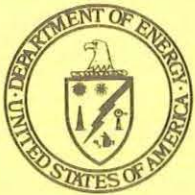


DOE/EIS-0012

**FILE
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Final Environmental Impact Statement



**Petroleum Production at
Maximum Efficient Rate
Naval Petroleum Reserve No. 1
(Elk Hills)
Kern County, California**

U.S. Department of Energy

August 1979

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COVER SHEET
FINAL ENVIRONMENTAL IMPACT STATEMENT
DOE/EIS-0012

(a) Lead Agency: The Department of Energy
(b) Proposed Action: Petroleum Production at Maximum Efficient Rate, Naval Petroleum Reserve No.1 (ELK HILLS), Kern County, California.

(c) For Further Information Contact: (1) Mr Richard Russell, P.E., Environmental Coordinator, Officer in Charge of Construction, Naval Facilities Engineering Command Contracts, Elk Hills, P.O. Box 40, San Bruno, California 94066, 415-877-7064. (2) Dr. Robert J. Stern, Acting Director, NEPA Affairs Division, Office of the Assistant Secretary for Environment, Room 4G-064, Forrestal Building, Washington, D.C. 20585, 202-252-4600. (3) Mr. Stephen H. Greenleigh, Esq., Acting Assistant General Counsel for Environment, Room 6G-087, Forrestal Building, Washington, D.C. 20585, 202-252-6947.

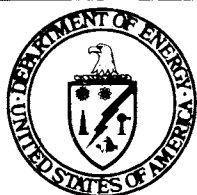
For Copies of the EIS Contact: Mr. Richard Russell at the address noted above.

(d) Designation: Final EIS

(e) Abstract: Proposed is the increase in petroleum production at Elk Hills from 160,000 barrels per day to a peak maximum efficient rate of between 200,000 and 240,000 barrels per day. This production increase involves; operation of collection, distribution, and injection systems for oil, gas, and water; operation of gas plants to handle up to 354 million cubic feet per day; loading up to 1.5 million gallons per day of gas liquids to trucks and railroad cars; and operation of surface handling facilities for disposal of up to 30,000 barrels per day of produced wastewater. Alternatives considered include; (1) alternative methods to produce oil from the reserve; (2) alternatives methods of shipping gas liquids from the reserve; (3) alternative locations for the railroad car loading facility; (4) postponement of the proposed action; and (5) cancellation of virtually all development and production at the reserve.

(f) The review period for this final EIS ends 30 days after its availability is announced in the Federal Register weekly report of the Environmental Protection Agency.

Final Environmental Impact Statement



**Petroleum Production at
Maximum Efficient Rate
Naval Petroleum Reserve No. 1
(Elk Hills)
Kern County, California**

U.S. Department of Energy
Washington, D.C. 20585

August 1979



SUMMARY

Statement Type: () Draft (X) Final Environmental Impact Statement

Prepared by: Department of Energy, Assistant Secretary for Resource Applications, Office of Naval Petroleum and Oil Shale Reserves

Comments to: Captain John Dick-Peddie
Office in Charge of Construction, Elk Hills
P. O. Box 40
San Bruno, California 94066

Title: Petroleum Production at Maximum Efficient Rate
Naval Petroleum Reserve No. 1 (Elk Hills)
Kern County, California

Type of Action: (X) Administrative () Legislative

1. Brief Description of Proposed Action: Pursuant to Public Law No. 94-258, the Naval Petroleum Reserves Production Act of 1976, the Naval Petroleum Reserves were opened up for production at maximum efficient rates (MER) consistent with sound engineering practices, for a period of 6 years. Additional open-up periods of 3 years each are also authorized if recommended by the President and approved by Congress. A major objective of this Act was to increase domestic petroleum production.

MER production for Naval Petroleum Reserve No. 1 (NPR-1) is expected to peak at between 205,000 and 240,000 barrels per day (B/D) of crude oil in 1982. The law also provides that the Reserve shall be produced in a manner which will secure maximum hydrocarbon recoveries. Consistent with this mandate, the producing reservoirs are pressure maintained by the injection of residue natural gas and water. Production at this peak rate will be reached after a rapid buildup and then gradually decline. The proposed project involves: operation of collection, distribution, and injection systems for oil, gas, and water; operation of existing and new gas processing facilities to handle up to 354 million cubic feet per day; loading of up to 1,500,000 gallons per day of gas liquids to trucks and railroad cars; operation of surface handling facilities for disposal of up to 30,000 B/D of produced wastewater; operation of electric power distribution systems, cathodic protection systems, and support facilities;

construction and use of well drilling access roads and the rehabilitation of existing primary road systems.

All facilities are located at NPR-1, in western Kern County, California, with the following exceptions: (a) existing Chevron gas processing facility at McKittrick (2 miles west of NPR-1) for handling 60 million cubic feet per day; and (b) new gas liquids pipeline system, railroad spur, and railroad car loading facility to be located east of Taft (6 miles south of NPR-1).

2. Summary of Environmental Impacts and Adverse Effects: Positive impacts of the project would be increased employment, use of vacant housing, increased local spending on goods and services, and the potential for increased domestic petroleum production with a commensurate decrease in the U.S. balance of payment deficit. The achievement of increased production, however, is dependent on continued buyer interest. Adverse effects of the project would include increased air pollution emissions, increased noise levels, reduction in vegetation, loss of the Petroleum Reserve for use in emergency situations, increased traffic levels, and decreased visual quality. It is anticipated that differential impacts of the project and alternatives could be significant enough to be controversial.

3. Alternatives Considered: Sale of up to 360 million cubic feet per day of the residue gas planned for near-term injection to maintain field reservoir pressure; injection rather than sale of a major portion of gas liquids; all-truck transportation of gas liquids; alternate locations for the railroad car loading facility to a point within NPR-1 boundaries; postponement of action; cancellation of virtually all development and production at NPR-1; and substitute ways of increasing energy production if there is no action at NPR-1.

4. Comments Received: Comments were received from the United States Departments of Agriculture; Army; Interior; and Transportation; the Advisory Council on Historic Preservation; Environmental Protection Agency; the State of California; regional and local government agencies; private organizations; and individual citizens.

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I. INTRODUCTION AND PROJECT DESCRIPTION

A. Purpose and Summary

1. Purpose

On April 5, 1976 Congress passed Public Law 94-258, directing that Naval Petroleum Reserve No. 1 (NPR-1), Kern County, California, (Fig. 1-1), be opened up and produced at the maximum efficient rate (MER) consistent with sound engineering practices for a period not to exceed 6 years after the date of enactment of Public Law 94-258. At the conclusion of the 6-year production period, the President may, with the approval of Congress, extend the period of production for additional periods of not to exceed 3 years each. Open-up of the Reserve began on July 3, 1976. The production rate at NPR-1 during the fourth quarter, 1978, was approximately 120,000 barrels of oil per day (BOPD). This document details environmental impacts associated with petroleum production of the Elk Hills Reserve at the estimated peak MER of between 205,000 and 240,000 BOPD.

Public Law 94-258 also calls for securing pipeline capacity for not less than 350,000 BOPD from NPR-1 to a marketing terminal. Available pipeline capacity in the vicinity of NPR-1 is approximately 160,000 to 170,000 BOPD and the Government is, therefore, considering the construction of a new conveyance system to move its crude oil from Elk Hills. Conveyance system alternatives and associated environmental impacts are described in the Draft Environmental Impact Statement "Crude Oil Transport Alternatives from Naval Petroleum Reserve No. 1, Tupman, California, Part One of Three, Elk Hills/Coalinga Conveyance System; Part Two of Three, Elk

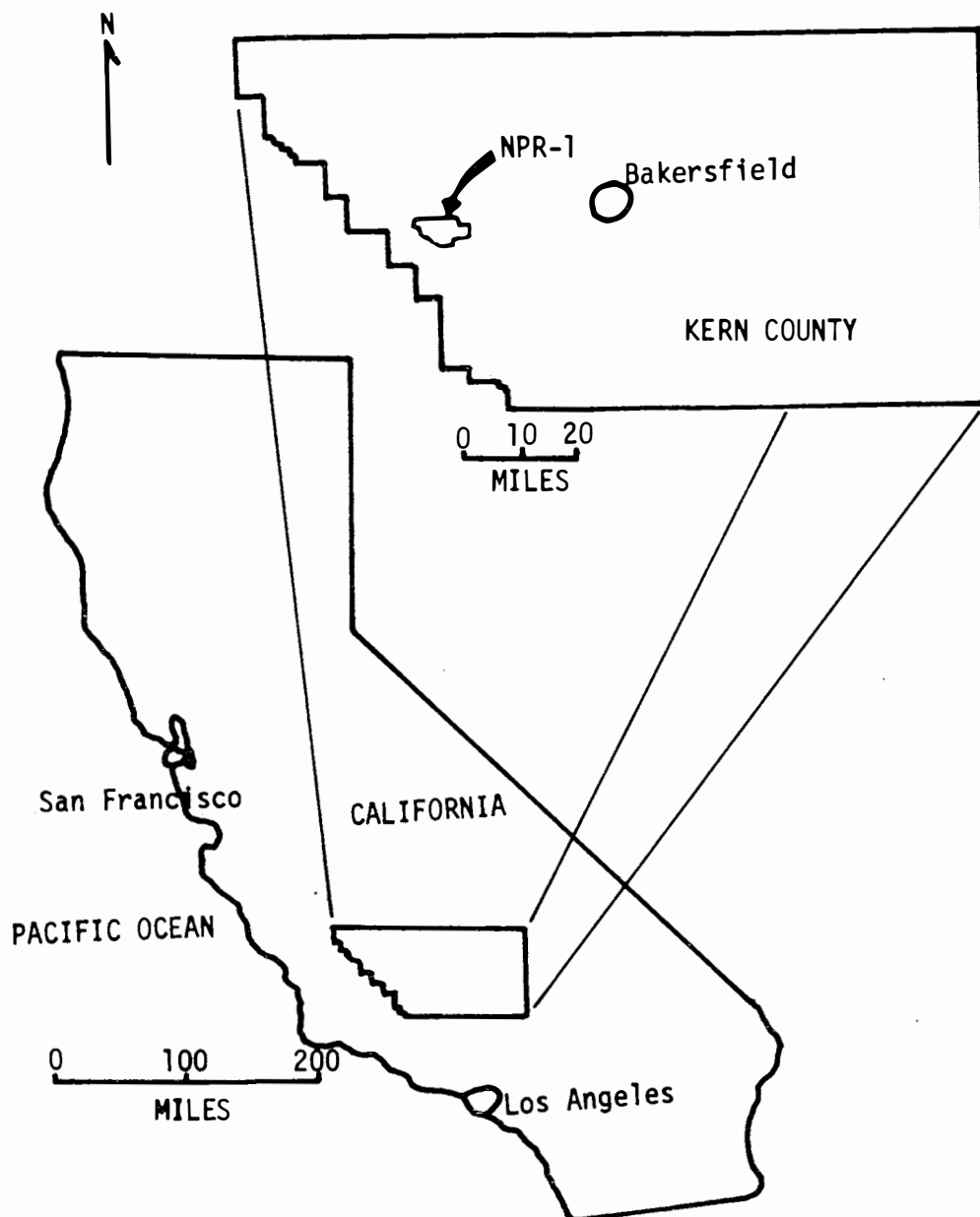


Figure 1-1. Location of the U.S. Naval Petroleum Reserve No. 1 at Elk Hills, Kern County, California.

Source: U.S. Navy

Hills/Port Hueneme Conveyance System; and Part Three of Three, Elk Hills/SOHIO Pipeline Connection Conveyance System," April 18, 1977; and in the Final Environmental Impact Statement (FEIS) "Crude Oil Transport from Naval Petroleum Reserve No. 1, Tupman, California", September 1977.

2. Background

The concept of a government-managed petroleum reserve began with President Theodore Roosevelt and his concern for assuring a secure source of oil supply for Navy ships. His concern eventually led to an Executive Order issued on September 27, 1909, by President William Howard Taft, withdrawing certain public lands from general sale. These lands included the Elk Hills.

On June 25, 1912, at the request of the Secretary of the Navy, the Secretary of the Interior identified for the Navy 38,073 acres of potential oil-bearing public lands in California, previously withdrawn from public sale, sufficient to insure a supply of 500 million barrels of oil. Accordingly, President Taft issued an Executive Order, dated September 2, 1912, setting aside these lands as NPR-1. At that time, of the 38,073 acres set aside, 12,103 acres appeared to be owned by private interests and 25,970 acres were owned by the Government. Except for a brief period between 1921 through 1927, when it was assigned to the Department of the Interior, management of the Reserve was vested in the Secretary of the Navy. Pursuant to Public Law 95-91, August 4, 1977 (Appendix A), management of this, as well as the other reserves, now rests with the Secretary of Energy (effective October 1, 1977).

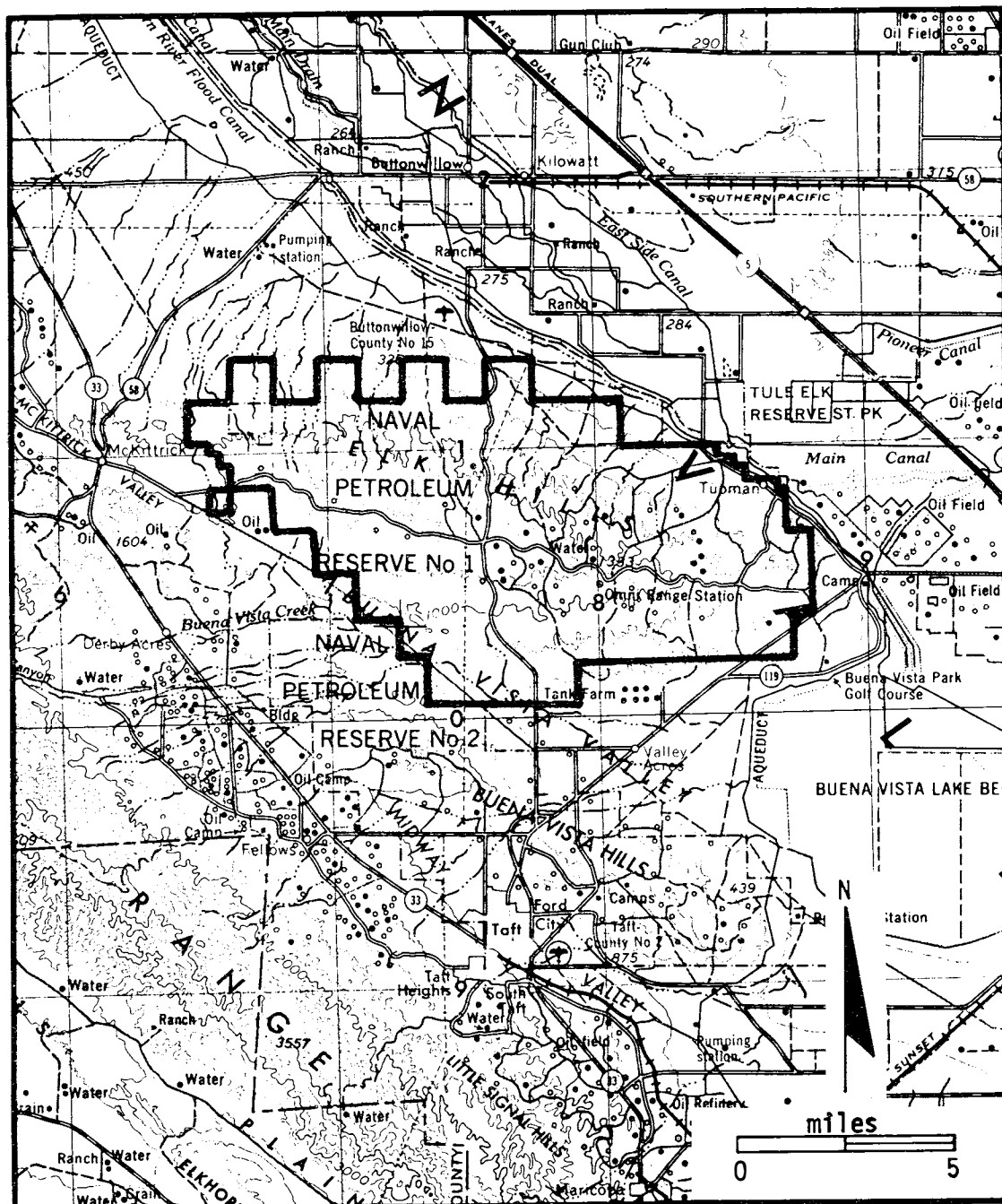
First production from NPR-1 is generally believed to have begun in 1919, from a well drilled by Standard Oil Company of California (Chevron) to the Shallow Oil Zone in the central part of the Reserve. However,

USGS records indicate that a much earlier well was completed on June 16, 1911, with an initial production of 75 BOPD. Development was rapid on industry-owned leases within Elk Hills following the 1919 completion and production in 1921 reached a high of approximately 60,000 BOPD. Subsequently, with the cancellation of leases, production was steadily reduced and maintained at approximately 10,000 BOPD from 1932 to 1943. By November 1942, some 153.5 million barrels of oil had been withdrawn from the Reserve. Toward the end of World War II, an extensive development program at NPR-1 was initiated by the government in order to raise the production rate to 65,000 BOPD as directed by a Joint Resolution of Congress. During the war years (1942-1945), approximately 27 million barrels of oil were produced from the Reserve. On August 18, 1945, production was reduced to an authorized rate of 15,000 BOPD. That rate was subsequently lowered in several increments to approximately 2,500 BOPD, which was the production rate just prior to open-up on July 3, 1976.

On October 15, 1942, President Franklin D. Roosevelt signed an Executive Order enlarging the limits of the Reserve to its present area of 46,095 acres (Fig. 1-2). The ownership allocation of land sections within NPR-1, as well as the Range and Township designations, is given in Figure 1-3.

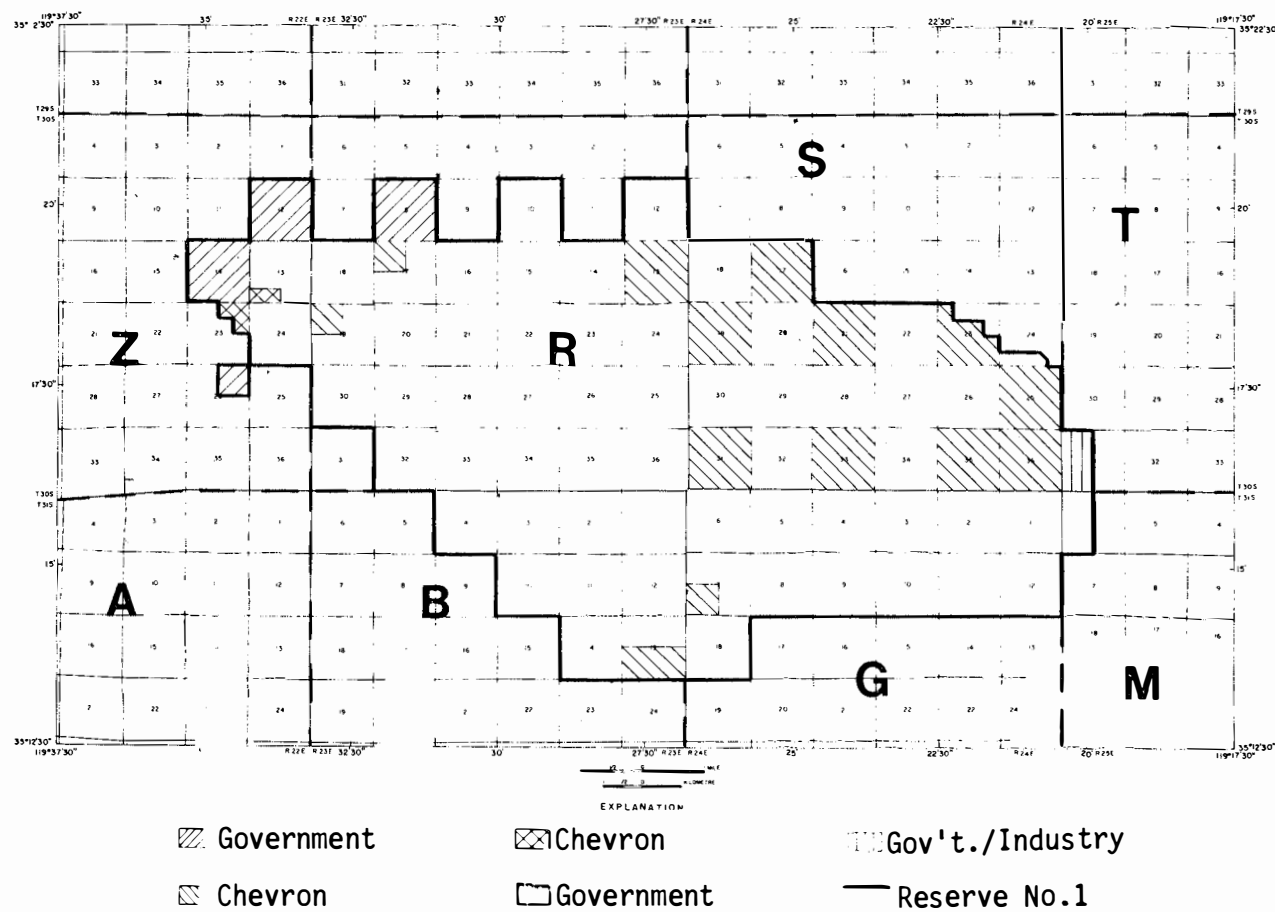
On November 20, 1942, following enlargement of the Reserve, a Unit Plan Contract (UPC) was negotiated with Chevron for the exploration, development, and operation of all Reserve lands included in the UPC. This concept was utilized since Chevron owns a significant amount of land within the Reserve (8,541 acres or 18.5%). Some time elapsed following negotiations and this UPC was ultimately authorized by Congress June 17, 1944, and approved by the President on June 28, 1944.

As amended and supplemented, the UPC provides for control of the Reserve to be vested in the Secretary of the Navy (now Secretary of



Source: U.S. Geological Survey, Bakersfield, scale 1:250,000.

Figure 1-2. General Location and Boundary of Naval Petroleum Reserve No. 1



Source: U.S. Geological Survey, 1975.

Figure 1-3. Present Area, Land Ownership, and Boundary of Naval Petroleum Reserve No.1

Energy) acting through the Director, Office of Naval Petroleum and Oil Shale Reserves and the Officer in Charge, Naval Petroleum Reserves in California. The contract further provides for exploration, development, and producing operations within the Unit to be performed under the supervision of an Operating Committee comprised of one government and one Chevron member, each having one vote. Also, as provided by the contract, an Engineering Committee, consisting of engineers and geologists, functions in an advisory and determinative capacity as a consulting body for the Operating Committee. The Engineering Committee has three members appointed by Chevron and three members appointed by the government. Day-to-day operation of development and production facilities is carried out by a prime contractor designated the "unit operator".

In FY 1974 Congress approved a 5-year exploration and development program for NPR-1 which provides for the assessment of the resource potential at Elk Hills as well as the development of the producing capability of the reserve to a maximum efficient production rate. Prior to open-up on July 3, 1976, two Candidate Environmental Impact Assessments were prepared. The first Assessment, prepared in 1974, assumed production of 160,000 BOPD for 1 year. The 160,000 BOPD represented the maximum existing spare pipeline capacity from the Reserve to marketing terminals identified at that time. The second Assessment assumed development of the field to a 400,000 BOPD production capability. Both Assessments were filed with the Navy's Environmental Impact Statement (EIS) Review Panel which determined that neither represented a major Federal action. The panel determined that an EIS would be needed if production were to exceed 160,000 BOPD. To date, production has been limited to less than 150,000 BOPD primarily due to pipeline, gas handling and other production facility constraints. When these constraints are relieved, it is expected that production at NPR-1 will reach MER (between 205,000 and 240,000 BOPD). This MER will be reached after a fairly rapid buildup before slowly declining (Fig. 1-4).

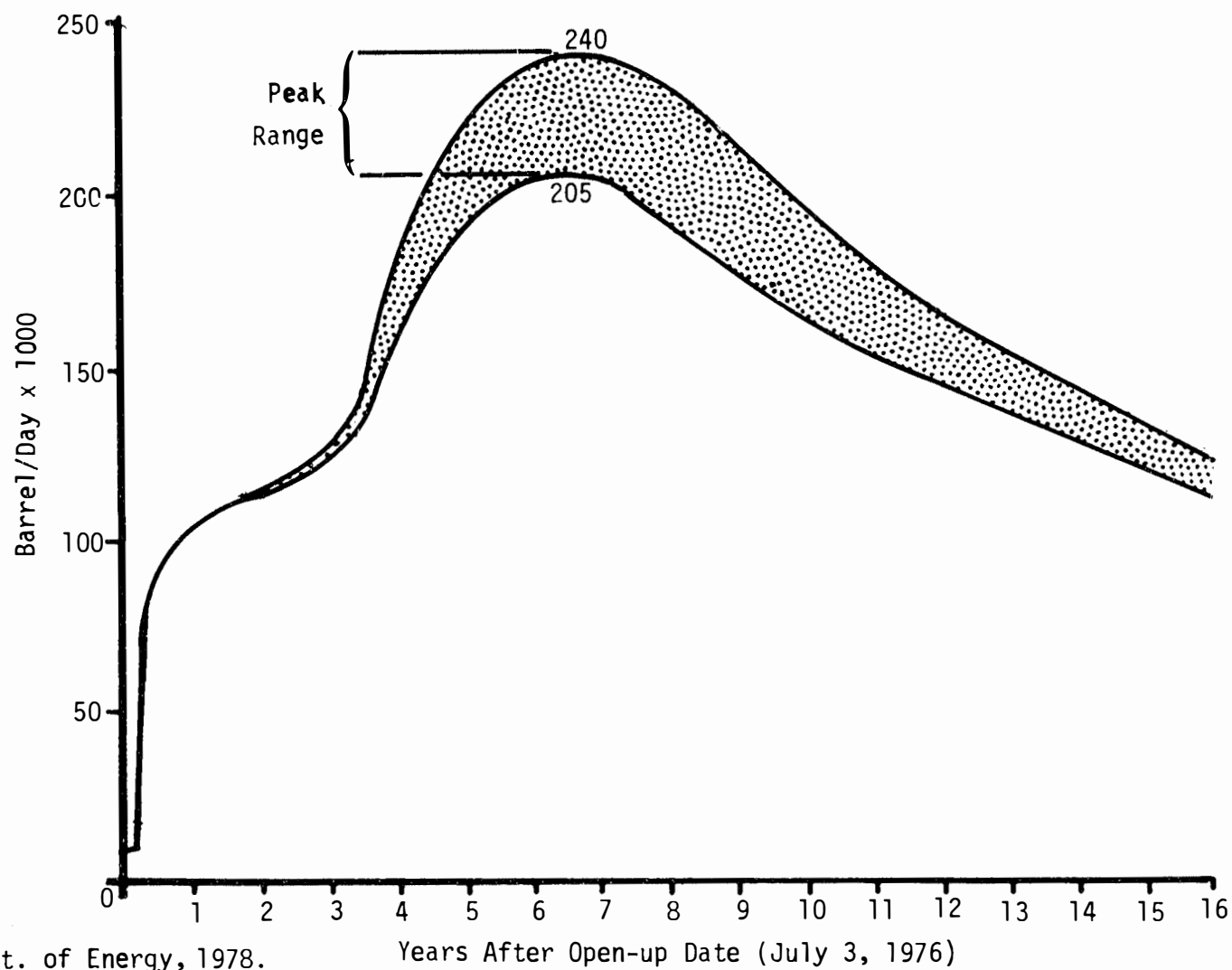


Figure 1-4. Expected MER Production at NPR-1

3. Summary

The proposed action would include operation of facilities at NPR-1 as required to achieve the purpose of crude oil production at MER. The overall elements of the action are as follows:

- o Production at MER, initially estimated to be between 205,000 and 240,000 BOPD and thereafter declining with time (Fig. 1-4), assuming gas injection and water injection field-pressure-maintenance programs (alternate production programs will also be considered).
- o Operation of collection, injection, distribution systems, and shipping facilities for oil, gas, potable water, and wastewater.
- o Operation of the existing 35R gas processing facility at a capacity of 94 million cubic feet per day (MMCF/D).
- o Operation of new gas processing facilities to handle between 200 and 500 MMCF/D.
- o Operation of on-reserve storage tanks for crude oil and gas liquids.
- o Operation of crude oil and gas liquid loading facilities, including a railroad spur and rail car loading facilities for gas liquids.
- o Operation of electric power distribution system.
- o Operation of surface handling facilities for treating, injection, and disposal of 200,000 barrels per day (B/D) of produced wastewater, and make-up injection water.

- o Operation of cathodic protection system.
- o Operation of support facilities.
- o Construction and use of access roads for future well drilling; and the continuing rehabilitation of existing primary road systems on the reserve.

B. Description of Proposed Facilities

A simplified diagram of the overall production facilities is presented in Figure 1-5. For simplicity, all of the production zones are not shown on the figure, but the basic disposition of the various streams is indicated and specific details for individual zones will be described in the following paragraphs.

1. Production Facilities

Production activities consist of three basic elements: first, drilling of new wells; second, withdrawal of oil, gas, and water from new and existing production wells; and third, injection of gas and water into new and existing injection wells. The basic purpose of this project is to produce crude oil from the Reserve at MER. In order to reduce the possibility of subsidence from production withdrawals and to ensure that the desired MER is achieved, gas and water are injected into selected wells.

Production from Elk Hills is from sediments of widely differing compositions located at various depths beneath the surface. Specific producing zones have been identified and named. The important producing zones for this project (see Fig. 1-6) are as follows (listed from shallowest to deepest): the Dry Gas Zone, the Shallow Oil Zone, the Olig Zone, the Stevens Zone, and the Carneros Zone. Petroleum production is from the Shallow Oil, Stevens, and Carneros zones only. Production from the

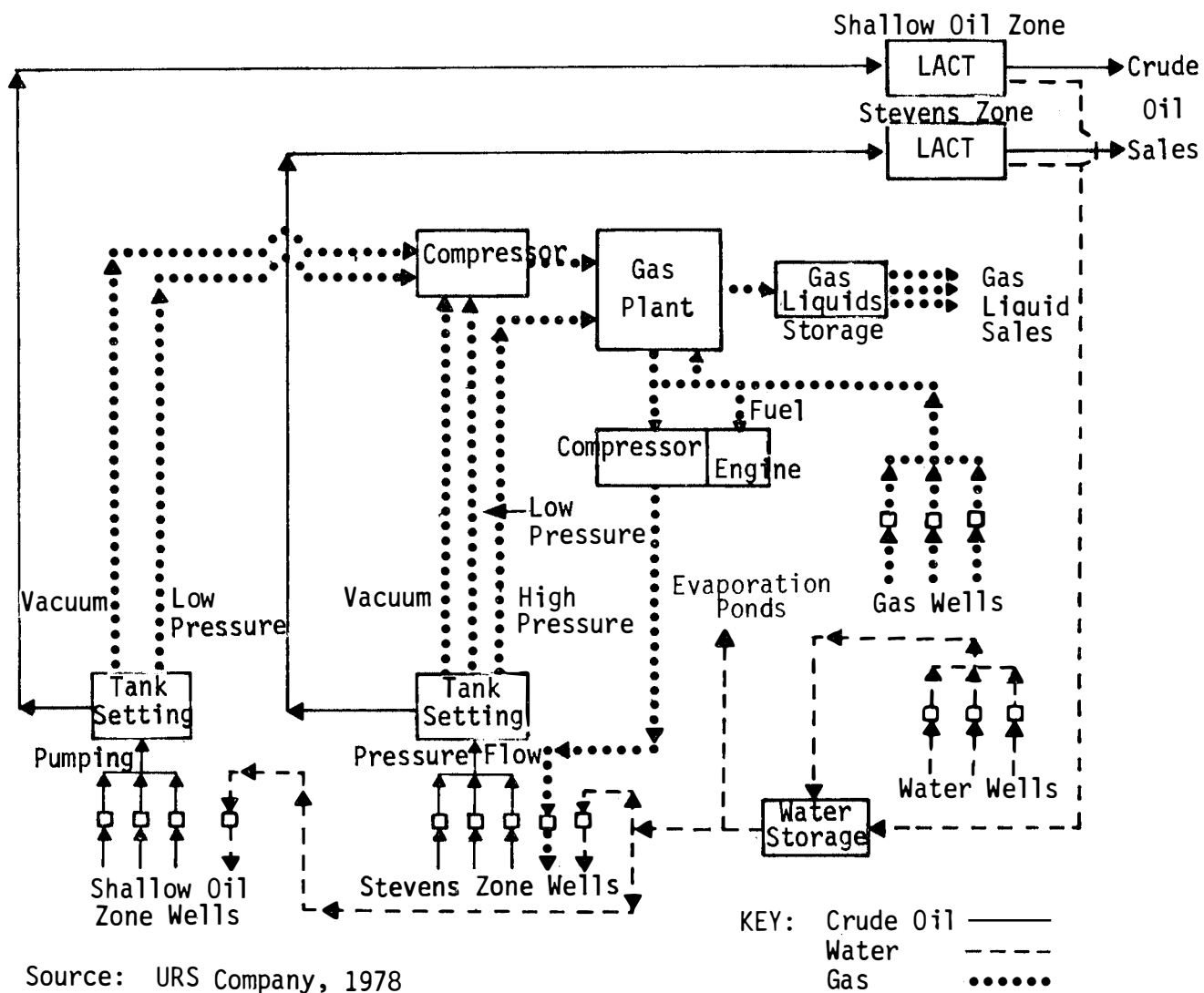
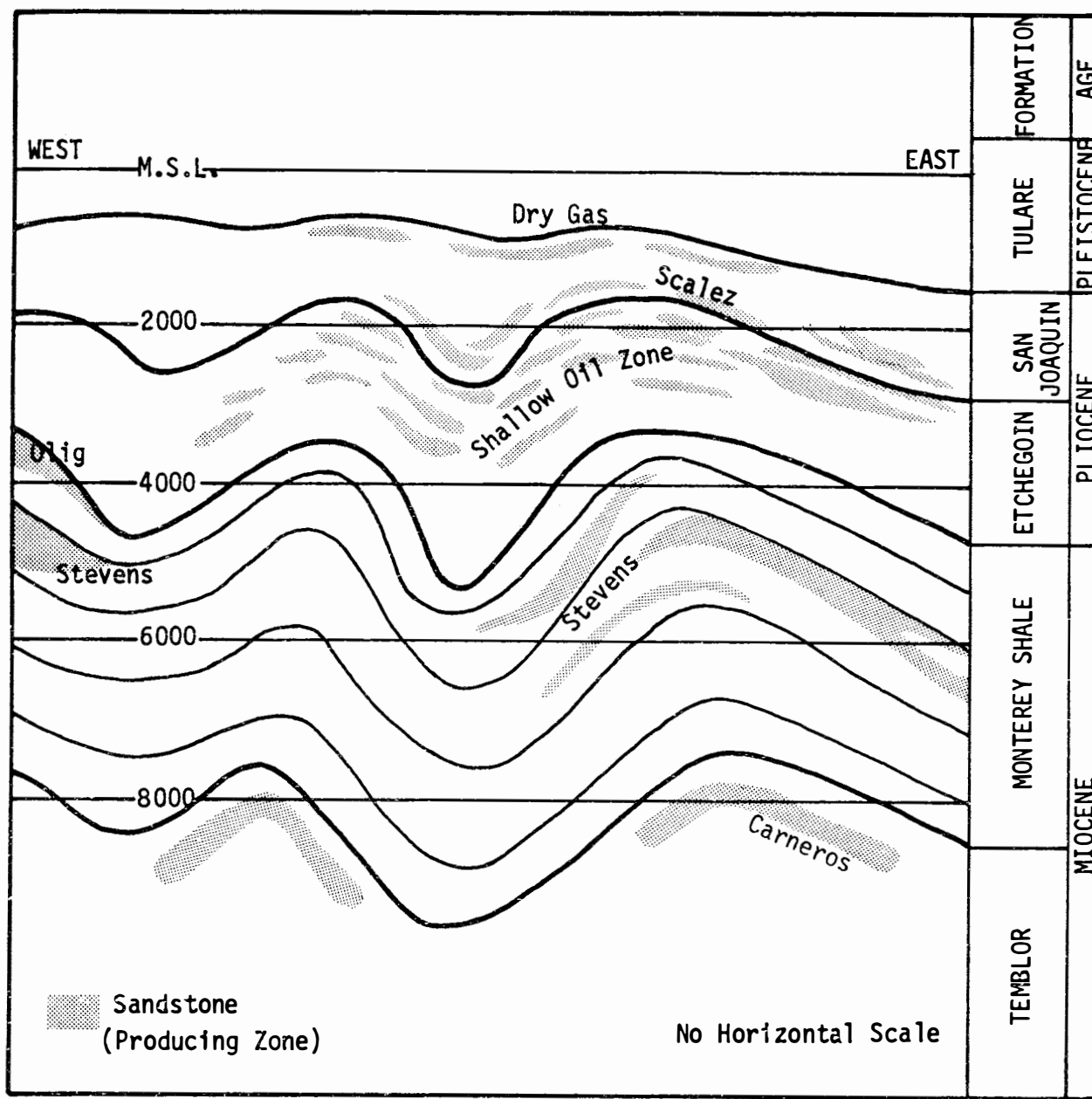


Figure 1-5. Overall Production Schematic



Source: Lance, R. J., 1968.

Figure 1-6. Simplified Geologic Cross-section of the Elk Hills Oil Field Showing Major Producing Zones

Shallow Oil Zone requires pumping, while the hydrocarbons from the Stevens and Carneros zones have sufficient reservoir pressure to be capable of flowing production, but will require pumping units in the future. The other zones yield only gas. The petroleum production areas yield a combination of oil, gas, and water which requires separation into gas and liquid streams after withdrawal. The liquid stream (oil and water) is separated in tanks of the Lease Automatic Custody Transfer (LACT) system. The separated water is either injected into selected wells on the periphery of the producing zones or is pumped to evaporation ponds on the reserve. When additional water is required for such injection, it is obtained from other selected wells on the Reserve (see subsection on injection system). The gas stream is subsequently separated in a gas processing facility into gas liquids for sale and dry gas. The associated dry gas (primarily methane and ethane) is injected into wells of the oil production zones to maintain reservoir pressures (see Section V for alternative production programs). Gas produced from the Dry Gas and Olig zones is either sent to a gas processing facility, injected directly into gas injection wells, or used as a fuel to run engines for gas compression.

a. Production and Disposal Quantities

Operation at the rate of 205,000 BOPD would result in expected production of oil, gas, and water from each of the production zones as shown in Table 1-1. The table also indicates disposition of the various streams. The quantities given in the table are a best estimate and represent an annualized average. Peak production may be somewhat higher. As production continues, overall volumes would decline as shown in Figure 1-4. It is also conceivable that as production continues, other significant changes in some of these figures would occur which could have important implications. For example, if the gas production is significantly higher, additional gas processing capacity could be required.

Table 1-1

PRODUCTION AND DISPOSITION OF OIL, GAS, AND
WATER STREAMS AT MER

Disposition	Zone of Origin				Total
	Stevens and Olig	Shallow Oil	Carneros	Dry Gas	
<u>OIL STREAM (1,000s BOPD)</u>					
All to LACT tanks	179.4	25.0	0.9	0	205.3
<u>GAS STREAM (MMCF/D)</u>					
Used as Fuel	0	5	0	0	5
Existing and new gas plants	264	10	20	0	294
Existing Chevron plant at McKittrick	60	0	0	0	60
Used directly for injection	0	0	0	50	50
<u>WATER STREAM (1,000s B/D)</u>					
All injected into oil production field wells					198

b. New Wells

In order to produce at peak MER, additional wells are required at NPR-1. Prior to the inception of the Total Capability Development Program in fiscal year 1974, approximately 1279 wells had been drilled at Elk Hills. Between fiscal year 1974 and fiscal year 1979 (through September 30, 1978), an additional 563 wells have been drilled. It is anticipated that development and exploratory drilling between September 30, 1978 and September 30, 1985 (fiscal year 1979 through fiscal year 1984) will result in approximately 351 new wells providing a grand total at Elk Hills of 2,193 wells. Drilling activity indicated for fiscal year 1979 and subsequent years is only an estimate and may vary depending on the accumulation of additional geophysical and reservoir data. Further, drilling beyond fiscal year 1984 may be required to develop new discoveries and to maintain a maximum productive capability. Table 1-2 presents the distribution of these wells between production zones and type of well.

