point Pedernales Field.

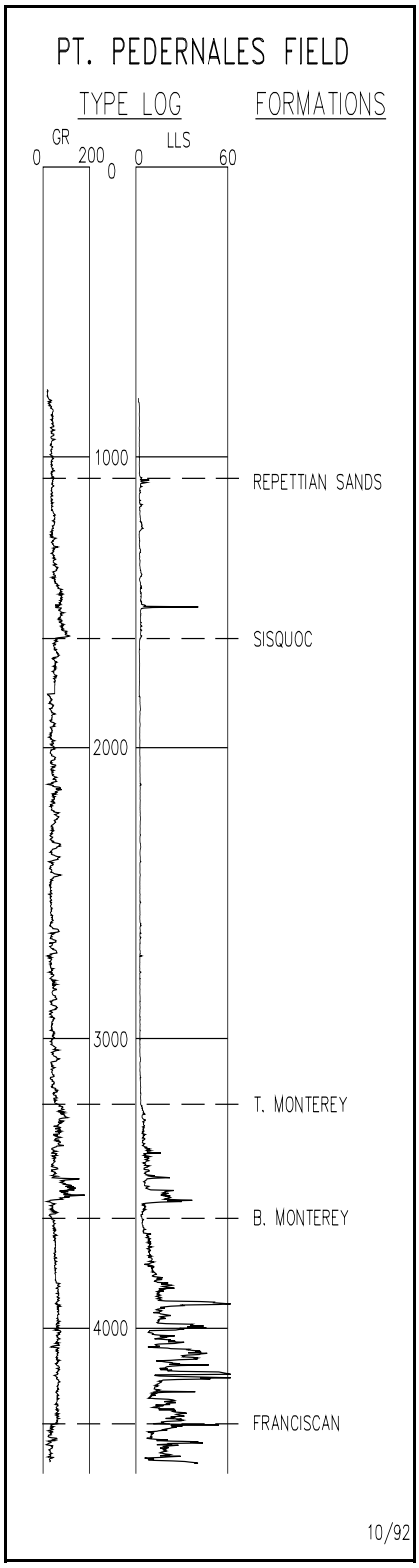

Figure H-3. Point Pedernales Field type log.

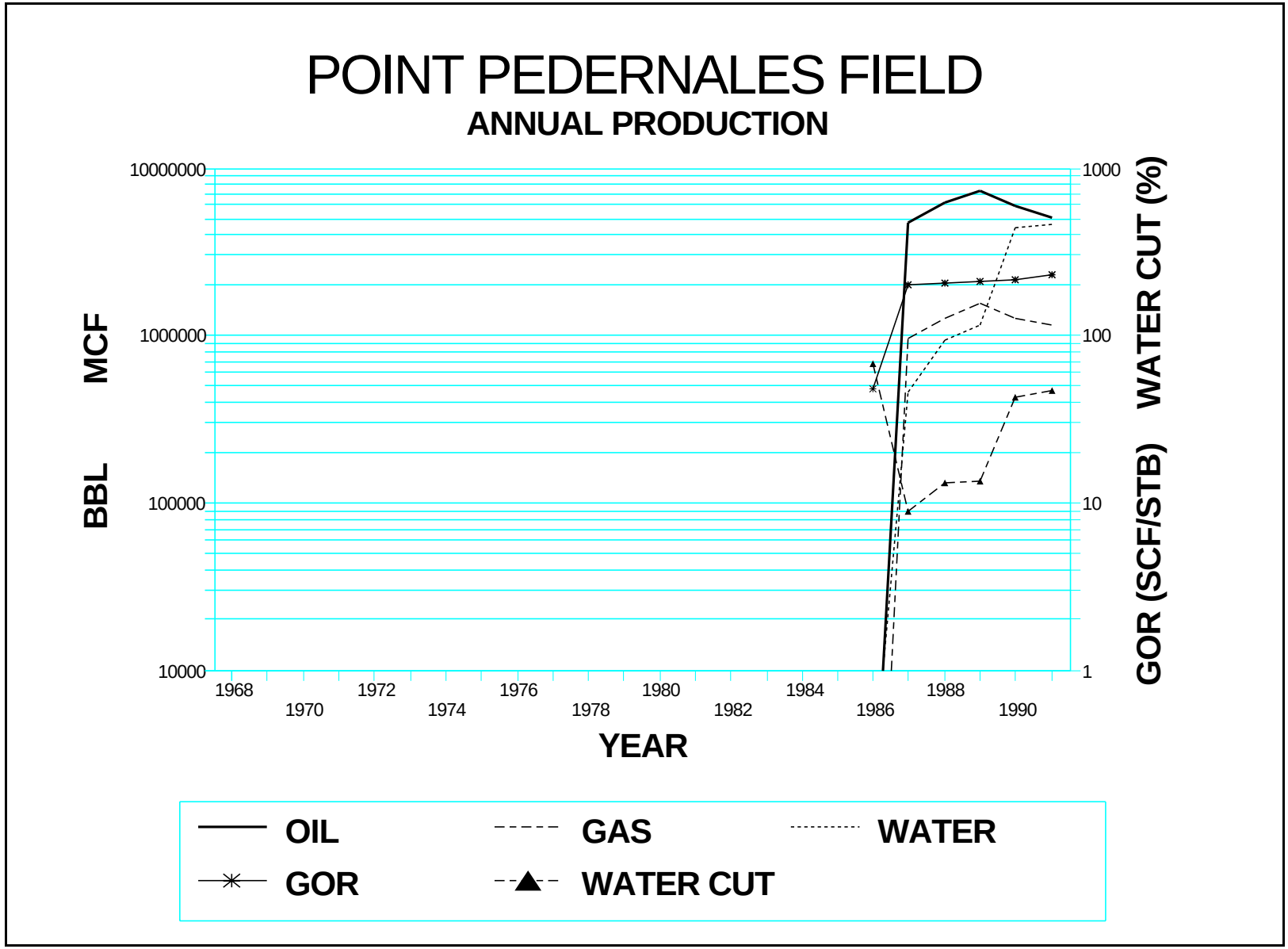

Figure H-4. Annual production from Point Pedernales Field.

Table H-1. Point Pedernales Field reservoir characteristics.

Point Pedernales Field	
Monterey Reservoir Characteristics	
Average Depth	5,000 feet
Porosity	2-39 %
Permeability	0.1-4,800 md
Reservoir Temperature	175° F
Original Reservoir Pressure	2,115 psig
Connate Water Saturation	46-95 %
Gross Pay Thickness	500 feet
Net Pay Thickness	425-475 feet
Productive Area	4,863 acres
Gas Specific Gravity	0.84

Table H-2. Point Pedernales Field fluid characteristics.

Point Pedernales Field	
Monterey Reservoir Fluid Characteristics	
Average Oil Gravity	16.3° API
Saturation Pressure	1,394 psig
Viscosity	10-40 cp
Initial Producing GOR	199 SCF/STB
Initial Oil Formation Volume Factor	1.13 RB/STB

Table H-3. Point Pedernales Field production.