2. Gathering and Processing Systems

a. Pipelines and Tank Settings*

Gas throughout the Reserve is gathered and transported to the gas processing plants for separation. Gas from gas producing zones flows directly to the processing plants for separation. Gas and oil are coproduced from oil producing zones. This mixture flows from the wells to a gas/oil separator system and tank setting, where gas is removed to the processing plants. Several steps of gas/oil separation take place, depending on the specific zone of origin involved, as shown on Figure 1-7. Only three of the existing Shallow Oil Zone tank settings now have vapor

*Tank setting is a term (used in the California oil industry) which is used to indicate the equipment for achieving initial gas/oil separation and storage of crude oil from one or more producing wells. A schematic of a typical tank setting is given in Figure 1-7.

Table 1-2

DISTRIBUTION OF EXISTING AND NEW WELLS

NEW WELLS REMAINING TO BE DRILLED
SEPTEMBER 30, 1978 to SEPTEMBER 30, 1985

Zone	Development Wells	Exploration Wells	Total Wells
Tulare	18	2	20
Dry Gas	11	2	13
Shallow Oil	82	2	84
Olig	7	--	7
Stevens	201	8	209
Carneros	10	7	17
Deep	--	<u>1</u>	<u>1</u>
TOTALS	329	22	351

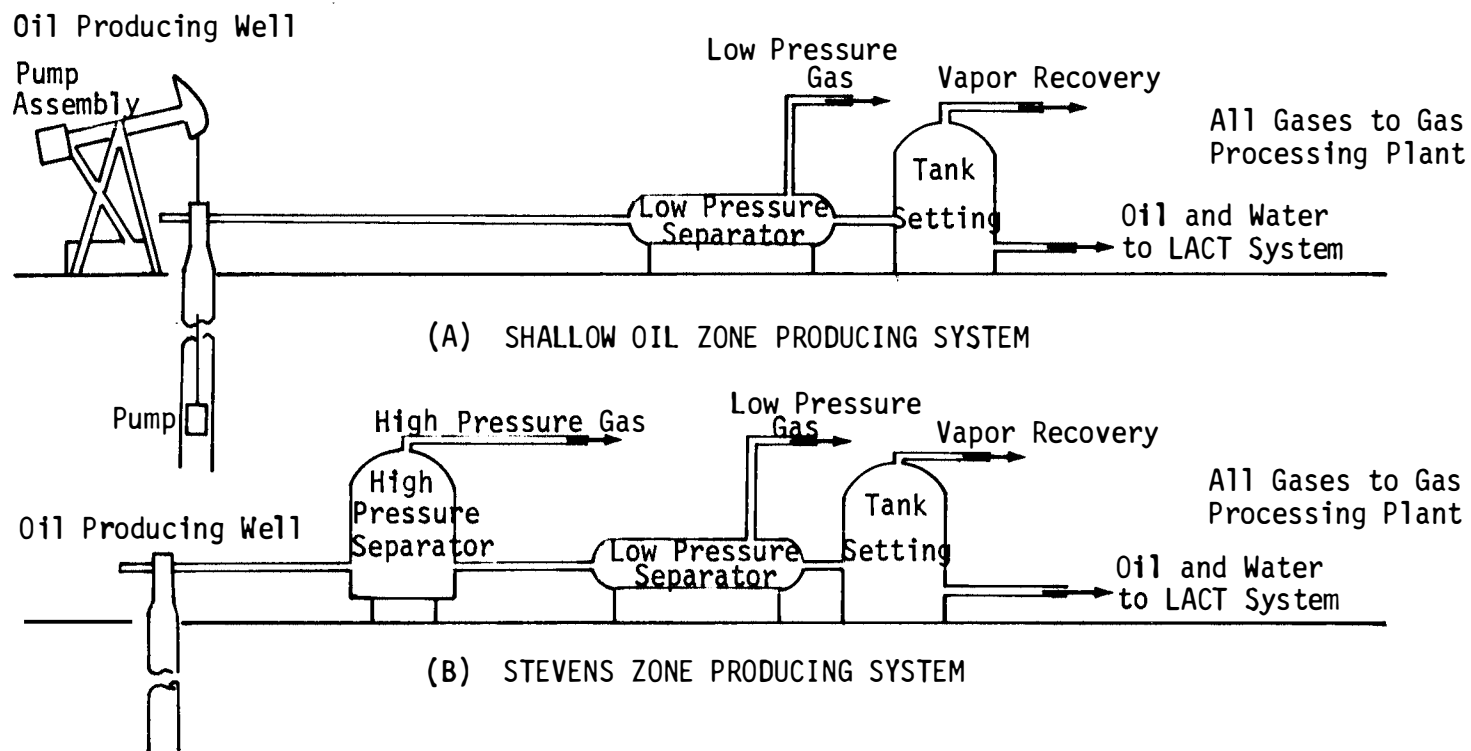
DISTRIBUTION OF EXISTING WELLS SEPTEMBER 30, 1978

Zone	Producible Wells	Injection Wells	Shut-in Wells*	Plugged and Abandoned Wells**	Total Wells
Tulare	2	--	--	--	2
Dry Gas	33	--	--	--	33
Shallow Oil	675	7	416	213	1,311
Section 14B	7	--	6	4	17
Antelope Shale	1	--	4	--	5
Stevens	422	19	7	15	463
Santos	--	--	--	(1)***	0
Carneros	<u>11</u>	<u>--</u>	<u>--</u>	<u>(1)***</u>	<u>11</u>
TOTALS	1,151	26	433	232	1,842

*Includes high-water cut, high gas/oil ratio, uneconomic, and wells in need of repair.

**Includes suspended drillers.

***Included as dual completion.



Source: URS Company, 1978

Figure 1-7. Gas/Oil Separation Systems and Tank Settings

recovery lines connected to the gas processing plant. For this project, all tank settings would have recovery lines connected for gas processing. Oil throughout the Reserve is gathered in the tank settings and transported to a Lease Automatic Custody Transfer (LACT) area for separation of the associated water and sale of the oil.

Existing lines are used where possible; however, at peak MER there would be an increase in flow rates and some of the existing gathering pipeline systems would be replaced. For production, some additional compressors are required, some existing tank settings are to be modified, and some new tank settings are needed, with appropriate connections to new wells. Further discussion is presented in Appendix O.

b. Gas Processing Plants

All new gas processing plants are designed to achieve an approximate 63 percent recovery of propane. Total gas liquids produced at MER would be about 1 million gallons per day.

New Gas Plants. To minimize gas gathering and dry gas injection costs, two new plants are to be located near the existing 35R plant (Fig. 1-8). The plants include facilities for extracting the gas liquids from the rich gas at low-temperature and separating them into propane, butane, and natural gasoline products for sale. Two new plants would be constructed, each with a capacity of 100 MMCF/D. Each new plant would have a compressor station with four compressors, three with 5,500 HP engines and one with a 2,000 HP engine. The two plants are to be called Low Temperature Separation Plants Numbers 1 and 2 (LTS-1 and LTS-2).

Existing Gas Plant. The existing gas plant, located at Section 35R on the Reserve, is of an old design. This plant could be upgraded to improve liquid recovery. The capacity of this plant will be limited to about 94 MMCF/D when processing a field mix of Reserve gas. The manpower and energy usage of this plant are significantly higher

than that of a new plant. Currently, this plant recovers only about 43 percent of propane.

Existing Chevron Gas Plant. Processing in the existing Chevron USA, Incorporated's McKittrick (Chevron) gas plant located at 17Z is available through a processing agreement, to handle about 60 MMCF/D of rich gas. The Chevron gas plant is of modern design (it recovers 85% propane and all other higher boiling temperature hydrocarbons as gasoline) and no upgrading is required to form a part of expanded reserve production. However, new pipelines from the Reserve to the plant are required (90,000 feet of 14-inch and 40,000 feet of 3-inch diameter pipe). A new compressor station is to be constructed at 35R for injection of the returned dry gas.

Gas Plant Products. The wet gas coproduced with the oil is processed to remove propane and higher boiling temperature hydrocarbons. Table 1-3 indicates the estimated gas plant production recoveries. The recoveries shown are based upon current gas process plant technology and practices for gas mixes typical of those produced by the Reserve.

c. LACT System

The Lease Automatic Custody Transfer (LACT) system, in addition to monitoring and metering, consists of a washing unit, settling unit, holding tank, and LACT pump as shown in Figure I-9. It receives oil from tank settings after associated gas and gas liquids have been removed. It achieves oil/water separation and measures the amount of oil entering the shipping pipeline. The LACT also measures the water content of the oil. If too much water is present, the oil is automatically rerouted back through the system. Existing systems are located at sections 10G, 18G, 24Z, 25S, and 26Z. Two additional systems for handling 25,000 B/D each are to be constructed at 18G. Each system is to

Table I-3

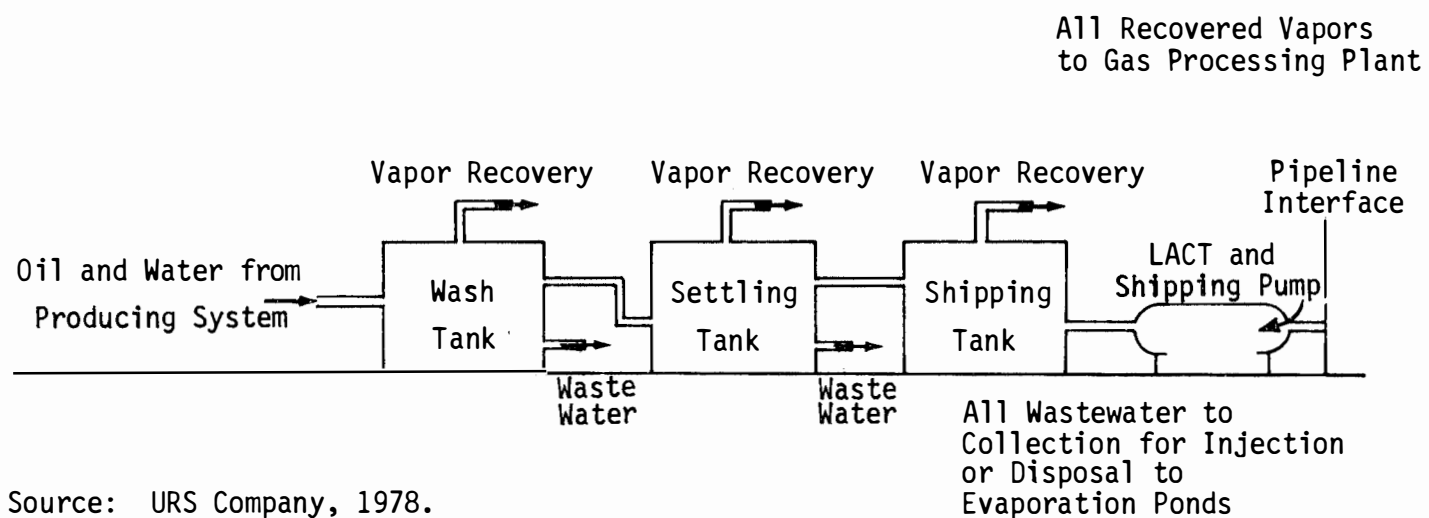
GAS PROCESSING PLANTS SPECIFIED PRODUCT
RECOVERIES AND DISPOSITION

Products	Recovery & Disposition		Quantities for Sale (gallons per day)	
	Reserve Plants	Chevron Plants	Reserve Plants*	Chevron Plants**
Methane/Ethane	Inject and/or use for fuel; no sale		--	--
Propane	43%-63% recovery sales grade	85% recovery sales grade	560,000	150,000
Butane	95%+ recovery sales grade	Collected with pentane and heavier products	390,000	--
Pentane and Heavier (plus Butane for Chevron Plant)	Sell as gasoline		260,000	130,000
TOTAL			1,210,000	280,000

*Based on processing 294 MMCF/D.

**Based on processing 60 MMCF/D.

Source: Department of Energy, 1978
Chevron U.S.A., Inc., 1978



Source: URS Company, 1978.

Figure 1-9. LACT System

have three tanks of 16,000 barrel capacity each. Additional systems may be added, if required. At peak MER, a total of about 100,000 B/D of water would be separated from all LACT tanks. Crude oil from the two major oil producing zones (Shallow Oil and Stevens) are kept segregated in separate LACT systems. Characteristics for these two different crude oils are presented in Appendix B.

d. Injection System

This system consists of gas and water injection elements as described below.

Gas Injection. After separation of liquids, the gas (methane/ethane) from the processing plant is compressed and injected into the Stevens Zone to maintain reservoir pressure. Operation at MER requires injection of dry gas into wells in four separate areas, with each operating at a different pressure. The injection system is comprised of separate pressure pipeline systems with all compressors located at 35R.

Water Injection. A water injection system is also planned to maintain reservoir pressure. Some of the water separated from oil in the LACT systems probably will require extensive pretreatment before it could be successfully used for injection (due to the chemical composition of the mixed waters separated from the oil originally in the Shallow Oil and Stevens zones). It is, therefore, planned to develop water wells in the Tulare formation (about 1,500 feet deep) and Olig Zone (see Fig. I-6) to obtain 50,000 B/D of water to supplement the up to 70,000 gallons of produced water which will be available from the LACT systems.

At the present time, 50,000 barrels (2.1 million gallons per day) of water are being produced daily by the LACT systems. Of this amount, 6,000 barrels per day are being used in a pilot flooding or injection program in the Stevens Zone, 6,000 barrels per day are being

injected in Section 24Z for migration control, and the remainder is disposed of. It is planned to increase produced water to 100,000 barrels per day by 1984, of which approximately 25,000 barrels will be injected (depending on the results of the pilot flooding program).

e. Liquid Storage and Loading

Propane, butane, and natural gasoline from the gas plants will be stored and loaded for truck and rail shipment.

Storage, loading, and transportation facilities associated with the Chevron gas plant are adequate to handle all liquid products that are to be produced at this plant.

Facilities on the Reserve. For the new gas processing facilities within the Reserve boundaries, pressure storage tanks (total capacity of 1.66 million gallons) and loading facilities are placed adjacent to the plants located in Section 35R (Fig. 1-8). At present, the limited storage and loading facilities are capable of handling only the production of the existing 35R plant.

Presently, all liquids recovered by the existing 35R plant must be shipped from NPR-1 via truck. With the expansion of the processing rates, the quantity of liquids would increase, with corresponding increase in the trucking of the liquids. Currently, shipping the liquids by truck includes the use of trucks with capacities ranging from 3,000 to 9,000 gallons. In the future, trucks serving the Reserve would probably average about 7,500 gallons in capacity and the amount of liquid hauled would be between 6,000 and 7,000 gallons (see details in Section IV.H.4. Transportation Impacts). The LTS-1 plant would become operational in mid-1979. The new railroad tank car loading facility off the reserve and LTS-2 plant would both become operational early in 1980. Based on maximum liquid production from the existing 35R plant and the

LTS-1 plant, and use of truck shipment only (until the railroad facility becomes available), a peak truck traffic of approximately 125 trucks per day would result. After the railroad tank car loading facility is completed and LTS-2 is operational, the peak liquid production of Table 1-3 would begin. After this time, a seasonal variation in the mix of truck and railroad car delivery would occur, with from 50 to 58 trucks per day hauling liquid products from the Reserve plants during the summer half of the year and a peak of approximately 150 trucks per day during the winter half of the year (see Section IV.H.4. for a detailed breakdown).

Facilities Off the Reserve. Utilization of the existing Chevron plant presents no new facility requirements for transportation and storage, except for the pipelines delivering wet gas to Chevron and returning dry gas to the Reserve for injection. The storage facility at this gas plant, as well as the loading racks for trucks, is more than adequate to handle the plant's total production. Additional truck traffic would be about an average of 43 per day.

The new railroad tank car loading facility and possibly a new truck loading facility will be located east of Taft along the existing Sunset Western Railroad Line (see Fig. I-8). Adjacent to this facility will be liquid storage capacity to handle two or more days of production from NPR-1. Three new underground pipelines will transport the products from the Reserve to this loading facility, a distance of approximately 11 miles.

3. Support Systems

a. Water Supply

The water requirements for production at MER can be divided into two distinct groups: (1) a freshwater supply system capable of

meeting potable, firefighting, and process water needs, and (2) a brackish water supply system that provides supplemental water for oil zone injection and pressure maintenance.

A freshwater supply system presently exists at the Reserve. This system has an overall capacity of 1.3 million gallons per day (mgd) and consists of pipelines and three tanks with a storage capacity of one million gallons. Water is supplied by the West Kern County Water District, which is under contract to deliver up to 1.76 mgd at the 5M pump station at the east end of the Reserve. In order to assure adequate supplies, the capacity of the present system is being expanded to 1.6 mgd by the construction of a parallel line and upgrading of existing pump stations on the Reserve.

Approximately 500,000 gallons of water per day will be required for construction related activities in the period 1978-80. The ultimate operational water demands are projected to be approximately 630,000 gallons per day.

A brackish water supply system will be constructed to supplement the water separated from oil in the LACT systems to be used for injection. A series of wells, tapping the brackish water of the Tulare formation and Olig Zone, will be drilled and connected to the water injection system. It is planned to develop 2.1 million gallons of supplemental water per day.

b. Waste Disposal

Wastewater disposal requirements can be divided into three distinct groups: (1) septic tanks and leach fields/percolation wells for sanitary sewage disposal, (2) injection facilities for disposal of

most of the production waters, and (3) percolation/evaporation ponds for use in disposing of a portion of the production waters and all process wastewaters.

The NPR-1 currently has facilities in each of these three areas. A series of septic tanks and three 50 foot percolation wells currently handle roughly 2,200 gallons of sanitary sewage daily. Similarly, a produced water pipeline and four injection wells exist onsite for disposal of a portion of the production wastewater. This pipeline system is also connected to a series of four percolation/evaporation ponds, which currently serve as the disposal mechanism for the remaining wastewater. Additional ponds will be used for ultimate disposal of 30,000 B/D of produced waters.

Production at MER requires an expansion of the sanitary disposal system, the injection system, and the percolation/evaporation system. Based on an expected sanitary sewage production of 7,700 gallons per day, additional septic system capacity is required. This addition would probably be in the form of septic tanks and associated leach fields. Similarly, the production wastewater injection system requires the addition of 35,000 feet of pipe, 18 new pumps, and 10 to 20 injection wells. The percolation/evaporation pond system requires expansion of its existing capacity to handle its expected loads which would consist of a portion of the production wastewaters and all of the process wastewaters. Process wastewaters could also be utilized for injection if additional injection waters are needed and such a step is shown to be economically feasible. It is also possible that additional production wastewaters will be diverted from injection to disposal in percolation/evaporation ponds. This would require additional expansion of the percolation/evaporation system.

At MER production, solid and liquid/solid wastes, such as tank bottoms and drilling muds, would be disposed of either onsite at one of the two existing Class II-1 disposal sites or would be hauled away by a local solid waste disposal company. Waste material generated by well drilling and production (e.g., drilling muds) is presently disposed at the Class II-1 disposal sites. Although some drilling muds were formerly used to improve soil conditions along the banks of roadways, this practice has been discontinued. All other trash and refuse is collected by the Westside Garbage Disposal Company. The onsite disposal areas cover a total area of 50 acres.

c. Power Supply

The increased production at the Reserve requires electrical service to be increased to approximately 40 megawatts (MW) from the presently-connected 5 MW. This service will be provided by Pacific Gas and Electric Company (PG&E). New power substations and transformers will be located within the Reserve in Sections 3G, 18G, and 35R. The resultant secondary distribution network is to be determined. NPR-1 will take power from PG&E at 115 kilovolts (kV) and about 7 to 9 miles of new government powerlines and poles will be required for the 115 kV primary system.

About 60 miles of 12 kV extension are required to serve the planned electric motor drives for the well pumps. The secondary system is a 440 volt, 3-phase service that will feed the pump motors and the cathodic protection (CP) rectifiers. A power factor (PF) correction may be required at each of these pump motor's starters.

Wastewater pumps, including those in Section 7G, 28S, 19S, 14R, and 24Z, are equipped with electric motors, and would be fed by the substation in their particular section.

Natural gas fuel from the gas processing plants is used to power the processing plants and compressor stations.

d. Road and Rail Service

No new primary roads would be constructed; however, access roads for new well drilling will be constructed. Existing primary roads (Skyline Road and North-South Access Road) will be restored to original design conditions by localized resurfacing. Existing secondary and tertiary roads will be maintained for continued use.

A new railroad spur will be constructed from an existing railroad line at a location east of Taft.

e. Security

The 46,095 acres of the reserve are not entirely fenced at this time and no change is planned. All roads providing access to the Reserve have gates and signs indicating the boundaries of the Reserve. During daylight hours main gates are unlocked. At night gates are locked and the Reserve is patrolled by a Kern County deputy sheriff. The two main gates into the Reserve have guards at night and on 24-hour duty for weekends and holidays.

New fencing would be provided around the processing area, including the existing 35R plant, the new gas plants, and the onsite loading facilities.

f. Fire Protection

Fire protection is provided to Elk Hills primarily through the Kern County Fire Department with stations at Taft, Buttonwillow, and Bakersfield. NPR-1 has minimal fire-response capability and general training program in fire protection and firefighting. The unit operator

does have a working agreement with the Kern County Fire Department that their various units visit the facility about three times a year for familiarization and general assessment of current practices. The Taft substation of the Kern County Fire Department, which is the closest, has four trucks capable of fighting oil fires with provisions for light-water, foam, monitors for long-distance delivery of both foam and water, and the ability to pump large volumes of water considerable distances. (The Taft unit has 2,000 feet of 4-inch fire hose and can quickly obtain an additional 4,000 feet if necessary). Once requested by NPR-1 personnel, the firefighting team's response time from the Taft station is approximately 25 minutes. The response time from Buttonwillow is also about the same, whereas from Bakersfield the time is more than 45 minutes. The Kern County Foam Cooperative, operated by the Kern County Fire Department and supported by the various oil industries in the valley, can also respond to fires at the Reserve.

Water supply for firefighting appears to be marginally adequate at the present time. Consequently, the freshwater system is being upgraded from an existing 1.3 million gallons per day to about 1.8 million gallons per day, an additional 3,000 gpm diesel electric pump is planned, and storage capacity for a million gallons is projected near the 35R gas plant. In addition to the freshwater system, the firefighting system can utilize the brackish water from the production system. This water is commonly stored in scattered tanks and can provide protection in areas where the firefighting water system is presently marginal. In a recent wellhead fire (October 1977) which burned for 3 days, firefighting was accomplished primarily using such brackish water sources.

In general the NPR-1 has an excellent fire safety record and housekeeping is well above average. Water is available at sites where major petroleum storage occurs. In general, storage tanks in the field are well-isolated and equipped with vapor recovery systems which further

reduce the probability of ignition. Lightning, although a cause for fire in the region, has not been a problem since tanks have been grounded through a loop grounding system.

Fire spread from one storage tank to another is generally a small problem since most larger storage tanks are isolated and, in general, containment dikes are designed to divert any spills away from the tanks, reducing the possibility of flashback. However, in the new LACT facility in Section 18G, the storage tanks are closely spaced and no provisions have been made for shell cooling (i.e., a series of water outlets spaced around the periphery of the tank designed to keep the tank's contents cool in case of fire in adjacent tanks). This matter is currently under investigation. While shell cooling is not a legal requirement, it must be recognized that fire in any one of the closely spaced tanks at the LACT unit is likely to cause ignition of one or more adjacent tanks unless shell cooling can be provided by directed sprays from fire truck monitors nozzles. An integral shell-cooling system would provide better protection of product.

g. Other Services and Facilities

Telephone services are provided by Continental Telephone Company of California.

Several new buildings will be constructed. A maintenance shops-warehouse building will be constructed, most likely in the 36R operations area. An administration-laboratory building will be constructed in the vicinity of the gas processing plants. An automotive repair shop will be constructed to replace the existing shop, convenient to the other facilities.

Each of the gas processing plants and shops will have change room for the personnel assigned to them. In addition, such facilities will be provided for the field workers. The optimum size and design of

this building will depend on the staffing of the Reserve.

There are several projects simultaneously under construction and each of these involves one or more contractors. For these organizations to operate effectively, certain facilities are dedicated to their use and others prepared prior to their arrival at the job site.

There is a construction area of approximately the same size as the project plot area at each new tank farm, tank setting, building and such, and one approximately twice the project plot area at the first new gas processing plant. In addition, there will be four strategically located laydown areas of about 2 acres each in the field for the piping spreads. These construction areas will be prepared by the contractors who will use them.

C. Land Requirements

1. New Wells

The drilling area required for each new well is approximately 2 acres. From the time of open-up for NPR-1 under P.L. 94-258 (July 3, 1976), a total of 686 additional new wells were required to complete the development program. For this number of wells a total of 1,372 acres of land would be required. As of September 30, 1978, approximately 351 more wells remain to be drilled and these wells would require 702 acres of Reserve lands.

2. Pipelines

The exact length of new pipeline to be installed is not known at this time. Much of this will depend on the extent to which old pipe can be utilized. In any event, the replacement of old pipe, installation of much of the new collection pipeline, and installation of new freshwater piping will follow or parallel existing pipelines. All piping will be

laid aboveground, with the exception of road crossings. Total Reserve land requirements would be no more than 100 acres.

3. Gas Processing Plants and Tank Settings

Two new gas plants would be constructed. Land occupied by these plants and associated storage facilities is approximately 40 acres.

Tank setting facilities consist of gas/liquid separators, compressors, tanks, and tank containment areas (see Fig. I-7). Each tank setting occupies about a half acre of land. Approximately eight new tank settings are required in the development program, which will add to the existing 120 already in place for a total land requirement of about 64 acres.

4. Road and Rail Facilities

No new primary roads will be constructed. Access roads for new wells will require about an average of 1,000 feet per well. Assuming a 20-foot roadway, land requirements for the new access roads will be approximately 160 acres.

The new railroad spur, storage, and loading facility will require about 200 acres of land.

5. Other Facilities

Several new buildings will be constructed. These buildings and their approximate sizes will be:

Administration-Laboratory Building	5,000 square feet
Auto Shop	6,000 square feet
Warehouse	26,000 square feet
Field Change House	<u>3,000 square feet</u>
Total for support buildings	40,000 square feet

Several staging areas will be operated during the construction period. Table 1-4 shows the areas required for various activities.

Table 1-4
LAND REQUIREMENTS FOR CONSTRUCTION
STAGING AREAS

Type of Staging Area	Size	Number	Total Area
Multipurpose	10 acres	1	10 acres
Support Buildings	1 acre	1	1 acre
Gas Plants	10 acres	1	10 acres
Pipeline	2 acres	4	<u>8 acres</u>
TOTAL			29 acres

D. Construction and Restoration Procedures

Construction is separated into a number of units: new wells, two new gas plants, tank settings, new pipeline segments, and LACT delivery systems all of which are being constructed simultaneously, but by different crews and with different time schedules.

1. Schedule

The facilities of this project will be completed at the earliest possible time consistent with sound engineering and economic practices. The construction schedule now calls for completion of most construction by late 1980 or 1981.

2. Organization and Methods

The design and construction activities are generally being administered by the Officer in Charge of Construction (OICC), Naval Facilities Engineering Command Contracts, Elk Hills, San Bruno, California acting as

Construction Manager for the Department of Energy. Onsite contract administration and direction of construction activities are provided by the Director of Construction resident at Elk Hills. Actual construction is being accomplished by contract with private firms.

In addition to the set of contractor-quality-control procedures which any contractor would operate under during construction, the OICC conducts independent inspections in accordance with government and industry inspection procedures. This includes government inspection and witnessing of tests for long lead-time equipment items and observance of pipeline construction techniques.

Some design and construction activities are being accomplished under Contracts awarded and administered by the Unit Operator.

3. Gas Processing Plants and LACT Systems

Construction of the processing plants and LACT plant requires heavy equipment for the site preparation, assembly and erection of facilities, and restoration and finishing. Site preparation involves testing of all finished substrates, minor grading, and clearing. All construction storage and shelter is provided on each site. Grading of the site provides erosion, runoff, and spill control during construction and provides a buffer against possible equipment-induced fires. Assembly and erection of tanks, metering and control facilities, is conducted as standard industrial practices require. As material arrives on the site, the crew constructs the various elements. For the storage tanks, steel plates are assembled by welding, using both automatic and manual techniques common to the industry. Large flatbed trucks are used to deliver the plates to the site. The plates are moved into position for welding by conventional cranes and sideboom tractors as needed. All exposed steel surfaces to the tanks receive shop cleaning and priming prior to delivery to the site, thereby minimizing the need for sandblasting. The

tanks receive a final protective coating of paint following construction. Upon completion of construction, the tank is given a hydrostatic test by completely filling it with water. This testing is at a controlled rate conforming with the foundation design and to accomplish a preloading and test of the foundation as well as the tank shell. Hydrotest water is obtained from the local water supply and the total amount required would be obtained over several days. All exterior surfaces of storage tank bottoms are cathodically protected to control external corrosion. For both delivery systems, asphalt emulsion is sprayed on the surfaces of all earthen containment berms to form an impervious collection system for storm and oily water within berms. Final grades for tank berms, roads, and general ground are provided.

4. Restoration and Erosion Control

It has been the general practice at the Reserve to permit restoration by natural processes such as wind-distribution of plant seeds. In the early 1970's the Reserve, in cooperation with the Soil Conservation Service and the Fish and Wildlife Service, undertook revegetation programs. It was found that these efforts succeeded only under continuous irrigation.

The Reserve routinely follows sound erosion and sediment control practices during and after the various construction activities which take place as part of the oil production and processing operations. Culverts and stabilization methods are applied at crossings of drainageways and topsoil is stockpiled and reapplied to the surface to the maximum extent feasible. Disturbed areas are re-graded to the original contour. These techniques have been found to be the most effective in this area.

E. Operations and Maintenance

The operations and maintenance of all facilities associated with production activities are being accomplished by the Unit Operator.

Storage and transfers of liquid products are controlled through the LACT units and the liquid storage and loading facilities associated with the gas processing plants. Security of all facilities include patrol. Emergency operating procedures include shutdown and isolation of facilities in the event of fires or product spills, and also include the monitoring, containment, and collection of product spills and restoration of affected areas. Emergency problems along pipelines leaving the Reserve (in the event that an off-Reserve liquid storage and loading facility is constructed for rail loading) will be the responsibility of Elk Hills operations personnel.

1. Wells and Tank Settings

Operation of these facilities is primarily automated. Whenever the stock tanks at any tank setting become full or any overpressure condition occurs, the associated wells automatically close off from further flow. Roving operator staff are on duty at the reserve around the clock. Staff perform periodic tests at each tank setting to determine gas and oil production rates. Periodic maintenance of pumps and tank setting equipment are undertaken on a defined schedule.

2. Gas Processing Plants

Each plant will be operated by a continuous staff. The flow of all major streams into and out of each plant will be metered and sampled for analysis. During normal operations, wet gases flow into the plants for processing, liquid products flow into storage, and dry gases are compressed and injected. During abnormal operations, such as overpressure conditions and other process upsets (less than 1% of the time), wet gases flowing into the plants are not processed, but burned or vented into the atmosphere. For the existing gas plant, these gases are vented into the stack for exhaust gases until a flare stack, currently under construction, is completed.

For the two new gas plants, these gases will be burned in the atmosphere through smokeless flares. The flares will be equipped with pilot lights of continuously burning gas.

3. LACT Units and Liquid Storage and Loading Areas

These areas will be operated continuously. Incoming and outgoing liquid products will be metered. In the case of off-Reserve liquid pipelines, periodic patrols of the lines will be conducted to locate and isolate leaks and other malfunctions. Metering equipment and controls will be maintained, tested, and calibrated on a periodic basis.

4. Abnormal Operations

Special considerations for a wide variety of abnormal operating conditions, in addition to those indicated in this subsection, are delineated further under subsection H. Risk Assessment.

F. Personnel Requirements

Personnel requirements involve both construction and operational phases of the proposed project. Operating personnel include vendor personnel involved with maintenance, repair, and the provision of goods and services as well as the government and Unit Operator personnel performing operational functions.

1. Construction Activities

Personnel requirements for the construction of the various facilities needed for production activities will vary considerably over the construction period. In general, the construction period will extend until 1980 or 1981, with many different phases of the overall construction beginning and ending before that time. Construction crew requirements are expected to peak at a value above 1,000 workers during 1979.

2. Operation

Operating personnel include some individuals working at facilities which have 24-hour-per-day operations with three rotating shifts. The total for government and Unit Operator personnel will be about 540, broken down as follows:

<u>Facility</u>	<u>Personnel</u>
New Administration Building	150 (primarily daytime only)
Old Office Building & Garage	180 (80 Daytime) (50/shift for two other shifts)
Gas Processing Plants (existing plus two new plants)	210 (90 Daytime) (60/shift for two other shifts)
Total	540

The vendor personnel providing maintenance, repair, and other goods and services will average about 300 individuals per day.

G. Mothballing and Abandonment Procedures

1. Mothballing

The project facilities could become temporarily unnecessary or undesirable at any time before expiration of the useful life of the facilities or depletion of the reservoir. Under such conditions it would become desirable to secure the facilities for later reactivation and such securing is called "mothballing."

Typical procedures to be followed would include:

- a. Shut in all wells.
- b. Empty storage tanks, pipelines, and equipment of all products.

- c. Refill the pipelines and storage tanks with water containing a corrosion inhibitor.
- d. Drain and remove pump seals and refill with vapor inhibitor to prevent corrosion.

2. Abandonment

The project facilities could become unnecessary or undesirable at some indefinite time in the future (at the end of the useful life of the facilities or upon depletion of the oil reservoir). Abandonment and surplus designation of all facilities would involve sale and removal of equipment. Much of the equipment would have real salvage value over the cost of removal.

H. Risk Assessment

1. Introduction

This assessment initially compares risks at typical oil production facilities with those at NPR-1. Next, the assessment identifies the risks associated with each of the major systems at the NPR-1 facility, discusses system components where risks may be high and, finally, evaluates the acceptability of each of these risks.

Two major types of risks are present in oil production facilities: fire and/or explosion, which threaten primarily personnel and property, and secondarily the environment; and oil spills which threaten primarily the environment. Since the hazards of dealing with large quantities of oil, gas, and natural gas liquids are well recognized in oil production facilities, standards and precautions to prevent accidents are necessarily highly developed, as are the capabilities of coping with such accidents as occur. Likewise in the transfer, processing, and storage of

large quantities of crude oil, inevitably some losses from spills occur. Recognizing the inevitability of such accidents, spill prevention is widely practiced and containment techniques have been highly developed. However, a degree of risk always remains and it is necessary to consider its implications.

2. Historical Risks - National and NPR-1

The most definitive data on the risks associated with the operations of a production facility are found in two reports issued by the Environmental Protection Agency (EPA) (Ref. 1, EPA, Petroleum Systems Reliability Analysis). In this study some 6,900 onshore spills of known origin were analyzed to determine the source and cause of spills. It was found, based upon the number of spills, that in about 3 percent of the cases the spill was less than 100 gallons (2.4 barrels); in 82 percent of the cases the spill was between 100 and 10,000 gallons (2.4 to 240 barrels); and in almost 15 percent the spill was greater than 10,000 gallons. The majority of spills, that is, those in the moderate category (100 to 10,000 gallons), generally occur on dry, porous land surfaces, (typical of NPR-1 terrain) where spread is limited to short distances.

This study found that the major cause (approximately 80%) of the spills was pipe failure, which, in turn, was caused by external corrosion (46%), rupture of the pipe (22%), internal corrosion (8%), and third-party intervention (primarily road machinery), 8 percent. A number of other components, such as valves and pumps, and operator failure to perform proper inspection action accounted for the remaining causes of spills.

A record of the number and volume of spills has been maintained at

NPR-1 since July 1976. The number of spills of less than 25 barrels has fluctuated widely from month to month, averaging 26 spills per month. Likewise, the total quantity spilled fluctuates, but has shown a decreasing trend in recent months. More importantly during this time frame, however, production has increased from about 20,000 barrels per day initially, to a target of 120,000 barrels per day currently. Thus, the amount of oil spilled per unit of oil produced has dropped sharply with time. It is anticipated that further improvements will occur as problems associated with the startup of this long dormant field are overcome and operator skills are improved. The cause of the spills, which will be discussed in greater detail later, are in general accord with the EPA study referenced above.

Spills greater than 25 barrels occur on occasion at NPR-1, with an average of 0.8 per month. Although the average size of the spill has not decreased appreciably as production expands, the oil spillage per unit production has decreased markedly. Furthermore, with few exceptions, the oil spilled has been contained completely within diked areas and the recovery of the spilled oil has approached 50 percent overall. In only one instance has oil spread beyond the limits of the facility, and in this instance, environmental damage was minimal. This case is discussed in Appendix C.

There are limited data on occurrence of accidents involving fire and/or explosion in oil field facilities. However, some information is available (Ref. 2, State of California, Division of Oil and Gas) on well blowouts over the last 22 years in the State of California. The calculated blowout rate is 0.8 per thousand new wells drilled. Similar data are not available for remedial action on wells, but the estimated rate for such blowouts is much lower, perhaps one-third. If these accident rates are applied to projected new wells at NPR-1 (Table 1-2, 351 wells)

and a blowout rate of 0.3 per thousand is assumed for remedial action on one-fourth of the present 1,718 wells, the number of blowouts at NPR-1 over a 10-year period would be less than 4. One such accident described below has already occurred. Normally, blowouts cause minimal damage and some loss of product, and are promptly controlled. Loss of life is rare. Thus, the possibility of a blowout every few years while the field is active falls within the acceptable range of risks.

A blowout at a well undergoing remedial action at 333-5G on October 25, 1977, resulted in explosion, the attendant death of three persons, and subsequent fire and loss of oil and gas. However, as with most serious accidents, causative factors related to improper operating procedures have been identified and corrective measures implemented. Therefore, the probability of a similar occurrence at NPR-1 has been significantly reduced. Although one other industrial accident resulting in death has occurred, the overall safety record is satisfactory.

3. Identification of Potential Risks Associated with Operations at NPR-1

Risk has two major components -- frequency and magnitude. It must be recognized that risks and the attendant accidents can never be fully avoided; rather, it is only possible to define an acceptable limit on the risks society is willing to take. Thus, the risk of having a flat tire on a lonely stretch of road is accepted because (a) it rarely happens, (b) the consequences are not severe, and (c) we anticipate such a happening and carry the necessary tools to correct the situation. Even severe risks, i.e., those with catastrophic consequences, must sometimes be lived with. Earthquakes are an excellent example. In areas with a history of damage from earthquakes, structures are designed to withstand anticipated stresses, but with the recognition that failure may occur.

Table 1-5 provides a rating of the risks associated with various systems and components of the operations at NPR-1. These risks have been rated according to frequency of occurrence and magnitude of the consequences. Unacceptable risks (the derivation of this definition is given in Appendix C) are generally identified as those which either occur too frequently, even though the consequences are fairly minor, or those in which the magnitude of consequences is so great that occurrence can be tolerated only in terms of millennia. For purposes of discussion of these risks in more detail, we will concentrate on categories 3D or 4D, i.e., infrequent occurrence (on the average, every 50 years) and with long-term environmental damage (see Appendix D) and possible loss of life and/or property. It is noteworthy that no risks with "E" ratings, i.e., catastrophic events with heavy loss of life, property, or long-term environmental consequences, have been identified at NPR-1.

Those risks which have been identified as marginally safe or possibly excessive in connection with NPR-1 operations are discussed below. The risks associated with normal or near-normal operations of the major systems at NPR-1 are given in Appendix C. However, some general comments about operations and protective measures which serve to lower the probability of accidents or spills will be noted at this point.

Recognizing that major spills can create serious environmental impacts larger tanks (usually greater than 10,000 bbl) are individually diked; the dikes limit the extent of oil spread and facilitate cleanup and recovery of oil. Tank settings (usually with a total capacity of less than 2,500 bbl) are protected by contingency catch basins located in drainage channels downhill of the tank setting.* Some 51 contingency catch

*The use of individual dikes around tank settings is not recommended since the containment at the site of oil from a spill would hamper work crews and present a safety hazard. A nearby contingency catch basin is preferable.