Field: POINT PEDERNALES

Year	Wells at Year End			Oil Production				Gas Production		Water Production			GOR
	Prod	Other	Total	Barrels	bpd	bpd/ Well	Cumulative Barrels	Mcf	Cumulative Mcf	Barrels	Cumulative Barrels	% Cut	CFB
1968													
1969													
1970													
1971													
1972													
1973													
1974													
1975													
1976													
1977													
1978													
1979													
1980													
1981													
1982													
1983													
1984				7,175			7,175	912	912	285	285	4	127
1985							7,175		912		285		
1986				1,109			8,284	53	965	2,314	2,599	68	48
1987	11	0	11	4,740,589	17,301	1,573	4,748,873	946,694	947,659	461,327	463,926	9	200
1988	10	1	11	6,213,200	17,022	1,702	10,962,073	1,255,206	2,202,865	932,418	1,396,344	13	202
1989	10	6	16	7,272,200	19,924	1,992	18,234,273	1,531,069	3,733,934	1,146,411	2,542,755	14	211
1990	9	7	16	5,959,782	16,328	1,814	24,194,055	1,284,388	5,018,322	4,386,233	6,928,988	42	216
1991	13	6	19	5,047,112	13,828	1,064	29,241,167	1,160,819	6,179,141	4,546,555	11,475,543	47	230

Note: 1984, 1986 figures represent test production from exploratory wells

Appendix I - SANTA CLARA FIELD

SUMMARY

Santa Clara Field is located in the eastern Santa Barbara Basin, approximately 10 miles north of Anacapa Island. The field covers portions of Leases OCS-P 0215, 0216, and 0217, all of which are included in the Santa Clara Unit. Water depths in the area vary from 205 feet at Platform Gilda to 318 feet at Platform Grace.

Santa Clara Field began producing oil and gas in July 1980. A peripheral waterflood is underway in Lease OCS-P 0216. To date, 101 development wells have been drilled; no new wells were completed in 1991. Production is from Miocene and Pliocene sands, as well as from fractured reservoirs in the Miocene Monterey Formation.

Oil and gas production for 1991 were 1,951,080 bbl and 2,807,179 Mcf, respectively. Produced oil was approximately 21° API gravity. Cumulative production had climbed to 25.3 MMbbl of oil and 52.0 Bcf of gas by December 1991, with estimated remaining reserves of 44.7 MMbbl oil and 62.2 Bcf gas.

GEOLOGY

The geologic structures in the Santa Clara Field area follow the general east-west trend of other major structures in the Santa Barbara Basin. The anticline in which the field is located forms part of the Montalvo (Twelve Mile) Trend. The Oak Ridge Fault is located just north of the field, and the Mid Channel (World's End) Fault bounds the field to the south. A number of small, northwest-southeast trending faults and structural saddles further subdivide the field (figures I-1 and I-2).

The oldest strata penetrated in Santa Clara Field are the nonmarine conglomerates, sandstones, and shales of the Oligocene Sespe Formation. The Sespe Formation is unconformably overlaid by a sequence of shallow to deep marine sandstones and shales similar to those found at nearby Hueneme and Sockeye fields.

The oldest Miocene unit is a discontinuous basal transgressive sandstone, which correlates well with the Hueneme and "Lower Topanga" sands in nearby fields. Above the basal sandstone, where present, is a series of upper bathyal to neritic claystones, mudstones, and siltstones that have been informally assigned to the Relizian Rincon Formation. Above the Rincon Formation is the middle to late Miocene Monterey Formation. This formation consists of siliceous, calcareous, and phosphatic shales, as well as cherts, carbonates, and sandstones. The sandy, middle to upper bathyal fan facies found in the lower Monterey Formation are analagous to the "Upper Topanga Sands" observed at Sockeye Field to the south. The uppermost Miocene-aged rocks in the area are the upper bathyal shales, siltstones, and minor sandstones of the Mohnian to Delmontian Sisquoc Formation.

Rocks younger than Miocene age are represented primarily by the Pliocene Pico and "Repetto" (or lower Pico) formations. These formations include interbedded marine sandstones, siltstones, claystones, and shales. A type log for Santa Clara Field is displayed in figure I-3.

Potentially productive hydrocarbon reservoirs have been identified in the Monterey, Sisquoc, "Repetto," and Pico formations. Oil reservoirs occur in the sandstones and fractured siliceous rocks of the Monterey Formation and in the sandstones of the Sisquoc Formation. Many of the "Repetto" Formation sands contain oil, with some forming stratigraphic traps as they onlap the structure from the north. Pico sandstones form both oil and gas reservoirs. A summary of reservoir characteristics is presented in tables I-1 through I-4.

EXPLORATION AND DEVELOPMENT

A number of stratigraphic coreholes were drilled in the vicinity of Santa Clara Field between 1956 and 1965. Although most of the coreholes were less than 500 feet deep, some were drilled to depths greater than 6,000 feet. The geologic data obtained helped confirm the presence of potential reservoirs in the area.

The three blocks containing Santa Clara Field were Leased during OCS Sale P4 in February 1968. Atlantic Richfield Company and Standard Oil Company of California obtained Lease OCS-P 0215 with a bonus bid of $1,181,491.20. Lease OCS-P 0216 went to Union Oil Company of California for $12,176,000. Humble Oil & Refining Company and Standard Oil Company of California acquired equal interests in Lease OCS-P 0217 with a high bid of $10,121,011.20.

Union spudded the Santa Clara Field discovery well, OCS-P 0216 No. 1, in October 1970. The well was drilled from the *George F. Ferris* jackup in 135 feet of water. Drill stem tests of the "Repetto" and Monterey formations produced oil and gas at aggregate rates of approximately 600 bpd and 4,600 Mcfpd, respectively. Ten additional exploratory and delineation wells were drilled in the three leases, the last in 1984.

In March 1973 Chevron U.S.A. Inc. (formerly Standard Oil Company of California) acquired 100 percent interest in Lease OCS-P 0217, and the Santa Clara Unit was formed. At its largest extent, the unit included the Santa Clara Field leases as well as Leases OCS-P 0204, 0205, 0208, 0209, 0210 and 0527. Leases OCS-P 0210 and 0527 are no longer in the unit, which has contracted to include only those leases containing Santa Clara Field and nearby Sockeye Field. Chevron is the designated unit operator.

Chevron installed Platform Grace in July 1979 in 318 feet of water. Wells drilled from the platform produce oil and gas from reservoirs in Lease OCS-P 0217. By March 1985, 34 wells had been drilled from the 48-slot platform. All producing wells use gravel-packed completions. Although many of the wells initially flowed oil at commercial rates, all have been converted to gas lift.

Union installed 96-slot Platform Gilda on neighboring Lease OCS-P 0216 in January 1981, setting a world record for number of slots. The water depth at the platform site is 205 feet. To date, 67 development wells have been drilled from the 96-slot platform; one well extends into adjoining Lease OCS-P 0215. All producing wells use gravel-packed completions. Producing oil wells use electric submersible pumps.

Some of the "Repetto" Formation reservoirs in Lease OCS-P 0216 are being developed with the aid of a peripheral waterflood. Injection rates peaked in 1985 at 15,174 bpd, through 21 wells. In 1991, the average

daily injection rate was 12,091 bpd, through 14 injection wells. The waterflood has helped control declining reservoir pressures, but has not made any significant contribution towards increasing oil recoveries. No secondary recovery efforts are underway in Lease OCS-P 0217.

A total of 101 development wells has been drilled at Santa Clara Field, all of which were completed by the end of 1990. Nineteen workovers were completed during 1991, including casing repairs, pump replacements, acid stimulations, and hydrogen sulfide reduction treatments. Due to frequent pump failures in wells producing from the Monterey Formation, Union is evaluating alternate artificial lift methods.

PRODUCTION AND RESERVES

Santa Clara Field began commercial production in July 1980 from Platform Grace in Lease OCS-P 0217. Production from Platform Gilda in Lease OCS-P 0216 began in December 1981. Reservoirs in the Pico, "Repetto," and Monterey formations are all producing, with production from the Monterey Formation amounting to about 36 percent of the field total to date. Production from Platform Grace is piped to Chevron's Carpinteria plant, while production from Platform Gilda is piped onshore for processing at Union's Mandalay Beach facility.

In April 1990 the daily average oil production from Santa Clara Field peaked at 4,672 bpd, from 12 producing oil wells. Associated gas production reached a maximum of 21,875 Mcfpd in October 1990. Oil and gas production from the field is shown in figure I-4.

Volumetric and decline-curve analyses have been used to calculate recoverable hydrocarbon reserves for Santa Clara Field. Original recoverable oil and gas reserves are estimated to have been 70.0 MMbbl and 114.2 Bcf, respectively. Cumulative production increased to 25.3 MMbbl and 52.0 Bcf in December 1991 (table I-5), with remaining reserves for the field estimated to be 44.7 MMbbl of oil and 62.2 Bcf of gas.

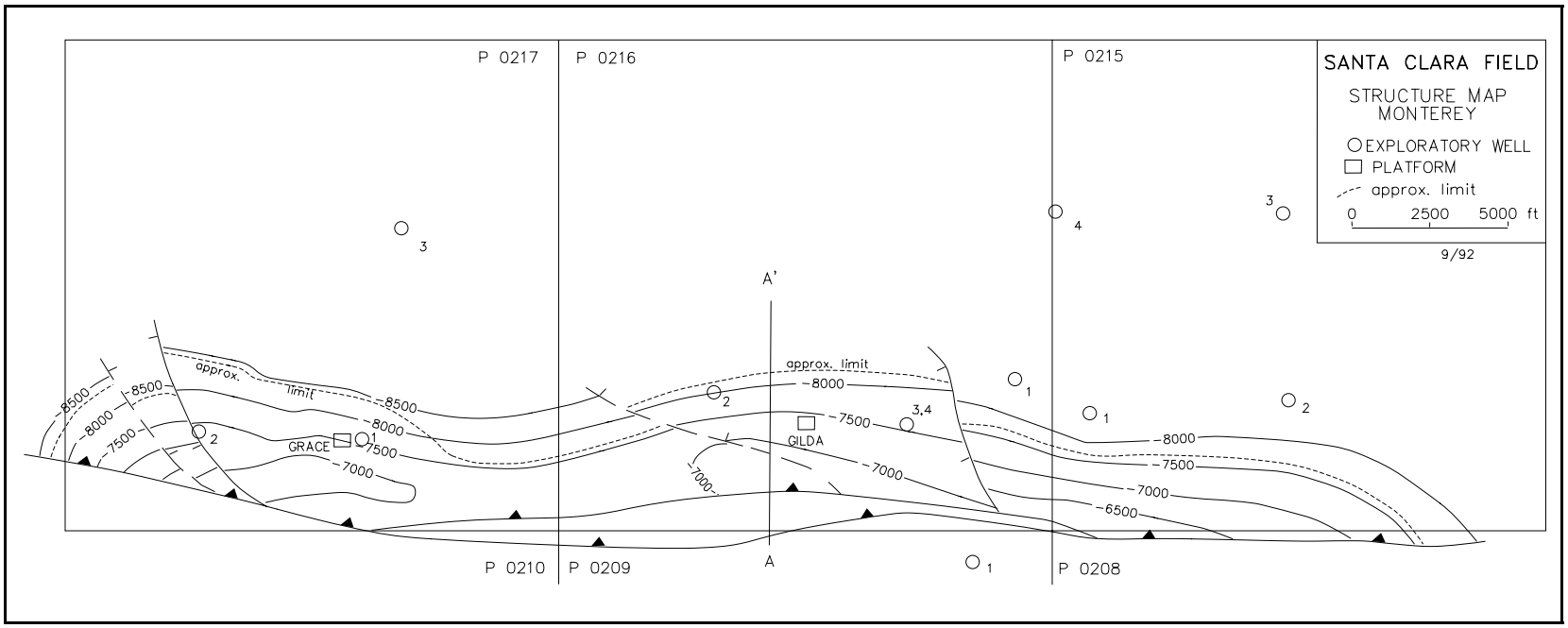

Figure I-1. Structure map of Santa Clara Field.