Table 1-5
RATING OF RISKS ASSOCIATED WITH OPERATIONS OF NPR-1

Systems and Components	Risks Associated With			Description of "Other" Risks
	Fire/Explosion	Contaminating Spills	Other	
Drilling System	4D	2B		
Production System (incl. tank settings)	3C		--	
Gathering and Distribution				
o Oil Lines and Tanks	3B	2C	--	
o HP Gas Lines	3C	--	--	
o Compressor Station (3G)	4D	--	--	
Ancillary Systems				
o Gas Plant, Old	5D	3B	3D	Unlit vent stack explosion.
o Gas Plants, New	6D	3B	5B	Lit vent stack radiation.
o Truck Loading, Old	3D	3C	2C	Onsite collisions.
o Truck Loading, New	3C	3B	4C	Onsite collisions.
o LACT	4D	5B	--	
Support Systems				
o Utilities	4C	4B		
o Reinjection				
- Water	--	2C	4C	Tank failure; flooding.
- HP Gas	3D	--	--	
LPG and Liquid Fuels Transport				
o Truck	3C	4D	4D	Offsite collisions.
o Rail	3D	4D	4C	Offsite collisions.

Rating System for Risks

Relative Frequency

- 1 - 0 - 1 month
- 2 - 1 month - 1 year
- 3 - 1 year - 10 years
- 4 - 10 years - 100 years
- 5 - 100 years - 1,000 years
- 6 - >1,000 years

Magnitude

- A - Minimal consequences; restored routinely
- B - Temporary disruption; easily restored
- C - Environmental or personnel short-term damage; possible property loss
- D - Long-term environmental damage and/or loss of life and property
- E - Catastrophic: loss of many lives and much property and/or massive long-term environmental damage

Source: URS Company, 1978

basins are also located strategically throughout the reserve to contain oil spills from any source including drilling operations, broken pipes, leaking valves, etc. (According to the code of the State of California [Ref: Administrative Regulations, Subchapter 2, Section 1773], contingency catch basins are satisfactory if: (1) they can contain normal rainfall plus the contents of the largest tank in the system plus 10 percent of the total value of the remaining tanks; and (2) they are cleaned immediately after any spill so that they do not prove a threat to birds or wildlife.)

All diked areas at NPR-1 meet the above requirements, including provision for a 100-year rainfall. Contingency catch basins are similarly sized; where capacity is in question, two or more catch basins may be placed in a drainage channel in series.

All pipelines at Elk Hills run above ground throughout most of their length and are supported on appropriate members where necessary. Lines do, however, run underneath roadways and are generally protected against damage from vehicles or other heavy equipment. Lines are not identified by code, so that in case of accident it may not be immediately obvious how serious the break might be.

Because so many of the facilities at NPR-1 are old, corrosion and deterioration have taken their toll, and many of the problems resulting in spills since startup can be attributed to these causes. As the entire facility is upgraded, including the replacement of gaskets, corroded pipe, etc., improvements in accident and spill rates can be expected. The casings of producing wells are, or will shortly be, tied into the cathodic protection system. Aboveground pipelines are not cathodically protected; the few belowground pipelines are. Some, but not all, tank bottoms are cathodically protected.

Returning to Table 1-5, the first unusually high risk identified is in the drilling system -- 4D for fire/explosion. Accidents do occur in drilling and workover, although not commonly. The fact that such an accident has occurred recently, that the cause was pinpointed, and that corrective action was taken, suggests that, in conjunction with the relatively low rate for such accidents, no undue risk is identified.

The next item is a compressor station at 3G, again with a rating of 4D. Compressor stations, including those in the existing and future gas plants, are basically one of the most dangerous operations within the Reserve. Because of safety, operational, and environmental concerns, compressor stations are enclosed; although well-ventilated, they are potential spaces in which gas leaks can accumulate to form explosive mixtures. All compressor stations are, or soon will be, equipped with suitable detectors and programmed shutdown procedures to minimize risks if a gas leak does occur. The gas plants, which have separation columns located outside, but adjacent to enclosed compressor rooms, are given a somewhat better risk rating (5D or 6D, depending on their size), because these facilities are always manned. Since gas plants and compressor stations meet standard operating and safety criteria, the risk entailed in their operations is deemed acceptable.

Light hydrocarbon fractions, including compressed gases, are stored adjacent to the present gas plant prior to sale. Presently an average of 20 to 40 tank trucks per day load at this facility and then move the products over the highway system of southern California to various markets (this number will rise to a peak of about 150 trucks per day during the winter half of the year). The facility has an excellent safety record despite relatively heavy traffic at the entrance. Storage tanks are located at some distance and uphill from both the gas plant and loading facility, and any spill would drain into a catch basin some distance away downhill. Thus, in contrast to the experience in the Arvin-Tehachapi earthquake of July 21, 1952 (California Division of

Mines, 1955), where two large spherical butane tanks collapsed, resulting in fire and explosion and extensive damage to the Paloma cycling plant (16 miles southwest of Bakersfield), even a catastrophic failure in the NPR-1 gas plant would be unlikely to threaten life or property.

Wet gas, as taken from the wellhead, always contains trace amounts of a radioactive gas, radon (^{222}Rn), which is preferentially concentrated, in the gas plant, into the ethane and propane fractions. Studies, discussed in detail in Appendix C, have shown that radon, in decaying radioactivity, can produce slight, but possibly significant, short term (to workers) and longer term (to consumers) hazards.

However, occupational risks can be readily minimized in gas separation plants if any areas with unacceptably high radiation levels are identified and warning signs posted.

Risks to the consumer which arise from inhaling combustion fumes from non-vented appliances, are best reduced by storing the LPG for at least 2 weeks so the radiation levels are significantly lowered prior to burning. If such is not feasible, the burning of the gas in non-vented equipment should be avoided.

Based on limited available data, California wet gas is well within the normal limits reported from other gas producing areas in the nation. Yet LPG sold in California (and primarily produced there) has the highest radon content of any state, possibly due to the rapid movement of the produced LPG to market.

To preclude the possibility that Elk Hills produced gas might be exceptionally high in radon content which could potentially lead to excessive occupational - or even consumer - radiation exposure base line values for each gas plant will be established. At a minimum the radon

content of the propane fraction will be determined (which will reflect the radon levels in the wet gas as well as the characteristics of the particular gas plant and its processes) and a survey of gamma radiation levels on pumps and compressors within the gas plants will be conducted. Further, since it is desirable to allow at least two weeks to elapse between the time of extraction and time of consumption (as LPG), maximum use of storage facilities at the loading facility and any intermediate locations should be scheduled.

The quantity of natural gas liquids (NGL) produced at MER with completion of the LTS-2 gas plant early in 1980 is expected to be about 1.2 million gallons per day--47% propane, 31% butane, and 22% natural gasoline. This production, amounting to about 10.5 million barrels of NGL per year, compares with the estimated 1977 production of NGL from gas processing plants (GPP) in California of 8.95 million barrels, of which an estimated 1 million barrels came from NPR-1. Thus by 1980, NPR-1 GPPs will be accounting for approximately 57% of California's production from this source. However, in this same time frame, it is estimated that NPR-1 production of NGL will account for only about 31% of all NGL transported in bulk (as contrasted to home delivery of liquified petroleum gas) within California. The difference is attributable to the rather large imports of NGL into California, which according to Parsons are likely to continue, and to the presumed movement of some NGL by pipeline within or between refineries. Certainly the movement of Elk Hills NGL into the market place will substantially increase the amount of compressed flammable gases moved on the rails and highways of the state. Hence, an analysis was undertaken to determine the likely extent of accidents which might result.

The accident analysis, reported in Appendix C, relied primarily upon data found in a 1973 report* which considered in some detail a limited

*Jones, G. P., et al., Risk Analysis and Hazard Materials Transportation, Volume 1, University of Southern California, prepared for Department of Transportation, March 1973.

number of accidents (about 40) for liquified petroleum gas (LPG) transported by truck and rail. The rates used (which are recognized as rather crude, particularly for rail transport) were: 1.8 to 6.3 accidents per million miles for trucks, dependent upon the type of highway; and 0.15 accidents per million miles for rails regardless of location. (On the other hand, the American Railroads reports that California railroads in both 1977 and 1976 experienced about 25% fewer accidents involving hazardous materials--including LPG--than did railroads in other parts of the nation.) Thus, transport of LPG by truck would appear, on the surface to produce about 20 times as many accidents as transport by rail. However, because rail cars carry, on the average, four times as much LPG as do tank trucks (that is 32,000 gallons vs. 8,000 gallons), the accident rate was recalculated to be: 1.93 accidents per million barrels for truck and 0.03 accidents per million barrels for rail. Thus, the accident rate for transport of LPG by truck is almost 65 times greater than that for transport by rail.

The actual accident occurrence likely to be associated with projected movement of NGL from Elk Hills can be estimated based on the projected transport mode and the accident rates for the very similar LPG discussed above. Initially, all NGL will be transported by tank truck (types MC-330 and MC-331 only) with maximum one-way traffic estimated at 124 trucks per day following the completion of LTS-1 in mid-1979. By early 1980, the rail spur and loading facilities near Taft will be completed and rail movement will be initiated. It is projected that shortly thereafter, LTS-2 would be operational and peak one-way truck traffic, estimated at approximately 150 trucks per day will occur during the winter half of the year, with summer traffic estimated at from 50 - 58 trucks per day. It is estimated that during the summer, the truck accident rate would be about 0.5 accidents per month and during the winter peak, this would rise to 1.6 accidents per month, for a total of nearly 13 truck accidents per year.

For rail movement we estimate 0.22 rail accidents per year. A special concern for rail transport relates to the rail track which is proposed for movement of NGL from the loading facility near Taft to the rail head in Bakersfield. A 35.5 mile section of the Sunset Railway Company is to be used; this track, according to a recent (December 1978) visual survey (referenced in Appendix C) is deteriorated and, unless corrective action is taken, will deteriorate at an accelerated rate with the increased usage generated by Elk Hills NGL (the estimated annual gross tonnage will increase from 300,000 to two million tons). Further, eight unprotected grade crossings on this line are not equipped with gates and flashing lights which is undesirable in light of the increased projected NGL traffic. Any voluntary or required upgrading of crossings or other track improvements is the responsibility of the Sunset Railway Company.

Fortunately, most accidents are minor in nature (but beyond the "fender bender" type); only 9% of truck accidents and 3% of rail accidents are found in the USC analysis to be severe, that is, resulting in a fuel-air detonation. Property damage associated with severe accidents is over tenfold higher for rail accidents than for truck accidents (probably due to the larger carrying capacity of rail cars and the likelihood that adjacent rail cars will be damaged in a rail accident). Injury and death can occur concurrently with severe accidents, and for trucks, even with minor accidents, due to their likely occurrence in or near public areas. Based on the frequency of severe (i.e., a fuel-air detonation) accidents, it is projected that a severe accident involving truck transported NGL from Elk Hills will occur about once a year whereas a severe accident involving rail transported NGL is likely only every 150 years. However, it appears that the incremental increase in all NGL transport related accidents in the state of California will increase only in proportion to the increase in NGL production, i.e., almost 30% above mid-1970 values.

The primary concern if a spill of an NGL occurs (whether rail or truck) would be the possibility of attendant fire, explosion, or detonation. Evacuation of the people (except firefighters) would be mandatory.

Only natural gasoline, if spilled, would likely persist long enough to cause substantial environmental damage for any distance downstream. If such a spill were to occur, techniques employed for gasoline (of which much larger quantities are transported by highway) would be used.

The possibility of contaminating crude oil spills has been identified in general as a risk, albeit controllable. Because of the terrain, and the containment features (that is, dikes around individual tanks, and contingency catch basins in drainage channels), the possibility of oil from even a very large spill doing extensive environmental damage is remote. Oil can also be accidentally released (broken wellhead valves, etc.) as an aerial spray, coating nearby hillsides and roads. Such spray is associated with Stevens Zone productions, which are sufficiently removed from NPR-1 boundaries to cause no off-facility concerns. A general concern with respect to safety is the presence of a number of unmarked medium (>50 psi) and high pressure (up to 3,500 psi) oil and gas lines throughout the Reserve. If ruptured, these lines can release large quantities of hydrocarbon in a very short time; they may also whip around, causing serious physical damage. These medium and high pressure lines, often exposed adjacent to roadways and work areas, are not identified and are easily confused with low pressure lines. Although few serious problems have been reported because of the lack of marking, distinctive marking of medium and high pressure lines adjacent to roadways and work areas would serve to reduce the likelihood of accident in the future. However, such marking procedures are not a common practice in oil fields. A Spill Prevention Control and Counter-

measure Plan, in compliance with EPA requirements is in preparation and will cover all aspects of protection and cleanup when completed.



II. EXISTING ENVIRONMENT OF PROPOSED SITE

Naval Petroleum Reserve No. 1 (NPR-1) is located in California, about 100 miles north of Los Angeles, about 30 miles southwest of Bakersfield, in the southerly end of the San Joaquin Valley. The proposed project site basically is primarily confined to NPR-1, but due to the wider implications of certain construction and operating effects, some areas outside of the Reserve are also included within the project sphere of influence.

The Reserve itself encompasses the Elk Hills, a foothill spur that extends from the Temblor Range southeastward, about a third of the distance across the flat San Joaquin Valley, with a maximum altitude of 1,300 feet above sea level. The Reserve consists of 46,095 acres, on which are over 1,000 oil wells ready for production. Most wells can be reached by oiled roads from about 50 miles of asphalt-paved roads within NPR-1. One of these asphalt-paved roads, known as Skyline Road follows the crest of the Elk Hills from east to west. Another known as the Elk Hills Road (County Road 261), crosses the middle of the Reserve from north to south. State Highway 119 crosses the southeast corner of NPR-1 enroute from Taft to Bakersfield and has an interchange with Interstate Highway 5 about five miles east of the Reserve boundary. Scheduled airline services are available in Bakersfield, 30 miles away by highway. Railheads exist in Taft and Buttonwillow.

Historic land uses within the valley have included oil field development, agriculture, and livestock raising. The development of the California Water Project, however, has made available great quantities of new water to the area via the California Aqueduct which has led to a great expansion of cultivation and associated urban land uses.

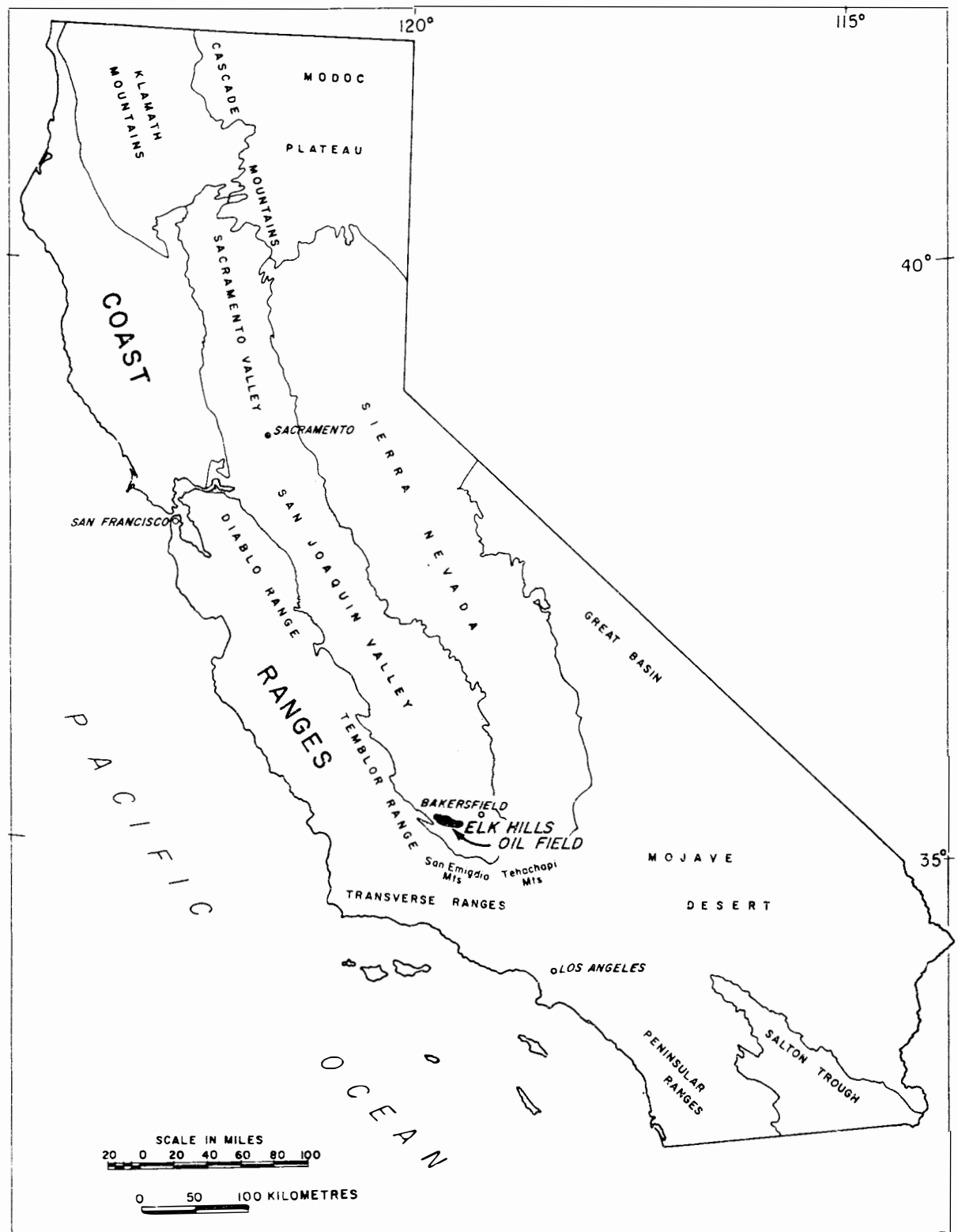
A. Geological Resources

1. Introduction

The following discussion of the geologic conditions at NPR-1 is an update and modification of the discussion contained in the previous Environmental Assessment of the reserve (Applied Science, 1974). The current discussion was based on existing publications and communications with professional geologists who are familiar with the geologic conditions in the Elk Hills area. No original field work or data collections were made. The primary reference used in updating the previous environmental report was the recently published U.S. Geological Survey Professional Paper 912 (Maher, Carter, and Lantz, 1975). This publication contains a comprehensive discussion of the geology, as well as the history, of NPR-1. Other supplemental references that were used are contained in the bibliography at the end of the volume. Only those references actually used in the construction of the following geologic description are listed in the bibliography. A much more comprehensive bibliography on the geology of the southwestern San Joaquin Valley in general and the Elk Hills area in particular is contained in Maher, Carter and Lantz (1975).

2. Regional Setting

NPR-1 encompasses most of the Elk Hills, a long, narrow ridge that projects eastward from the California Coast Ranges into the southwestern corner of the San Joaquin Valley. The San Joaquin Valley is the southern half of a large structural depression called the Great or Central Valley of California. The Central Valley extends for nearly 500 miles, and



Source: Maher, Carter, and Lantz, 1975.

Figure 2-1. Location of the Elk Hills Oil Field, San Joaquin Valley, Calif.

separates the Coast Ranges to the west from the Sierra Nevada to the east. The southern boundary of the San Joaquin Valley (or Central Valley) is the Tehachapi Mountains. The location of the Elk Hills in relation to the major geomorphic provinces of California is shown in Figure 2-1.

The Central Valley is filled with many thousand feet of unconsolidated and partially consolidated sediments that have been eroded from the surrounding uplands. The attitude and structure of the strata in the east side of the San Joaquin Valley differs markedly from the strata in the west. The sedimentary strata in the eastern part of the San Joaquin Valley dips gently westward toward the axis of the Central Valley trough and reflects the subsurface extension of the westward-tilted Sierra Nevada fault blocks. In contrast, the sedimentary strata beneath the western side of the valley dip steeply eastward and are sharply folded, and broken by low angle faults. The structural portion of the strata on the west flank of the San Joaquin Valley has been determined by the development of the adjacent Coast Ranges, specifically the Temblor Range. The Temblor Range is composed of a series of tight folds that diverge from the generally southerly trend of the other ranges within the Coast Ranges, and plunge southeastward into the valley. The Elk Hills represent one of the upfolds (anticlines) associated with the Temblor Range.

3. Local Setting

a. Physiography

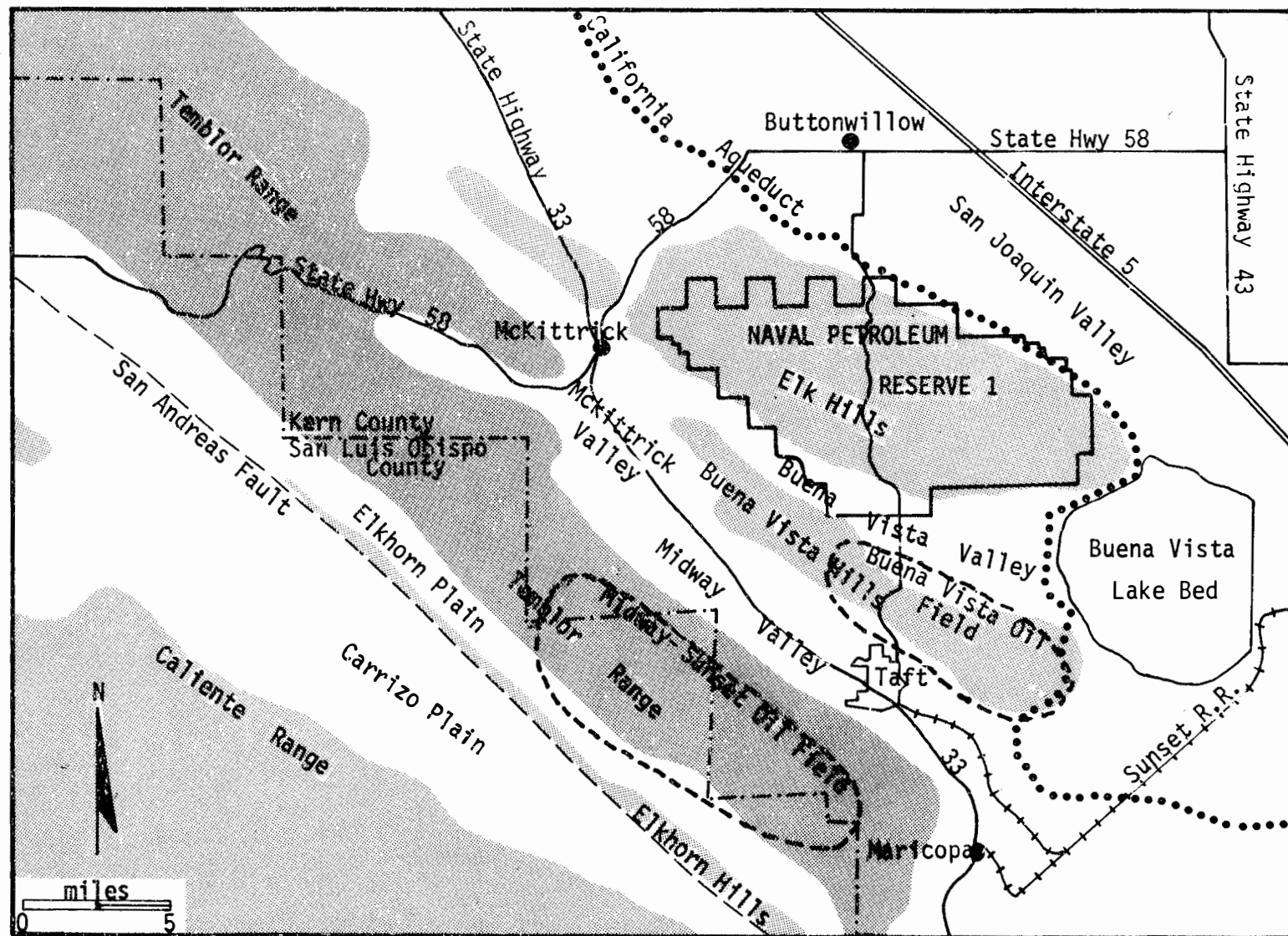
The Elk Hills consist of a low, elongate swell about 20 miles long and 7 miles wide that protrude about 1,000 feet above the surrounding valley floor. Elevations within NPR-1 range from 290 feet

above sea level on the valley floor at the northeastern boundary (near Tupman) to 1,551 feet at Hillcrest Point along the main ridge in the western part of the reserve (sec. 28, T.30S., R23E). The Elk Hills are connected to the main foothills of the Temblor Range by a narrow stream gap known as Railroad Gap. Buena Vista Hills, a similar foothill spur but somewhat lower and shorter than Elk Hills, lies just to the southeast. The Buena Vista Hills are separated from the Elk Hills by Buena Vista Valley and its northwestward extension, McKittrick Valley. The east side of Elk Hills is bordered by the main portion of the San Joaquin Valley. The southern end of Elk Hills beyond the boundaries of NPR-1 is marked by steep bluffs about 15 feet high that have been cut by the Kern River and the Buena Vista Slough near the mouth of Buena Vista Lakebed. The location of the local physiographic features is shown in Figure 2-2.

In general, the terrain of NPR-1 is characterized by numerous, rounded divides (ridges between two areas of drainage) and smooth slopes. A large number of ephemeral streams draining the hills have created a highly dissected stream pattern of gullies and channels. Sediments eroded from the higher elevations have been deposited along the base of the hills resulting in a smooth topographic transition into the adjacent flat valley lands except as mentioned above at the southern end of the hills.

b. Stratigraphy and Structure

Seven geologic formations ranging from Recent (Holocene) alluvium to the Miocene age Temblor Formation either occur at the surface or have been penetrated by oil producing wells at NPR-1. The stratigraphic column contained in Figure 2-3 shows the geologic age, relative position and approximate thickness of these seven geologic units. As shown in the geologic map in Figure 2-4, Elk Hills and most of NPR-1 is underlain by the Tulare Formation of Plio-Pleistocene age; alluvium occurs at the outer edges of the reserve, at the base of the hills and out onto the valley floor.



Source: Maher, Carter, and Lantz, 1975.

Figure 2-2. Local Physiographic Features in the Vicinity of NPR-1

Geologic Age	Geologic Formation	Physical Description	Thickness (ft)
Holocene (Recent)	Alluvium	Unconsolidated, loose, sand, gravel, silt, and clay deposits covering valley floor and at foot of upland areas.	
Pleistocene-Pliocene	Tulare Formation	Unconsolidated sand, light-colored clays, silts, gravels and marls.	600-2,200
Pliocene	San Joaquin Formation	Primarily claystones, silts, and friable sands. Some of the sand lenses contain oil. The two lowest sand lenses are commonly called the Scalez Zone.	1,200-2,100
Pliocene	Etchegoin Formation	Sandstone, siltstones, shales, and claystones. Unconsolidated to poorly consolidated sand lenses contain oil (Shallow Oil Zone).	1,700-3,500
Middle and Late Miocene	Reef Ridge Shale	Silty or sandy shale containing some thin silty to clayey sandstone beds, dolomite layers are scattered throughout sequence.	200-1,150
Middle and Late Miocene	Monterey Shale	A fine-grained elastic sequence of diatomaceous or silty claystone and shale containing sandstone lenses. Divided into, from bottom to top, Gould and Devilwater Shale Members, undifferentiated; McDonald shale of local usage; and Elk Hills Shale Member. Contains Stevens Oil Zone.	2,100-4,100
Early Miocene-Oligocene	Temblor Formation	Alternating beds of shale and sandstone, including from bottom to top: Cymric Shale Member, Wygal Sandstone Member, Santos Shale Member, Carneros Sandstone Member, and Media Shale Member.	2,900-4,100
Oligocene	Wagonwheel Formation	Primarily siltstone and sandstone.	250- 700
Late Eocene	Kreyenhagen Formation	Primarily sandstone and shale; includes Welcome Shale Member, Point of Rocks Sandstone Member, and the Credal Shale Member.	2,300-2,900+
Mesozoic	Basemen Complex	Probably green metamorphic rocks of Jurassic(?) age.	Unknown

Source: Maher, Cartor, and Lautz (1975), and Environmental Assessment and Resource Planning (1975).

Figure 2-3. Stratigraphic Column of the Naval Petroleum Reserve No. 1.

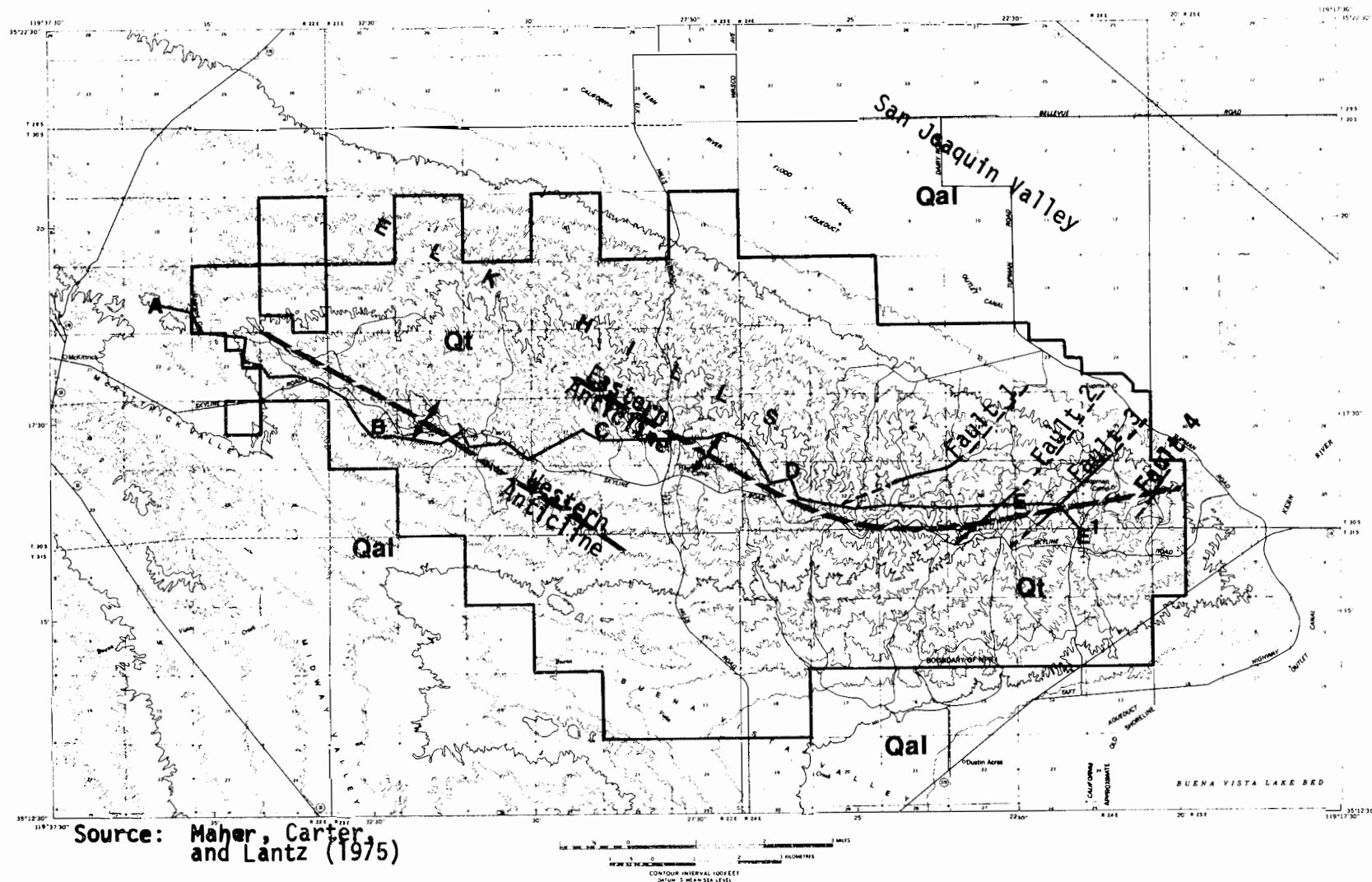


Figure 2-4. Geologic Map of NPR-1 Area

Except for the alluvium, the strata that make up the Elk Hills have been folded into an anticlinal structure. Although not readily discernible at the surface this structure consists of two, large en echelon anticlines commonly referred to as the eastern and western anticlines. The axis of the western anticline is oriented in a southeasterly direction, while the eastern anticline curves eastward to an eventual orientation just north of east (Fig. 2-4). The western anticline is a relatively simple fold with no faults. However, the eastern anticline is cut by numerous normal faults, four of which reach the surface (see Fig. 2-4).

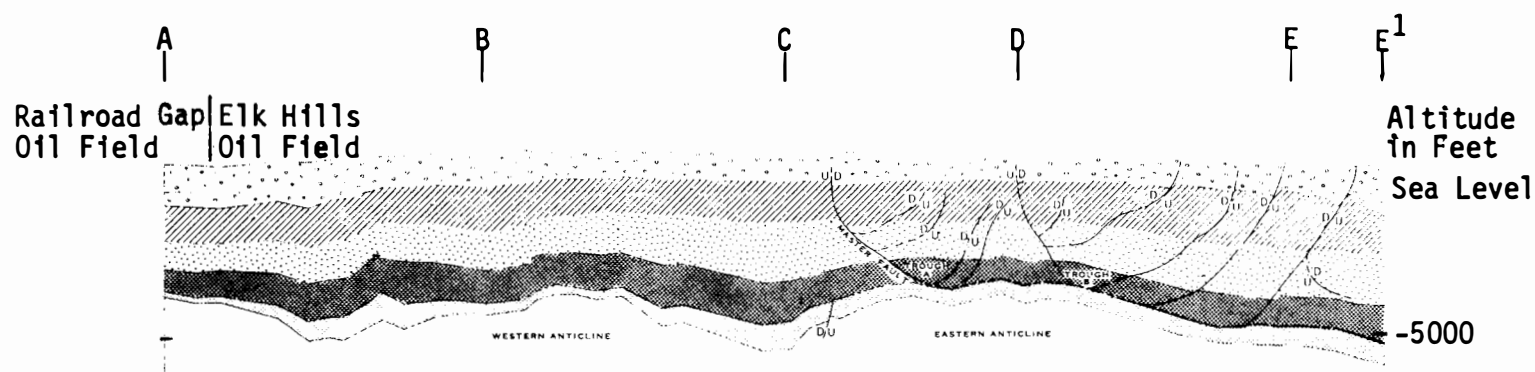
A geologic cross-section through the length of Elk Hills (line A-E¹ in Fig. 2-4) depicting the subsurface folding and faulting at Elk Hills is contained in Figure 2-5.

The folding and faulting along with lithologic changes within the geologic formations are important factors in the entrapment and concentration of petroleum and natural gas. A simplified geologic cross section of the Elk Hills oil field showing the relationship of the structure to oil producing zones is shown in Figure 2-6.

c. Soils

The soils of the Elk Hills area are characteristic of a semi-arid region that has hot dry summers and mild, somewhat moist winters. The representative soil is a loose, light-colored, well-drained loam containing rock fragments. Like most soils developed in a semiarid region they contain an abundance of plant nutrients but also can be calcareous and contain an abundance of gypsum or alkaline salts. In some barren areas of the south slopes, wind erosion has produced an effect called "desert pavement."

The soils at NPR-1 have been divided by the U.S. Soil Conservation Service into two types on the basis of topographic and geo-



Vertical Exaggeration x 2

KEY

Pleistocene and Pliocene Series

 Tulare Formation

Pliocene Series

 San Joaquin Formation

 Carman Sandstone Member of Etchegoin Formation

 Tupman Shale Member of Etchegoin Formation

Miocene Series

 Reef Ridge Shale

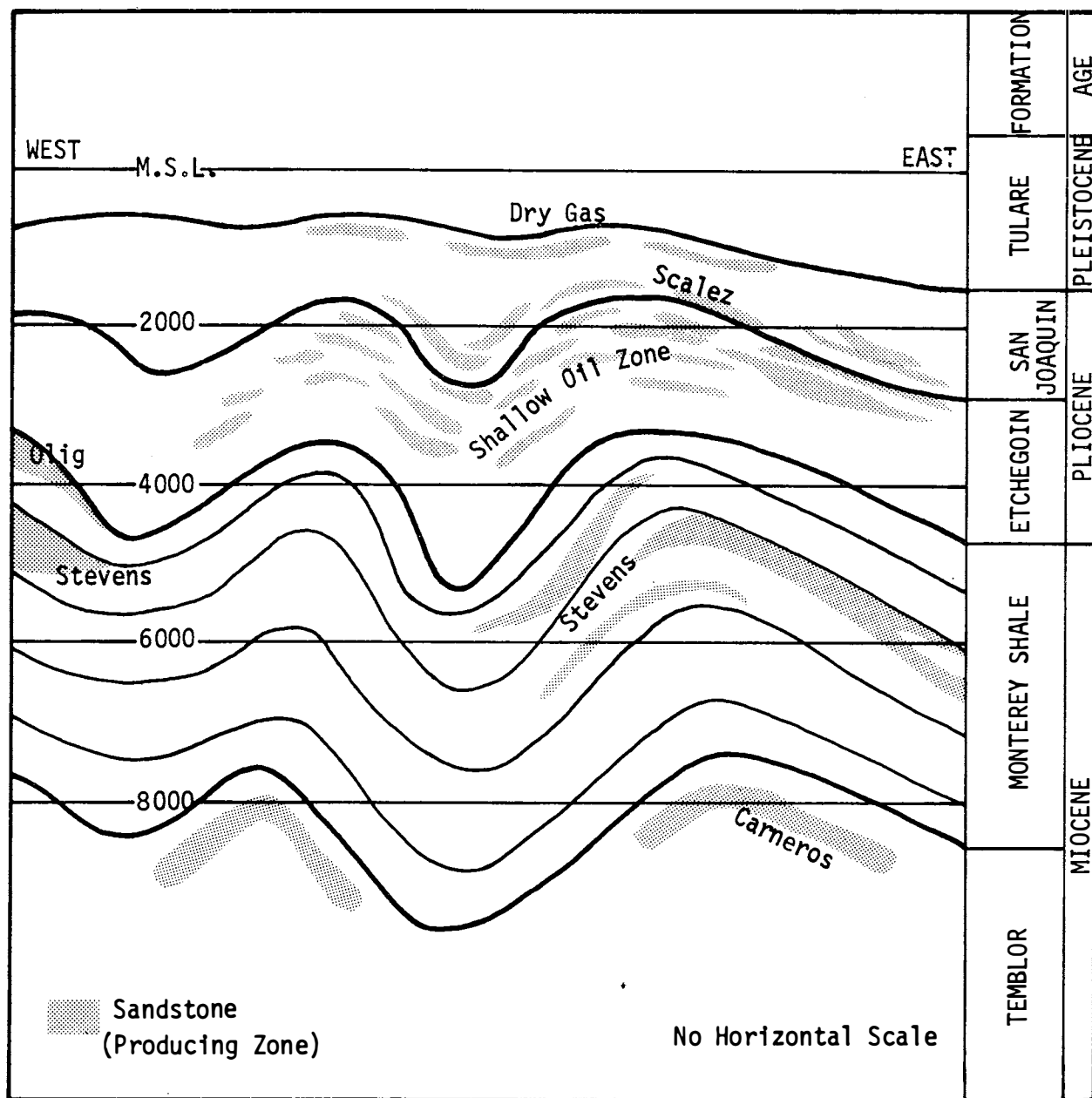
 Monterey Shale (Elk Hills Member at Top)

 — — Major Normal Fault

Solid where missing interval could be identified on electric log. Dashed where interpreted, D=Down-thrown side: U=Upthrown side.

Source: Maher, Carter, and Lantz, 1975.

Figure 2-5. Geologic Cross-section of Elk Hills.



Source: Environmental Assessment and Resource Planning, Oct., 1975
 (modified from Lantz, 1968).

Figure 2-6. Simplified Geologic Cross-section of the Elk Hills Oil Field
 Showing Major Producing Zones

logic associations. These two soil types are the Kettleman Series, which occurs on the upland portions of the reserve, and the Panoche Series, which occurs on the alluvium on the periphery of Elk Hills.

The Kettleman soils have formed on the poorly consolidated sand, gravels, claystone, mudstone, gypsum and limestone of the Tulare Formation. Since the surface soil has an abundance of rock fragments, it is often difficult to distinguish the soil from the underlying parent material. Small areas contain impure limestone and gypsum. These areas are associated with limestone and gypsum beds in the Tulare Formation. The soil is strongly calcareous throughout and contains moderate amounts of salts. However, not enough salt is present to prohibit or adversely affect native plant species.

The Kettleman soils have been subdivided into two types by the percent slopes on which they occur and by the degree of erosion that has taken place. These soil types are the Kettleman loam and Kettleman loam, rough and broken phase. Kettleman loam is usually found on slopes less than 25 percent and rolling to hilly relief with gully erosion. Kettleman loam, rough and broken phase, is found on slopes that generally exceed 25 percent and are strongly eroded. Presently the agricultural use of the Kettleman soils is limited to grazing.

The Panoche soils have a distinctive light yellow to light gray-brown, loose, and calcerous surface soil and a subsoil that ranges from a sandy loam to a gravelly sandy loam. These soils are, with very few exceptions, well drained and relatively free of alkali or saline constituents (Laskowski, 1968; United States Department of Agriculture, 1942). The Panoche soils have only been used for grazing purposes primarily because of the lack of available water for irrigation. Such grazing, although outlawed for years, has apparently continued intermittently and much overgrazing has occurred, with resultant acceleration of erosion.

d. Mineral Resources

No mineral resources other than oil and gas have been commercially developed within NPR-1. The coarser deposits of alluvium and the Tulare Formation could be used as a local source of sand and gravel.

e. Unique/Unusual Features

The Elk Hills are interesting as a geomorphic feature. Their relatively isolated location within the San Joaquin Valley make them a conspicuous feature on the landscape. A much less conspicuous physiographic feature occurs along the base of the eastern slope of Elk Hills. First reported by Woodring, Roundy and Farnsworth (1932, p. 11) during examinations of aerial photographs, it consists of a narrow swale or "trench" a few feet deep and 10 to 15 feet wide that extends westward from the vicinity of Tupman and curves around the west end of the hills. The origin of this feature has not been determined, but speculation includes ancient irrigation ditches, secondary earthquake cracks or regional subsidence cracks.

According to Woodring, Roundy, and Farnsworth (1932, pp. 25-26), no invertebrate fossils have been found in outcrops at Elk Hills, but some vertebrate fossils, fossil algae (chara) and silicified wood have been found. The vertebrates include remains of a camel (Procamelus?), a rabbit (Lepus), a wood rat (Neotoma), a cotton rat (Sigmodon), and some horse teeth. These were found in a buff mudstone and a sandy limestone that occurs near the middle of the formation (Maher, Carter, and Lantz, 1975, p. 76).

f. Geologic Hazards (nonseismic)

Naturally occurring geologic conditions at NPR-1 that could result in hazards include erosion, slope failure, subsidence, and corrosive and expansive soils.

The loose soils and sediments existing on the surface at NPR-1 are easily erodible. Little natural vegetation is present to prevent further erosion during winter rains. Similarly, the physical properties of the Tulare Formation in conjunction with the attitude of the strata make these sediments subject to slope failure where oversteepening, either along stream channels or due to man-made alterations, occurs on slopes that are oriented in the same direction as the dip of the strata.

Portions of the southern San Joaquin Valley have experienced subsidence from groundwater withdrawal (deep subsidence), from hydrocompaction (shallow subsidence), and from oil and gas withdrawal. Hydrocompaction occurs on irrigated lands when the alluvial deposits above the water table compact upon application of water. This kind of subsidence usually is irregular, and can cause construction problems for structures. Such problems were experienced at several locations along the west side of the San Joaquin Valley during the construction of the California Aqueduct. Although the alluvial deposits along the northeastern base of the hills did not create serious hydrocompaction problems for the California Aqueduct, the alluvial soils throughout the NPR-1 have not been tested for this phenomenon.

Subsidence related to groundwater withdrawal has occurred and is continuing in the alluvial sediments of southern San Joaquin Valley. Subsidence is most noticeable in the Kern Lakebed, according to the California Department of Water Resources (1962), where 2.4 feet of subsidence took place from 1957 to 1962. The potential for subsidence due to excessive withdrawals of groundwater exists in most alluvial areas of the San Joaquin Valley, including the alluvial areas of NPR-1.

Subsidence associated with oil and gas withdrawals centers over and extends beyond the producing areas. As pore pressures in reservoirs are reduced by fluid withdrawal, the overburden load is gradually transferred to reservoir rocks, causing compaction of the poorly consolidated oil bearing strata and subsidence at the surface.

To date no subsidence has been reported in the Elk Hills oil field, although some subsidence has occurred in the nearby Buena Vista and Midway-Sunset oil fields (Fig. 2-2). Subsidence in the Buena Vista oil field appears to be connected with the Buena Vista thrust fault. However, according to Nason (1976) slippage along this thrust fault has been caused more by oil withdrawal than by tectonic forces. Research of subsidence in the Buena Vista oil field by Yerkes (1969) indicates no movement in the NPR-1 toward the Buena Vista thrust fault based on his measurements taken at bench mark 1333 in Elk Hills. This is not an indicator of subsidence within the Elk Hills oil field, however, but documents the zone of movement created by the Buena Vista thrust fault.

The Midway-Sunset oil field is structurally similar to the Elk Hills oil field; there are no thrust faults; and fluid is being withdrawn from depths that could cause subsidence. Table 2-1 compares subsidence in the Buena Vista and Midway-Sunset oil fields. An analogy with Midway-Sunset will allow projections to be made for subsidence at Elk Hills.

The soils that occur throughout the upland areas of NPR-1 have demonstrated severe corrosion potential for unprotected iron and steel. Present corrosion preventive measures include elevation of pipe above the ground on cradles and cathodic protection for well casings.

Some of the clays in the soil do have a moderate shrink-swell potential. Since the majority of the roads in the reserve are dirt roads, the clays of the Kettleman series can make passage a problem during the wet season.

g. Seismic Setting

The geological structure and the associated historic and future seismic activity of the project area is discussed in Appendix E and summarized below. No known active fault zones cross the project

Table 2-1
DOCUMENTED SUBSIDENCE

Field & Discovery Year	Maximum Producing Area (km ²)	Median Depth of Production (m)	Differential Subsidence ¹			Horizontal Displacement		Surface Faulting			
			Maximum Measured (m)	Area of Subsidence (km ²)	Period of Measurement	Maximum Measured (m)	Period of Measurement	Type ²	Displacement (m)	Length (m)	Year First Obsrv
Buena Vista 1910	48	1,130	0.27		1957-1964	0.39	1932-1959	Lr	0.74	2,600	1932
			2.3		1942(?) - 1964						
Midway-Sunset Central Area 1901	65	555	0.49		1935-1965						
Globe Anticline 1912	15	1,020	0.43		1935-1965						
Sunset Area 1900?	20	590	0.18		1935-1965						

¹ Determined with respect to local control near margins of fields, any regional subsidence gradient removed. In many cases, determined only for a point within the field and maximum subsidence not known.

² H, high angle; L, low angle; N, normal; R, reverse.

Source: Yerkes, 1969.

site and no earthquake epicenters of Richter magnitude greater than 4.0 have been recorded as occurring on NPR-1.

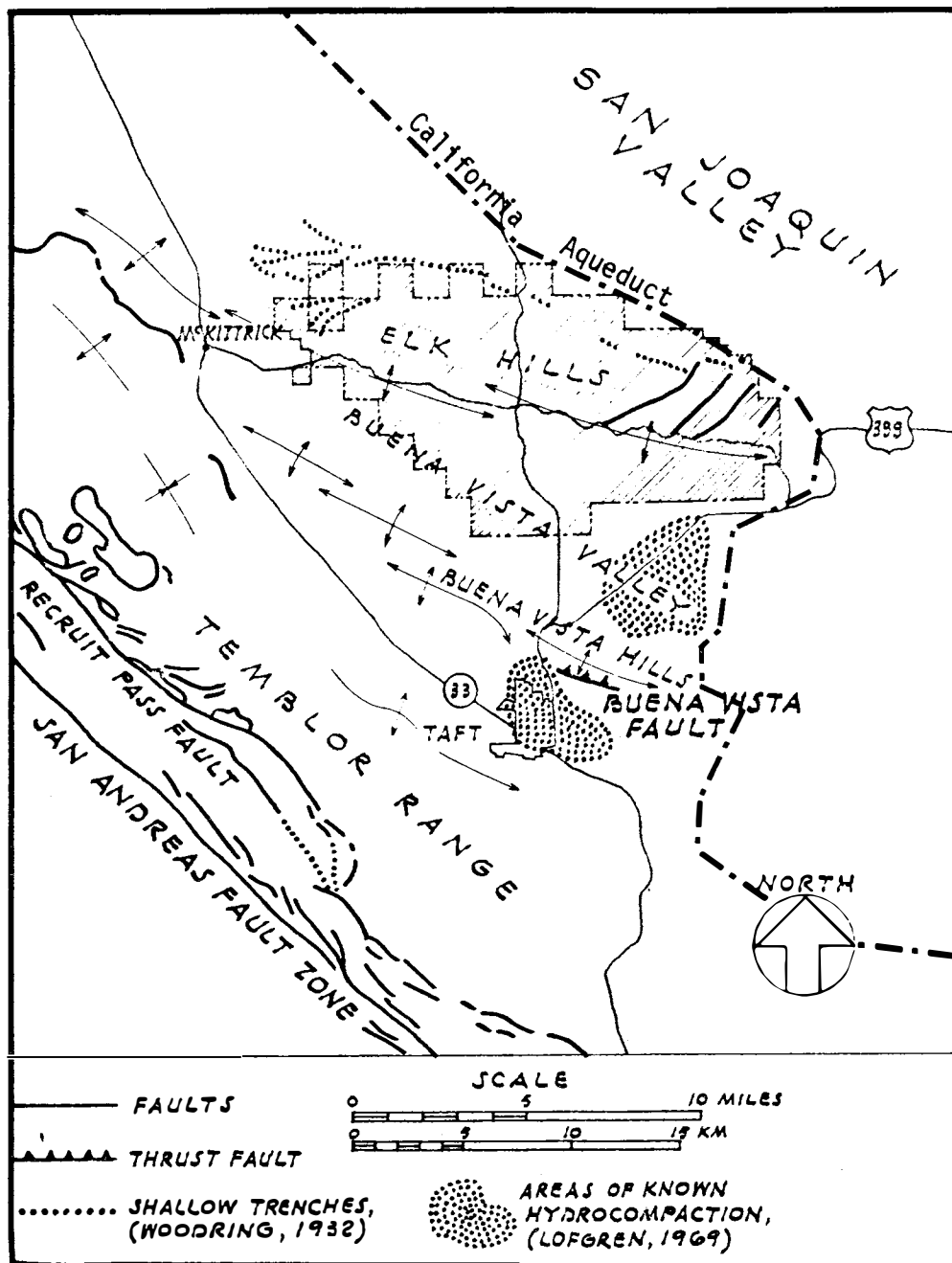
The San Andreas fault zone passes within about 12 miles to the southwest of NPR-1. Some minor inactive faults and shallow trenches do exist on NPR-1 (Fig. 2-7). Some earthquake epicenters of Richter magnitude 3.5 to 4.0 have been recorded near the project site and some larger ones within 10 miles (Fig. 2-8). Areas of known hydrocompaction are located south of the reserve.

B. Air Resources

1. Climate

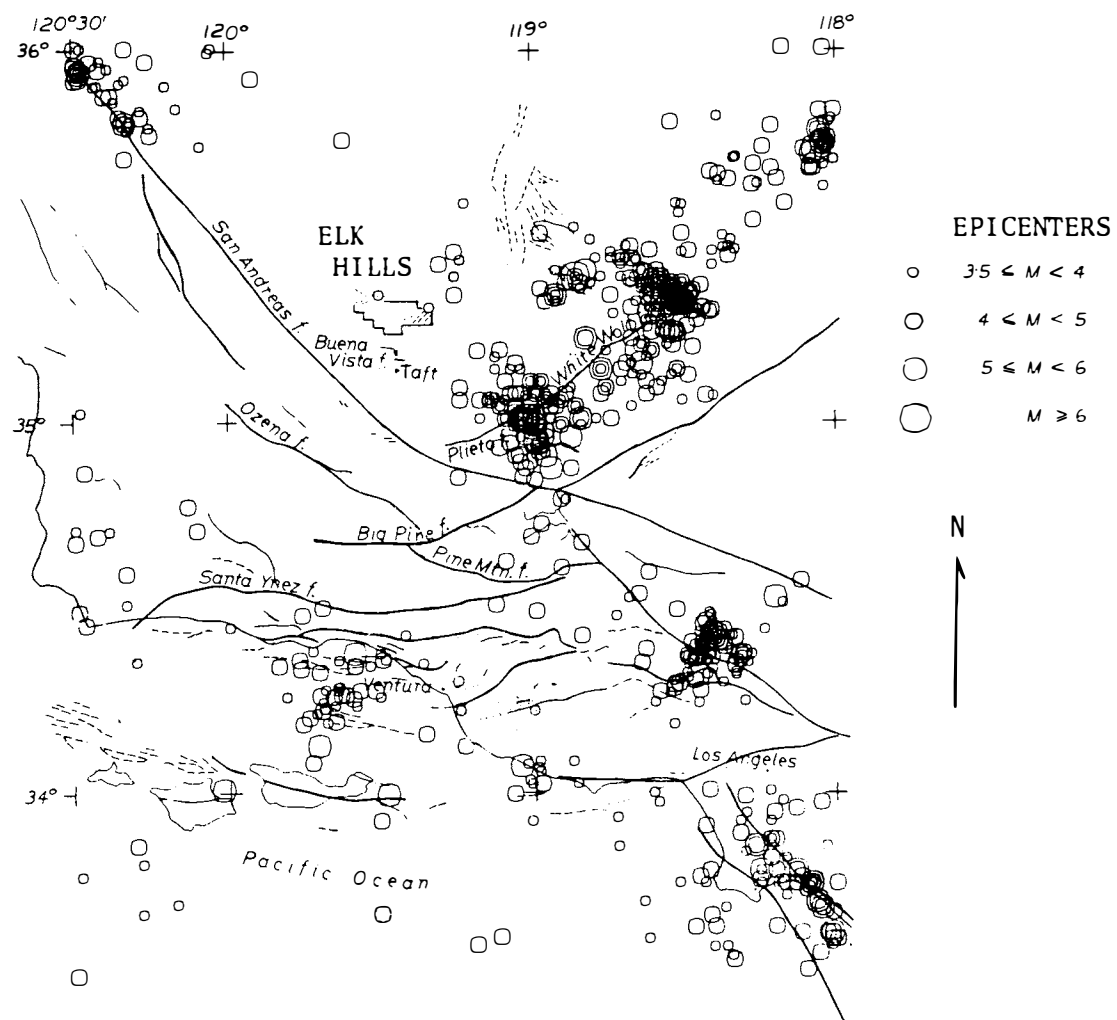
The climatic parameters that are important in determining photochemical pollution potential are winds, mixing depths, and sunshine. Summer winds in the San Joaquin Valley are dominated by a light, prevailing northwesterly flow caused by the semipermanent high pressure system and by the flow of marine air from the ocean through the Sacramento-San Joaquin Delta area. Mixing depth is the depth of the layer of air beneath the inversion level. During the summer, a persistent inversion exists in the San Joaquin Valley between 1,600 and 2,000 meters (5,200 to 6,600 feet) above sea level. Night and early morning inversion heights are generally lower but usually rise or dissipate with the heat of the sun. Sunlight during the summer months is abundant in the San Joaquin Valley because of the presence of a persistent high-pressure area. During the summer, the light winds, abundant sunlight, and shallow mixing depths lead to the accumulation of hydrocarbons and photochemical pollution.

A more detailed treatment of the San Joaquin Valley climate as it relates to air pollution is presented in Appendix F.



Source: URS/John A. Blume & Associates, Engineers, 1978

Figure 2-7. Faults and Surface Features Elk Hills Naval Petroleum Reserves



Source: URS/John A. Blume & Associates, Engineers, 1977

Figure 2-8. Quaternary Faults and Epicenters of Earthquakes of Richter Magnitude 3.5 or More, 1932-1974

2. Air Quality

Air emissions and ambient air quality are presently regulated by a combination of federal, state, and local agencies (Appendix G). The most significant regulations for this petroleum project include:

- o New Source Review procedures and New Source Performance standards of the U.S. Environmental Protection Agency
- o The Air Quality Maintenance Planning effort currently underway involving federal, state, and local entities
- o The national and state ambient air quality standards
- o The New Source Review procedures adopted by Kern County Pollution Control District
- o Emission limits and controls required by Kern County Control District

National ambient air quality standards have been promulgated for the following pollutants: carbon monoxide, sulfur dioxide, suspended particulates, nitrogen dioxide, nonmethane hydrocarbons, and photo-chemical oxidants. The latter pollutant is of particular concern because its high concentrations are a significant problem in the San Joaquin Valley Air Basin. Oxidants form as a result of complex reactions between reactive hydrocarbons, nitrogen oxides, and sunlight. The project's primary emissions would be hydrocarbons and oxides of nitrogen; consequently, impacts on existing oxidant concentrations would be the primary concern.

The National Ambient Air Quality Standard for oxidants is exceeded on a substantial number of days (97 days in Bakersfield-Vineland during 1977) in the San Joaquin Valley. The 1975 data showed an apparent large decrease, but this represents a calibrational change in the instruments and not necessarily improved air quality. General oxidant concentrations are higher in the eastern and southern portions of the valley. Oxidant

concentrations in nonurban areas south of Bakersfield have been shown to be higher than those concentrations measured at the air quality monitoring station in Bakersfield.

Emission controls, especially on automobiles, are expected to reduce oxidant concentrations in the San Joaquin Valley in the near future. Population and automobile use will increase, however, and total emissions will catch up with the controls' benefit, assuming existing technology. Sulfur dioxide sources are expected to increase in the future, due primarily to increased replacement of natural gas-driven pumps by fuel oil-driven pumps and new steam injection units at re-claimed oil fields (none of this will be true for production at NPR-1).

A more detailed discussion of the San Joaquin Valley Air Basin air environment is presented in Appendix H.

C. Noise

The results of a noise survey (Appendix I) indicate the Naval Petroleum Reserve at Elk Hills has noise levels typical of a wilderness/rural environment (40 to 45 dBA) except near the gas plant, compressor station, well pumps, and well drilling operations. The noise levels near the 35R gas plant and compressor station (60 to 80 dBA) are similar to those in an industrial area. Noise levels in these areas are generally constant and occur over a 24-hour period. Noise levels near well pumps are localized noise sources and occur throughout the Reserve. Well drilling creates noise levels typical of a construction site. These noise levels are temporary, lasting only until a well is drilled.

D. Water Resources

NPR-1 is situated within the boundaries of the Tulare Lake Basin (Basin 5D). This basin encompasses the southern half of the San Joaquin Valley and is essentially closed from a hydrologic standpoint. Surface and groundwater flows within the basin converge towards the basin's central valley floor. In the past, this convergence resulted in the development of several large lakes (e.g., Tulare, Buena Vista, and Kern). However, upstream diversions, heavy groundwater pumping, and high evaporation rates have helped to reduce these lakes to dry lakebeds, which are now used as farmlands.

While the water resources of the basin are quite large, the project site and the adjacent foothills have relatively limited water resources (see Appendix J). Less than 1 percent of the basin's total surface flow originates from this region with Buena Vista Creek, which is immediately south of the project site, carrying most of it (California State Water Resources Control Board, 1975). This flow occurs entirely in the form of intermittent streams that have sustained flows only during and immediately after periods of heavy precipitation. These surface flows seldom reach the valley floor; instead, they tend to percolate rapidly into their streambeds. This percolation provides the primary source of recharge for local groundwaters.

The groundwaters underlying NPR-1 can be divided into two distinct groups: (1) the freshwaters found in the Tulare Formation, and (2) the brackish waters of the underlying marine formations. Because of the local geologic structure, the freshwater aquifers located onsite are limited to the first several hundred feet of strata, while the brackish waters of the oil zone extend several thousand feet in depth. The quality of both these groundwaters is poor. The freshwaters are highly mineralized with total dissolved solids (TDS) concentrations averaging 5,000 mg/ (Maher, et al., 1975). The cause of this degradation is not

completely known, but the high TDS levels (3,400 mg/l) associated with local surface streams, which are the primary source of recharge for these aquifers probably are a major contributing factor (California State Water Resources Control Board, 1975). The water quality of the brackish waters is even poorer, with TDS levels averaging in excess of 30,000 mg/l (Weddle, 1968).

Because of the poor quality of the above waters, the most important water resource within the project site is neither surface nor ground-water but rather imported water. In particular, the California Aqueduct, which crosses the northern and eastern edges of the project site, annually carries more than 500,000 acre-feet of high quality water into the Tulare Lake Basin for agricultural use. Site surface waters, on the other hand, can be used only for groundwater recharge and the underlying groundwaters are essentially unusable.

E. Biological Resources

1. Vegetation

The following discussion is based on field work performed in late November 1976, and January 1978, literature review as cited in text, and interviews with knowledgeable persons.

The vegetation of the NPR-1 consists entirely of the Lower Sonoran grassland described by Twisselman (1967). This vegetational type is characterized by few or no trees, a scattered shrub stratum, and an herbaceous ground cover composed of annual plants. The density of the herbaceous layer depends upon yearly rainfall.

The dominant shrub in the study area is common saltbush (Atriplex polycarpa). A species of goldenbush (Haplopappus cf. linearifolius), white burrobrush (Hymenoclea Salsola), bladderpod (Isomeris arborea),

and the introduced Russian thistle (Salsola kali) are also present. The latter three species appear to preferentially inhabit the dry creeks and draws that dissect the land.

The dominant herb at NPR-1 is red-stemmed filaree (Erodium cicutarium). This introduced species is not a grass, but several grass species are interspersed with it. In the partial shade of saltbush plants and human-made structures, the grasses grow more vigorously, and outcompete the filaree. The only grass species seen during field survey were the introduced red brome (Bromus rubens), and seedlings of a fescue (Festuca sp.), probably the native F. microstachys var. simulans (Twisselman, 1967).

Two populations of cotton eriogonum (Eriogonum gossypinum) (in N 1/2 Section 31, T30S, R24E, and in N 1/2 SW 1/4 Section 7, T31S, R24E) have been reported in the Reserve (California Natural Areas Coordinating Council, 1977). This species is included in the California Native Plant Society's inventory of very rare and rare and endangered species (Powell, 1974). Additional populations of this and other rare plants are known from the vicinity of Elk Hills, but not in the Petroleum Reserve itself.

Oil production development at NPR-1 has had considerable impact on the vegetation. In many regions that have been disturbed by earthmoving activities, recovery of ground cover has been slow and is not yet complete. The most serious impact has been soil erosion caused by runoff from roads and other compacted areas. Despite the construction of diversion drains and check dams (Natural Resources Conservation Award Nomination Report, 1972), erosion continues to reduce vegetational habitat on high-gradient slopes throughout the Reserve.

The vegetation has been augmented by plantings of oleander (Nerium oleander) and other introduced species at several wildlife management areas within NPR-1. The presence of these introduced plants has not affected the remaining vegetation to any significant extent.

A list of plant species expected or observed at Elk Hills is presented in Appendix K.

2. Wildlife

The following discussion is based upon previous work, literature review as cited in text, and interview with knowledgeable persons.

During field survey, the most frequently observed mammal in NPR-1 was the black-tailed hare (Lepus californicus). The remains of kangaroo rats (Dipodomys spp.) and mice were frequently found around predator burrows. San Joaquin antelope ground squirrels (Ammospermophilus nelsoni) were seen in NPR-1, and burrows of Botta pocket gophers (Thomomys bottae) and California ground squirrels (Otospermophilus beecheyi) were abundant. Coyotes (Canis latrans) and badgers (Taxidea taxus) are expected to occur within the Reserve. A bobcat (Lynx rufus) was seen in the western end of the project area, just north of McKittrick Valley.

No amphibians or reptiles were observed during the field survey. It is not likely that any amphibians inhabit the site, with the possible exception of the western toad (Bufo boreas) and the western spadefoot toad (Scaphiopus hammondi). Reptiles are expected to be fairly common. It is likely that the greatest number of reptile species inhabit the undisturbed portions of the higher elevations within the study area, where the more broken terrain, steeper slopes, and rock outcrops provide shade and diversity of habitat.

The bird life of this region is neither exceptionally diverse nor abundant. The sparse cover provides good hunting ground for birds of prey like the American kestrel (Falco sparverius), red-tailed hawk (Buteo jamaicensis) and golden eagle (Aquila chrysaetos). Sign of burrowing owls (Athene cunicularia) was found around apparently abandoned

kit fox dens. A number of Say's phoebes (Sayornis saya), loggerhead shrikes (Lanius ludovicianus) and sparrows were also observed. Small (1974) has reported that LeConte's thrasher (Taxostoma lecontei) is highly characteristic of this type of habitat, although this species was not seen. Game birds at NPR-1 include the California quail (Lophortyx californicus), chukar partridge (Alectoris chukar), and mourning dove (Zenaidura macroura). Shorebirds and waterfowl occur as migratory transients.

Two vertebrate species that occur within the project area, the San Joaquin kit fox (Vulpes macrotis mutica) and the blunt-nosed leopard lizard (Crotaphytus silus), have been declared rare and endangered by the U.S. Fish and Wildlife Service (Environmental Reporter, 1977). The San Joaquin Kit Fox Recovery Team has submitted a proposal for the regional office of the U.S. Fish and Wildlife Service that the entire NPR-1 be designated as critical habitat of the kit fox (Howard Leach, personal communication). It is likely that, within the year, portions of the Reserve will also be proposed as critical habitat by the Blunt-nosed Leopard Lizard Recovery Team (John Brode, personal communication).

Both of these species inhabit the open, flat plains that typify much of the region surrounding Elk Hills. Leopard lizards also appear to live in some of the arroyos of the hills themselves. The largest lizard populations, however, are thought to occur on the periphery of the project area, in the southwestern portion of the Naval Petroleum Reserve, and on the gentle north slope of the Elk Hills.

The wildlife management plan (Appendix L) that has been in effect since 1963 (Cooperative Plan, 1963) has benefited most species. The most salient features of this plan are elimination of livestock grazing, installation of watering areas, and control of hunting.

The relationships among resident wildlife and their dependence upon the regional vegetation are discussed in the following section, "Ecological Relationships." Partial lists of the animal species expected or observed in the study area may be found in Appendix K.

3. Ecological Relationships

The southern end of the San Joaquin Valley in which the Elk Hills are situated is a true desert. Its annual rainfall averages less than 6 inches. It is therefore not surprising that the primary factor that limits and shapes the biotic communities of this region is moisture. The scant rainfall, the dense winter tule fogs, and the atmospheric moisture that results from the area's proximity to the coast almost always combine to provide sufficient moisture for germination of the seeds of the annual plant species. This accounts for the floristic differences between this region and the Mojave Desert. However, there is not enough moisture to support a predominantly perennial vegetation. Even the winter annual plants are somewhat stunted, except in very rainy years (Twisselman, 1967).

Differences in moisture regime between different areas have a marked effect on the vegetation. It was noted in the vegetation subsection above that grasses grow much more thickly beneath bushes and in the shade of artificial structures. This occurs because moisture is evaporated from the plants and the soil less rapidly in the shaded areas; it is not a direct effect of the presence or absence of light. A similar phenomenon is observed on roadside berms: the south side is characteristically barren, while the more shaded north side supports filaree and grasses. The denser vegetation in the intermittent streams and washes, and the apparent preference of some plant species for these locations is also a response to moisture regime.

Rapidly growing winter annual plants are more successful in the Elk Hills than perennials, which would require more moisture throughout the year. Wildlife of the study area also tend to be less dependent upon water than the animals in many other regions. In particular, kangaroo rats require no surface water. They can obtain this all-important liquid totally from the food that they eat.

Wildlife also respond to moisture indirectly, through the distribution of vegetation. Rodents, hares, and small birds are able to find food and cover most easily where the vegetation is most dense. Similarly, predators are better able to hide in thick vegetation, and to get closer to the prey species that feed there.

Interestingly, the two endangered wildlife species that inhabit the study area live in the broad, flat plains where there is less plant cover. This is no coincidence. The kit fox and the leopard lizard are endangered, not because of excessive hunting or direct destruction by humans, but because their habitat is ideal for conversion to irrigated farmland. Such conversion has proceeded rapidly to date, and is likely to continue.

Oil production development has affected the wildlife habitat within NPR-1. Catchment dams, recontoured areas around well sites, and other earthworks have been extensively colonized by pocket gophers and other burrowing animals, because of the less compacted soil. However, this has probably resulted more in a redistribution of the animal population than in an increase in the number of animals present. The limiting resource in this extremely arid region is food, not living space. Consequently, the reduced vegetational cover that has resulted from oil production development has equivalently reduced the value of the region as wildlife habitat.

In contrast, the wildlife management program (Natural Resources Conservation Award Nomination Report, 1972) has benefited the resident wildlife (see Appendix L). The watering program has helped a greater proportion of the native wildlife population to survive times of drought. The most beneficial action included in the program has been the elimination of grazing, which has removed food competition by livestock. Moreover, the absence of grazing permits more grass to mature, spread, promote more extensive ground cover, and thus increase the total food available.

NPR-1 is not isolated from the other biotic communities of the southern San Joaquin Valley. It provides habitat for plant and animal species that interbreed and interact with populations throughout the region. Because of this interaction, the land does more than support its resident biota. Each segment of land that supports a set of species contributes to the stability of the regional populations of those species. Uncultivated, undeveloped areas like the Elk Hills Naval Petroleum Reserve have become increasingly scarce in recent years. For this reason, the contribution that the study area makes to the continued biological stability of the remaining undeveloped land has become increasingly important.

F. Cultural Resources

The southern San Joaquin Valley area was populated by peoples from various Yokut tribes for thousands of years before European contact. Abundant archaeological evidence of the Yokuts way of life has been noted along the shorelines of what once were Kern Lake, Buena Vista Lake, and Buena Vista Slough. Most of NPR-1, however, is rated as being of low sensitivity to archaeological resources since this area is generally undesirable for any long-term occupation. Appendix M presents details of the cultural resources evaluation.

No physical structures or features dating from the 18th or 19th century history of the area are in existence on NPR-1. More recent history of the area includes petroleum production and the sites of historical events are identified with markers. No such markers are situated in locations proposed for this project development.

G. Land Use

NPR-1 is located in the hilly western edge of Kern County.

1. Regional

Land use in Kern County depends on geographical features. The valley floor and Sierra foothills in western Kern County are sites of extensive agricultural and petroleum development. Western Kern also contains the majority of the county's urban development, located in centers along major transportation corridors. The mountainous areas include major U.S. Forest Service holdings, open for public recreation. The desert in eastern Kern is also the site of major federal landholdings.

The valley's rich resources were first developed for cattle ranching. Later, development of groundwater resources and the availability of imported water led to an intense development of cultivated agriculture. Kern County is presently one of the leading agricultural counties in the state.* Approximately 3,408,000 acres are devoted to agriculture. Of these, 815,000 acres are irrigated. About 60 percent of irrigation water comes from groundwater, 15 percent from surface water, and 25 percent is imported water from the California Aqueduct and Central Valley project. The county's major crops include potatoes, alfalfa hay, grapes, and cotton; and cattle ranching is still a big industry.

*California State Governor's Office. 1976. California Statistical Abstract. p. 70.

Though Bakersfield began as a cattle town, over time the primary economic activities there shifted to agriculture and oil. With this shift, the western edge of the county experienced urban growth, as many small petroleum towns appeared. Taft, one of these petroleum towns, was established early this century. Petroleum production became a major land use in Kern County in the early 1900's.

The primary land uses in the Tehachapi Mountains in eastern Kern County are recreation and cattle grazing. Portions of the Sequoia and Los Padres National Forests, and Lake Isabella (a major recreational lake managed by the Army Corps of Engineers), are located in these mountains. China Lake Naval Weapons Center is located in a nearby desert area.

The Bureau of Land Management controls extensive government lands in the desert, open for informal public recreational use. Edwards Air Force Base is also in desert lands in the southeast corner of Kern County.

There are small towns located along major transportation corridors throughout the mountain and desert portions of the county.

2. Local

In 1912 Congress set aside NPR-1 and NPR-2. NPR-1 encompasses 46,095 acres, or 0.9 percent of Kern County's land area. Until 1955, parts of the Navy-owned Reserve lands were leased to ranchers for cattle and sheep grazing. These activities continued on portions of Standard Oil inholdings until 1967.* At the present time oil production and support facilities are the only use of the property. Public access is restricted.

Land use in the immediate vicinity of NPR-1 is shown in Figure 2-9. The Naval Petroleum Reserve No. 2 is located to the south. To the

*Natural Resources Conservation Award Nomination Report for Naval Petroleum Reserve No. 1, Tupman, Kern County, California. 1972. p. 7.

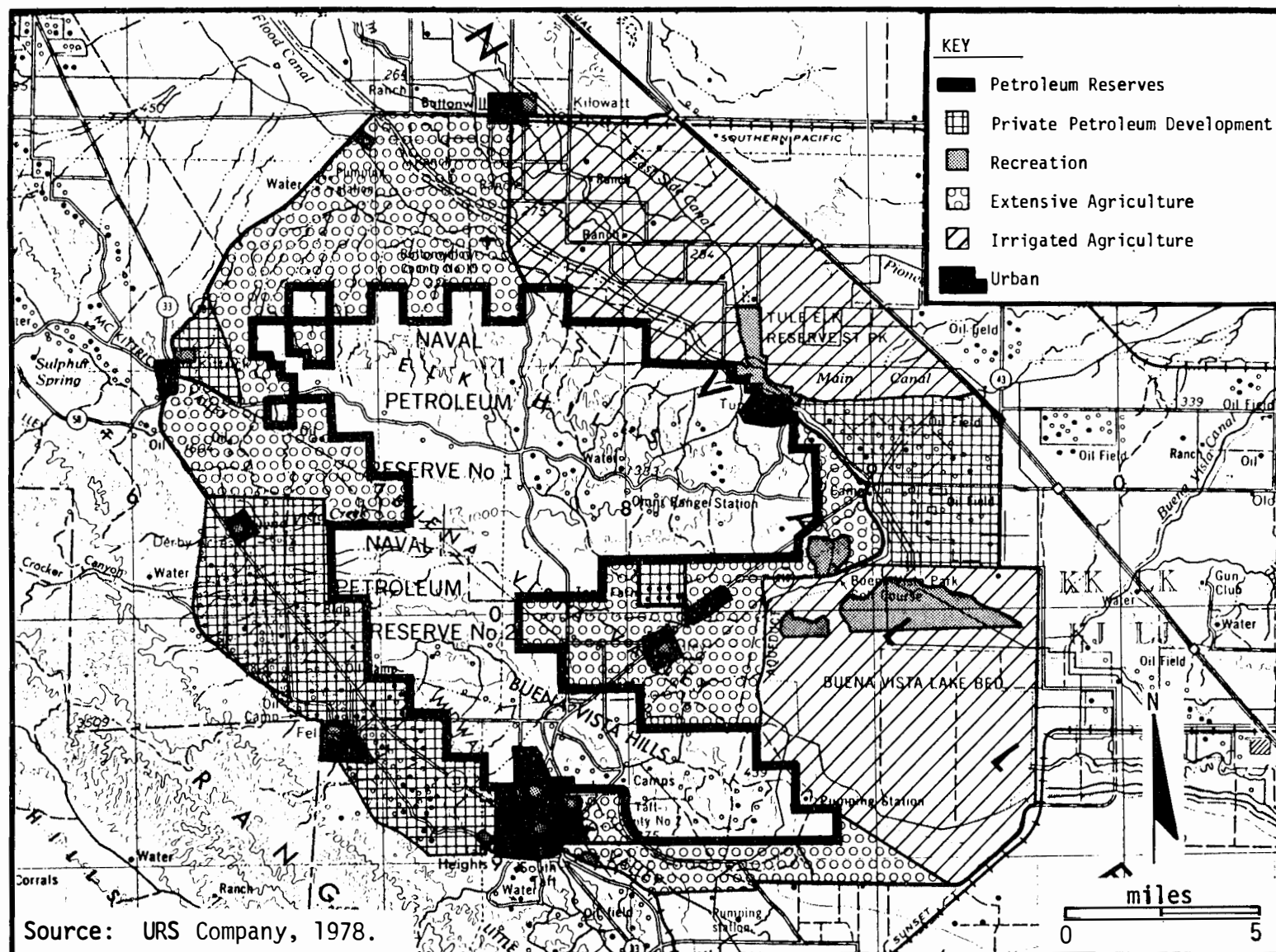


Figure 2-9. Land Use Near Elk Hills

north, west, and south of the two Petroleum Reserves, land is used for grazing or petroleum production and storage; or remains unused open space. At the Buena Vista lakebed to the east, and in the Buttonwillow area to the north, land is used for irrigated agriculture. The Tule Elk Reserve and the Buena Vista Aquatic Recreation Area and Golf Course are located just east of the Petroleum Reserve.

H. Socioeconomics

1. Employment and Trade

The following environmental description includes both regional and local socioeconomic settings. The site's regional economic environment comprises the greater Bakersfield metropolitan community, an area co-terminus with Kern County and the Bakersfield Standard Metropolitan Statistical Area. The site's local economic environment considers Kern County's west-side, including the communities of Taft and Buttonwillow.

a. Regional

The greater Bakersfield area economy (metro-economy) is strongly resource-based. Since the mid-19th century when major immigration began, the region's economy has drawn its economic energy from two primary resources: cultivatable land and minerals.

Agriculture has provided a stable and enduring economic base. Even recently, as the regional economy has begun to expand its base to include nonresource-based activity, agriculture has continued to grow in both scale and intensity. Thus during the past decade, while the metro-economy has added support for 27,000 workers, agricultural employment has increased by 6,000. Current employment within the agricultural sector is estimated at 26,700, representing 20 percent of the entire metropolitan work force. Prospects for continued agricultural development are good as additional acreage comes under cultivation and as more

intensive farming techniques are applied to existing agricultural land. More than 1 million acres are expected to be under cultivation within the region by 1980, making the area one of the most productive agricultural systems in the country.

Mining continues to provide a secondary -- although still vital -- source of economic support to the region. Gold was the mineral that initiated much of the community's early economic activity. By the turn of the century, however, petroleum was recognized as the resident mineral of greatest potential. Currently, oil production from within the region probably approaches \$1 billion annually. The work force supported by this production is currently estimated at 9,000.

Other economic sectors within the metro-economy -- manufacturing, trade, services, and government -- have grown substantially during the past decade. Agri-business, recreation, and tourism are also strong and emerging industries.

Unemployment within the metro-economy remains lower than both statewide and national averages. Unemployment during 1977 was 6.6 percent of the region's civilian work force. Although the area has recovered strongly from the 1974 recession and shown great resilience to the effects of drought, the United States Department of Labor has nevertheless defined unemployment within this area as substantial. On the basis of unemployment insurance claims, the level of unemployment and the rate of unemployment growth was highest in the agricultural sector. Unemployment claims grew by more than 30 percent between 1975 and 1976. The occupation groups most impacted were farming, forestry, and fisheries. The strongest recovery took place in the processing and construction fields where unemployment levels were reduced by nearly 30 percent.

b. Local

The community of Taft, together with its surrounding populations, remains strongly dependent upon the petroleum industry. By 1972, oil production from the fields of Taft, South Taft, Ford City, and Taft Heights totaled more than 2 billion barrels. It is estimated the petroleum industry can support approximately 2,000 workers within the greater Taft area. This is more than 40 percent of the entire local resident labor pool.

Prospects for broadening this economic base depend on the vagaries of accessible and affordable water supplies. If suitable water resources can be developed, both the Cuyama Valley and the Carrizo Plain southwest of Taft are prime for agricultural development.

Though dominated by the petroleum industry, the local work force is nevertheless a diverse occupational group. About 15 percent of the local labor pool is employed in revenue-producing activities: construction and manufacturing. Fifty-five percent are employed in revenue-catching or recycling activities: wholesale and retail trade, finance, insurance, government and other support services. The remainder of the local work force is comprised of workers of undefined occupational characteristics.