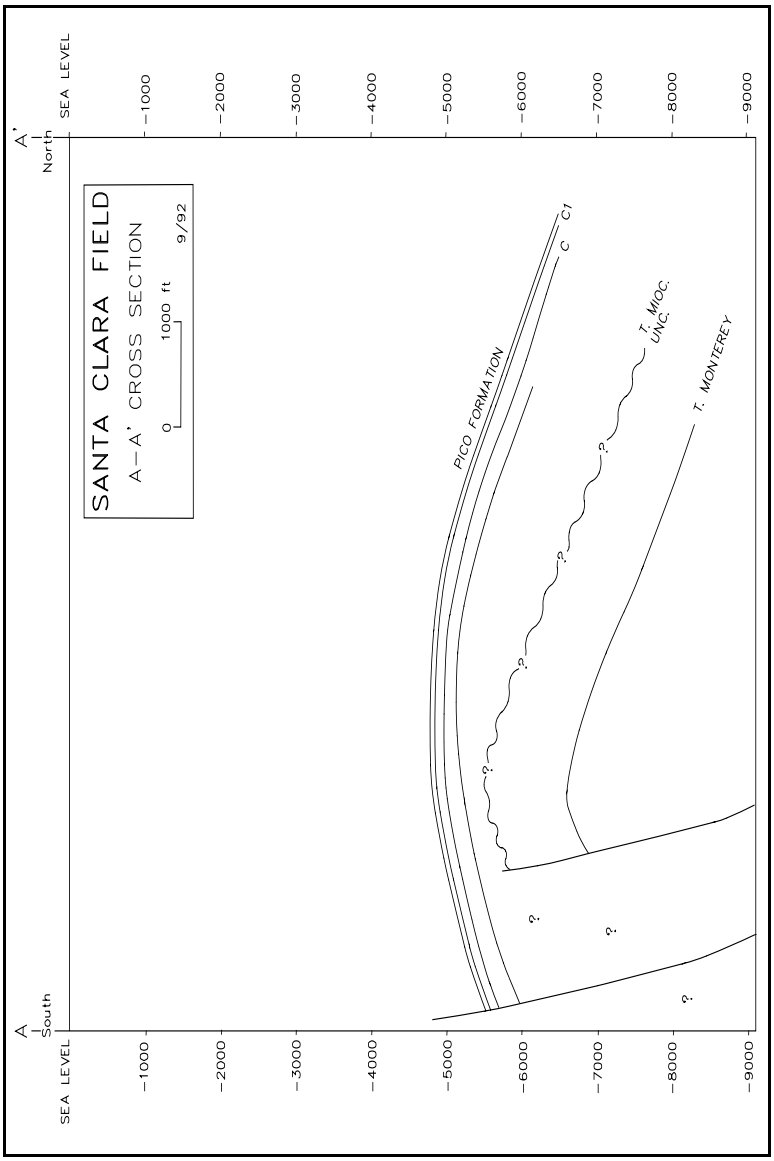

Figure I-2. Cross section through Santa Clara Field.

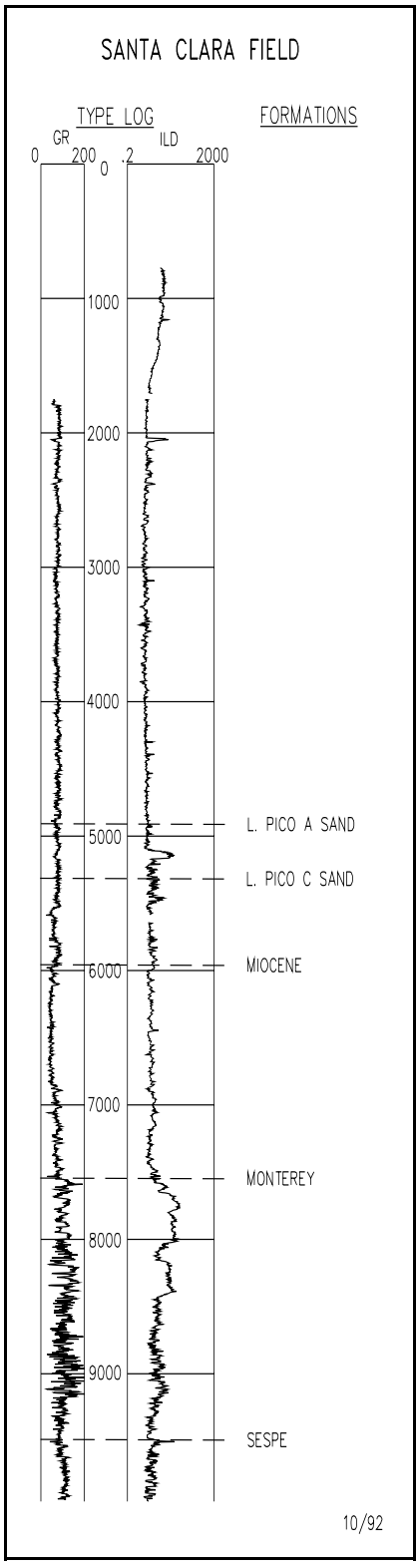

Figure I-3. Santa Clara Field type log.

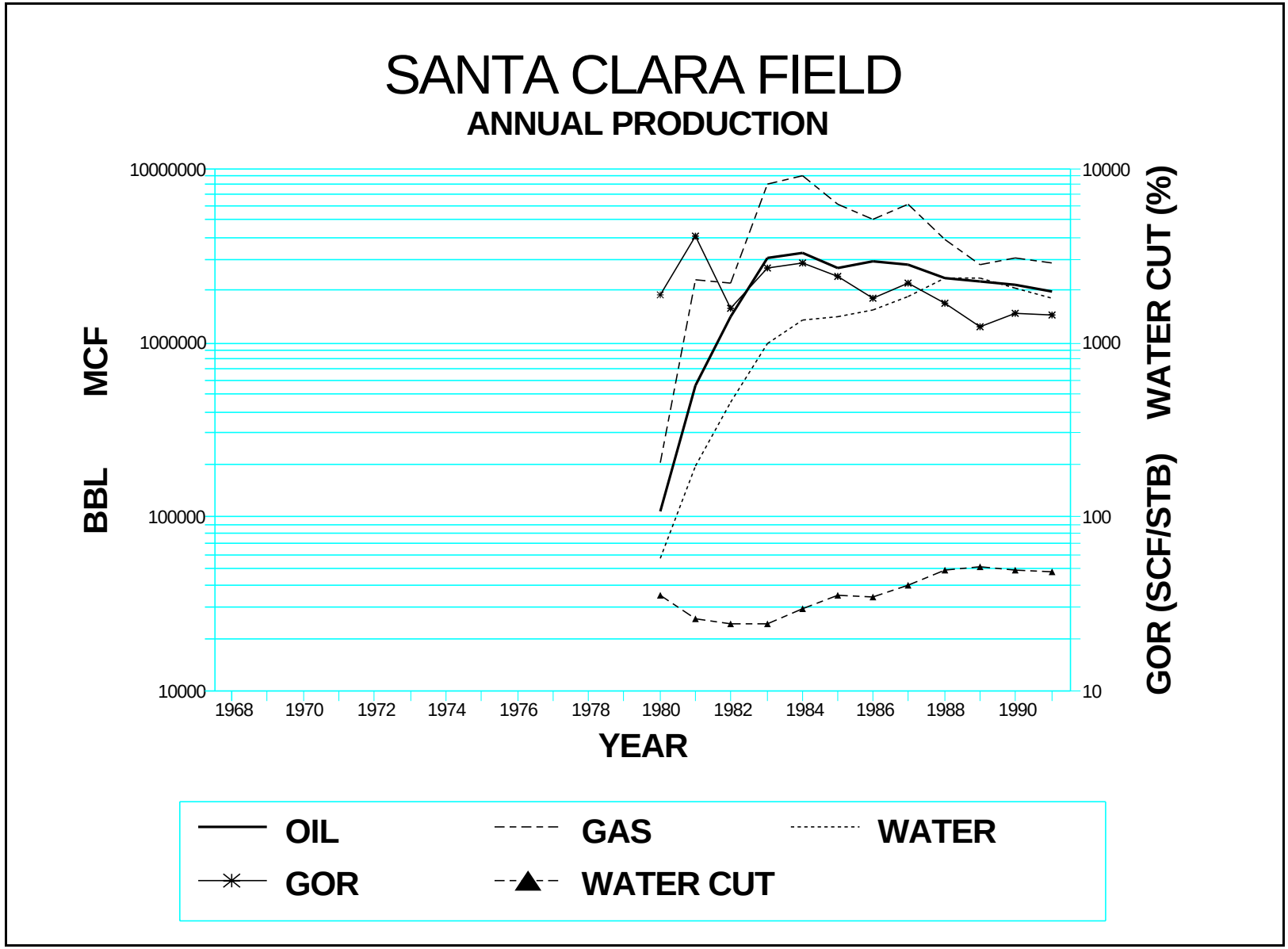

Figure I-4. Annual production from Santa Clara Field.