2. Population

a. Regional

The greater Bakersfield metropolitan region had a population as of mid-1976 of approximately 354,700, 7 percent more than in 1970. Recent population gains are mostly attributable to natural increases -- the excess of births over deaths. In addition, in-migration is greater than out-migration, reflecting a healthy economy and an attractive living environment for some people.

Most recent growth within the region is concentrated in existing major urban areas. Between 1970 and 1976, more than 70 percent of the region's total population increase could be found in Bakersfield, Delano, Edwards, and Ridgecrest.

The regional population is predominately white, fairly young, and productive. Noteworthy is the fact that approximately 20,000 new workers will age into the available regional labor pool by 1980.

b. Local

The environs of Kern County's westside (Elk Hills vicinity) are estimated to contain 18,660 persons, about 5 percent of the regional population. Greater Taft comprises about 12,000 of this number. The west-side population has been declining for over a decade. Between 1960 and 1970 the area lost 7 percent; by 1980 it is expected to lose 5 percent more.

The west-side population (Elk Hills area) is characterized as largely white, lower-middle to middle class, and mature.

3. Housing

a. Regional

The greater Bakersfield metropolitan region contains more than 130,000 housing units. This is an increase of more than 10 percent over 1970 housing stock estimates. About 15 percent of total existing housing is defined as vacant; approximately 3 percent is both vacant and available for occupancy.

b. Local

West-side housing (Elk Hills area) has higher rates of vacancy than does the region, more because of population decline than new construction. Between 1970 and 1974 only 24 permits for single-family residences were issued by the City of Taft. This increased substantially between 1974-78 to permits for 99 single family units. Meanwhile much of the area's housing stock, particularly rentals, is deteriorating. 42 demolitions were recorded between 1970-78. Eighty-five percent of local housing is classed as "substandard". Good quality housing units of rental type or of low to lower-middle income classification are scarce.

4. Transportation

a. Regional

Regional transportation needs are served by a large number of Federal, state, and county highway systems in Kern County. Interstate 5 is the major north-south traffic route. Primary state routes include SR 99, SR 33, SR 119, SR 43, SR 65, SR 58, SR 14, and SR 155.

Kern County has developed an area-wide Transportation Plan (Kern COG, 1975) for inclusion into the 1976 California Transportation Plan. The transportation methods covered in the Plan, which are of importance for the marketing of NPR-1 petroleum products, include trucking, highway improvements, railroads, and pipelines. The Plan points out the importance of using pipelines to distribute petroleum products to market by illustrating the strain that would be placed on tanker trucks and railroad cars if there were no pipelines.

b. Local

The transportation needs of NPR-1 are served primarily by Elk Hills Road and Skyline Road. Elk Hills Road is the north-south route to

Buttonwillow and Taft, respectively. Skyline Road serves McKittrick to the west and the North-South Access Road to the east. The North-South Access Road, which is privately maintained, provides access to State Route 119 and Interstate 5.

No traffic data are available for the Naval Petroleum Reserve itself. Traffic volumes for 1976 on Skyline Road, Elk Hills Road, Reserve Road, and Tupman Road in the vicinity of the project site are shown in Table 2-2. These figures incorporate all traffic vehicles since no surveys have been conducted to break out the proportion contributed by trucks. Traffic on State Routes 119 and 58 is also included in Table 2-2. From the indicated volumes, it appears that there are no obvious traffic problems on any of these routes and they are providing an acceptable level of service. The only exception is State Route 58 near the junction of State Route 99 where the peak-hour volume indicates heavy usage.

There is no railroad service to within Naval Petroleum Reserve No. 1. The closest rail lines are the Sunset Western Railroad which terminates in Taft and the Southern Pacific line passing through Buttonwillow.

There are presently about 20 tank trucks per day transporting liquid petroleum products from the 35R gas plant.

5. Public Services and Utilities

a. Police Services

Regional. Police services in the unincorporated areas of Kern County are provided by the Kern County Sheriff Department. The Sheriff Department consists of 333 commissioned officers stationed in communities throughout Kern County.

Table 2-2
EXISTING TRAFFIC VOLUMES (1977) NEAR
NAVAL PETROLEUM RESERVE NO. 1

Road	Location	Annual Average Daily (AADT)	Peak Hour
Elk Hills	North of SR 119	500	50
	At Brite Road	500	50
Skyline Road	At Reserve Road	100	10
Reserve Road	West of Skyline	320	32
Tupman Road	North of SR 119	600	60
	South of Adohr Road	300	30
State Route 119	East Limits of Dustin Acres	5,300	540
	At Tupman Road	4,600	552
State Route 58	East Limits of Buttonwillow	2,700	439
	Junction of Route 99	22,000	2,724

Source: State of California, Department of Transportation, 1978; Kern County, Road Commission, 1978 Personnel Communication.

Local. There are three sheriff department offices in the Elk Hills area. Six men are stationed at Wasco, three at Buttonwillow, and five at Taft. There is at least one officer on duty 24 hours a day at each location. In addition, Taft and Bakersfield have their own police departments.

A deputy sheriff patrols the Reserve each night. NPR-1 is not entirely fenced, and the deputy sheriff is responsible for keeping out unauthorized visitors and grazing sheep. Officers at the west side sheriff's offices and in Bakersfield share this duty.

Local sheriff offices and fire stations are shown in Figure 2-10.

b. Fire Protection

Regional. The principal fire protection agency in Kern County is the Kern County Fire Department, which mans and maintains 44 year-round fire stations and 2 seasonal stations. The department has 500 full-time paid firefighters. Seven communities have their own fire departments, sometimes in addition to the county stations. The largest community fire department is the Bakersfield City Fire Department, which mans and maintains eight stations.

The county fire department maintains and operates a foam trailer, at a county fire station in Bakersfield. This firefighting equipment for oil fires was purchased for the county by local oil companies.

Local. There are four Kern County Fire Department stations in the Elk Hills local area. These include two-man stations at McKittrick, Fellows, and Buttonwillow, and a five-man station at Taft.

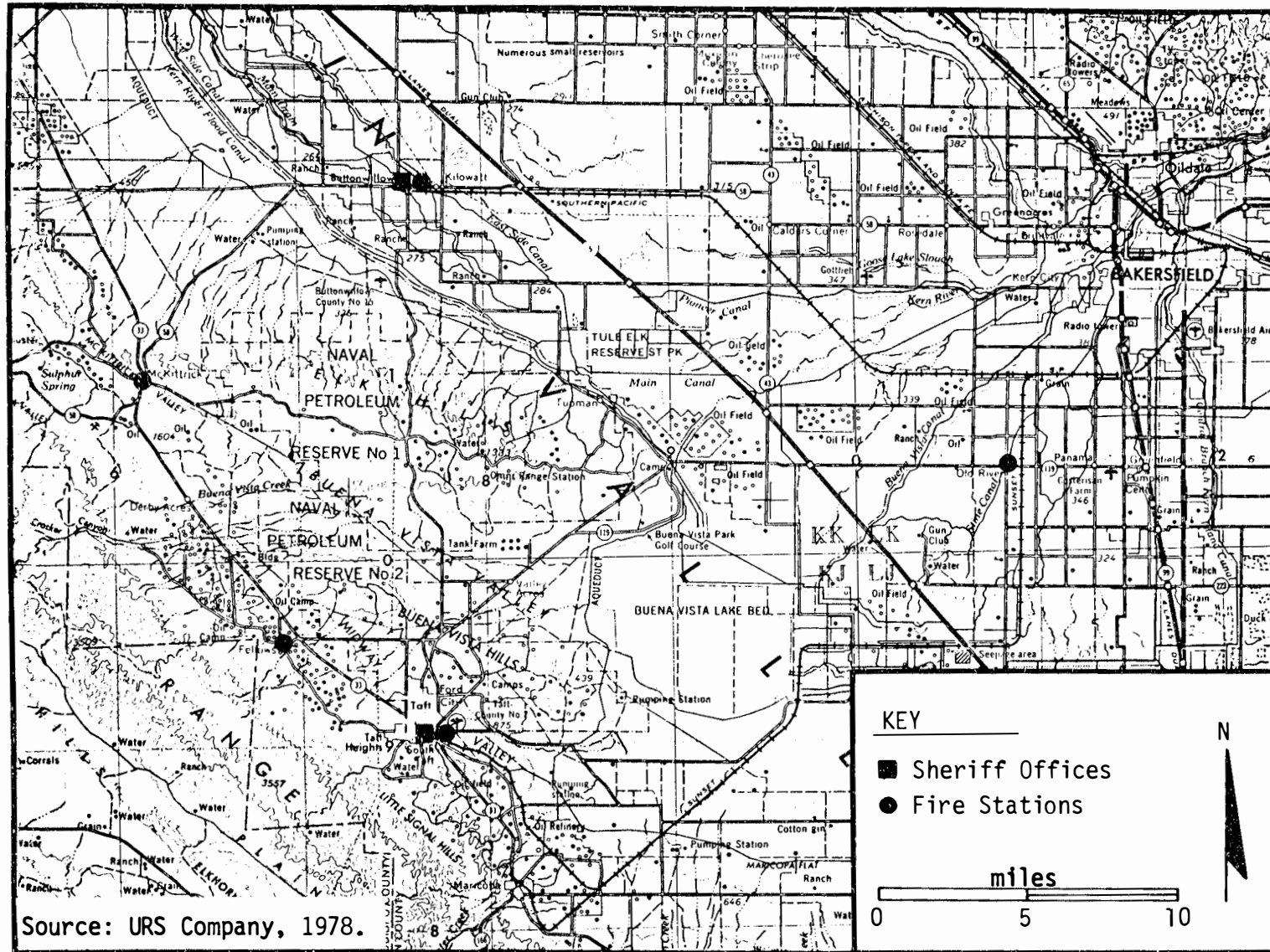


Figure 2-10. Location of Fire and Sheriff Services

NPR-1 has a mutual aid agreement with the Kern County Fire Department. Thus, firefighting manpower and equipment at NPR-1 can be supplemented by the manpower and equipment at the local county fire stations. Fire equipment at the Reserve and the local county fire stations is listed in Table N-1, Appendix N.

Basically, each county station has at least one engine carrying 1,000 gallons of water and one pickup truck carrying 200 gallons of water. The Reserve has one pumper with a pumping capacity of 500 gallons per minute and minimal storage capacity. Volunteer firefighters, present during normal working hours, operate the Reserve's equipment. The nearest foam truck is located at Taft.

Other elements of the fire protection system at NPR-1 include water hydrants at most oil well and tank locations, and portable fire extinguishers in all Reserve vehicles. Brush is cleared from areas adjacent to structures and equipment to minimize brush fire hazards. Fire alarms are transmitted over the telephone system.

c. Education

Regional. Kern County schools are operated by 45 individual elementary school districts, 10 joint elementary and high school districts, and 2 community college districts. Countywide enrollments in elementary schools have fallen by 9 percent since 1971. About half of this loss occurred in Bakersfield. This loss reflects nation-wide trends of lower fertility rates during the last 10 years. During this same period high school enrollments increased 31.5 percent. This increase in high school enrollments occurred within the smaller districts outside of Bakersfield and may have resulted from both the education of students which contributed to previously high elementary school enrollments and a higher educational attainment for rural students.

Local. There are five elementary school districts and two high school districts in the local communities where NPR-1 employees tend to live. In addition, there is a special education program administered by the county superintendent's office. Enrollment trends in these districts are shown in Table N-2, Appendix N. Enrollments have fallen over the past 3 years in the Bakersfield City, Buttonwillow Union, and Elk Hills elementary school districts. Enrollments in McKittrick and Taft City elementary school districts have remained fairly stable. Of the two local high school districts, enrollments have declined at Kern Union (Bakersfield) and increased at Taft Union. Enrollments have fluctuated in the county's special education program.

Forty students, whose parents currently work at NPR-1, attend the Bakersfield City Elementary School District. Two others are enrolled in the county's special education program. These students represent less than 1 percent of their districts' enrollment.

d. Recreation

Regional. The mountain, desert, and valley environments of Kern County offer a wide range of recreational opportunities. Federally-owned recreation lands are located in both the mountain and desert of the county. The Forest Service maintains the Sequoia and the Los Padres National Forests, partially located within the county. The Bureau of Land Management manages 717,000 acres of mountain and desert lands open to recreational use. The Corps of Engineers built and operates Lake Isabella, a large recreational lake which attracts large numbers of visitors from southern California.

State-owned lands include Red Rock Canyon State Park and Fort Tejon Historical Park in the mountains, and Tule Elk Reserve near NPR-1.

The county operates 4,402 acres of regional parks, including recreation lakes, golf courses, mountain and desert parks, fishing access points, and the newly opened Buena Vista Aquatic Recreation Area.

Local. There are two regional parks and many community parks in the vicinity of NPR-1. The larger two parks include the Tule Elk State Reserve near Tupman, and the Buena Vista Aquatic Recreation Area, on the northeast edge of the Buena Vista Lake bed. Tule Elk Reserve includes approximately 935 acres. Initial acquisition for the Reserve began in 1931. Last year the Reserve had 21,160 visitors, an increase of nearly one-third over the 1973-1974 season. The Buena Vista Aquatic Recreation Area is a county-owned park. This new facility encompasses 1,585 acres.

Community parks in the Elk Hills vicinity are located in Taft, Buttonwillow, McKittrick, Derby Acres, Valley Acres, Ford City, and Fellows.

The Buena Vista Golf Course and A. W. Noon Memorial Park, a small county park, lie between NPR-1 and the northwest corner of the Buena Vista Lakebed.

These local parks are shown in Figure 2-11.

NPR-1 has a small recreational area for its employees. In addition, the Reserve's administration gives entry permits to a few naturalist groups each year for rock collecting, bird watching, and similar activities.

e. Water

Regional. Water supply in Kern County comes from both local resources and imported waters. Most municipal and industrial water

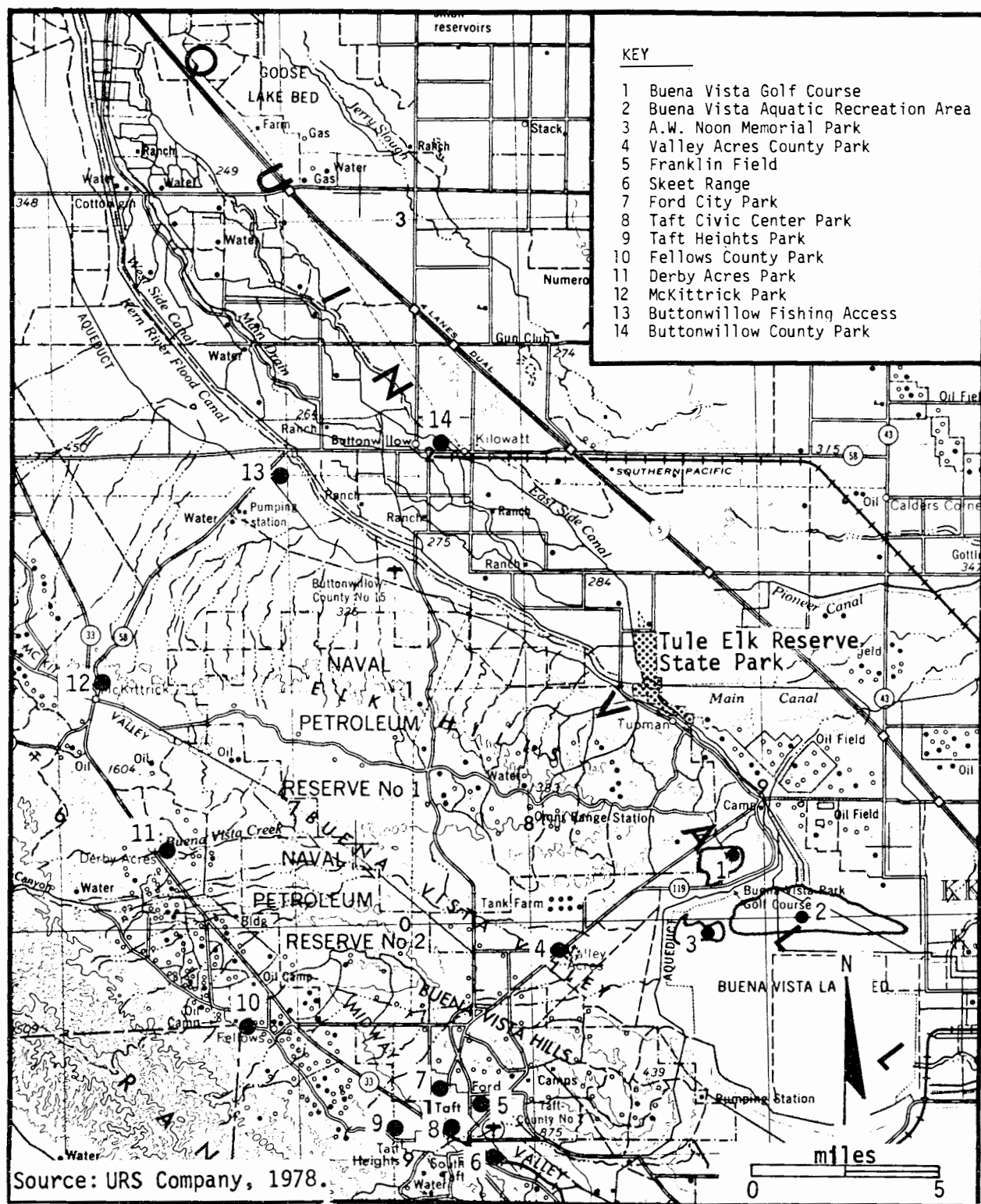


Figure 2-11. Recreation Resources Near Elk Hills

needs are met with local resources, primarily groundwater. For agricultural water requirements, groundwater supplies are supplemented with water from the Bureau of Reclamation's Central Valley Project and from the State Water Project. The county's total estimated water use for 1980 is 3,230,000 acre-feet of groundwater, 1,404,400 acre-feet of imported water, and 1,056,200 acre-feet of surface water (California State Water Resources Control Board, 1975).

Local. Water supply in the Elk Hills vicinity is administered by several local water districts. The West Kern County Water District supplies water to Elk Hills and an area south and west of the Petroleum Reserve. This water district obtains its water from 4 wells located northeast of the Petroleum Reserve. In 1974, these wells delivered 10,500 acre-feet of water. The district plans to withdraw up to 18,720 acre-feet per year by 1980. The district obtains water to replenish their groundwater reserves by trading their State Water Project entitlement with other Kern County agencies for local water.

The highest quality water source at NPR-1 is the imported water in the California Aqueduct. However, the Reserve uses water from the West Kern County Water District. In addition, three water storage tanks are located on the west side of NPR-1. They provide emergency storage of 25,000 barrels. Water from Chevron's pipelines system is available as a backup supply. Chevron has a 12-inch water line which runs north-south through the Reserve, from wells in the Kern River Basin to the north to Chevron and Getty oil fields south of the Reserve. The water is used by those companies for steam injection. The NPR-1 water system ties into this pipeline in section 35S. NPR-1 has an existing contract with Chevron and Getty to use up to 1,500 barrels per day of this water for emergency purposes only. If more water is needed, permission must be secured from Chevron.

Current water use at the Petroleum Reserve is 19,500 barrels per day. This water is used for construction, domestic uses, and in the gas processing plant.

f. Wastewater

Regional. Most of the urban areas of Kern County are serviced by sewer systems and wastewater treatment plants. Rural areas rely on individual septic tanks.

Local. Within the Elk Hills local area, both Bakersfield and Taft have sewers and wastewater treatment plants. Characteristics of these plants are given in Table N-3, Appendix N.

The two treatment plants in Bakersfield and the plant in Taft are operating under capacity.

At NPR-1, wastewater is disposed of through septic tanks and leach fields.

g. Solid Waste

Regional. Solid wastes in Kern County, which are largely agricultural, are disposed of in 15 sanitary landfills through the county. The remaining life spans for these sites range from 6 to 134 years.

Local. At NPR-1 there are two landfill sites. One of these sites is located in Section 35R, to the northwest of gas plant LTS-2. The other site is near the center of Section 10G. These areas are used for the disposal of wastes generated by oil well drilling and production facilities. Drilling muds were formerly distributed along banks of roadways but are now disposed of at the two landfill sites according to the stipulations of the permit issued by the Regional Water Quality

Control Board. Water quality aspects of this action are discussed in Section IV.D and Appendix J. Domestic wastes are collected by the Westside Garbage Disposal Company and disposed of in a county landfill. Characteristics for solid waste disposal sites in the local area are given in Table N-4. Appendix N.

h. Power

Regional. Electrical power in Kern County is generated by oil-powered and hydroelectric plants. Pacific Gas and Electric Company (PG&E) operates two oil-powered plants and one hydroelectric plant in Kern County. Southern California Edison has hydroelectric plants at Bishop Creek, Borel, and along the Kern River.

Local. PG&E supplies electrical power to NPR-1. PG&E's total sales in 1975 were 60,262 million kilowatt hours, and the peak use was 12,983 megawatts. Currently, the Reserve uses 23.5 million kilowatt hours, or .04 percent of PG&E's total sales. The electrical power is transported on a main overhead feeder line coming onto the property from the southwest. There are two alternate feeds from the north.

NPR-1 obtains natural gas fuel from onsite resources. In 1974, the Reserve was using 1,135,000 cubic feet per day. Natural gas use has remained stable since that time. It is used to heat the three homes on the site and the administration building.

6. Public Finance

a. Regional

Kern County government's sources of income and expenditures are summarized in Figures N-1 and N-2 and in Table N-5, Appendix N. The greatest revenue source (48.8%) is aid from other government agencies. The only other major source is property taxes, which contribute 14.2 percent of the income. Minor sources include services charges, other

taxes, investment returns, and miscellaneous fees, fines, and penalties.

The main areas of county spending are public assistance (25.8 percent), general government (18.9 percent), public protection (29.3 percent), and health and sanitation (17.2 percent).

The existing facility at NPR-1 is not directly contributing to county income or expenditures.

b. Local

The seven school districts in the Elk Hills local area get from 30 percent to 95 percent of income from local taxes. Federal and state aid contribute from 5 to 69 percent of school district incomes. Income sources are summarized in Table N-6, Appendix N. In general, the large school districts collect a high percentage of income from federal and state aid and a low percentage from local taxes. The small school districts exhibit the opposite tendency.

The Bakersfield City Elementary School District and the County Superintendent of Schools' Special Education Program both receive special federal funds because of the presence in their schools of children whose parents work at NPR-1. Public Law 874 allocates funds to those school districts which educate children whose parents work or live on federal property. These funds are to compensate for the lack of property tax and business tax income from the parents' residences and employment. Currently, Kern County schools receive about \$315 for a student whose parents either live or work on federal property, and \$700 for a student whose parents both live and work on federal property. Thus, Kern County schools currently receive approximately \$13,200 for the 42 school-aged children of NPR-1 employees.

7. Visual Quality

The visual character of NPR-1 is determined largely by its geologic

characteristics, the prevailing dry climate, and the existing petroleum-related facilities at the site.

The site is typical of much of the westside of the southern San Joaquin Valley. The Elk Hills rise to a maximum elevation of 1,551 feet, some 1,000 to 1,200 feet above the valley floor. The hills, sparsely covered with chaparral and fragmented by numerous small canyons and gullies, are approximately 16 miles long and 6 miles wide.

The exposed slopes and ridgetops can be seen easily from many of the surrounding lowlands of the San Joaquin, Buena Vista, and McKittrick valleys. The site is also visible from parts of similar hill formations in the vicinity, such as the Buena Vista Hills, and from various points in the more distant Coast, Tehachapi, and Sierra Nevada mountain ranges.

The Elk Hills ridgetops and slopes also afford vistas of the surrounding lowlands, hills, and distant mountains. The rugged topography, especially prevalent in the relatively undeveloped northern portion of the site, offers some onsite visual interest.

Views from the site are often obscured by the presence of haze. The southern San Joaquin Valley is particularly susceptible to the accumulation of atmospheric components that create haze and smog. In addition, dense fogs often occur on the valley floor during the winter months. In the nearby Bakersfield area visibility is 6 miles or less, approximately 20 percent of the time, and 15 miles or less about 80 percent of the time. Visibilities exceeding 35 miles occur less than 2 percent of the time (Applied Science, 1974). Localized visibilities experienced at the site and in the vicinity probably vary somewhat from these values.

Another variable that influences local aesthetic conditions is the timing and abundance of precipitation. A number of flowering annuals, indigenous to the area, are dependent on the amount of rainfall for

germination. Rainfall in sufficient amounts causes wildflowers to bloom, introducing colorful variations to the normally brown hills. Emerging grasses can also give the slopes a greenish cast.

Natural aesthetic conditions in portions of western Kern County are influenced by petroleum-related development occurring throughout much of the area. The installation of derricks, roads, pumps, pipelines, storage tanks, refining equipment, overhead powerlines, and associated facilities, as well as necessary grading, have introduced man-made elements into the natural landscape. The visual effects of these intrusions have been accentuated by the lack of screening vegetation in the region, and by the slow rate of recovery when natural conditions are altered.

Although approximately 80 percent of the sections comprised by the reserve have already been altered by grading, erosion, and the installation of facilities, there are some undeveloped portions which still provide attractive views. But few people ever see the Elk Hills, though widely visible on a clear day, because of the area's sparse population, and its remoteness from major transportation corridors. For the most part, the site is visually prominent only to persons working there or in the oil fields in the immediate vicinity, to farmers in the Buena Vista Lake and Buttonwillow vicinities, to residents in a few small nearby communities, such as Tupman, and to travelers using recreational facilities and roadways in the area.

In spite of the development that has already occurred at the site, only structures and accompanying alterations located along ridgelines or on outward facing slopes are apparent from a distance.



III. RELATIONSHIP OF THE PROPOSED ACTION TO LAND-USE PLANS, POLICIES, AND CONTROLS FOR THE AFFECTED AREA

This section discusses the relationship of the proposed production and support facilities to the land-use plans, policies, and controls of Kern County, the State Department of Fish and Game, the U.S. Fish and Wildlife Service, and the U.S. Soil Conservation Service.

A. Kern County

Federal agencies, including the Department of Energy, are not required to conform to local land-use plans, policies, or controls, they commonly plan with an awareness of local issues and may go through an informal presentation of the project to local authorities. The information on Kern County presented here is drawn from the county's general plan elements and zoning ordinances. The County Planning Department was asked for specific plans and policies relating to petroleum production. Applicable documents include the Zoning Ordinances Open Space and Conservation Element, and Land Use Element of the General Plan.

NPR-1 lies on lands zoned by the county for agricultural uses. Within both of the two agricultural zones, A and A-1, oil and gas drilling and production are specifically permitted without a review or permit from the county government. The zoning ordinance also requires, in Section 7242, that "all installations and operations conform to state law and to fire and safety ordinances or regulations of the County of Kern in force and effect and applicable. . ."

The purpose of the agricultural zones is to "preserve the maximum amount of the limited supply of agricultural land in the County of Kern." The agricultural value of the lands in NPR-1 is minimal, thus, the use of the land for large-scale petroleum production is consistent with the purpose of zoning regulations.

Both the Kern County Open Space and Conservation Element and the Kern County Land Use Element designate the project site as "Natural Resource" land. The Land Use Element states that the objective of this designation is "to utilize the natural resources available in a manner compatible with (1) achievement and maintenance of all Federal, State, and local air and water quality standards; and (2) conservation of nonrenewable natural resources." The project, which meets Environmental Protection Agency requirements, will be compatible with these goals.

The Land Use Element also prescribes principles of natural resource development. The development should not constitute a nuisance to surrounding properties. Aesthetic values should be maintained in established scenic areas, and landscape should be reestablished after production ceases. Activities that interfere with the development should be restricted in areas designated as Natural Resources. Wildlife and livestock should be protected. Lastly, property parcels should be large enough to prevent development at a density incompatible with the natural resource production use.

The principles are met to varying degrees by the proposed project. The proposed site is surrounded by open land uses -- extensive agriculture, a tule elk preserve, and vacant land; the proposed development should not present a nuisance to these property owners. Some of the proposed construction, however, is located near a county-designated scenic highway.

All activities that could interfere with the production of NPR-1 oil would be restricted from the site, since the site is federal property. Wildlife will generally be protected as much as current oil development technology allows, but there will be unavoidable habitat reduction and road kills. The production activity will be separated from other properties by undeveloped Federal land; there will be no opportunity for high density development to occur near the production site.

In general, the proposed production of NPR-1 crude oil at maximum efficient recovery is compatible with Kern County's plans and policies.

B. State Department of Fish and Game

The California Fish and Game code prohibits destruction of rare and endangered animal species in California. In addition, it prohibits the possession or sale of all or part of the dead body of certain species, excluding the San Joaquin kit fox and the blunt-nosed leopard lizard.

In 1963, the Department of Fish and Game (DFG) entered into an agreement (Appendix L) with the Officer in Charge of Naval Petroleum Reserves and the U.S. Bureau of Sport Fisheries and Wildlife to develop a cooperative Wildlife Management Plan at Elk Hills Naval Petroleum Reserve No. 1. Under this agreement DFG and the Bureau of Sport Fisheries and Wildlife have assisted the Officer in Charge in developing a Master Wildlife Management Plan, which was completed in 1966, and have participated in an annual meeting which assesses the progress of the management program and recommends new directions for it. The Officer in Charge has been responsible for following through with the management program.

The agreement acknowledges that the primary function of the reserve is the production of crude oil, and that no management measure can be implemented that would injure this primary function.

C. U.S. Fish and Wildlife Service

Section 7 of the Endangered Species Act of 1973 requires that federal agencies work with the Secretary of the Interior to "carry out programs for the conservation of endangered species and threatened species and to take such action necessary to insure that actions authorized, funded, or carried out by them do not jeopardize the continued existence of such endangered species or threatened species or result in the destruction or modification of habitat of such species which is determined by the Secretary, after consultation as appropriate with the affected states, to be critical."

In January 1978, the Fish and Wildlife Service (FWS) (designated Lead Agency for the Secretary of Interior's Section 7 responsibilities) published regulations governing the interagency cooperation dictated in Section 7.* These regulations provide for the following steps:

1. A federal agency, after identifying one of their projects that may affect endangered or threatened species or their habitat, sends a written request for a consultation to FWS; or, FWS, upon discovering a proposed project that could affect these species or their habitats, requests a consultation.
2. FWS prepares a "threshold examination" of the project to determine if the project is likely to jeopardize the continued existence of an endangered or threatened species or destroy or modify the habitat of any of these species.
3. FWS sends a biological opinion to the federal agency contemplating the project.
4. This federal agency must decide how best to proceed in light of the responsibilities described in Section 7 of the Endangered Species Act of 1973, quoted above.

*Federal Register, January 4, 1978, p. 870.

The Department of Energy will gather field data during the spring 1979 on endangered species and habitats at Elk Hills. This information is essential to initiate the Section 7 consultation process with FWS.

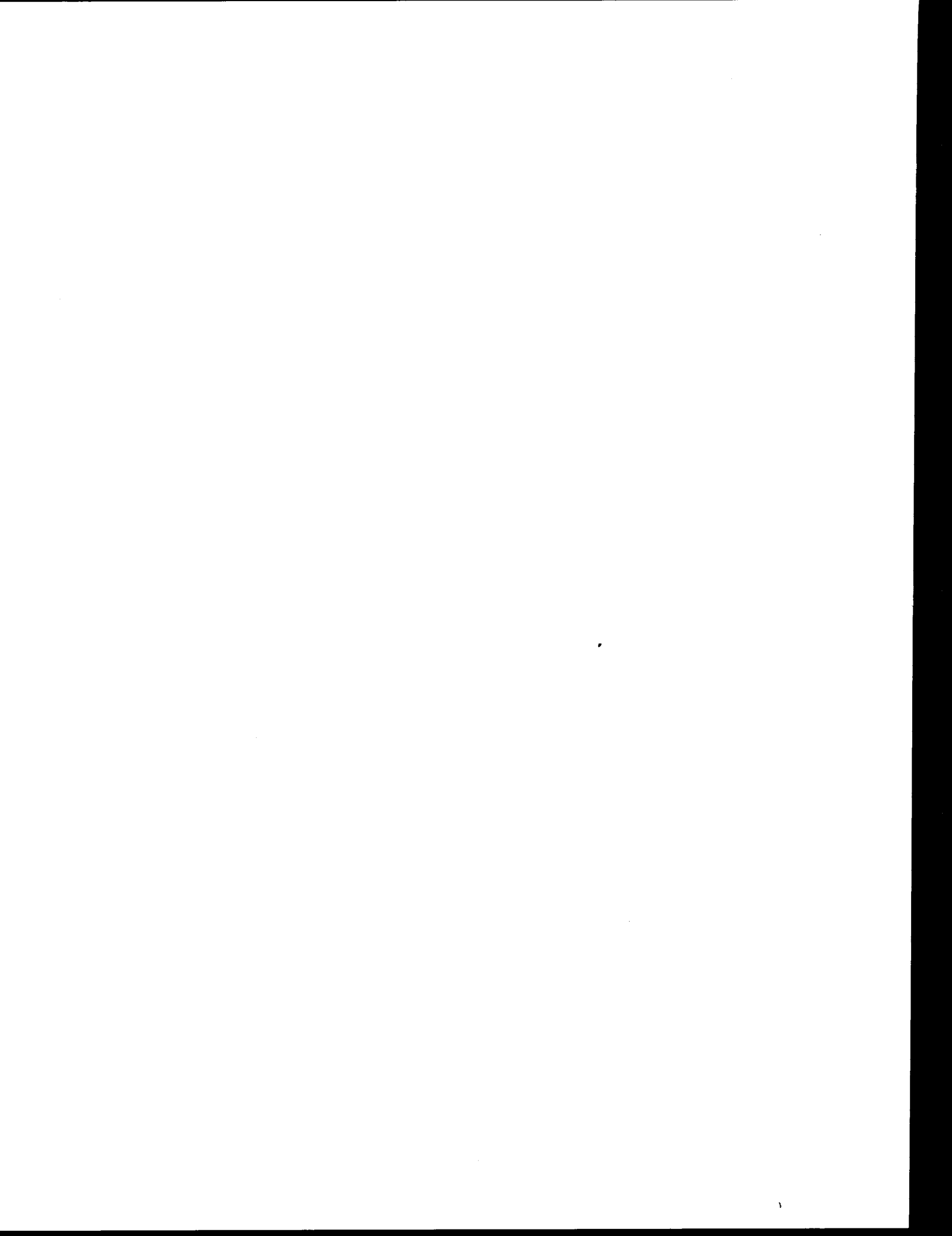
D. U.S. Soil Conservation Service

The Soil Conservation Service (SCS) is engaged in a program to inventory prime and unique farmlands in the U.S. In the proposed rules governing this inventory, it is stated that "SCS is concerned about any action that tends to impair the productive capacity of American agriculture. The Nation needs to know the extent and location of the best land for producing food, feed, fiber, forage, and oilseed crops."*

No lands within Naval Petroleum Reserve No. 1 or in its immediate vicinity have been designated as prime or unique farmlands by the Soil Conservation Service.** Thus, the proposed project has no impact of the SCS program and purpose.

*Federal Register, Vol. 42, No. 163, 8-23-77, p. 42359.

**Pat Berke, District Conservationist for western Kern County, Soil Conservation Service. Personal communication, Feb. 27, 1978.



IV. PROBABLE IMPACT OF THE PROPOSED ACTION ON THE ENVIRONMENT

Adverse and beneficial effects will result from production of NPR-1 at MER. Adverse effects include increased air pollution emissions, increased noise levels, reduction in vegetation, increased traffic levels, and decreased visual quality. Beneficial effects include increased employment, increased use of vacant housing, increased local spending for goods and services, and increased domestic petroleum production.

There is some question about the overall nature of the increased petroleum production which the NPR-1 project will achieve. Crucial factors are the means by which NPR-1 oil is transported to market and where that market is. Further discussion of this issue and the relation of NPR-1 production to national energy policy are given in Appendix P.

Production of NPR-1 will be an irretrievable commitment of non-renewable natural resources. Once the petroleum from NPR-1 has been sold, the property will no longer exist as a national petroleum reserve for use in emergency situations.

A. Geology

1. Construction

Construction-related geologic impacts would be restricted to an increased potential for onsite erosion and the consumption of mineral resources. An increase in erosion at construction sites can be expected,

though the amount would depend on the slope of the land, the amount of rain falling during the construction period, and the erosion-control practices employed. Because of the naturally dry conditions at NPR-1, there is sparse vegetation cover. As a result, extensive gullying is a common and natural occurrence in this area.

Mineral resources consumed during the construction of the proposed facilities would include steel for the gas plants, storage tanks, and pipelines, concrete for foundations, and miscellaneous building materials.

2. Operation

The major geological concern regarding the operation of NRP-1 is the potential for surface subsidence. Other less significant long-term impacts are induced seismicity, consumption of mineral resources, and increased potential for onsite erosion.

The potential magnitude of surface subsidence at the northeastern perimeter of NPR-1 is not anticipated to be great enough to cause damage to critical surface structures such as the California Aqueduct. Nevertheless, because of the uncertainties of subsidence prediction, it should be assumed that subsidence is possible, and that appropriate mitigation measures should therefore be planned and instituted. This, in fact, is the approach being taken by the Department of Energy (DOE) and the Unit Operator which is subsequently discussed in the mitigation subsection. Subsidence is a potential not only from the withdrawals from the producing zones, but from water withdrawn from the Tulare Zone which would serve as injection water.

Ever since the dramatic subsidence that accompanied the development of the Wilmington Oil Field in the vicinity of Long Beach, California, subsidence has been a serious concern at all subsequent oil field developments in California, particularly in the urbanized Los Angeles Basin. The magnitude of subsidence that occurred over the Wilmington Field was an extreme example, affecting an area of 29 square miles with a maximum of 29 feet of downward vertical ground movement. Nothing approaching this magnitude of subsidence has been known to occur at other oil fields in California. However, more precise leveling measurements that have been instituted as a matter of course since the Wilmington Field event, have indicated that some amount of subsidence can generally be expected from most oil fields when pore pressure within buried sediments or rocks is reduced by the withdrawal of oil, gas, and associated water. Generally the amount of subsidence has been limited to a few inches.

Although much has been learned over the past two decades regarding the control of subsidence, the mechanisms of subsidence are not fully understood because of the complex interrelationships involved. Thus, the ability to accurately predict the maximum amount of subsidence that could occur is not yet available.

The basic prerequisites for oil field subsidence are: (1) reservoir fluid pressure must be lowered; (2) the reservoir rock must be compactable (uncemented) and unable to effectively resist deformation upon the transfer of load from the fluid phase to the grain-to-grain contact phases; and, (3) the overburden must lack internal self-support and be of such a nature as to easily fall and supply a constant load to the underlying sediments (Allen and Mayuga, 1969).

According to Erickson (1976), the following are the geologic characteristics controlling oil field subsidence:

- (1) Regional Structural Conditions
 - (a) Geologic structure
 - (b) Depth of production
 - (c) Breadth and length of zone of accumulation
 - (d) Thickness of productive zones
- (2) Physical Properties of Producing Zones
 - (a) Porosity
 - (b) Lithology
 - (c) Preconsolidation and cementation

Thus, the basic approach in evaluating the potential for oil field subsidence is to examine the above geologic characteristics and assess the above prerequisite conditions for the oil field under consideration. This evaluation can then help determine what the probability for subsidence would be. A rough estimate of the amount of subsidence that could be expected can then be made by comparing conditions with other oil fields that have experienced subsidence.

Using this approach, it appears that the following general statement can be made regarding the subsidence potential at the NPR-1 oil field. Unless an adequate reservoir pressure maintenance program involving water injection is used, there is a great potential for subsidence occurring at NPR-1. It appears that the greatest potential for subsidence is within the Shallow Oil Zone, the Dry Gas Zone, and the Tulare Zone. The amount of potential subsidence appears substantially less for the deeper Stevens Oil Zone.

The following is a description of the major subsidence-controlling characteristics of the NPR-1 oil field.

a. Geologic Structure

The geologic structure of the oil field has a significant bearing on the capability of the overburden (strata above the producing

reservoir) to resist collapse should support from the underlying producing reservoir be reduced from compaction. In general, the best conditions (greatest self-support) are tight anticlinal structures (arches), while those structures with the least internal self-support are relatively flat-lying strata, especially if high-angle faults are present.