Table I-1. Santa Clara Field Repetto reservoir characteristics.

Santa Clara Field	
Upper Repetto Reservoir Characteristics	
Average Depth	7,050 feet
Porosity	12-40 %
Permeability	1-200 md
Reservoir Temperature	150^{o} F
Original Reservoir Pressure	3,252 psig
Connate Water Saturation	29-31 %
Gross Pay Thickness	175 feet
Net Pay Thickness	150-160 feet
Productive Area	1,200 acres
Gas Specific Gravity	0.610

Table I-2. Santa Clara Field Repetto fluid characteristics.

Santa Clara Field	
Upper Repetto Reservoir Fluid Characteristics	
Average Oil Gravity	23^{o} API
Saturation Pressure	3,096 psig
Viscosity	3.6 cp
Initial Producing GOR	400 SCF/STB
Initial Oil Formation Volume Factor	1.22 RB/STB

Table I-3. Santa Clara Field Monterey reservoir characteristics.

Santa Clara Field	
Monterey Reservoir Characteristics	
Average Depth	7,500 feet
Porosity	3-30 %
Permeability	1-1,300 md
Reservoir Temperature	207° F
Original Reservoir Pressure	3,600 psig
Connate Water Saturation	10-40 %
Gross Pay Thickness	1,200 feet
Net Pay Thickness	12-450 feet
Productive Area	8,500 acres
Gas Specific Gravity	0.695

Table I-4. Santa Clara Field Monterey fluid characteristics.

Santa Clara Field	
Monterey Reservoir Fluid Characteristics	
Average Oil Gravity	23° API
Saturation Pressure	3,400 psig
Viscosity	7-10 cp
Initial Producing GOR	1,800 SCF/STB
Initial Oil Formation Volume Factor	1.38 RB/STB

Table I-5. Santa Clara Field production.

Field: SANTA CLARA

Year	Wells at Year End			Oil Production				Gas Production		Water Production			GOR
	Prod	Other	Total	Barrels	bpd	bpd/ Well	Cumulative Barrels	Mcf	Cumulative Mcf	Barrels	Cumulative Barrels	% Cut	CFB
1968													
1969													
1970													
1971													
1972													
1973													
1974													
1975													
1976													
1977													
1978													
1979													
1980	5	1	6	108,161	591	118	108,161	202,877	202,877	57,633	57,633	35	1,876
1981	11	4	15	568,264	1,557	142	676,425	2,287,072	2,489,949	194,396	252,029	25	4,025
1982	21	7	28	1,412,501	3,870	184	2,088,926	2,181,738	4,671,687	456,583	708,612	24	1,545
1983	43	12	55	3,039,935	8,329	194	5,128,861	8,018,237	12,689,924	970,120	1,678,732	24	2,638
1984	51	24	75	3,260,783	8,934	175	8,389,644	9,201,326	21,891,250	1,342,621	3,021,353	29	2,822
1985	52	33	85	2,645,039	7,247	139	11,034,683	6,274,448	28,165,698	1,409,649	4,431,002	35	2,372
1986	56	33	89	2,896,916	7,937	142	13,931,599	5,128,451	33,294,149	1,529,681	5,960,683	35	1,770
1987	57	35	92	2,757,273	7,554	133	16,688,872	6,090,916	39,385,065	1,819,621	7,780,304	40	2,209
1988	57	36	93	2,358,881	6,463	113	19,047,753	3,953,971	43,339,036	2,313,374	10,093,678	50	1,676
1989	56	38	94	2,236,486	6,127	109	21,284,239	2,762,081	46,101,117	2,329,400	12,423,078	51	1,235
1990	57	40	97	2,112,150	5,787	102	23,396,389	3,057,801	49,158,918	2,023,203	14,446,281	49	1,448
1991	55	42	97	1,951,080	5,345	97	25,347,469	2,807,179	51,966,097	1,773,513	16,219,794	48	1,439

Appendix J - SOCKEYE FIELD

SUMMARY

Sockeye Field is located approximately 11 miles west of Port Hueneme, California, in the eastern Santa Barbara Basin. The field extends through Leases OCS-P 0204, 0205, 0208 and 0209, all of which are included in the Santa Clara Unit. Water depths in the vicinity of 36-slot Platform Gail exceed 700 feet.

Production from Sockeye Field began in September 1988. The 14 development wells drilled to date were completed by May 1990. Hydrocarbon production is obtained from Oligocene and Miocene sands, as well as from fractured reservoirs in the Miocene Monterey Formation.

Oil and gas production for calendar year 1991 was 2,274,232 bbl and 7,667,630 Mcf, respectively. Produced oil averaged 26° API gravity. Cumulative production reached 8.1 MMbbl and 20.5 Bcf in December 1991, with remaining reserves estimated to be 41.3 MMbbl oil and 84.8 Bcf gas.

GEOLOGY

The major geologic structures in the Sockeye Field area trend northwest-southeast, in keeping with other major structures in the Santa Barbara Basin that exhibit a general east-west orientation. The doubly plunging anticline containing the field is asymmetrical and bounded by the North Sockeye and South Sockeye high-angle reverse faults. The field is further subdivided by other, subparallel reverse faults (figures J-1 and J-2).

The stratigraphic section in the Sockeye Field area includes rocks ranging in age from Cretaceous to Recent. The oldest strata in the vicinity of the field are the marine sandstones, siltstones, and shales of the Jalama Formation. Unconformably overlying the Cretaceous rocks are the marine sandstones and siltstones of the Eocene Juncal Formation. Deposited unconformably above the Juncal Formation are the nonmarine sands, shales, and conglomerates of the Oligocene Sespe Formation. These Cretaceous and Paleogene strata are analogous to the Great Valley Sequence of the San Joaquin Basin.

The Miocene section begins with the "Lower Topanga Sands." This unit is analogous to the Hueneme Sand of Hueneme Field and consists of neritic to littoral, relatively massive sands deposited in a transgressive marine environment. Conformably overlying the "Lower Topanga Sands," and in places interfingering with them, are shales of Relizian age that may correlate with the Rincon Formation. The "Upper Topanga Sands" were deposited conformably above the Relizian shales as part of the Topanga subsea fan system. The middle to late Miocene Monterey Formation conformably overlies, and interfingers with, the "Upper Topanga Sands." This formation consists of siliceous shales, dolomites, sandstones, cherts, and limestones, which were deposited at depths ranging from middle to upper bathyal. The uppermost Miocene rocks in the area are the upper bathyal siltstones and diatomaceous shales of the Sisquoc Formation.

Rocks younger than Miocene age are represented primarily by the Pliocene Pico

Formation. The Pico Formation includes interbedded neritic to upper bathyal sands, clays, and diatomaceous siltstones deposited conformably on the older Sisquoc strata. Above the Pico Formation are undifferentiated Pleistocene to Recent sands, silts, and clays. A type log for the field is displayed in figure J-3.

Productive hydrocarbon reservoirs have been identified in the upper and lower "Topanga Sands," as well as the Sespe and Monterey formations. The deepest of these, the Sespe Formation, contains low sulfur, 26-29° API gravity oil. A gas cap has been identified in the uppermost portion of the Sespe reservoir. The "Lower Topanga Sands" produce 30° API gravity oil, and the "Upper Topanga Sands" produce 18° API gravity oil. Finally, fractured intervals in the Monterey Formation have produced 11.5-18.4° API gravity oil and associated gas. A summary of reservoir characteristics is presented in tables J-1 through J-4.

EXPLORATION AND DEVELOPMENT

The four blocks containing Sockeye Field were leased during OCS Sale P4 in February 1968. Humble Oil & Refining Company and Standard Oil Company of California acquired equal interests in Leases OCS-P 0204 and 0205 with bonus bids of $265,651.20 for each lease. The same two firms obtained equal interests in Leases OCS-P 0208 and 0209 with high bids of $622,771.20 and $421,171.20, respectively.

Humble spudded the Sockeye Field discovery well, OCS-P 0205 No. 1, in September 1970. The well was drilled from the *Wodeco IV* drillship in 719 feet of water. Drill stem tests of the Sespe Formation flowed 25° API oil at approximately 1,100 bpd. Tests of the "Upper Topanga Sands" produced gas at a rate of approximately 3,100 Mcfpd. The Monterey Formation tested small quantities of 17° API oil. Eight additional exploratory and delineation wells had been drilled in the vicinity by 1984, proving the potential for commercial oil and gas production from the field.

Santa Clara Unit was formed in March 1973. The unit at one time included the Sockeye Field leases, as well as Leases OCS-P 0210, 0215, 0216, 0217, and 0527. Leases OCS-P 0210 and 0527 are no longer in the unit, which has contracted to include only those leases containing Sockeye Field, and Santa Clara Field to the north. In February 1991 Chevron U.S.A. (formerly Standard Oil Company of California) acquired the interest held by Exxon (formerly Humble Oil & Refining Company) in each of the four leases, leaving Chevron as sole interest holder and unit operator.

Chevron installed Platform Gail in April 1987. The platform is located in 739 feet of water in Lease OCS-P 0205. A total of 14 production wells was drilled from the 36-slot platform between 1988 and 1990, producing oil from reservoirs in Leases OCS-P 0205 and 0209. All wells use perforated completions. Most of the wells initially flowed at commercial rates, although a number have been converted to gas lift. Three of the 14 wells also employ dual completions.

No new development wells were drilled at Sockeye Field during 1991. Other work included adding perforations to eight existing wells producing from sandstone reservoirs, increasing total oil production over 1,000 bpd. Acid stimulations of the two wells producing from Monterey Formation reservoirs increased production

from those completions over 80 percent. The operator has no plans to implement pressure maintenance or enhanced recovery programs.

PRODUCTION AND RESERVES

First production from Sockeye Field occurred in September 1988. The "Lower Topanga Sands," Sespe, and Monterey formation reservoirs have all contributed production. The Sespe Formation reservoirs have proven the most prolific, however, with only about 2 percent of production coming from the Monterey Formation. Production is piped onshore via Chevron's Platform Grace at Santa Clara Field.

In April 1990 the daily average oil production peaked at 9,917 bpd from 12 producing oil wells. Gas production reached a maximum rate of 25,581 Mcfpd in November 1991. By December 1991 oil production was only about half that of the peak rate attained, with production declining at an annual rate of 27 percent. Both oil and gas production data are shown in figure J-4.

Volumetric and decline-curve analyses have been used to calculate recoverable hydrocarbon reserves for Sockeye Field. Original recoverable oil and gas reserves are estimated to have been 49.5 MMbbl and 105.3 Bcf, respectively. Cumulative production increased to 8.1 MMbbl and 20.5 Bcf in December 1991 (table J-5), with remaining reserves for the field estimated to be 41.3 MMbbl of oil and 84.8 Bcf of gas.