Regarding geologic structures, the NPR-1 oil field could be rated as good to fair for self-support, depending on the production zone considered. The Stevens Zone and the Carneros Zone are located within a rather tight anticline at depths of 7,000 to 9,300 feet respectively. These are favorable conditions for resisting subsidence. However, the Shallow Oil Zone, the Dry Gas Zone, and the Tulare Zone are located near the top of the Elk Hills structure where the anticline is much broader and less distinct; thus, the strata are nearly flat-lying and offer less self-support. In addition, the eastern anticline is cut by several high-angle faults which could provide zones of weakness to facilitate downward movement.

b. Physical Properties of Producing Zones.

The major physical properties of producing zones affecting subsidence potential are porosity, lithology, and degree of preconsolidation and cementation. These properties control the reservoir rocks' susceptibility to compaction when the pore pressure is reduced by fluid withdrawal.

Porosity of a rock or sediment is the amount of void space per total volume of material. In an oil zone, most of this void space is taken up by oil, gas, and water. When these elements are withdrawn from the reservoir rock, part of the intergranular support is also withdrawn, thus creating a potential for compaction of the reservoir rock. Thus, the greater the porosity the greater the potential for the reservoir rock to undergo a greater change per unit volume.

The average porosity of producing zones at NPR-1 varies from 36 percent in the Dry Gas Zone to 11 percent in the Caneros Zone. The porosities of the two major producing zones -- the Shallow Oil Zone and the Stevens Zone -- are 31 percent and 19 percent respectively.

The lithology of the producing zones vary from thin lenses of sand and siltstone in the Shallow Oil Zone, ranging from 15 to 80 feet thick, to much thicker zones (several hundred feet) of fractured, siliceous shale with interbedded siltstone and sandstone in the Stevens Zone. Generally, thick, poorly sorted sands are more susceptible to consolidation than are clean, well-sorted quartzitic sands. Lithologically then, the reservoir rocks at NPR-1 have a moderate potential for compaction.

The reservoir rocks at NPR-1 are fairly well consolidated, particularly in the deeper Stevens Zone and Caneros Zone. None of the producing zones resemble the loose sands that comprise the reservoir rock at the Wilmington field.

Comparisons of production zones and geologic characteristics of the North Coles Levee, Buena Vista, and Midway-Sunset fields can help establish a general range of the maximum amount of subsidence at NPR-1. This range is 0.6 feet to 7.5 feet. However, it should be emphasized that the conditions at each of these fields are not identical to NPR-1, and the amount of subsidence is often based on infrequent and relatively recent leveling surveys. Thus, this range has its limitations.

Comparison with the North Coles Levee oil field is considered appropriate for several reasons. The North Coles Levee field is adjacent to the NPR-1 field to the east; production has been from the Stevens Zone at a depth of 8,000 to 9,500 feet; average porosity is nearly the same as NPR-1; and the field has been produced with pressure maintenance, first by gas injection and recently by water flood. However, the size of the field is substantially smaller than the NPR-1

field. Of special interest is the fact that the California Aqueduct passes over the North Coles Levee field. Leveling surveys performed along the California Aqueduct indicate a steady decline totaling 0.5 feet in the area of North Coles Levee during the period 1951-1970. No repair work on the Aqueduct has been required due to this settlement.

Subsidence in the Buena Vista Hills oil field, which lies just south of the NPR-1, has been measured at a maximum of 7.5 feet near the center of the field, over the period 1942 to 1964. From 1957 to 1964, about one foot of subsidence has been measured near the central part of the field. In addition to this vertical movement, horizontal displacement of up to 1.3 feet has been measured near the outer portion of the field, and movement of 2.4 feet along the Buena Vista thrust fault has been attributed to oil field production (Nason, 1976).

The Buena Vista Hills oil field is also similar to the NPR-1 field in several ways. The Buena Vista Hills oil field is located just south of NPR-1 in a similar but, somewhat smaller and flatter anticlinal structure. Production has been from the same formation as at NPR-1, the Shallow Oil Zone producing horizons, and the Stevens Zone, but at slightly shallower depths. The field has been produced using a gas injection program since 1927 and water flooding since 1954.

Maximum amounts of subsidence at the Midway-Sunset oil field, which is located just southwest of Buena Vista field, have ranged from 0.6 feet to 1.6 feet during leveling surveys performed during the period 1935 to 1965. The general structure is similar to NPR-1 and the average depth of the production zone is generally the same as, or less than, the NPR-1 Shallow Oil Zone. Although much of the production came from zones at shallower depths than at NPR-1, and thus would probably be more susceptible to compaction during reservoir pressure reduction, the leveling data were obtained after much of the production from the Midway-Sunset field had already occurred. Gas injection for pressure maintenance was begun in 1944. Water flood in part of the producing zone was begun

in 1954. Due to the success of water flood, steam flood, and cyclic-steam projects, a peak oil production of about 34.6 million barrels was reached in 1972. Total cumulative oil production for the Midway-Sunset field as of 1972 was over 1.1 billion barrels.

In summary, the following positive and negative statements regarding the subsidence potential at NPR-1 can be made.

Positive characteristics of the NPR-1 oil field regarding the potential for subsidence are outlined below.

- o The reserves of the Shallow Oil Zone have been about 50 percent depleted and the original reservoir pressures have been substantially reduced, up to 60 to 90 percent, particularly at the eastern end of the field. Thus, if subsidence were going to occur, it probably already has occurred. Peak productions occurred between 1920 and 1926 and during the years of World War II. Greatest potential for subsidence was during or immediately following these periods of peak production.
- o The Stevens Zone, where most of the oil will be produced, is located at a relatively great depth (approximately 6,500 feet) and is in a rather tight anticline. Thus, overlying strata would tend to resist collapse even if support from reservoirs in the Stevens Zone were reduced due to compaction.
- o The lithology of the Stevens Zone reservoirs consists primarily of fractured shale with interbedded siltstone and sandstone, which resists compaction better than thick, loose sandstones such as occur at the Wilmington field.

- o Reservoir pressure within the Stevens Zone will be maintained by gas injection and water flood. As long as reservoir pressure is maintained, any potential for subsidence can be essentially eliminated.
- o The areal extent of the Stevens Zone is restricted primarily to the central portion of the Elk Hills oil field. Thus, even should subsidence occur due to compaction of the Stevens Zone, the effect on the California Aqueduct located along the northeastern edge of the NPR-1 would be minimized.
- o A natural water drive from the northeast exists in the oil-producing zones. This upward pressure along the northeastern flank of the eastern anticline would tend to compensate for reduced reservoir pressures in the northeastern portion of the Elk Hills oil field.
- o The surface structure most sensitive to subsidence -- the California Aqueduct -- is located at the periphery of the Elk Hills oil field, along the relatively steep eastern flank of the eastern anticline. Thus, even should subsidence occur, the greatest movement would be concentrated over the top of the anticline where production would be greatest. Potential subsidence in the vicinity of the California Aqueduct would be significantly less than over the center of the producing zones.

Negative aspects of the Elk Hills oil field regarding subsidence potential are outlined below.

- o The Shallow Oil Zone, the Dry Gas Zone, and the Tulare Zone occur in relatively flat-lying strata at the top of a broad anticline with

several high-angle faults. This geologic structure does not afford good support if compaction occurs within the producing zones.

- o The reservoir rock of the Dry Gas Zone and Shallow Oil Zone have high porosities, 36 percent and 31 percent respectively. Rocks with high porosities have potential, all other factors being equal, for greater volume reduction when oil or gas is withdrawn.
- o Relatively large volumes of fluids (oil and water) and gas will be removed from the Elk Hills field over a relatively short period of time. Although gas injection and water flooding is planned, it will require strict monitoring and coordination to insure that the proper reservoir pressure is maintained.

Other geological impacts associated with the operational phases of the NPR-1 development include the consumption of mineral resources and an increased potential for onsite erosion and induced seismicity. Mineral resources consumed in the operation of NPR-1 include natural gas from the Dry Gas Zone for the operation of processing plant and compression facilities, wet gas from the Stevens and Shallow Oil zones for the operation of about 800 small field gas engines, and various fossils consumed offsite in the production of electricity that would be consumed at the site.

Construction of new facilities and percolation/evaporation ponds for disposal of wastewaters would slightly increase the potential for long-term erosion at the reserve unless adequate erosion-protection measures are employed in the design of these ponds.

Oil field withdrawals have been known to stimulate seismicity in the range of magnitude 3.3 and less, with the possibility of events as

large as magnitude 4.6. Such an earthquake, however, is unlikely to produce the motion and duration critical to sensitive large structures (see Appendix E).

3. Mitigation

To insure that any subsidence is detected in time to initiate adequate control, a survey leveling net will be extended across NPR-1 which will tie into survey stations located on the California Aqueduct. In addition, arrangements will be made to make casing collar surveys in selected wells in order to delineate the zone of compaction should the surface-leveling survey indicate subsidence. An agreement between the California Department of Water Resources and the NPR-1 Unit Operator was finalized on June 2, 1978 to establish and maintain such a leveling network and collar-monitoring program. Should subsidence be detected, a program of increased water-injection would be required to arrest it.

Seismic hazards affecting production facilities can be mitigated to a low-risk level with adequate earthquake-resistant design. In addition, the survey leveling net mentioned above together with a microseismic network could be used to monitor precursors of larger earthquakes and proper response to this information could mitigate possible faulting and seismicity hazards (see Appendix E).

B. Air Quality Impacts

1. Construction

Air quality impacts could occur due to several activities during the construction phase of the project. Potential sources of pollutants include land clearing for new wells, gas plants, pipelines, and roadways (fugitive dust); diesel engine emissions during drilling operations; and increased emissions from auto and truck traffic on the Reserve during

construction. All emissions will be temporary in nature and are not expected to cause significant impacts off the Reserve.

2. Operation

Operation of additional wells, tank settings, compressor stations, LACT units, and gas plants at full development will generate additional hydrocarbon (HC), nitrogen oxide (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), and particulate emissions. Also, improvements will be made to some existing sources at the Reserve which will reduce existing emissions.

In order to accurately estimate the net emission change due to new production facilities, a detailed emission inventory of both existing and proposed future facilities was performed. Both combustion sources and fugitive hydrocarbon sources were quantified. Details of the emission calculations are presented in Appendix O. A summary of existing and future emissions is presented in Table 4-1.

For the purpose of this study, existing emissions are defined as those from sources that were operating as of December 1977. The date was selected for two primary reasons -- detailed information was available on reserve hardware and operational characteristics for only that period, and emissions during earlier periods were abnormal since Reserve production was just starting up and there were many problems.

a. Hydrocarbon Impacts

Table 4-1 shows that total and nonmethane hydrocarbon (NMHC) emissions are significant at present and that new facilities will add a significant amount in the future. However, improvements to be made to existing facilities should cause a net decrease in total and nonmethane hydrocarbon losses in the future. The major reductions in existing

Table 4-1

Existing Emission Sources

Source Characteristics	Emissions (lbs/hr)					
	THC	NMHC [*]	NO _x	CO	SO ₂	Particulates
COMBUSTION SOURCES						
35R Gas Plant - 3 Boilers (1.8 × 10 ⁶ ft ³ NG/day)	0.2	---	17	1.3	0.1	1.1
Compressors - IC - Natural Gas*						
35R { 4 feed gas @ 1200 hp each	47	6	115	15	↓ 0.1 ↓	---
1 feed gas @ 395	4	1	10	1		
3 injection @ 1528	45	5	110	14		
2 injection @ 4000	78	9	192	25		
3G Compressor Station 9 Units @ Total of 3260 hp	32	4	78	10	---	---
Well Dump Engines 536 Units @ 20 hp	67	12	257	33	---	---
Other Field Pump Engines 35 Units @ 20 hp	4	1	17	2	---	---
FUGITIVE HC SOURCES						
Fixed Roof Tanks - Shallow Zone 132 Tanks - Flashing Losses	602	205				
Slop Tanks	9	4				
Well Heads (687 Wells)	1	1				
Well Cellers (1048 Wells)	87	40				
Field Control Valves 32,302 Valves	135	37			← Using KVB Emission Factor of 0.1 lbs/valve day	
Field Relief Valves 419 Valves	50	15				
Field Pumps	10	10				
35R Gas Plant						
Control Valves - 841 Valves	9	3				
Relief Valves	7	2				
Pumps	3	1				
Compressors	12	3				
Cooling Tower	2	1				
Venting	1649	650				
3G Compressor Station						
Control Valves (92 Valves)	1	↓				
Relief Valves	1	1				
Compressor	11	↓				
Cooling Tower	1	↓				
Two Field Compressors	2	1				
Control Valves	1					
Percolation Ponds						
142--Two Ponds						
100' x 100'	42	21				
100' x 30'	13	6				
262--Three Ponds						
100' x 100'	42	21				
100' x 50'	21	11				
100' x 30'	13	6				
T O T A L S	3000	973	796	101		

*At rated capacity. Equipment operates at 85% capacity.

Source Characteristics	Emissions (lbs/hr)					
	THC	NMHC	NO _x	CO	SO ₂	Particulates
<u>COMBUSTION SOURCES</u>						
LTS Gas Plant #1						
Heaters	0.4	0.1	8	0.2	0.2	0.5
Compressors	92	10	470	36	0.1	---
LTS Gas Plant #2						
Heaters	0.4	0.1	8	0.2	0.2	0.5
Compressors	92	10	470	36	0.1	---
17 Z Compressor Station*	158	5	288	24	---	---
17 R Compressor Station	15	2	36	5	---	---
30 R Compressors						
7 Units @ 1000 hp each	68	6	168	22	---	---
33 S Compressors						
4 Units @ 2000 hp each	87	9	216	28	---	---
1 Unit @ 1000 hp						
15 R or 16 R Compressor						
1 Unit @ 1000 hp	10	1	24	3	---	---
Shallow Zone Low Pressure Gas Compressors						
2 Units @ 500 hp	11	1	24	3	---	---
35 R Compressor for Stevens Zone Low Measure Gas						
3 Units @ 1000 hp	29	4	72	9		
Flare, 2 Units (98% efficient)	(33)**	(13)**	---	---	---	---
Truck Transport (in Kern County)	20	20	58	83	8	5
Rail Transport (in Kern County)	2	2	9	3	1	1
Associated Automobile Traffic (in Kern County)	13	13	6	115	---	---
<u>FUGITIVE HC EMISSIONS</u>						
Well Heads (518 Wells)	1	1				
Well Cellars (248 Wells)	21	10				
Field Control Valves (4165 Valves)	17	3				
Field Relief Valves (196 Valves)	24	5				
LTS Plant #1						
Control Valves (1648 Valves)	17	6				
Relief Valves (127 Valves)	13	5				
Pumps	4	2				
Compressors	5	1				
Cooling Tower	3	1				

* Assumes 3 engines @ 4000 hp (Supercharged)

** Not included in the total. Emissions are considered in offset credits.

continued

Table 4-1 Continued

New Sources

Source Characteristics	Emissions (lbs/hr)					
	THC	NMHC	NO _x	CO	SO ₂	Particulates
<u>FUGITIVE HC EMISSIONS</u> continued						
LTS Plant #2						
Control Valves (1648 Valves)	17	6				
Relief Valves (127 Valves)	13	5				
Pumps	4	1				
Compressors	5	1				
Cooling Tower	3	1				
17 Z Compressor Station						
Control Valves (30 Valves)	1	---				
Relief Valves (3 Valves)						
Compressors	4	1				
17 R Compressor Station						
Control Valves (10 Valves)	1	---				
Relief Valves (3 Valves)						
Compressors	1	---				
30 R Compressor Station						
Control Valves (40 Valves)	1	---				
Relief Valves (12 Valves)						
Compressors	4	1				
33 S Compressors						
Control Valves (50 Valves)	1	---				
Relief Valves (15 Valves)						
Compressors	5	1				
15 R or 16 R Compressor						
Control Valves (10 Valves)	1	---				
Relief Valves (2 Valves)						
Compressor	1	---				
Shallow Zone Low Pressure Compressors						
Control Valves (10 Valves)	1	---				
Relief Valves (2 Valves)						
Compressors	1	---				
35 R Compressor for Stevens Zone						
Low Pressure Gas						
Control Valves (30 Valves)	1	1				
Relief Valves (10 Valves)	1					
Compressors	3	1				
Truck Transport Loading	8	8				
Storage Tanks (5) (Crude Oil)	10	10				
Storage Tank (Gasoline)	2	2				
Gasoline Transport (Kern County)	4	4				
NEW SOURCES (TOTAL)	695	159	1877	394	13	9
TOTAL EXISTING	3000	973	796	101	---	---
VENTING OFFSET (35 R Gas Plant)	-1616	-637				
FINAL EMISSION LEVEL	2079	495	2673	495	13	9

emissions will be the flaring of gases currently vented at the 35R gas plant during upset conditions.

Despite the net hydrocarbon emissions decrease, the new sources will be subject to New Source Review (NSR) at the federal (EPA) and local (Kern County APCD) levels. The NMHC emissions from the new sources, before credit for emissions reductions, would exceed 100 tons/year, the EPA definition of a major source, and 15 lbs/hour, the Kern County definition of a major source. Therefore the project will be required to show a net emissions reduction in order to receive an NSR permit. The magnitude of the emissions offsets required will be determined by the agencies during the NSR procedure. The DOE is committed to achieving the net HC emissions reductions required to attain and maintain the National Ambient Air Quality Standard (NAAQS) for oxidants. It appears that the offset obtained from the control of venting at the 35R gas plant is sufficient to demonstrate a net hydrocarbon emissions reduction from NPR-1.

b. Nitrogen Oxides

A significant increase in nitrogen oxide (NO_x) emissions will result primarily from natural gas combustion at compressors and process heaters. The pollutant is emitted primarily as nitric oxide (NO) but is oxidized in the atmosphere to nitrogen dioxide (NO_2), a pollutant for which health-related ambient air quality standards have been set. NO_x emissions also are of concern due to their participation in photochemical reactions to form oxidant and possibly nitrates and aerosols. The net emissions increase estimated for new facilities would be a significant contribution to the air basin. Using a projected 1980 Kern

County emission rate of 192 tons/day of NO_x ,* the emissions increase at the Reserve would represent 11.7 percent of the total 1980 county emissions.

The effect of NO_x emissions on NO_2 concentrations is somewhat difficult to determine, since a whole series of atmospheric reactions take place involving these gases. A diffusion modeling effort was undertaken to estimate ground level concentrations of NO_x in order to determine the order of magnitude effect on NO_2 concentrations. A description of the modeling effort is presented in Appendix 0.

An annual average national ambient standard has been set for NO_2 at .05 ppm, and a state 1-hour standard for NO_2 has been set at .25 ppm. The annual average modeling study showed that the maximum total NO_x concentration increase expected is 0.012 ppm. When the background caused by existing sources in the 35R area was added, the maximum annual NO_x concentration was estimated to be 0.020 ppm. All concentrations are well below the annual NO_2 standard of .05 ppm.

The modeling study addressing 1-hour NO_x concentrations showed the maximum 1-hour concentration to be 0.24 ppm. The concentrations at the Reserve boundary are well below the 1-hour NO_2 standard of .25 ppm.

Since the public has access to the Elk Hills Road near the 35R complex, 1-hour concentrations were also estimated along the road. Preliminary analysis of possible air quality using screening models indicated that maximum ground level concentrations would be in excess of the short-term, 1-hour NO_x standard of 0.25 ppm. As a result of this finding, a more detailed modelling effort was undertaken, which included all existing and future sources, including background levels caused by

*California Air Resources Board Emissions Inventory for Kern County, 1977.

sources off the Reserve. (A complete description of the modelling study is provided in Appendix O.) The new model projections indicate that no violations in the air quality standards will occur on the Elk Hills Road.

c. Carbon Monoxide

A net CO emissions increase would result from natural gas combustion at compressors and process heaters. The net increase of 365 lbs/hour is below both EPA and Kern County limits for a major CO source and new source review. The small increase is not expected to interfere with the attainment or maintenance of applicable CO ambient air quality standards. Further discussion of CO levels is presented in Appendix O.

d. Sulfur Dioxide

A small net increase in SO₂ emissions will result from combustion sources. The increase is very small and will not be subject to New Source Review and will not interfere with the attainment or maintenance of applicable air quality standards. Note: Potential emissions of SO₂ from new gas plant flares have not been quantified. Information received to date has indicated that the H₂S content of gas at the gas plants is negligible.

e. Particulates

A small net increase in particulate emissions will result from new combustion sources. The small increase will not be subject to New Source Review and will not interfere with the attainment or maintenance of ambient air quality standards.

f. Other Potential Sources

Chevron Gas Plant at McKittrick. Approximately 60 million cubic feet/day of wet gas is expected to be piped to the Chevron gas plant at McKittrick for processing. Recovered liquid products will then be sold and shipped from that plant, while dry gas will be piped back to Elk Hills for injection. Current input to the plant is estimated to be 18 million cubic feet/day, therefore a substantial increase in throughput is expected. Some emissions increases due primarily to increased compressor operation are expected. However, the McKittrick plant was designed to process 60 million cubic feet per day and no new construction is anticipated.

Transportation Emissions. Increased truck and/or train traffic is expected in the future to handle the increased output of petroleum liquids. All loading stations will be equipped with vapor recovery systems with better than 90% control. As many as an additional 150 trucks/day could be expected on NPR-1 prior to the construction of a new rail loading facility. Emissions due to the truck traffic were quantified for the Kern County area. Total emissions when compared basin-wide were found to be small, producing little ambient air quality impact.

When the railroad spur is operational in early 1980, as many as one train/day is expected to haul petroleum liquids from the gas plant. Emissions from train activity are expected to have little impact on ambient air quality.

Increased auto traffic of up to 150 cars/day to NPR-1 is expected at full production. Emissions in Kern County were estimated and the air quality impact was found to be insignificant.

Emissions estimates for transportation sources are included in Table 4-1.

Increased Power Consumption. A substantial increase in power consumption of 35 MW is expected. Increased power will be provided by PG&E. Power provided by PG&E originates from a complex grid network including hydroelectric operation, oil-burning power plants, and geothermal. It is impossible to tell exactly where the additional power required by the Reserve would originate. Some would undoubtedly come from oil-burning power plants, possibly from PG&E's Kern power plant. Due to the distributed nature of power generation, significant impacts are not expected in any particular air basin. However, if this generation occurred in a specific air basin and oil was used, the emission increase could be significant. Based on a power plant burning 0.5% sulfur fuel oil, SO_x and NO_x emissions are estimated to be 183 lbs/hr and 88 lbs/hr respectively.

3. Mitigating Measures

The major air quality problem during construction would appear to be fugitive dust, given the existing problem in the San Joaquin Valley. Dust can be controlled to a reasonable degree if appropriate steps are taken to suppress dust generating sources. The following measures have been written into the contract specifications for field construction work:

"Dust shall be kept down at all times during working hours. Soil at the site, haul roads, and other areas disturbed by the Contractor's operations shall be sprinkled or treated with dust suppressors as necessary to control dust. No dry power brooming will be permitted. Vacuuming, wet mopping, wet sweeping, or wet power brooming shall be used instead. Air blowing will be permitted only for cleaning off nonparticulate debris, such as that from reinforcing bars. No sandblasting will be permitted unless the dust therefrom is confined. Only wet cutting of concrete

blocks, concrete, and asphalt will be permitted. No unnecessary shaking of bags will be permitted where concrete mortar and plaster milling is done."

Emissions expected to have significant impacts during operation are hydrocarbons and nitrogen oxides, due primarily to their participation in photochemical reactions to form oxidants. Hydrocarbon emissions from new production facilities will be offset by reducing existing sources of emissions on the Reserve. This will result in a net decrease of hydrocarbon emissions.

C. Noise Impact

1. Construction

Construction noise at NPR-1 should not impact people living near the area because of the attenuation of noise over distance. The construction of the pipelines and railroad spur for storage and loading of liquid products may impact noise-sensitive receptors near these routes. The nature and degree of these noise impacts, although thought to be small, cannot be determined until exact routes are known.

Construction noise may temporarily affect some of the wildlife at NPR-1. Construction of the new gas plants and compressor stations should not impact wildlife because the noise levels in these areas are already high. Well-drilling operations will temporarily impact localized areas at NPR-1. Other construction projects (pipelines, tank farm, well hookup systems, etc.) at NPR-1 could impact some areas for short periods of time.

2. Operation

Noise impacts of the project on people are insignificant due to the absence of residential development near the Reserve. Operational impacts

on local animal life in and near the Reserve are thought to be minor because the new facilities will be constructed adjacent to the noisiest sources and because of the nature of other noise sources in the Reserve. For further information, see Appendix I.

D. Water Resources

1. Construction

The construction of the NPR-1 production facilities would have few, if any, significant impacts on the water resources of the study area in which it is located. In general, this lack of impact is attributable to the absence of any major water bodies within the study area (see Appendix J).

Possible sources of construction impact include the use of local water supplies during construction, disposal of wastewaters and drilling muds, accidental spills, and ground-clearing operations with their potential for increased rates of erosion and turbidity. For the most part, the size of these impacts would be relatively small, even if no mitigation measures are undertaken.

The quantity of water required during construction has been estimated to be on the order of 500,000 gallons per day (G/D). While this quantity is substantial, the existing supply capability for NPR-1 from its primary fresh water supplier, the West Kern County Water District, is well in excess of this demand (1.3 million G/D). Thus, even under peak demand conditions, no significant impacts should occur.

Wastewaters generated by project construction include both hydrostatic test waters and sanitary sewage. While hydrostatic test waters would contain construction debris, mill scale, and hydrocarbons, it is expected that the amount of this material suspended or dissolved in the water would be slight. Moreover, before any of these waters can be

discharged to local receiving waters, they would have to meet all applicable discharge regulations. Sanitary wastewaters would be treated similarly with these wastes disposed via existing treatment facilities (septic tanks and leach fields).

Because of the absence of any usable surface or groundwaters within project boundaries, the probability of impact due to accidental spills, ground-clearing operations, or contamination by toxic materials from drilling muds disposed of along roadways would be low. The degree of impact resulting could be further reduced through the use of proper construction techniques (e.g., erosion control berms) and the institution of prompt cleanup procedures in the case of spills. Both of these measures are already included as part of the proposed project. It is also suggested that the construction that does occur should be limited to periods of low or no streamflow in order to further limit the potential for erosion-related impacts.

2. Operation

a. Normal

Normal operation and maintenance of the project facilities would require substantial quantities of water. Current estimates place this demand at an average of 2,730,000 G/D (630,000 gallons of freshwater to be obtained from the West Kern County Water District and 2,100,000 gallons of brackish water to be obtained from wells). This level of freshwater consumption is still within existing and proposed water delivery capacities. The saline water consumption should have little impact on local or regional groundwaters. Thus, this increase in consumption should not have adverse impacts.

Wastewaters produced by the proposed facility have a greater potential for impact. The specific wastewaters generated by the project include production wastewaters (approximately 3 mgd), blowdown waters

(53,000 G/D), and sanitary sewage (7,700 G/D). Assuming the pilot project is successful, most of the production waters will be injected back into the oil zones from which they came as part of a pressure maintenance program. Such injection would have no adverse impacts in light of the already poor water quality of these zones. The rest of the production waters and all of the blowdown waters will be disposed to percolation/evaporation ponds. To avoid possible adverse effects on adjacent groundwaters, the production waters will be discharged to either lined ponds or ponds having very slow percolation rates. This calls for use of about 300 acres of evaporation ponds on NPR-1 (specific location not yet defined). Sanitary wastewaters, on the other hand, would be disposed via onsite septic systems. As long as these septic systems are operated in conformance with existing regulations, no adverse impacts are expected (see Appendix J).

The only other potential area of impact would result from contaminated surface runoff reaching local receiving waters. The inclusion of onsite collection of the waters through the use of berms into project plans should minimize the possibility of this impact.

b. Abnormal

Abnormal operations, especially major spills of crude oil or gas liquids, have the potential for water resource impact. In particular, spills into surface waters could have important effects. However, because of the limited water resources and general absence of surface streams within the project area, it is expected that the occurrence of even a major spill would have relatively little effect. Those water bodies that do have year-round flows, such as the California Aqueduct, are protected from contamination by bermed banks and bypass channels. Because of both the physical properties of oil and gas liquids, and the structure and quality of local groundwater systems, the amount of intrusion that these substances might make into local groundwaters if spilt should also be relatively insignificant.

Further discussion of all of these potential impacts and the factors affecting their significance is presented in Appendix J.

3. Mitigation

A number of mitigation measures are currently listed as part of the project plans. Construction measures include the employment of sediment control measures, particularly in areas where project facilities impinge on natural waterways, and construction techniques that conserve water. Similarly, as part of normal project operations, it has been proposed that all major project facilities (tank settings and LACT and gas processing units) be surrounded with earthen berms to contain runoff waters. These berms would also be used as an oil and gas liquid spill control measure. Other proposed operational procedures that would help to minimize the impact of spills on local water resources include continuing test and maintenance programs for all facility equipment and a spill contingency plan that would provide for quick response to, and cleanup of, any spill should it occur.

E. Biological Resources

1. Vegetation

The primary impacts of increased oil production at NPR-1 would be direct removal and destruction of vegetation during drilling and new construction operations, and reduction and degradation of vegetational habitat in the long term. Two populations of the cotton eriogonum (Eriogonum gossypinum) may also be damaged or killed (this species is included in the California Native Plant Society's inventory of very rare and rare and endangered species -- Powell, 1974).

The two populations of the cotton eriogonum are located in N 1/2 Section 31 T30S R24E and N 1/2 SW 1/4 Section 7 T31S R24E and, if they have not yet been eliminated, are likely to be removed by drilling operations unless caution is exercised in selecting well sites.

Vegetational habitat is initially removed whenever a site is prepared for drilling an exploratory or producing oil well. A roughly rectangular portion of land comprising approximately two acres is excavated, filled, and graded until level. This operation kills all the vegetation on the drilling site. The 351 new wells required to complete the development program require approximately 702 acres.

After the drilling operations are completed at most sites, the land is recontoured to approximate its original topography. Where this is done, vegetation can potentially colonize the disturbed soil. Whether this occurs naturally depends on a number of factors, including the amount of rainfall, time of year, slope and aspect of the recontoured land, and exposure to continued disturbance by people and wind. Some older areas which are especially prone to erosion do not appear to be recovering at all. Attempts have been made to artificially revegetate the cleared land, but have rarely been successful (Williams Brothers Engineering Co., Memoranda 726.570 and G0-144, 1975).

Ultimately, the only area that is maintained in an unvegetated state is a roughly circular zone, approximately 65 feet in diameter, around the well. This comprises 26.7 acres for the 351 wells to complete the development program.

The total land area directly disturbed by well-drilling will be 702 acres, or 1.5 percent of the area of the Reserve. With time, most of this will partially recover, so that a minimal area of the potential plant habitat will be maintained vegetation-free. The value of this restored habitat, however, will not be equivalent to that of the original vegetational communities. The effects of disturbance in as arid a region as the Elk Hills will persist for a long time, possibly beyond the lifetime of the oil wells, especially in areas where erosion can occur.

Other direct removal of vegetation will result from construction of pipelines (a maximum of 100 acres), two gas processing plants (10 acres), access roads (240 acres since startup; 140 acres after September 30, 1978), support buildings (0.9 acre), and construction staging areas (29 acres). There will also be an indeterminate number of tank settings, requiring 0.5 acre each. These disturbances total less than 1 percent of the Reserve land area.

Other impacts are also caused by oil development at Elk Hills. Earthwork disrupts the drainage characteristics of the hillsides resulting in substantial gullying on slopes below roads and well sites in many locations. This process removes topsoil from erosion-prone areas and places it in alluvial or stream-bottom deposits. A quantitative estimate of the percent reduction in vegetative cover is beyond the scope of this study. However, field survey observations revealed many existing eroded slopes supported as little as half of their potential cover. Moreover, the areas affected are as large as the area normally cleared for drilling. This extensive erosion and consequent long-term reduction of vegetational potential constitutes the most important ecosystem-level impact on NPR-1.

Several additional impacts, all less extensive than the above, may be expected. The new wells will add their burden of spilled oil and liquid wastes to the two class II-1 disposal sites and the runoff sumps throughout the reserve. These materials must be considered destructive to vegetation, even though most of them are probably innocuous in the long term. Also, additional damming of gullies, if required would affect the vegetation both above and below the dams.

In summary, the basic ecosystem function of the NPR-1 vegetation would not be destroyed by increased production development. However,

the vegetational habitat will be degraded, and some erosion-prone areas may never recover.

/ 2. Wildlife

The increased development at NPR-1 will have a number of effects upon resident wildlife. The well sites, fill banks, and other earth-works introduce heterogeneity into the environment and provide soft ground that may be exploited by digging or burrowing animals. However, the vegetation, which is the food resource of all animals on the reserve, will be reduced. Since the limiting resource in this arid region is not space for burrowing or nesting but food, it follows that the quality of the wildlife habitat on the reserve also will be reduced. If and when the vegetation recovers, so will the wildlife.

A number of factors combine to mitigate this impact on resident animals. First, not all of the wells are drilled at the same time. Since animals are mobile, they can move from an area under construction to an area where construction is complete. Nonetheless, the food resources on completed well sites do not recover as fast as new wells are drilled, so a net overall reduction of habitat quality results. In addition, to the extent that areas adjacent to disturbed areas may already be inhabited, displaced fauna could upset local ecological balances.

A more important mitigating factor is that the production will be increased in the hills, which currently constitute the least valuable habitat on the reserve. The virtually untouched flatland in the Buena Vista Valley and to the north of the Elk Hills will only be disturbed

minimally, thus providing a large area that is more valuable to native wildlife than an equivalent area of small, disconnected patches of native habitat, interspersed with human development.

The distribution of proposed new construction will also lessen the potential for damage to the two populations of resident rare and endangered animal species. Both the San Joaquin kit fox and the blunt-nosed leopard lizard preferentially inhabit the flatlands of the Reserve, although they have been sighted in ravines and gullies that extend into the hills. Most developments will not affect them. However, if intensive drilling for brackish wells is included in production development, these wells would most likely be located off of the hills, within the prime kit fox and leopard lizard habitat. The populations of these animals could then be reduced as the food and shelter were eliminated. The proposed railroad spur and electric power substations could have similar effects.

Roadkills can be expected to increase with traffic associated with both sustained increase in oil production and the temporary needs of construction activities. Although this may appear a negligible impact, Morrell (1975) found that 128 of 152 reported kit fox mortalities in the westside were attributable to roadkill. This figure may be somewhat high, however, and it is not clear that it would apply in NPR-1.

Some burial of burrows and destruction of individual animals is inevitable during construction. Impacts of this nature will virtually cease once all new construction has been completed. The kit fox is currently protected from this type of impact by inspection for active dens of all proposed drilling sites prior to site preparation.

A final, local impact on resident wildlife will be increased levels of noise. The greatest noise levels associated with increased production occur during drilling. This source will be eliminated with the completion of all production and injection wells. The National Research Council (1977) has recommended that the area of disturbance to wildlife can be considered the same as that for humans (see Section IV.C). However, the response of wildlife to noise probably varies widely from species to species. Noise probably most seriously affects predators that rely on hearing to locate prey.

The above impacts apply only to resident wildlife. Migratory bird species may avoid the Reserve to some extent during construction, but this effect will have no long-term ecological consequences. Some homophilic species like house mice, house sparrows, and starlings may increase minimally, but the essentially intact indigenous fauna, through competition and predation, will prevent their populations from increasing excessively.

3. Mitigation

Impacts on vegetation and wildlife will be mitigated by compliance with the Master Wildlife Management Plan for the Elk Hills Naval Petroleum Reserve No. 1 (Appendix L of the draft EIS). In addition, DOE is conducting a biological survey to develop mitigation measures for the affected endangered species and has recently initiated consultation with the U.S. Fish and Wildlife Service as required by Section 7 of the Endangered Species Act.

The initial phase of the biological survey involves gathering field data on species density and habitat and is essentially complete. Phase two of the survey, which is scheduled to begin in September 1979, will provide the biological information necessary for the determinations to be made pursuant to Section 7. In addition, phase two of the survey will involve the preparation of a specific plan to mitigate impacts on the endangered species and their habitats.

F. Cultural Resources

The only known cultural resources which could potentially be impacted are four archaeological sites located within the general corridor of the gas liquids pipeline system to Taft. An additional cultural resources survey is being done with these archaeological sites in mind and all attempts will be made to avoid them. It is highly probable that a pipeline system through this area can be developed without disturbing the environment of the defined resources.



G. Land Use

The primary impact of the development of NPR-1 on regional land use will be the conversion of unused land to oil production uses. This development of petroleum resources would be coming at a time when, according to Kern County's 1972 Open Space and Conservation Element, petroleum production was expected to diminish in Kern County. This General Plan Element projects that by 1990 most of the oil fields in Kern County will close down unless new discoveries are made, and the three largest oil fields -- Kern River, Midway-Sunset, and South Belridge -- will approach the final stages of production. Thus, the production of oil at NPR-1 will result in a boost to petroleum-related industries and a shift in the location of the major crude oil production in the county to NPR-1.

1. Construction Impacts

Many of the effects of construction of the support facilities and drilling of new wells can be more accurately described as impacts on traffic, air quality, economics, visual quality, and noise. These potential impacts are discussed in this report in the appropriate sections.

2. Operation Impacts

The use of lands at NPR-1 will have no effect on the present or future uses of neighboring lands, although the economic activity at Elk Hills may indirectly lead to minor commercial or industrial development (thus, commercial or industrial use of land) in the local area.

Construction and use of a railroad spur in Section 20D (east of Taft) will result in a change in land use along the railroad right-of-way.

The land crossed by the railroad spur includes agricultural fields and oil fields. The total impact on land use will be slight.

3. Mitigation Measures

Any development fostered by the economic activity at NPR-1 will be subject to planning policies and ordinances of the City or County governments with jurisdiction over that area. In addition, any major industrial development with potentially significant land-use or environmental impacts would come under the provisions of the California Environmental Quality Act. Thus, there now exists an operational structure to identify and minimize land-use impacts from such development.

H. Socioeconomics

1. Employment and Trade

Impacts on employment and trade will derive from both the construction and operations phases of the proposed project. Since each phase produces impacts distinct in both magnitude and duration, the following discussions individually address the employment and trade implications of each.

a. Construction

The proposed project involves 14 separate construction elements phased over a 32-month period. The labor requirements of each project element are not now precisely known. The best available indicator of project employment is the current schedule of construction expenditures. Table 4-2 shows projected expenditures by element and broadly interprets their labor-force implications. As shown, the elements will have widely varying labor implications -- ranging from only 13 men per day to nearly 300.

Table 4-2

SCHEDULE OF CONSTRUCTION EXPENDITURES AND
OF IMPLIED EMPLOYMENT

PROJECT ELEMENT	CONSTRUCTION PERIOD	WORK INTERVAL	PROJECTED EXPENDITURE (\$000)	EXPEND. PER DAY (\$000)	MEN PER CONST. DAY*
@ Gas Plant #1	3/78 - 6/79	450 days	26,200	58.22	131
@ Gas Plant #2	11/78 - 1/80	420 days	14,800	35.24	79
z Gas Collection	4/79 - 8/80	17 months	51,200	100.39	226
z Gas Injection	3/78 - 1/80	22 months	31,300	47.42	107
z Oil Collection	6/77 - 8/80 (4 mos. down)	39 months	54,100	46.24	104
** Water Injection	11/79 -12/81	26 months	26,800	34.36	77
z Electrical	1/79 - 3/80	15 months	15,000	33.33	75
z Cathodic Protection	2/79 - 9/79	210 days	8,600	15.78	36
	10/79 - 5/80	240 days			
z Water System	4/79 -10/79	7 months	3,600	17.14	39
x Roads	10/78 -10/79	12 months	3,500	9.72	22
+ Support Buildings	2/77 - 9/77	8 months	5,400	11.25	25
	5/79 -12/79	8 months			
= LACT Systems	12/78 - 7/79	8 months	3,800	15.83	36
@ Compression Plant	4/78 -12/78	270 days	21,800	80.74	182
# Railroad Spur & Loading	6/79 - 4/80	11 months	23,700	71.82	162

* Labor estimate is based on current labor -- expenditure relationships. Thus project foundation work has shown a 54 percent labor component and an average cost per worker of \$240 per day.