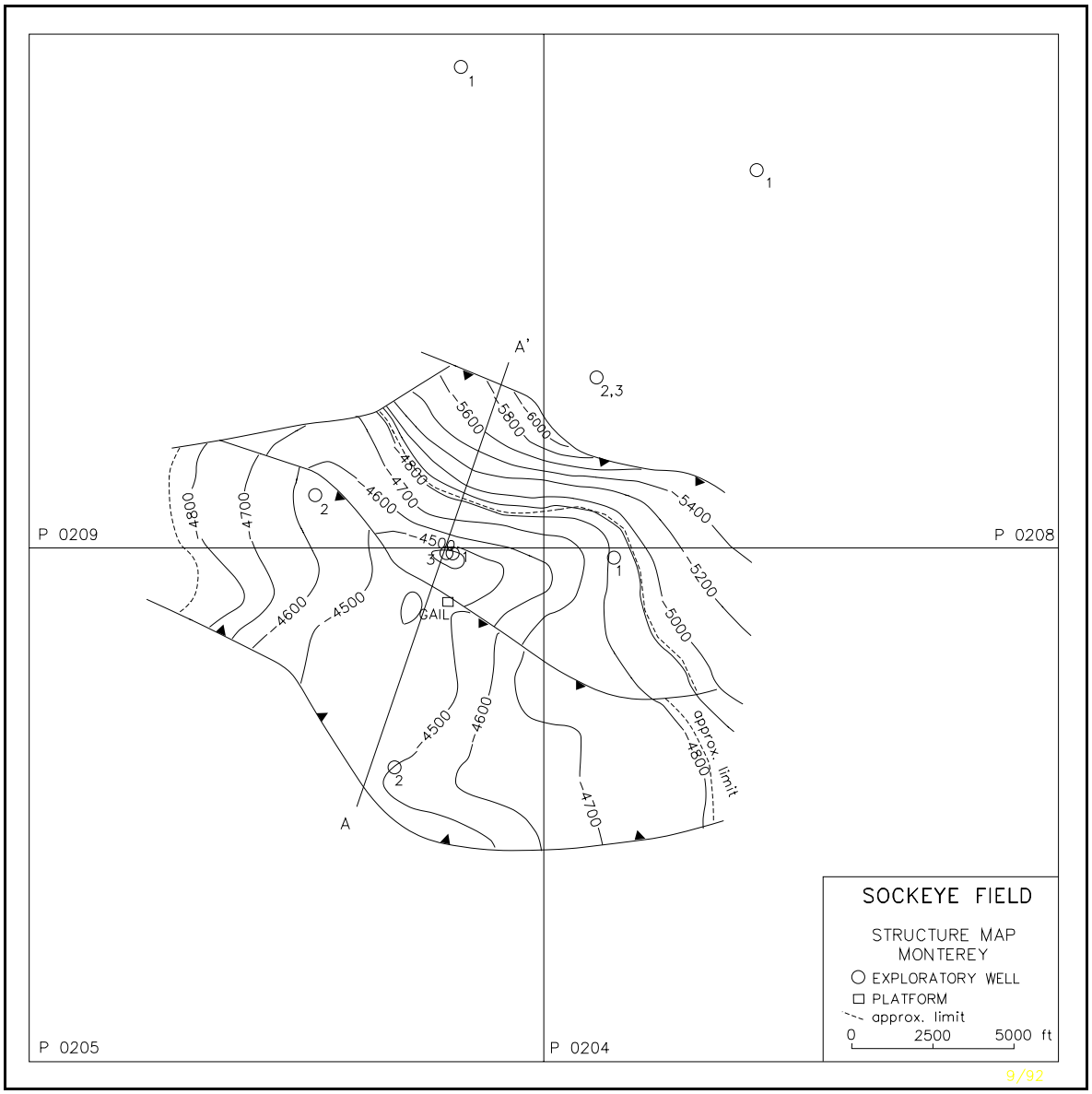

Figure J-1. Structure map of Sockeye Field.

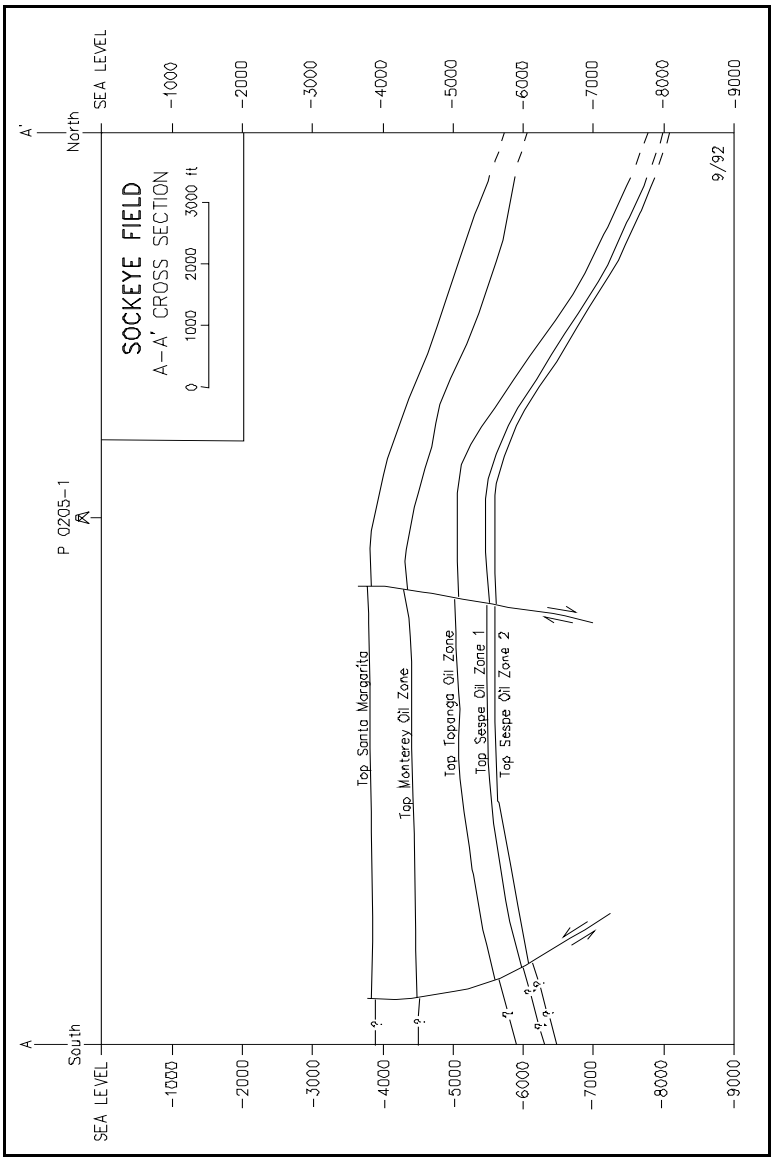

Figure J-2. Cross section through Sockeye Field.

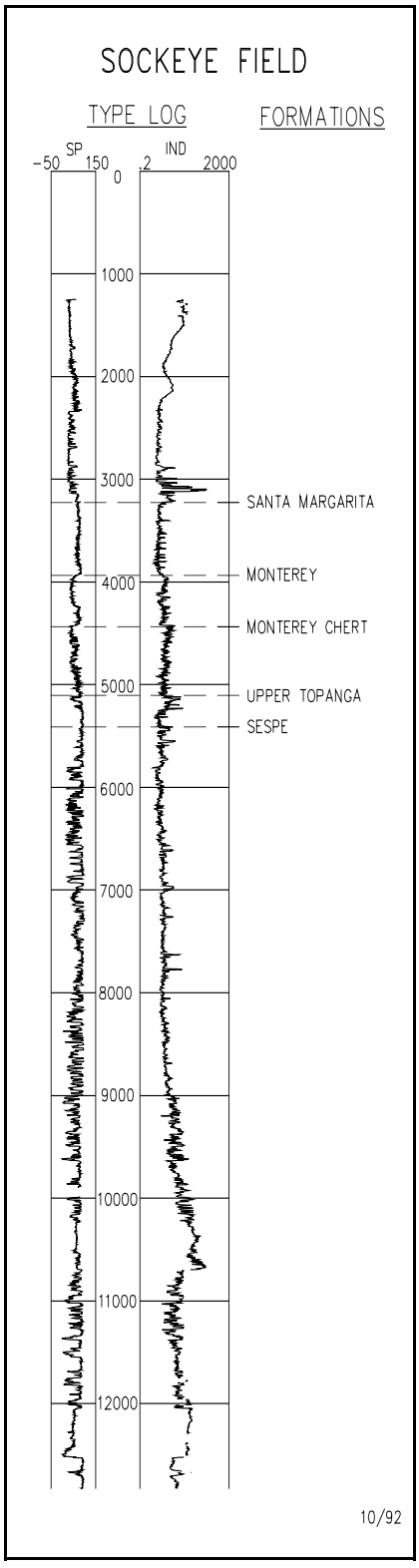

Figure J-3. Sockeye Field type log.