Sources: URS Company, 1978
Officer in Charge of Construction, Elk Hills,
Project Schedule, 1978
NPR-1, Budget Estimates, 1977.

Code for Location of Project Elements Within Reserve Sections:

- @ 35R
- # 20D
- + 35R and 36R
- = 18G
- ** 2G, 3G, and 24Z
- x Main Roads within Reserve (See: Figure 1-8)
- z Located Throughout NPR-1 and Many Locations Yet to be Established.

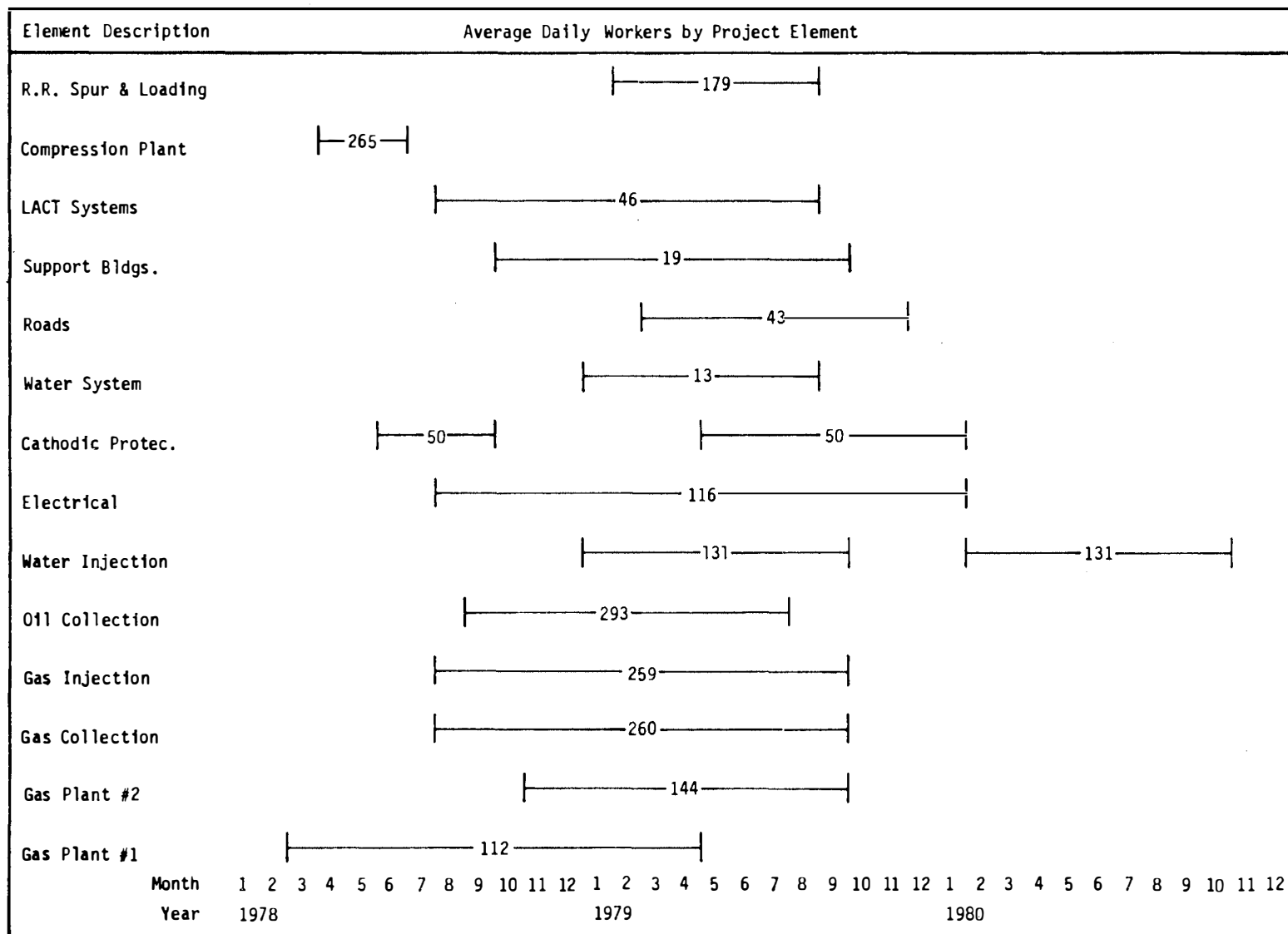
In order to assess the cumulative effect of these project efforts, Figure 4-1 was prepared. Clearly, the heaviest employment effect can be expected between mid-1978 and late 1979. During that interval, the cumulative project construction work force will exceed 1,000.

Table 4-3 summarizes the average daily employment that may be expected to derive from the project by month under two participation-rate assumptions. The resulting estimate-pairs may be assumed to effectively bracket the eventual labor realities. The table provides two frames of reference by which to consider these estimates: first, it shows the weight of the labor requirement as a proportion of total Standard Metropolitan Statistical Area (SMSA) construction employment; then, it relates the requirements to current levels of construction unemployment. By either measure, the proposed project will have a substantial employment effect on the regional labor market from August 1978 until September 1979.

That the project will substantially affect construction employment is undeniable; the desirability of these effects is less obvious.

Several highly subjective value assumptions must be made in order to qualify these labor estimates.

- (1) Full employment is desirable:
 - (a) when employment is permanent, or
 - (b) when community infrastructure is not burdened by in-migrants.
- (2) Secondary and tertiary employment (in support of construction labor) is desirable only:
 - (a) when source of support (construction labor) is permanent, or



Source URS Company 1978.

Figure 4-1. Schedule of Construction Labor Use

Table 4-3
EXPECTED DAILY CONSTRUCTION EMPLOYMENT

	Average Daily Project Workforce ²		Percent Estimated of SMSA Constr. Labor Force ³		Percent Estimated of SMSA Constr. Unemployment ⁴	
	High Range ¹	Low Range ²	High	Low	High	Low
1978						
Mo 1						
2						
3	112	73	3	2	24	16
4	377	244	9	6	82	53
5	377	244	9	6	82	53
6	427	277	10	6	93	60
7	162	125	4	2	35	23
8	843	546	20	13	184	*
9	1,136	736	26	17	248	*
10	1,105	716	26	17	241	*
11	1,249	810	29	19	273	*
12	1,249	810	29	19	273	*
1979						
1	1,393	903	32	21	304	*
2	1,592	1,032	37	24	348	*
3	1,635	1,060	38	25	357	*
4	1,635	1,060	38	25	357	*
5	1,573	1,020	37	24	343	*
6	1,573	1,020	37	24	343	*
7	1,573	1,020	37	24	343	*
8	1,280	830	30	19	279	*
9	1,022	662	24	15	223	*
10	209	135	5	3	46	
11	209	135	5	3	46	
12	166	108	4	3	36	
1980						
1	166	108	4	3	36	
2	131	85	3	2	29	
3	131	85	3	2	29	
4	131	85	3	2	29	
5	131	85	3	2	29	
6	131	85	3	2	29	
7	131	85	3	2	29	
8	131	85	3	2	29	
9	131	85	3	2	29	
10	131	85	3	2	29	
11						
12						

*Period of probable labor deficit.

Source: URS Company, 1978

¹Based on 54 percent labor component of total construction cost.

²Based on 35 percent labor component of total construction cost.

³Using 4,300 as SMSA construction labor estimate.

⁴Using 458 as SMSA construction unemployment estimate.

- (b) when existing surplus labor is used.

Given these value judgments, the proposed project will afford the following benefits:

- (1) Essentially full employment for regional construction labor over the project's midrange, August 1978 to September 1979 so long as no additional burdens will be placed on the regional infrastructure,
- (2) Major injections of construction labor dollars into secondary and tertiary enterprises would enable use of surplus capital and would provide opportunities to employ otherwise unemployed service sector workers over the project's midrange is substantial -- 1,000 to 2,000 secondary and tertiary workers could be returned to the region's labor rolls.

The following adverse effects cannot be predicted. Rather, they should be considered potential employment liabilities of the project:

- (1) The proposed project will act as a major labor attractor -- a stimulus to regional committing or in-migration. At its peak, the project will require almost four times the current level of SMSA surplus construction labor, far more in secondary and tertiary labor markets. Potential in-migrants will burden the various support systems of the region -- they will encourage infrastructure expansion. Unfortunately, the in-migrants and the expanded support systems may outstay their source of support. The result may be higher far-term unemployment, overextended support systems, and long-term fiscal burden.

- (2) As a major injector of new revenue to the region, the proposed project may indirectly stimulate the development of new commercial enterprise -- long-term capital commitments to opportunities of only short-term support. A rash of business failures may follow the project's completion.

b. Operation

Project operation will provide long-term support for about 800 workers. The project's operating work force will be divided between three task areas as follows:

- (1) Gas Plant Work Force: each plant will require 70 employees per day (3 shifts) 3 plants x 70 = 210 daily employees
- (2) New Administration Building: 150 employees per day (1 shift)
- (3) Old Office and Garage: 180 employees (3 shifts).

Thus, the total primary operating employment will be 540.

Secondary employment in the form of various vendor and service personnel will amount to about 300 per day.

The quality of these employment effects is beneficial. The labor support is substantial and will be long-lived. Residual levels of construction-related unemployment will be mitigated by the long-term support opportunity of project operation.

c. Mitigation

County and municipal decision-makers should be aware of the economic stimulation which the project will deliver. They should recognize the potentials inherent in such stimulation -- economic growth,

reduced unemployment, fiscal efficiency. They should also recognize the risks: spurious stimulation from construction spending, poorly supported worker in-migration, an over-burdened infrastructure, and a lack of tax base from government activities.

Government decision-makers could then employ their permit, licensing, zoning, and other regulatory processes to deter investments from either the private or public sectors that are not based on long-term project support. Further, such decision-makers could ensure that subcontracts provide for maximum employment of local surplus labor and minimum burden on municipal and county infrastructure.

Cooperative inter-governmental efforts are needed by federal, state, and local governments to deal with the socio-economic impacts. These efforts should be directed toward two objectives: (1) to provide the infrastructure necessary to support growth (schools, roads, sewers, water supply; and (2) to plan for sound balanced growth which will sustain the area economically when oil production begins to decline. Planning for economic diversification should be initiated now to deal with this issue. The Kern County Council of Governments would appear to be a logical vehicle for such planning because it is an intermediary between local government and the federal and state levels and serves as a regional clearinghouse for federal grant programs.

2. Population

a. Construction-Related

Although substantial employment stimulation will result from the proposed project, worker in-migration cannot be predicted. The broader population consequences are, similarly, possible but not predictable project outcomes.

b. Operations-Related

The project will support 850 employees directly or indirectly.

It is safe to assume that some worker in-migration will derive from this support.

While in-migration cannot be predicted, if it is assumed that half of the operating employment can be developed from within the SMSA's existing labor force, then approximately 400 immigrants will generate from the project. Given a household average of 2.8 (from population statistics for the Bakersfield area), using the above assumption about 1,100 persons will be added to the region's existing population. The increase would be 0.3 of 1 percent.

3. Housing

a. Construction-Related

Within the Bakersfield metropolitan area, almost 4,000 housing units are identified as vacant and available. Since the maximum short-term housing need for construction worker shelter will only slightly exceed 1,000 (assuming project employment of existing surplus construction labor), no adverse housing impacts are anticipated.

b. Operation-Related

The project's operating work force will require only 400 to 500 housing units (assuming, once again, employment of existing surplus labor). The effect of this requirement will be beneficial to the region's housing stock by alleviating existing conditions of vacancy.

4. Transportation

a. Regional

Construction

Regional construction impacts related to traffic would be minor. It is assumed that over half of the construction force would

live in Bakersfield and commute to the Reserve. The remainder would reside in neighboring communities. Therefore, the major traffic impacts would be local. The construction workers and their families would use the regional road network for trips not related to the Naval Petroleum Reserve, but there is no means to quantify this impact. The regional road network should have no problem handling the additional burden.

Operation

Operation of the Reserve would also have a slight impact upon regional traffic. Most of the permanent work force would probably reside in Bakersfield and generate additional traffic in that city and on the regional road network. The major traffic impact, however, would be local in nature. In addition, up to 150 truck trips per day will be generated to transport liquid petroleum products. Most of this truck traffic will be temporary until completion of the rail spur in early 1980. This is discussed further later in this section.

Mitigation

No regional mitigation measures are necessary since the major traffic impacts would be local.

b. Local

Construction

The number of construction workers necessary to build the proposed production facilities at NPR-1 would be greatest in mid-1979, at which time peak traffic to and from the site is expected. The total number of trips generated would range from 1,700 to 2,500 based on an estimated 1.3 occupants per vehicle (State of California, 1973). Most of these workers would be expected to live within the City of Bakersfield while the rest would reside in other neighboring communities.

Given these assumptions, traffic volumes were distributed on the local highway and road network. This analysis shows that annual average daily traffic would double over existing volumes on Elk Hills Road and Skyline Road at the entrances to NPR-1. In particular, Elk Hills Road from Buttonwillow to the reserve and Skyline Road from State Route 119 to NPR-1 would be most affected. Since most workers would be

arriving about the same time in the morning and leaving at the same time in the evening, traffic flow would be impaired at these two locations.

Less severe impacts would occur on State Route 58 from Bakersfield to Buttonwillow and on State Route 119 from Interstate 5 to the North-South Access Road. Route 58, near the junction of State Route 99, currently has a high traffic load and would experience further congestion during the morning and evening rush hours.

The adverse impact identified for construction traffic would build gradually as more workers are needed. It is expected that the work force would peak in 1979, then taper off as construction activities neared completion. Therefore, the associated traffic impact would follow a similar pattern and be short-term in nature.

Table 4-4 shows the estimated peak annual average daily traffic volumes expected as a result of construction and the associated peak-hour volumes. The values shown assume the peak projected work force and do not include existing traffic.

Operation

Operation of the proposed production facilities would add about 152 trips per day to the existing local road network due to new employees. Approximately half of these trips would originate in Bakersfield. The routes people would take to reach the Reserve would be similar to that of the construction workers; that is, Elk Hills Road from Buttonwillow and Skyline Road from State Route 119.

The traffic patterns due to the new employees would differ from that of the construction workers since the new employees would work in three shifts. (It is assumed the construction workers would work one 10-hour shift, 6 to 7 days per week.) Therefore, only a minor adverse impact would be expected from new employee traffic.

Vendor personnel providing goods and services would average about 600 trips per day. Most of these trips would originate in

Table 4-4

PROJECTED TRAFFIC VOLUMES DURING THE
PEAK CONSTRUCTION PERIOD
(new traffic only)

Road	Location	Annual Average Daily Traffic (AADT)	Estimated Peak Hour
Elk Hills Road	North of SR 119	500	100
	At Brite Road	800	160
Skyline Road	At Reserve Road	250	50
State Route 119	East of Dustin Acres	100	20
	At Tupman Road	875	180
State Route 58	East Limits of Buttonwillow	750	150
	Junction of Route 99	875	180

Source: URS Company, 1978.

Bakersfield and occur throughout the day. Therefore, only a minor adverse effect would be expected.

Operation of the two new gas plants would require a means to transport the liquid products to market. Current plans call for three product pipelines to be built from the new gas plants to a railroad loading facility east of Taft. From here a railroad spur would be built to connect with the existing Sunset Railroad line in Taft.

The first of the new gas plants (LTS-1) would be completed in mid-1979, prior to completion of the new railroad loading facility and truck traffic would be the only means of delivering the liquid products until the railroad facility becomes operational. The railroad loading facility and the other new gas plant (LTS-2) would be completed early in 1980, with the railroad facility scheduled for completion first. After the railroad loading facility becomes operational, the liquid products would be delivered via a mix of tank trucks and railroad tank cars, with a seasonal variation as indicated below:

<u>PRODUCT</u>	<u>PORTION OF THE YEAR</u>	<u>PERCENTAGE OF TOTAL PRODUCTION DELIVERED BY VARIOUS MEANS</u>	
		<u>TANK TRUCK</u>	<u>RAILROAD TANK CAR</u>
Propane	1/2 year; summer	20 to 25	75 to 80
Propane	1/2 year; winter	90	10
Butane	1/2 year; summer	20 to 25	75 to 80
Butane	1/2 year; winter	75 to 80	20 to 25
Gasoline	All year	50	50

Railroad cars for the propane and butane products would be 32,184 gallon capacity, noninsulated cars. Railroad cars for natural gasoline would be 20,000 gallon, insulated cars. Assuming maximum production rate and the maximum summertime railroad delivery, 32 railroad cars would be required per day. The railroad tank cars must be leased

or purchased. Assuming that 32 cars are needed per day, and a 14-day roundtrip per car, approximately 448 cars would be required. A switching locomotive capable of moving tank cars with a 80-ton load would also be necessary.

The capacity of each truck would vary from 3,000 gallons to 9,000 gallons. For the purposes of this analysis, it was assumed that the average tank size would be 7,500 gallons. Department of Transportation regulations restrict tank capacity for liquefied petroleum products to approximately 90 percent of water volume capacity. Therefore, each truck carrying propane and butane would be filled to less than capacity. Trucks carrying natural gasoline are limited by State of California law to a total weight of 80,000 pounds, including the cargo.

Given the assumed tank capacities noted and maximum production at all NPR-1 gas plants, there would be a wintertime maximum of 146 trucks needed per day, or 292 trips per day to and from the loading facility. The trucks would be loading on a 24-hour basis. Therefore, there would be an average of 6.1 trucks or 12.2 trips per hour. Assuming that the loading facilities can accommodate this truck volume, there should be only a minor adverse effect upon traffic.

Such a volume of truck traffic, however, would rapidly deteriorate the roads, especially Elk Hills Road and Skyline Road. These two routes are currently in poor condition, but would be restored to original design conditions by localized resurfacing prior to MER production.

Approximately 280,000 gallons per day of petroleum liquids would be produced at the Chevron gas plant in McKittrick. These liquids primarily propane and gasoline, would have to be transported via tank trucks since no rail service is available or planned. Given the same assumptions as before regarding tank truck size, 43 trucks per day would be needed at the Chevron plant on a 24-hour basis. This would constitute 86 trips per day, or 3.6 trips per hour. The impact upon existing traffic volumes would be minor.

An existing gasoline-only pipeline serves the Chevron plant, but it is currently over-committed and cannot be used for this expanded production.

Table 4-5 summarizes the total number of vehicles expected if the proposed project were implemented.

Mitigation

The adverse traffic impacts during the construction phase of the project could be reduced by encouraging carpools, instituting a bus service, and staggering working hours. These are all recommended measures; none have been proposed.

Tank truck traffic presented in this section represents a worst-case scenario. It assumes less than maximum size tank trucks and operation of both gas plants before the pipeline railroad spur, and loading facility are built. It is now planned that the railroad loading facility will be functioning prior to operation of the second gas plant. This would reduce the tank truck traffic to one-half of that identified in Table 4-5.

5. Public Services and Utilities

a. Police Services

Construction. There will be minor impacts on regional and local police agencies during construction of the project. Some increase in patrols may be needed.

Operation. Current security measures at NPR-1 will continue when construction is completed.

The Kern County Sheriff's Department will continue to patrol the Reserve nightly. In addition, the production area will be fenced.

Table 4-5
TOTAL NEW VEHICLE TRIPS GENERATED
BY THE PROPOSED PROJECT ABOVE CURRENT VOLUMES

Activity	Trips per day	
	With Maximum Use of Railroad Spur	With Minimum Use of Railroad Spur
Gas Plant	140	140
Old Office Building and Garage	58	58
Vendors	600	600
Liquid Petroleum Transportation		
At LTS Gas Plant	100	292
At Chevron Plant	86	86

Source: URS Company, 1978

b. Fire Protection

Construction. There will be no significant impact on the county's firefighting agencies from the construction of this project.

Operation. The fire risks associated with the development of oil and gas at Elk Hills are discussed in Section I, Introduction and Project Description. In response to this increased fire risk at NPR-1, the government will be instituting a series of fire-protection and firefighting measures.

Design of these measures is still in a preliminary stage, but the finished design will expand the present fire-water system by bringing the total freshwater capacity to 1.6 mgd.

Despite this increased level of fire protection at NPR-1, it is likely that the local stations of the Kern County Fire Department will be involved in more firefighting at Elk Hills in the future than they have been in the past. The county fire department at Taft can respond to a call at Elk Hills in 25 minutes. The Taft Fire Station has four big trucks which use light water and foam, and another truck which carries 2,000 gallons of water and a foam supply. Personnel from Taft spent 3 days at NPR-1 during October 1977 fighting the explosion-caused fire. The fire department then billed the government for their services.

Another agency which is currently involved in operations at NPR-1 and will continue to be is the California State Division of Industrial Safety. This state agency is responsible for enforcing fire-safety regulations. Their jurisdiction includes all contractors working for the Federal government, but excludes government employees. The full development of oil and gas at NPR-1 will slightly increase the responsibilities of this agency.

Mitigation Measures. During construction and operation of the project, the crew would take all measures possible to prevent fires. The government and local fire agencies would investigate arrangements for compensation of the local agencies for their part in any firefighting that would be more acceptable to the fire department than current billing procedures.

c. Education

Construction. During project construction from mid-1978 to late 1980, many construction employees will in-migrate into Kern County. Principal locations will be Taft, McKittrick, Buttonwillow, Tupman, and Bakersfield. At the peak construction period, if all of the construction workers move into the region with their families, local school districts would need to accommodate between 300 and 350 new students. This estimate is an absolute maximum; it is likely that many of the project employees will already live in the county or will move in for the construction period without their families. The schools have adequate capacity to handle the projected increase of students (see Table N-2, Appendix N).

Operation. The operation of the NPR-1 production will result in an increased student population of about 132. These students would probably be enrolled in the school districts listed in Table N-2, Appendix N. School capacities could easily accommodate this projected increase in students. The only school district which has expanding enrollments over the past 3 years - Taft Union High School District - still has capacity for 103 students.

d. Recreation

There will be no impacts on neighboring recreation lands due to the development of oil and gas at NPR-1.

e. Water

Fresh-water demand at NPR-1 is projected to rise from the current average demand of 19,500 barrels per day (B/D) to 21,500 B/D during the construction period; and then to fall to 16,200 B/D during operation.

Construction Impacts. Water needs during the construction period will continue to be met by the West Kern County Water District which will have adequate supplies to meet the demand at NPR-1 without a negative impact on local water supply. The Water District is currently involved in an expansion program, designed to meet the rising water demands of the west-county oil industry by increasing supply by 82,000 B/D. The Water District anticipated a demand of 30,000 B/D for NPR-1 in its calculations for additional water supply needs. The district plans to construct a new well and pump station additions.* The district has also indicated its willingness to increase its water supply further if necessary.**

Operation Impacts. Fresh-water demand, excluding fire protection water, is projected to decline at the completion of the construction period. Water supplies will continue to be adequate.

The largest demand for water during the operation of the Reserve will be for fire protection. Although the exact quantity of water needed has not yet been determined, several alternative sources are being studied. These include the West Kern County Water District, some other Kern County water district, the Getty water pipeline that crosses the Reserve, and the onsite saltwater-injection system. The West Kern County Water District might need to undertake further expansion programs if they were to supply this additional water need.

*Bob Boone, McAnlis, Boone and Cook, Personal communication, Dec. 14, 1977.

**Dave Requa, TYA/Black and Veatch, Personal communication, Jan. 3, 1978.

f. Wastewater

Construction. During the construction period at NPR-1 the wastewater disposal systems will be permanently expanded. There will be no impacts on local wastewater systems from the construction activity.

Operation. As discussed in the Introduction, all wastewater facilities needed for oil and gas development at NPR-1 are currently provided or will be constructed. There will be no impact on local wastewater systems.

g. Solid Waste

Construction. Waste materials generated during construction activities at oil fields include drilling muds, scrap materials, and domestic wastes (sack lunches, paper towels, etc.). At NPR-1, drilling muds, or cuttings, are placed in a shaker tank to remove solids. Then they are placed in a sump near the drilling site. From there they are spread out over a Class II-1 dumping site on NPR-1. The site has been approved for this use by the Central Valley Regional Water Quality Control Board on the condition that wastes were not to exceed 10,000 gallons per day. Ground water underlying the site is unusable because of high salinity concentration.*

Scrap materials are sold and hauled away. Domestic wastes are collected by the Westside Sanitary Company and taken to a county landfill.

Operation. Solid wastes generated by the continued operation of Elk Hills production will be identical to those generated during construction, except in significantly smaller quantities.

*California Regional Water Quality Control Board, Central Valley Region. Order No. 73-141. Waste Discharge Requirements for Williams Brothers Engineering Company. Elk Hills (North), Kern County. May 28, 1976.

h. Power

Construction Impacts. There will be little or no impact on local power resources and companies from the construction of this project.

Operation Impacts. Although exact electrical requirements for the proposed project cannot yet be determined, preliminary studies by Ralph M. Parsons Company determined that the power supply to NPR-1 should be increased from 10 megawatts to 40 megawatts. This increase includes allowance for change from gas-power to electric power to run existing pump motors.

Present electrical use is 23.5 million kW hours. If existing pumps are converted to electricity this use is projected to increase to 58.7 million kW hours. There is some question as to whether or not PG&E can increase the power supplied to the site economically and within the projected time frame. If they cannot, the pump motors will continue to operate on gas in the near future.

The increase in power supply will definitely be a part of this proposed project, however. PG&E would construct one new substation to the east of the Reserve and another within it. Assuming electrical consumption would increase by the same proportion as system capacity would be expanded, annual electrical use would increase to 94 million kW hours -- an increase of 0.12 percent in PG&E's total electrical sales.

6. Public Finance

Federal exemptions from state or local taxes and fees limit the income of the proposed project on public finance. The NPR-1 operation is exempt from the state's Oil and Gas Severance Tax and from business income taxes. The operation at NPR-1 does contribute to state and local public revenues through sales tax on construction materials, federal

funding to schools, and business taxes on the trucking operations which carry gas to market.

Costs to state and local governments are minor.

a. Construction

There are no noteworthy direct government costs from the construction stages of the proposed project. The only costs to Kern County are the voluntary costs of reviewing the project and providing informal feedbacks with regard to project design, which is not required, but which is in the county's best interests. The Department of Energy would be responsible for ensuring that new construction conforms to federal guidelines; thus, local governments are relieved of potential inspection costs.

Costs to local governments from the construction of this project will result from supplying services to the net population increase attributable to Elk Hills construction.

Local revenues from project construction will result from sales tax and federal school funds. Although the California Sales and Use Tax Law exempts federal purchases, purchases of a construction company under contract with the Federal government to make real improvements on Federal property are not exempt from sales tax. Project engineers estimate that 46 percent of the projected \$288,920,000 construction costs will go for materials. Thus, local governments would receive a total of \$2.7 million dollars in sales tax revenues over the construction period. Construction purchases and, thus, sales tax revenue would be distributed among several cities and perhaps more than one county.

Between mid-1978 and late 1979 the cumulative work force will exceed 1,000. Many of the workers either already living in the region

or moving in for the construction period will have school-age children. The Federal government gives school districts in Kern County \$315 annually for each student whose parents work on federal property such as the Naval Petroleum Reserve. This income from Public Law 874 will help compensate the costs of educating the children of the project construction workers.

b. Operation

Costs to state and local governments from the operation at NPR-1 would be minor. They include the costs of increased public services, especially the cost of educating the children of new NPR-1 employees; costs from an added load on the county landfill system (although solid waste collection at NPR-1 is performed by a private company which is paid for its services); and costs of providing emergency services in the event of a fire at Elk Hills.

Some of these costs will be repaid by the Department of Energy or other federal source. The Department of Energy would investigate an arrangement for reimbursement of emergency-service costs with Kern County.

Public school costs for children of federal employees are compensated by the Federal government under Public Law 874. As stated previously, Kern County schools receive approximately \$315 annually for students whose parents work on federal property. At full capacity, the NPR-1 operation will support 800 to 850 employees. Half of these may move into the area with about 132 school-age dependents. Local public school districts, thus, would receive approximately \$41,580 annually to compensate for the expenses of educating these children.

Until railroad facilities are operational in 1980, the propane, butane, and gasoline produced at NPR-1 must be shipped to market solely by truck. Currently, the gas processed at NPR-1 is being

sold to customers around the Bakersfield area. Gas from additional production may have to go much farther -- possibly out of the state -- to find customers.

The revenues of the trucking companies transporting NPR-1 gas liquids now or in the future, are subject to three fees payable to the California Public Utilities Commission. If the truck companies operate on state highways for hire -- in other words, if they are not direct employees of the Department of Energy or of the purchaser of the gas -- they must pay, on a quarterly basis, a \$10 transportation fee; a rate-fund fee equal to three-tenths of 1 percent of gross revenue; and a uniform business license tax, equal to one-tenth of 1 percent of gross revenue.

These fees have been estimated in Tables 4-6 and 4-7. Table 4-6 shows tax revenues from trucking and gas produced at the existing NPR-1 gas plant and at the Chevron plant. Annual revenues should approximate \$40,600. In June, 1979, the first low-temperature separation (LTS #1) plant is scheduled to begin operation. Table 4-7 shows the tax revenues resulting from trucking the gas produced by all three of these plants through the time when the railroad is operable. Revenues for this 4-month period should approximate \$22,600. When the second LTS plant begins operating, train transport of gas will have begun and dependence on trucking (and thus tax revenues from this source) will be greatly reduced.

7. Visual Quality

a. Construction

The construction of production-related facilities at Naval Petroleum Reserve No. 1 is scheduled to take about 36 to 40 months.

Table 4-6

STATE PUBLIC UTILITIES COMMISSION REVENUES FROM CARRIER TAXES THROUGH MAY 1979¹

PART A FREIGHT REVENUE								
Existing Gas Plant to Local Markets					Existing Gas Plant to Out-of-State Markets			
	Annual Tons Transported ²	Average Miles To Markets ³	Ton-Miles	Annual Revenue ⁴	Annual Tons Transported ⁵	Miles to Market ⁶	Ton-Miles	Annual Revenue ⁴
Propane	22,710	35	794,850	270,119	114,530	193	22,104,290	
Butane	24,787	35	867,545	146,029	86,721	193	16,737,153	
Natural Gasoline	21,775	35	762,125	187,389	69,252	193	13,365,636	
TOTAL			2,424,520	\$225,480			52,207,079	\$4,855,25
Chevron Gas Plant at McKittrick								
Propane					114,975	211	24,259,725	
Butane					---	---	---	
Natural Gasoline					142,350	211	30,035,850	
TOTAL							54,295,557	\$5,049,488
PART B ANNUAL TAX REVENUES								
		EH/Local	EH/Out-of-State	Chevron				
1. \$10/quarter		\$40	\$40	\$40				
2. .003 x revenues		676	14,566	15,148				
3. .001 x revenues		225	4,855	5,049				
SUBTOTALS		941	19,461	20,237				
TOTAL				\$40,639				

¹MER production level:

354,000,000 cu. ft. of gas processed - (60 mm. cu. ft. in McKittrick, 94 mm. cu. ft. at old plant)

Propane = 560,000 gal/day at reserve; 150,000 gal/day at Chevron

Butane = 390,000 gal/day at reserve

Gasoline = 260,000 gal/day at reserve; 130,000 gal/day at Chevron

²Propane = 4.2 lbs/gal. Butane = 4.9 lbs/gal. Liquid Natural Gas = 6.0 lbs/gal.³Market centered in Bakersfield = 35 miles away.⁴Average freight revenue per ton-mile, 1974, for Class I intercity motor carriers of property = 9.3¢.
Source: American Trucking Association, 1976. American Trucking Trends Statistical Supplement.⁵Annual tons processed above and beyond 1977 production.⁶Miles required to leave California (via Needles).

Source: URS Company, 1978

Table 4-7

STATE PUBLIC UTILITIES COMMISSION REVENUES FROM
CARRIER TAXES AT PEAK -- JUNE THROUGH SEPTEMBER, 1979

<u>Part A. Freight Revenue from LTS #1</u>				
	Annual tons transported	Average miles to market	Ton-miles	Annual Revenue 1/3 year
Propane	146,000	193	28,178,000	
Butane	118,625	193	22,894,625	
Natural Gasoline	96,837	193	18,689,622	
Total			69,762,247	6,487,889 \$2,162,630

Part B. Tax Revenues -- May-September, 1979

	LTS #1	All other ¹
1. Quarterly fees	\$13	\$40
2. .003 x revenues	6,488	10,130
3. .001 x revenues	<u>2,163</u>	<u>3,377</u>
Sub Totals	8,664	13,907
Total		\$22,571

¹1/3 of revenues reported in Table 4-6, Part B.

Source: URS Company, 1978

During that period the most visually prominent onsite activities will be the construction of two new gas plants in Section 35R, the drilling of approximately 350 new oil and gas wells, construction of a surface network of oil and gas wells, construction of a surface network of oil and gas collection pipelines, installation of secondary well-access roads, and construction of LACT, tank storage, and various other support facilities.

The most visually-prominent offsite construction activities will be the installation of an underground gas pipeline from the Reserve to the Chevron gas plant at McKittrick, and the construction of a pipeline system, railroad spur, and related onsite storage tanks, from either Buttonwillow or Ford City to the Reserve.

Various staging areas, comprising a total of about 29 acres, will be centers of activity for many of the construction activities.

Although these activities collectively represent a very large-scale construction effort, their visual impact may be considered to be relatively minor for several reasons:

- o Construction activities will be of relatively short duration.
- o The natural scenic character of the area is common to large areas of the San Joaquin Valley, and is of generally low scenic quality.
- o Petroleum-related development is commonplace in the area.
- o The viewability of the project area is extremely limited due to its lack of residential development, the small size of neighboring population centers, and the relatively low traffic volumes along roads through the site.

b. Operation

The operation of petroleum-related facilities at Naval Petroleum Reserve No. 1 will have visual implications for several areas of the site. The greatest visual effects will be concentrated west of the intersection of Elk Hills Road and Skyline Road in Section 35R. This general area will be the site of the two proposed gas plants, tank storage, loading facilities, injection compressors, and various other support structures. Although these structures, or portions of them, may be seen from distances exceeding 1 mile, they would not be viewable from populated areas. However, at least a portion of these facilities (as well as the new tank farm and LACT facilities in Section 18G) will be viewable from Elk Hills Road, which has been designated a scenic route in the Kern County General Plan. Other existing production facilities, mostly well pumps and surface pipelines, are intermittently viewable from Tupman Road and State Highway 119, which have also been designated scenic roads by the county.

In general, the visual effects of production facilities and activities during project operation will be extensive and negative, but regionally minor, for the following reasons:

- o The natural scenic character of the area is common to much of the western San Joaquin Valley, and is of generally low scenic quality.
- o Petroleum-related development is commonplace.
- o The viewability of most project areas is very limited due to the lack of onsite population, the small size of neighboring population centers, and the relatively low traffic volumes through NPR-1.
- o Meteorologic conditions of fog, smog, and haze frequently inhibit any long views to and from project sites.

c. Mitigation

Measures for mitigating the potential adverse visual impacts of project construction and operation include the following:

- o Molding and contouring modified earth forms, where feasible to conform with, and complement, natural topography
- o Unobtrusive, visually screened storage of materials and equipment
- o Maximum use of existing utility corridors, rights-of-way, and structures
- o Use of dust-reducing palliatives
- o Minimization of duration of construction
- o Preservation of natural land forms and vegetation
- o Restoration of natural land forms at staging areas
- o Restoration of exposed surfaces with native ground cover or, alternatively, treatment of them with cosmetic covering (e.g., aggregate) compatible in texture and color with the surrounding landscape
- o Unobtrusive siting and low-profile structural design elevations, as feasible
- o Use of natural or earth-colored and textured exterior finishes, particularly for storage tanks
- o Use of indigenous architectural styling of accessory structures.

V. ALTERNATIVES

This project results from a Congressional mandate in Public Law 94-258 (the Naval Petroleum Reserves Production Act of 1976, Appendix A), which, in part, directed the openup of NPR-1 to production at the maximum efficient rate (MER). A major objective of this Act was to increase domestic petroleum production. Specifically, the Act required the government to achieve production of NPR-1 at the maximum sustainable daily oil or gas rate from the reservoir which will permit economic development and depletion of that reservoir without detriment to the ultimate recovery.

Project alternatives are separated into the following three groups for discussion: (1) alternative methods to produce NPR-1 at maximum rates; (2) changes within the proposed project to provide alternative methods for shipping gas liquids from NPR-1; and (3) the postponement and no action alternatives.

Alternative methods of production at NPR-1 involve maintenance of reservoir pressure by various combinations of reservoir gas, inert gas, gas liquids, and water; certain of these alternatives would involve the sale of a portion or all of the reservoir gas resulting in detriment to ultimate recovery and to the achievement of MER, in violation of the Congressional mandate under Public Law 94-258.

Alternatives that involve changes in the proposed project itself include: (1) use of an all-truck method of transporting the gas liquids; and (2) construction of a railroad spur to a point within the

boundaries of NPR-1 and use of a liquid storage and railroad loading facility there.

The postponement and no action alternatives would be unresponsive to the Congressional mandate in Public Law 94-258 and would, therefore, require modification to this legislation. For the case of no action at NPR-1, there are substitute methods of increasing domestic petroleum production, such as: (1) immediate decontrol of oil prices; (2) a stepped-up enhanced oil recovery program; and (3) speed up of Outer Continental Shelf leasing. In addition, alternative energy sources such as solar, geothermal, wind, and synthetic fuels could be substituted for oil. Such substitute methods would also require modifications to the Congressional mandate in Public Law 94-258.

For each of the project alternatives presented, comparative effects are discussed, wherein the effects of the alternative are compared with effects of the proposed project (or base case). Air pollution emissions, for example, are quantified to show increased or decreased emission levels for the alternatives when compared with the base case emissions as quantified under the future sources totals of Table 4-1 in Section IV. In addition to the presentation in terms of lbs/hour, the emission changes for the alternatives (increases or decreases) are shown in terms of percentage increase or decrease over the base case emissions.

A. Sell Nonassociated Gas (from Olig, Carneros, and Dry Gas Zones)

1. Description

Under this alternative, a portion of the gas not associated with crude oil reservoir production would be sold instead of reinjected. In this case, a total of about 50 MMCF/D of gas would be diverted from injection and marketing of the gas would be required. Equipment changes would include the following: (1) the injection compressors for the 50 MMCF/D would not be needed; (2) an interconnecting pipeline would be

constructed from the Reserve to a nearby gas utility company pipeline (as yet unidentified, but possibilities include Pacific Gas & Electric Company and Southern California Edison); and (3) appropriate gas dehydration, odorization, and metering equipment and possibly gas compressors to boost low pressure gas up to transmission line pressure would be required. The sale gas would have a heating value in the range of 960 to 1,030 BTU per cubic foot (comparable to usual natural gas).

2. Comparative Effects

Two families of effects would result from this alternative. The first is associated with how the gas would now be used (as a fuel) and the second is associated with the loss of injection gas to the reservoir.

a. Using the Gas as Fuel

In comparison with the proposed project, this alternative would generally be more beneficial from a Kern County air quality standpoint (at least during the oil production phase) since a portion of the injection compressor emissions would be eliminated at NPR-1 and the use of gas as a fuel would also displace more polluting utility fuels such as fuel oil (the benefits from using the gas as a fuel would merely be displaced in time since the same benefits would presumably occur when the gas becomes available after oil production stops). The reduced compressor emissions would occur at the Reserve and the net result would be a reduction in emissions as follows (all expressed in lbs/hour): total hydrocarbons (THC): 24 (5.5%); nonmethane hydrocarbons (NMHC): 4.1 (5.5%); oxides of nitrogen (NO_x): 77 (6.4%); carbon monoxide (CO): 8.1 (7.7%); and sulfur dioxide (SO_2): 0.07 (4%). Using the gas as a fuel would yield beneficial air quality effects in areas far beyond the Reserve and probably in other air basins. The magnitude of such benefits would depend on the specific fuel displaced and burning conditions.

Whereas the net results would generally be beneficial, under certain conditions, specific pollutants would show higher emission levels using gas; for other pollutants, no change in emission levels would occur. The following table presents net results in terms of the range of changes in emission which would occur.

Emission Reductions Compared to Base Case

Pollutant	Range of Reductions			
	lbs/hour		Percentage	
	Min.	Max.	Min.	Max.
THC	8.3	10.6	2.0	2.5
NO _x	(170)*	1290	(14)*	107
CO	38	47	36	45
SO ₂	97	1330	5400	74,000
Particulates	0	137	0	14,000

*Indicates an actual increase in emissions.