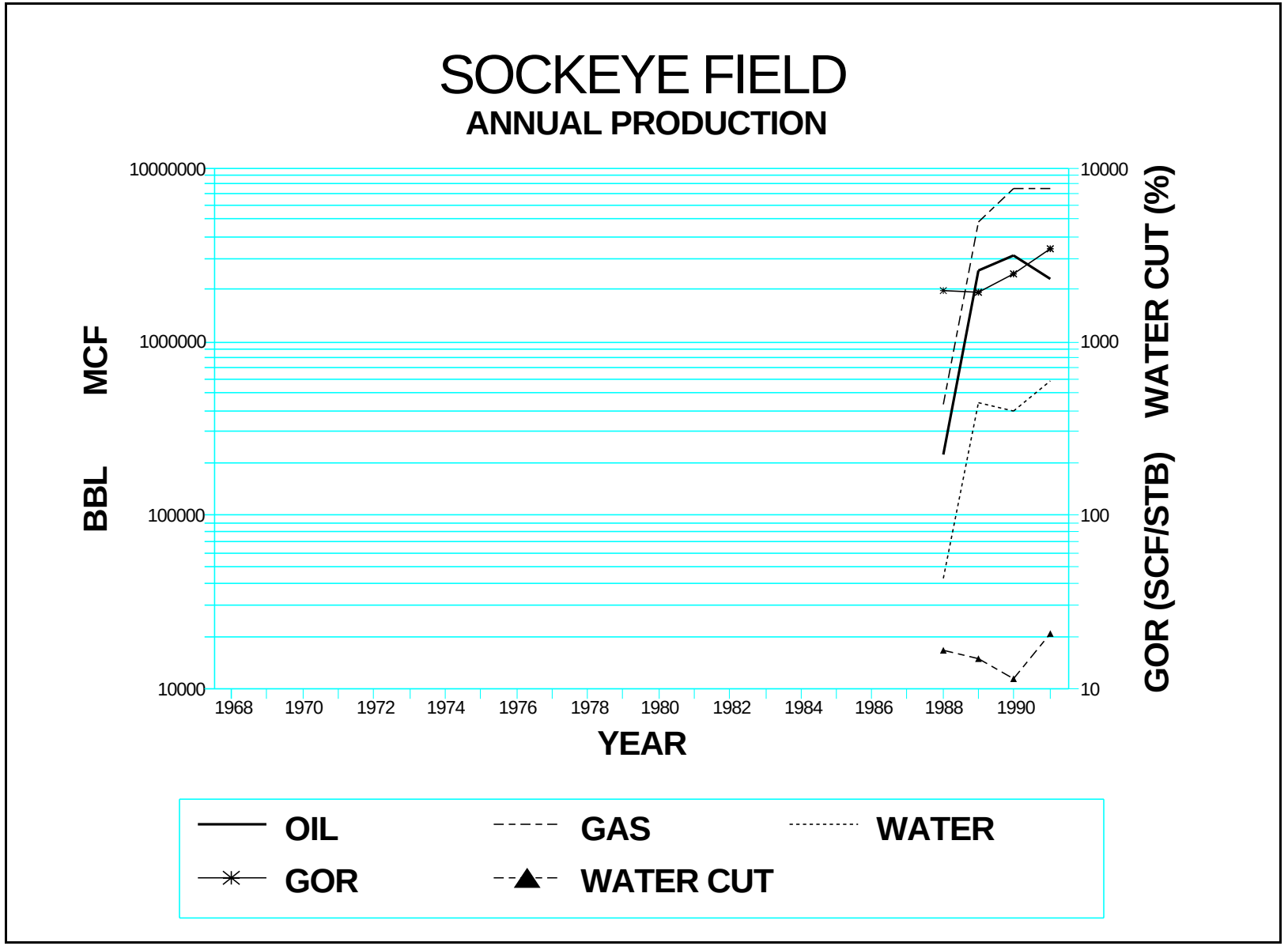

Figure J-4. Annual production from Sockeye Field.

Table J-1. Sockeye Field Monterey reservoir characteristics.

Sockeye Field	
Monterey Reservoir Characteristics	
Average Depth	4,500 feet
Porosity	2-30 %
Permeability	0.1-1,000 md
Reservoir Temperature	140° F
Original Reservoir Pressure	2,140 psig
Connate Water Saturation	45-55 p%
Gross Pay Thickness	320 feet
Net Pay Thickness	200-250 feet
Productive Area	2,900-3,300 acres
Gas Specific Gravity	0.85

Table J-2. Sockeye Field Monterey fluid characteristics.

Sockeye Field	
Monterey Reservoir Fluid Characteristics	
Average Oil Gravity	16.5° API
Saturation Pressure	2,140 psig
Viscosity	11 cp
Initial Producing GOR	435 SCF/STB
Initial Oil Formation Volume Factor	1.14 RB/STB

Table J-3. Sockeye Field Sespe reservoir characteristics.

Sockeye Field	
Sandstone (Upper Sespe) Reservoir Characteristics	
Average Depth	5,700 feet
Porosity	20-30 %
Permeability	1-7,200 md
Reservoir Temperature	150° F
Original Reservoir Pressure	2,520 psig
Connate Water Saturation	30-40 %
Gross Sand Stratigraphic Thickness	850 feet
Net Sand Thickness	40-100 feet
Productive Area	900-1,200 acres
Gas Specific Gravity	0.675

Table J-4. Sockeye Field Sespe fluid characteristics.

Sockeye Field	
Upper Sespe Reservoir Fluid Characteristics	
Average Oil Gravity	29.5° API
Saturation Pressure	2,520 psig
Viscosity	1.20 cp
Initial Producing GOR	1,960 SCF/STB
Initial Oil Formation Volume Factor	1.24 RB/STB

Table J-5. Sockeye Field production.

Field: SOCKEYE

Year	Wells at Year End			Oil Production				Gas Production		Water Production			GOR
	Prod	Other	Total	Barrels	bpd	bpd/ Well	Cumulative Barrels	Mcf	Cumulative Mcf	Barrels	Cumulative Barrels	% Cut	CFB
1968													
1969													
1970													
1971													
1972													
1973													
1974													
1975													
1976													
1977													
1978													
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1980													
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1986													
1987													
1988	5	0	5	218,655	2,403	481	218,655	430,543	430,543	43,041	43,041	16	1,969
1989	9	0	9	2,557,451	7,007	779	2,776,106	4,902,875	5,333,418	439,983	483,024	15	1,917
1990	13	1	14	3,096,776	8,484	653	5,872,882	7,483,225	12,816,643	395,999	395,999	11	2,416
1991	13	1	14	2,274,232	6,231	479	8,147,114	7,667,630	20,484,273	592,165	988,164	21	3,372

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 the wisest use of our land and water resources, protecting our fish and wildlife, 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 assure that their development is in the best interest of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. Administration.