Some additional adverse short-term impacts would occur during construction of the new gas pipeline. Overall capital and operating costs should be lower, with corresponding lower construction employment levels. After oil production decreases to a point that blow-down of the gas cap is initiated, the gas which then would be recovered from the reservoir would be reduced by the gas which has been already sold.

b. Loss of Injection Gas

Use of the nonassociated gas as a fuel would divert 50 MCF/D of gas from being injected to maintain reservoir pressure. This would

represent a significant reduction in total injection gas (from about 360 to 310 MMCF/D, or a 14% reduction). Such a reduction would result in a decrease in the total volume of oil recoverable from the reservoir. Production rates would also be adversely affected since reservoir pressure would be significantly lower. To the extent that this occurs, NPR-1 would not be produced at MER, but at some lower level of recovery and such production would be unresponsive to the Congressional mandate in Public Law 94-258 to produce at MER (see definition of MER on page A-1 of Appendix A).

B. Sell All Associated (from Stevens and Shallow Oil Zones) Gas and Inject Inert Gas

1. Description

Under this alternative, the nonassociated gas and all gas associated with crude oil reservoir production would be sold and field-generated inert gas would be injected in place of the sold gas. In this case, a total of about 315 MMCF/D of gas (360 MMCF/D less 45 MMCF/D for inert gas generation, presuming that 8 cubic feet of inert gas is generated by burning 1 cubic foot of fuel gas) would require marketing as a fuel and some 360 MMCF/D of inert gas would be generated and injected. Equipment changes would include: (1) installation of overall higher horsepower injection compressors since inert gases would all be near atmospheric pressure instead of various elevated pressures before compression; (2) combustion systems would be constructed for generation of inert gas by burning a portion of the gas to be sold; (3) an inter-connecting pipeline would be constructed from the reserve to a nearby gas utility company pipeline; and (4) appropriate additional gas treating and/or metering equipment would be installed. The initial gas to be sold would have a heating value of about 1,100 BTU per cubic foot, but this value would decrease with time since the inert gas injected would dilute the reservoir gas.

2. Comparative Effects

In comparison with the proposed project, this alternative would initially provide air quality benefits since the use of gas as a fuel would generally replace more polluting utility fuels such as fuel oil, although the benefit would be somewhat offset by the increased injection compressor emissions. Using the gas as a fuel would yield benefits and detriments in air basins beyond the Reserve and the following table presents net results showing the range of changes in emissions which would occur.

Emissions Reductions Compared to Base Case

Pollutant	Range of Reductions			
	lbs/hour Min.	Max.	Percentage Min.	Max.
THC	54	60	12	14
NO _x	(1110)*	8460	(92)*	699
CO	250	310	240	300
SO ₂	628	8690	35,000	480,000
Particulates	0	900	0	90,000

*Values in parentheses indicate an actual increase in emissions.

Increased compressor emissions would occur at the Reserve and the net result would be an increase in lbs/hour of emissions as follows: THC: 93 (22%); NMHC: 15 (20%); NO_x: 423 (35%); CO: 34 (32%); and SO₂: 0.6 (33%). In time, however, with the decline in heating value of the gas, air quality benefits would also decline and could cease altogether

if the heating value reaches such a low level that marketing becomes difficult. Some additional adverse short-term impacts would occur during construction of the new combustion equipment and gas pipeline. Overall capital and operating costs would be considerably more than the base case with corresponding higher construction and operating employment levels. After the oil production phase ends, hydrocarbon gases then in the reservoir would be so diluted by inert gas that they would probably be uneconomic to recover.

C. Sell All Associated Gas and Inject Additional Water

1. Description

From the standpoint of sound engineering practices, some reservoirs are more suitable for water injection and some for gas injection. Thus, realistically, it may not be possible to inject water in lieu of gas and still conform to the provisions of PL 94-258. Notwithstanding this fact, under this alternative, the nonassociated gas and all associated gas would require marketing and about 300,000 B/D of additional water would be obtained from wells and injected; however, at the present time, the availability of injection water in the order of magnitude of 300,000 B/D has not been determined. Equipment changes would include: (1) new water production and water injection systems and new or refurbished injection wells to handle about 300,000 B/D; (2) deletion of gas injection compression equipment; (3) construction of a new interconnecting pipeline from the Reserve to a nearby gas utility company pipeline; and (4) construction of new gas treating and/or metering equipment. The gas to be sold would have a heating value of about 1,100 BTU per cubic foot.

2. Comparative Effects

In comparison with the proposed project, this alternative would provide air quality benefits since the use of gas as a fuel would generally replace more polluting utility fuels such as fuel oil and there would be elimination of the gas injection compressor emissions.

Using the gas as a fuel would yield benefits and detriments in air basins beyond the Reserve, as shown in the following table. Compressor emissions would either decrease or increase, depending on whether the additionally injected water is pumped electrically or using gas engines. Net results would range as shown in the following table.

Emissions Reductions Compared to Base Case

Pollutant	Range of Reductions			
	lbs/hour		Percentage	
	Min.	Max.	Min.	Max.
A. Using Gas as a Fuel				
THC	62	80	15	19
NO _x	(1270)*	9700	(105)	802
CO	290	360	280	340
SO ₂	717	9940	40,000	500,000
Particulates	0	1030	0	100,000
B. Compressor Emissions				
THC	(73)	175	(17)	41
NMHC	(12)	29	(16)	39
NO _x	(356)	562	(29)	46
CO	(27)	57	(26)	54
SO ₂	(0.53)	0.52	(29)	29

*Values in parentheses indicate an actual increase in emissions.

The higher levels of water production for injection would carry possible higher risks to other water supply aquifers and could adversely affect hydrocarbon production in the zones where water is withdrawn. Additional adverse short-term impacts would occur during construction of the new wells and gas pipeline, but this would be somewhat offset by reduced construction impacts due to elimination of gas injection compressors. Overall capital and operating costs would be lower, with corresponding

lower construction employment levels. After the oil production phase ends, the gas which then remained to be recovered from the reservoir would be reduced in quantity by the gas already sold. In addition, under some circumstances, a portion of the associated reservoir gas would be unrecoverable due to having been flooded out by injection water.

D. Inject Associated Gas Liquids and Gas (Unprocessed Field Gas)

1. Description

Under this alternative, separation and sale of most of the associated gas liquids would not occur and these gas liquids would be injected along with the associated gas. In this case, a total of about a million gallons per day of gas liquids would be diverted from sale and injected instead. Equipment changes would include: (1) construction of new gas processing and handling facilities for recovery of liquids would be postponed into the future for use during the blow-down phase (blow-down occurs after all recoverably oil has been produced and wells are used to produce gas); (2) gas injection and compression facilities would have to be expanded somewhat to handle the additional volume; and 3) additional interstage scrubbing and cooling facilities would have to be constructed to remove liquids prior to compression and injection.

2. Comparative Effects

In comparison with the proposed project, this alternative would be more detrimental from an air quality standpoint (at least during the oil production phase) since the deletion of gas liquids from sale (at this time) would probably mean the use of additional, more polluting utility fuels such as fuel oil. Using fuel oil in place of the gas liquids would yield primarily detriments (but some benefits) in air basins beyond the Reserve, as shown in the following table.

Emissions Reductions Compared to Base Case

Pollutant	Range of Reductions			
	lbs/hour		Percentage	
	Min.	Max.	Min.	Max.
THC	(21)*	(19)	(5.0)	(4.5)
NO _x	(2510)	326	(207)	27
CO	(93)	(89)	(89)	(85)
SO ₂	(2640)	(219)	(150,000)	(12,000)
Particulates	(268)	(1)	(27,000)	(100)

* Values in parentheses indicate an actual increase in emissions.

Injection compressor emissions would be slightly higher. Compressor emissions would increase by about 0.1% at the Reserve, with lbs/hour values as follows: THC: 0.3; NMHC: 0.04; NO_x: 0.9; CO: 0.09; and SO₂: 0.001. These detriments would, however, be offset by the elimination (at this time) of gas processing facility emissions and the possible benefits of increased oil and gas reserves available at a later time. An increase in gas reserves would occur since the fuel losses associated with processing of the gas would be reduced. The detriments associated with eliminating gas liquids from sale during oil production could have corresponding benefits in the future when gas liquids are sold after the oil production phase ceases and the gas is then recovered. Higher annual oil production rates could be achieved and there could be a corresponding reduction in the total duration of production. Overall capital and operating costs would be considerably lower during oil production with corresponding lower employment levels.

E. Changes Within the Proposed Project

1. Description

The proposed project calls for transportation of gas liquids from the Reserve by truck until completion of a system which would transport some of the liquid products by pipeline to the vicinity of Taft, where a rail spur and rail car loading facility would be constructed. Alternatives to this approach would be use of an all-truck transportation system or construction of the rail spur to a point within the NPR-1 boundaries.

a. All-Truck Transportation

Under this alternative, truck loading and transport only would be used to move the gas liquids. The construction and operation of the rail spur, rail car loading facility, and pipelines from the Reserve would not occur.

b. Rail Spur Within NPR-1 Boundaries

Under this alternative, a much longer rail spur would be constructed (4 to 6 miles) to a point within the NPR-1 boundaries. The spur would run from the Sunset Western line near Taft on land within the NPR-2 to within the southern boundary of the NPR-1 (Section 13B). Correspondingly shorter gas liquids pipelines would be required.

2. Comparative Effects

a. All-Truck Transportation

In comparison with the proposed project, this alternative

would continue a higher level of truck traffic (and associated emissions) for transporting gas liquids from the Reserve. Using trucks only for gas liquids transport would generally result in higher emissions, when compared with transport by a mix of trucks plus railroad cars, but depending on the model years of trucks involved and the specific type and size of railroad engines involved, certain conditions would yield lower emissions. The range of net results is as shown on the following table.

Emissions Reductions Compared to Base Case

Pollutant	Range of Reductions			
	lbs/hour		Percentage	
	Min.	Max.	Min.	Max.
THC	(5.3)*	1.9	(1.3)	4.5
NO _x	(21)	(14)	(1.7)	(1.2)
CO	(52)	(43)	(50)	(41)

*Values in parentheses indicate an actual increase in emissions.

All truck transportation would also entail a greater risk of accidents. As production of crude oil increases and continues, the amount of gas produced with the crude oil increases. Hence, with the passage of time, the quantity of liquid products can be expected to increase with a corresponding increase in truck traffic. Capital costs would be considerably lower, with corresponding lower employment. The adverse short-term construction impacts associated with the rail spur and pipeline would be eliminated.

b. Rail Spur Within NPR-1 Boundaries

In comparison with the proposed project, this alternative would require considerably higher capital costs with correspondingly higher construction employment levels. It is probable that the construction schedule would be longer and this would delay switch-over from the existing all-truck transport system to a mixed system of rail and truck transport. The adverse impacts of railroad trains (noise, air pollution emissions, and traffic disruption) would be increased. The increase in the length of railroad spur would result in higher air pollution emissions in lbs/hour, as follows: THC: 0.02 to 0.18; NO_x: 0.27 to 0.46; and CO: 0.06 to 0.19 (all values less than one percent of the base case).

F. Postponement of Action

1. Description

P.L. 94-258 directed that the Reserve be produced at MER in accordance with sound engineering practices, without detriment to the ultimate recovery of hydrocarbons. Therefore, postponement of action or delay in production at MER, would require a modification to current legislation. This alternative assumes that the ongoing development program, consisting of the drilling and completing of new wells and the construction of surface facilities needed to produce NPR-1 at MER, will continue to completion. Production, however, would be postponed by shutting in wells, mothballing the gas processing facilities, and reducing production to standby levels. MER production would be implemented, after a suitable startup period, at some future time.

2. Comparative Effects

Postponement would have little influence on most of the described effects of the proposed project and schedule. A primary effect, however, would be that the crude oil from the Reserve would not be delivered into the national supply during postponement.

If the project were postponed, the quality of the Kern County air affected by the project would at first improve (oxidant concentrations are expected to decrease until the 1980's). After the mid-1980's, concentrations would probably increase as population increases overcome the benefits of emission controls.

Any potential growth inducement from the project would be postponed until implementation.

G. No Action Alternative

1. Description

The no action alternative would require a revision in current legislation to eliminate the mandate to produce crude oil at MER. The implementation of this alternative assumes termination of construction and development activities, shutting in wells, shutting down the gas processing facility, and reassigning or terminating employees.

2. Comparative Effects

All potentially adverse and beneficial impacts that would be associated with the project would be eliminated with cancellation. In addition, the beneficial and adverse effects associated with existing activities would be eliminated. Existing impacts include air pollution

emissions, noise, traffic, spending for goods and services, and employment. In addition, Elk Hills crude oil would not be delivered into the national market at this time but would remain for future use.

H. No-Action Alternative: Mitigation Measures

1. Description

Other methods of increasing domestic petroleum production have been described and assessed for environmental impact by the Federal Energy Administration (FEA).^{*} The various methods have been shown by FEA as alternatives to currently legislated pricing incentives for increasing the supply of fossil fuels in the U.S. In this FEA document, a spectrum of pricing incentives have been examined and the potential affects on 1979 and 1985 crude oil production and demand have been delineated. The alternative methods are compared with pricing incentives with respect to oil production and demand effects and environmental impacts. These substitute petroleum production methods are briefly discussed below.

a. Immediate Decontrol of Crude Oil Prices

Current legislation precludes this action, but if it were done, the result would be an increased incentive for domestic crude oil production in the next few years. In 1979, the production increase could be in the range of 200,000 to 260,000 barrels per day (B/D). By 1985, however, the increase would be negligible, based on the current plan for deleting price controls. The increased production would occur primarily in California and the Gulf Coast.

^{*}Draft Environmental Impact Statement (DEIS) for the Cumulative Production/Consumption of the Crude Oil Price Incentive Rulemakings, Federal Energy Administration DES 77-7, August 1977.

b. Stepped-Up Federal Encouragement of Enhanced Oil Recovery

Enhanced oil recovery (EOR) techniques could yield increased petroleum production, but industry has not as yet made the investments in research and development (R&D) to prove such techniques. Federal funding of such R&D could favorably influence use of EOR to increase production.

Several EOR techniques have potential, but the steam injection projects appear to have the greatest potential. By 1979, such projects could contribute up to 300,000 B/D of additional oil in comparison to the case with no R&D funding. These projects could contribute 300,000 B/D and more from 1979 up to 1995 and beyond. This increased production would occur principally in California.

c. Speed-Up of Federal Leasing

Federal leasing of Outer Continental Shelf (OSC) lands for petroleum production requires a lengthy process. Domestic production could be increased if a means were found to accelerate the rate of leasing. It is unlikely, however, that any such increases could be achieved by 1979-81 and only minor increases could be realized by 1985. No specific quantification of increases possible have been made at this time.

2. Comparative Effects

a. Immediate Decontrol of Crude Oil Prices

Decontrol could provide a comparable increase in petroleum production by 1979, but by 1985 it would provide a negligible increase, whereas NPR-1 could still be producing significant quantities of crude oil.

Decontrol would produce higher levels of air pollution emissions. Specifically, hydrocarbon emissions would be higher than the comparable NPR-1 case by from 422 to 1705 lbs/hr (100 to 404%). Localized problems in showing a net emission reduction would, therefore, be greatly aggravated.

Some of the production technologies which decontrol would stimulate use significantly higher quantities of water than would be used at NPR-1. Specifically, steam injection uses about 5 barrels of water for every barrel of oil produced. In addition, the water used must be of higher quality. The local problems of obtaining sufficient high-quality water for such use could be substantial.

b. Stepped-Up Federal Encouragement of
Enhanced Oil Recovery

Federal funding of R&D for EOR techniques could provide increased petroleum production comparable to NPR-1 from 1979 up to 1995 and beyond.

Steam injection projects in California with production levels comparable to the NPR-1 level would yield significantly higher air pollution emissions for oxides of nitrogen - 9300 lbs/hr (800%), sulfur dioxide - 23,600 lbs/hr (22,000%), and particulates - 1730 lbs/hr (96,000%). Specific local problems could be encountered with respect to particulate and sulfur dioxide emissions in attainment or non-attainment areas. Emission offset programs may be required.

c. Speed-Up of Federal Leasing

Speeded-up leasing of OCS lands would probably not provide increased petroleum production comparable to NPR-1 until some time beyond 1985. This alternative would, therefore, be similar to a postponed or deferred project at NPR-1.

In general, production of crude oil from OCS areas would have similar impacts as an onshore facility, with the addition of the increased risks due to oil spills at sea.

I. New Technology Alternatives

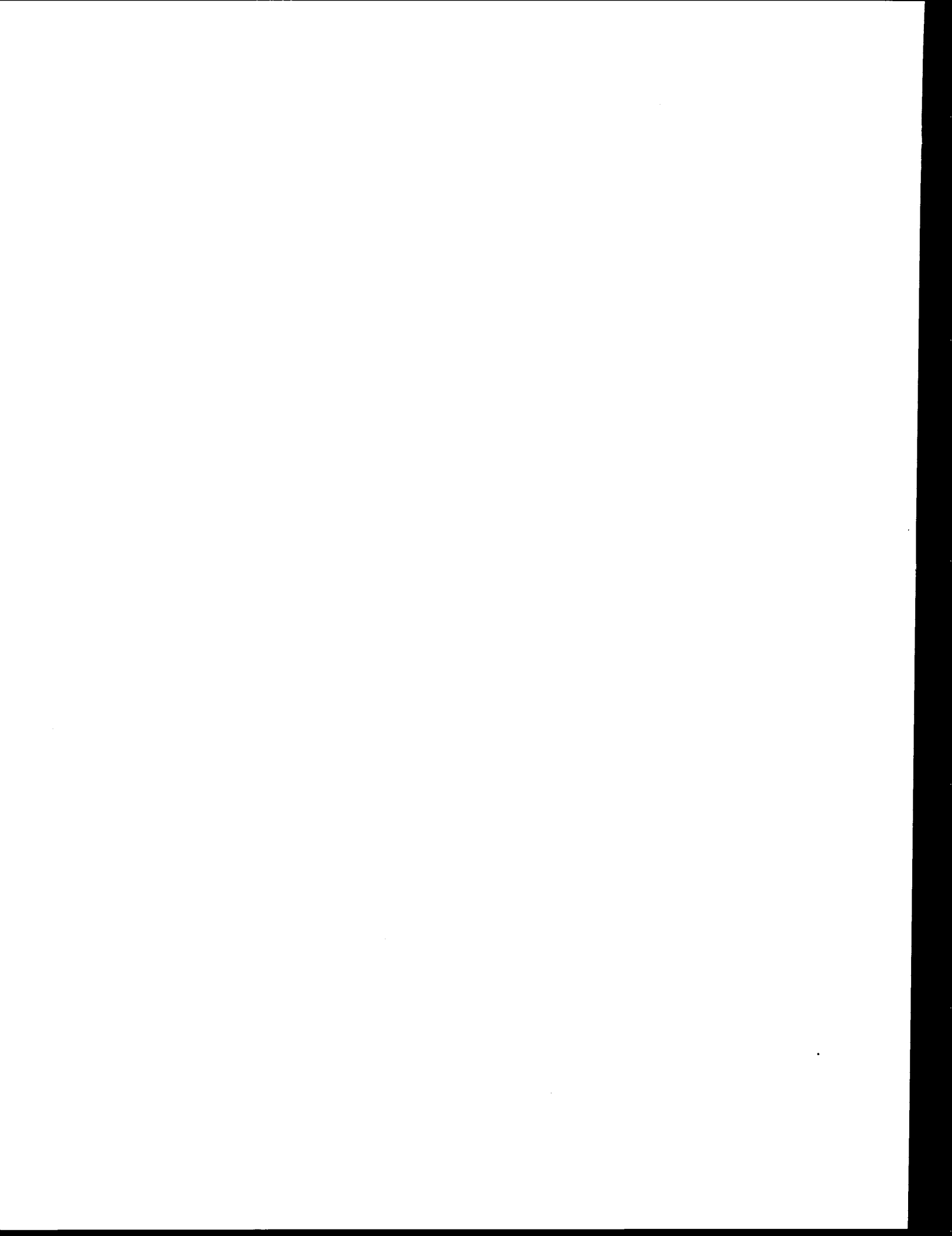
1. Description

This alternative is similar to the no action alternative in that the mandate to produce crude oil at Elk Hills at MER would have to be revoked. The anticipated gap in meeting projected domestic energy needs, however, would be filled by new technology energy sources, primarily solar, geothermal, wind, and synthetic fuel sources. The federal government, acting through the Department of Energy, is sponsoring research, development, and demonstration projects to develop new sources of energy supply which may be substituted for traditional fossil fuels. Energy conservation is also receiving much more attention as a method to reduce reliance on fossil fuels, although to date, voluntary conservation programs have not had a significant impact on domestic energy consumption. Given the present state of technology, the widespread application of new technology sources cannot be expected to occur for at least 10 to 20 years. The actual timing and rate of implementation of these alternative energy sources will be directly influenced by the effectiveness of conservation programs, the international price of oil, discovery of new domestic and international oil fields, and the success of ongoing federal and private research, development, and demonstration programs.

2. Comparative Effects

As in the case of the no action alternatives above, all impacts associated with increased production of NPR-1, both beneficial and adverse, would be avoided if new technologies were substituted for

crude oil as an energy source. As also indicated above, however, the present state of technology does not allow for widespread application of solar, geothermal, wind, and synthetic fuel sources for at least 10 to 20 years. Domestic energy consumption is continuing to grow at a more rapid rate than increased production at Elk Hills could fill. To curtail domestic oil production now, therefore, in favor of new energy sources, would result in increased imports of foreign oil or energy shortages until the widespread use of alternative sources becomes technologically and economically feasible.



VI. ANY PROBABLE ADVERSE ENVIRONMENTAL
EFFECTS WHICH CANNOT BE AVOIDED
SHOULD PROPOSAL BE IMPLEMENTED

The proposed project will create certain unavoidable adverse impacts during operation activities. Unavoidable adverse impacts largely involve air pollution emissions, losses of vegetation and wildlife, and truck traffic.

A significant increase in nitrogen oxide (NO_x) emissions will result from the project. Hydrocarbon emissions will also increase during most of the project period, but an emissions offset program will be instituted to achieve the net hydrocarbon emissions reduction required to attain and maintain the National Ambient Air Quality Standard for oxidants.

Direct removal and destruction of vegetation will occur in construction areas. Most of the disturbed area will partially recover, although the value of the restored habitat will not be equivalent to that of the original. Increased traffic due to the project will result in increased roadkills of wildlife and these increased roadkills could include the rare and endangered animal species -- the San Joaquin kit fox and the blunt-nosed leopard lizard.

The project will also result in increased risks to the human population, primarily to employees at the site.

Transportation of gas liquids from the gas processing plants will result in significant increases in truck traffic even after the new railroad car loading facility is completed. The adverse impacts of

air pollution emissions, noise, traffic disruption, and animal roadkills associated with truck traffic will continue.

VII. RELATIONSHIP BETWEEN LOCAL SHORT-TERM
USE OF MAN'S ENVIRONMENT AND
MAINTENANCE AND ENHANCEMENT OF
LONG-TERM PRODUCTIVITY

The short-term uses of the environment largely involve the vegetation losses at construction sites, temporary increased truck traffic, and use of the produced petroleum and gas liquids now rather than in the future.

As indicated in Section VI, partial recovery of vegetation losses will occur for most areas impacted, although the restored habitat will not be equivalent to that of the original vegetational communities. If the project were postponed into the future, similar losses and recovery would occur.

The adverse impacts of increased truck traffic will occur even after the railroad tank car loading capability is installed. Offsetting these adverse impacts will be the beneficial effects of using the delivered gas liquids, which presumably will replace more polluting fuel oil.

If unprocessed field gas were injected at this time, a reduced quantity of the gas liquids could be produced at the end of petroleum production. Air quality benefits from use of gas liquids could be more important at a later date.

VIII. ANY IRREVERSIBLE AND IRRETRIEVABLE
COMMITMENTS OF RESOURCES THAT
WOULD BE INVOLVED IN THE PROPOSED
ACTION IF IMPLEMENTED

Two major commitments of resources would be created by the proposed project: (1) the energy (i.e., electricity and fuels) consumed by construction and operation of production activities; and (2) the fossil fuels themselves as obtained and sold from the Elk Hills Reserve in the manner and schedule proposed. Energy consumption would include energy used for ultimate recovery of reservoir gas after oil production stops and eventual salvage of the system's facilities. A portion of the equipment and materials used in fabrication and assembly of project facilities would not be lost, since the equipment would generally have some salvage value even after long years of use.

Commitment of the fossil fuels to sale would render them irretrievable for use in the future. This applies to the petroleum and gas liquids planned for sale throughout the operating period. The associated gas would be injected and recovered at the end of petroleum production. The initial commitment designated by P.L. 94-258 is for a 6-year production period. After this time the President may extend production by additional periods of up to 3 years each.



IX. CONSIDERATIONS THAT OFFSET ADVERSE ENVIRONMENTAL EFFECTS

The beneficial effects from this project consist of achieving increased domestic petroleum production, increased employment, and economic activity.

The project alternatives of selling all or a portion of the associated gas in addition to the crude oil and gas liquids would achieve some additional air quality benefits in the short term, but these benefits are ones which would have to be subsequently given up since the associated gas would not be available after petroleum production ceases.

The no project alternative would eliminate all beneficial and adverse impacts described as resulting from the proposed project. In addition, the impacts associated with ongoing development activities (employment and adverse air pollution emissions) would also be deleted.



X. PUBLIC HEARINGS

A. Introduction

Public hearings to receive comments and answer questions relating to the Draft Environmental Impact Statement for petroleum production at NPR-1 at the maximum efficient rate were conducted during the afternoon and evening of August 1, 1978 at the City Council Chambers, 1501 Truxton Avenue, in Bakersfield, California.

A notice announcing the availability of the DEIS and the time and place of the public hearing was published in the Federal Register on June 23, 1978. Press releases announcing the public hearings were also distributed to the local news media in advance of the hearings.

The hearings were conducted by a three member Presiding Board comprised of Mr. John B. Farmakides, chairman, Board of Contracts Appeal, Department of Energy; Dr. Richard F. Hill, Executive Manager, Engineering Societies Commission on Energy; Dr. Philip Gustavson, Director of Environmental Impact Studies, Argonne National Laboratory.

A technical panel consisted of Commander Roger Martin, Officer in Charge, Naval Petroleum Reserves in California; Mr. Joseph Lagler, Field Projects Manager, Naval Petroleum Reserves in California; Mr. Peter Antonelli, Director of Crude Oil Supply and Allocation Division, Economic Regulatory Administration, Department of Energy; Mr. Richard T. Russell, Engineer-in-Charge of EIS Contracts, U.S. Naval Facilities Engineering Command; and Mr. William Van Horn, URS Company, EIS contractor.

A transcript of the hearing was made and is available for public review at the offices of the Director, Naval Petroleum and Oil Shale Reserves, Department of Energy, Washington, D.C. and the offices of the Officer in Charge of Construction, U.S. Naval Facilities Engineering Command, San Bruno, California. In addition, the Presiding Board has prepared its report, identifying unresolved issues raised at the public hearing which are deemed critical to the Board and presenting the recommendations of the Board concerning the treatment of these issues in the final environmental impact statement in a manner which will promote informed decision making. The full text of the Board Report is included later in this section.

The following is a summary of the public hearings, focusing on the issues raised by speakers addressing the Board. Where appropriate, responses to the comments of the speakers are included. Staff presentations on the proposed operations and scope of the project are not included in detail since this subject matter is fully covered in the DEIS and FEIS. Following the hearing summary are copies of letters submitted in response to Board requests and the report of the Presiding Board.

The following speakers addressed the Board:

1. Mr. Stephen Wright, City Manager, City of Taft
2. Mr. Melvin Krause, Kern County Planning Department
3. Mr. William T. Houghton, Coordinator of Strategic Planning, Chevron, U.S.A.
4. Mr. Stephen J. Pehanich, Assistant Vice President, California Independent Producers Association
5. Mr. John Bergquist, Senior Supply Planning Engineer, Southern California Gas Company
6. Mr. Keith Birdswell, Manager of Supply, Beacon Oil Company
7. Mr. John Zaletel, Bakersfield, California

B. Summary of Hearings

1. Introductory Statements

Chairman Farmakides opened the afternoon session of the public hearings at 2:00 p.m. by welcoming those present and explaining the purpose of the hearings. This was to identify issues unresolved in the draft environmental impact statement. He stated that notice of the public hearing had been published in the Federal Register in June, 1978, and that the hearing would be legislative and not adjudicatory. That is, formal procedures such as cross-examination, discovery, and testimony under oath would not be followed, and that questions could be asked of staff by participants and the Board, and of participants by staff and the Board. A record of the procedures would be available through the public doctrine rules of the Department of Energy as noted in the Federal Register. Mr. Farmakides then introduced the other board members.

Commander Martin then introduced the other members of the technical panel and gave a slide presentation on the Elk Hills production project, covering the following: role of the Department of Energy; the background of the reserve; the ownership pattern and involvement of Chevron, U.S.A. in the production activities; operational organization; production and exploration zones; current production; disposition of crude oils; developmental activities associated with increased production (including about 700 new wells, two new gas plants, tank settings, pipelines, railroad siding); development schedule and projected production.

Mr. Russell then gave a presentation on the environmental impact statement. Mr. Russell reviewed the Congressional authorization for development and exploration in 1974; the preparation of two candidate environmental impact assessments (one assuming production of 160,000 barrels of oil per day (BOPD) for one year, and the second assuming

production at 400,000 BOPD); determination by the Navy's Environmental Impact Statement Review Panel that neither represented a major Federal action; the authorization in December 1976 by that panel to assume production at 160,000 BOPD for two years rather than one; and the purpose of the draft environmental impact statement under consideration which is the construction and operations of facilities necessary for production at the maximum efficient rate, estimated at 260,000 BOPD initially and gradually tapering off.

2. Mr. Stephen Wright, City Manager of Taft

The City of Taft supports the project, but is concerned that the question of socioeconomic impacts on the City are not adequately addressed in the DEIS. It is erroneous to assume, as the DEIS did, that all the growth stemming from the project will occur in the Bakersfield area. In addition, some of the building data used in the analysis are out of date. The mitigation measures mentioned in the report are inadequate. The federal government should assist in the mitigation of impacts, which will be substantial for the City of Taft.

RESPONSE:

The building data in the report has been updated to reflect more current data. The City has engaged a planning consultant to assess the impacts which increased oil production will have on the City of Taft. See responses to Mr. Wright's letter in Section XI.

3. Mr. Melvin Krause, Kern County Planning Department

Written comments have been submitted and included in Section XI of this FEIS. He summarized the comments orally.

RESPONSE:

See Kern County Planning Department letter and responses in Section XI.

4. Mr. William T. Houghton, Chevron, U.S.A.

I would like to focus on one question: will increased production of Elk Hills crude result in a net increase in domestic production? The Department of Energy wants to maximize domestic crude production and in doing so, reduce the national balance of payments deficit. We believe Elk Hills production will result in a net increase in domestic oil production by displacing some of the high sulfur foreign crudes imported to the West Coast. Chevron U.S.A. projections indicate imports of high sulfur crude declining 5 last year to 250,000-300,000 barrels per day in 1985. Increased production may result in more Alaskan crude being shipped through the Panama Canal. However, the effect will still be to reduce imports. The DEIS, relying on a study by the Pace Company, states that increased production at Elk Hills may result in curtailment of other California crude oil production. We do not believe this is a correct interpretation of the Pace study. The study expects price pressure to result from Elk Hills production but not decreased production. This should be studied further.

A second point to consider is that light Elk Hills crude may serve as a diluent and facilitate the movement of other San Joaquin Valley heavy crudes through updated pipelines. A range measure is two barrels of Stevens Zone crude with one barrel of San Joaquin crude. (Mr. Houghton was requested by Board members to submit supporting data on this matter. See Mr. Houghton's letter which is included in Section X.C.)

RESPONSE:

The Pace Study has been reevaluated in light of more recent data concerning the disposition of Alaska North Slope crude oil production. Appendix P and other relevant portions of the DEIS have been revised to reflect the new analysis of the impact of Elk Hills production on West Coast oil supplies.

5. Mr. Stephen J. Petanich, California Independent Producers Association

Independent producers in California and especially in the San Joaquin Valley, have been and will continue to be adversely affected economically by increased Elk Hills production. The C.I.P.A. Board of Directors adopted a policy statement that "Elk Hills production should be partially curtailed in accordance with good reservoir and engineering practices until adequate entitlement adjustments are made by the Department of Energy to eliminate Elk Hills price advantages. Once these adjustments are made, Elk Hills production may proceed at maximum efficient rates."

In addition, the emissions of nitrogen oxides from the Naval Petroleum Reserve should be carefully studied and evaluated. Emissions trade off possibilities in the San Joaquin Valley are limited, and Elk Hills emissions should not be exempted.

RESPONSE:

The entitlements program is under continuous evaluation by the Department of Energy. Changes have been made to the program to provide further entitlement relief for heavy California crude oil and to provide economic incentives for transporting California crude oil to Gulf Coast, East Coast, and other domestic refineries.

6. Mr. John Bergquist, Southern California Gas Company

Southern California Gas Company is the largest single gas distribution utility in the United States, serving an area of 13 million. We would be interested in any sale of natural gas from Elk Hills, as discussed in Alternatives A, B, and C in the DEIS. Under Alternatives A, B, or C, new facilities would be required to convey the gas at estimated costs of \$1 million, 13 million, and 14.5 million, respectively. This gas would be of considerable benefit to SoCal's customers, particularly during the next 3 to 4 years. However, a definite commitment as to availability of this supply would have to be made before SoCal could undertake to install the required facilities. We would like to suggest two other alternatives concerning possible gas sales: (1) a modified peaking supply arrangement, whereby SoCal would call for specific, limited quantities during winter months to meet the requirements of its high priority customers; and (2) sale of Elk Hills gas as a contingency supply to serve as a backup for proposed LNG imports. Under either of the above arrangements, SoCal could repay the quantities received plus a bonus.

RESPONSE:

The Government has conducted an economic analysis of the sale of natural gas and found the current method of operation to yield the greatest amount of petroleum reserves.

7. Mr. Keith Birdswell, Beacon Oil Company

Beacon Oil Company is a small independent refiner located in Hanford, California. Our refinery runs 12,000 barrels of San Joaquin crudes per day, of which more than 50% are Elk Hills crude. The conclusions in the DEIS concerning the impact of increased production at Elk Hills on the West Coast oil supply situation are not up to date. To my knowledge, no California crude production has been shut in as a result of Elk Hills production, and little, if any, Alaskan North Slope production has been displaced. This is due to the superior quality and environmental acceptability of Elk Hills crude. About 400,000 to 500,000 barrels per day of North Slope crude have to be shipped to Gulf and East coasts due mainly to environmental reasons. This causes an added expense, but this oil is consumed in the U.S. and displaces foreign oil. This benefits the international balance of payments problem. Neither Beacon Oil Company or the Independent Refiners Association has seen any evidence that Elk Hills production has been directly responsible for any shut-in California oil production.

RESPONSE:

Text references to such shut-in California production have been deleted.

The evening session of the public hearings was called to order in the Bakersfield City Council Chambers at 7:05 p.m. The presentations made during the morning session were repeated for the benefit of the new audience. Following the presentations, members of the Presiding Board were given an opportunity to ask questions.

8. Questions by Board Members

Dr. Hill: How long before the field is depleted, assuming production at MER?

CDR. Martin: Approximately 30 years, starting in 1976.

Dr. Hill: What is the relationship of Elk Hills production with the Strategic Reserve Program? Could Elk Hills production be reduced to allow it to serve as part of the Strategic Reserve?*

CDR. Martin: The Naval Petroleum Reserves Production Act of 1976 authorizes the President to move Elk Hills crude to the strategic petroleum reserve or to exchange Elk Hills crude for comparable crudes to place in the strategic reserves.

*This issue was addressed by George McIsaac, Assistant Secretary of the Department of Energy for Resource Applications, in an interview published in the August 21, 1978 issue of the Energy Insider, a DOE newsletter. According to McIsaac, a strategic reserve must be able to produce a large quantity of oil and move it quickly to areas of need, predominantly the Midwest and Northeast areas of the country. Elk Hills could not serve as a strategic reserve because the 240,000 barrels of oil per day it will provide would be a small fraction of the oil that would be lost in another embargo situation (the U.S. imports about 8 million barrels of oil per day), and there is no way to move Elk Hills crude quickly to where it will be needed most.

Dr. Hill: Could the air quality impacts associated with the alternatives discussed in the DEIS be quantified?

Mr. Russell: Yes. The FEIS will be amended to include this information.

Dr. Hill: Under Alternative C, is the question concerning the availability of injection water a serious constraint?

CDR. Martin: We have initiated a pilot program to determine the susceptibility of some of the reservoirs to water flooding. We are also conducting an exploratory program to test the saline water formations at Elk Hills, but it will be at least six months before any meaningful data are available.

Dr. Gustavson: Is there any way to economically reduce the nitrogen oxides emissions associated with this project?

Mr. Russell: We are looking into this issue in conjunction with EPA. The technology for controlling nitrogen oxides is just developing and we are looking into these alternatives. EPA has to approve the New Source Review Application.

Dr. Gustavson: What is the economic impact of nitrogen oxides emissions on agriculture?

Mr. Russell: This is a very difficult issue which is still under investigation. The Kern County Air Pollution Control District, which has to approve our permit, has indicated

they are interested in nitrogen oxides emissions to the extent that the nitrogen dioxide standards are met. The air quality aspects of this project are addressed in three processes: the environmental impact report which we are discussing today, the New Source Review Application, which is approved by EPA, and a permit for authority to construct and operate the facility, which is filed with the Kern County Air Pollution Control District.

9. Mr. John Zaletel

Has the level of hydrocarbons and nitrogen oxides present at Elk Hills prior to increased production increased? Is there ongoing air quality monitoring?

RESPONSE:

The Kern County Air Pollution Control district has been monitoring air quality levels in the Elk Hills areas for several years. Historical and recent air quality information is presented in Appendix H.

Following Mr. Zaletel's questions, the hearings were adjourned.

C. Letters Requested at Public Hearings

During the course of the public hearings, two speakers were requested by the Presiding Board to submit further information, which would be incorporated into the public record. Mr. William T. Houghton was asked to submit information substantiating the ratio of light Elk Hills crude used as a diluent in combination with San Joaquin Valley heavy crudes to facilitate their movement through unheated pipelines. Mr. Peter Antonelli was asked to submit information on the disposition of Alaskan crude oil.

The two letters submitted in response to these requests are included in this section.



Chevron U.S.A. Inc.

575 Market Street, San Francisco, CA 94105

August 10, 1978

Planning and Analysis

R. R. Bowles

General Manager

J. W. Dewes

Manager, Business Planning

J. J. Motroni

Manager, Operations Planning

Officer in Charge of Construction
Naval Facilities Engineering
Command Contracts, Elk Hills
San Bruno, California 94066

Dear Sir:

At the August 1, 1978 hearing held in Bakersfield, Chevron U.S.A. provided comments on the Draft Environmental Impact Statement regarding the production of Elk Hills crude at the maximum efficient rate.

Following our prepared statement, Chairman Farmakidis asked a question related to the pipeline diluent benefits of Elk Hills Stevens Zone crude. At that time we responded that a rough rule of thumb suggested that each additional two barrels of Elk Hills Stevens crude would allow an additional one barrel of San Joaquin Valley heavy crude to be moved through an unheated pipeline.

Our basis for the above rule of thumb is the following:

- Chevron U.S.A. currently moves Elk Hills Shallow Zone crude through our unheated pipeline, without the presence of a lighter crude as diluent.
- A mixture of 60% Elk Hills Stevens crude and 40% San Joaquin Valley heavy crude would have the same viscosity as Shallow Zone crude. Therefore, such a mixture can be moved economically through an unheated pipeline. (Our rough 2:1 rule of thumb is slightly more conservative than the 2:1.3 ratio suggested here.) Our calculations are attached.

We trust that the foregoing will prove useful.

W. T. HOUGHTON

Coordinator, Strategic Planning

WTH:mcw

Attachment

TABLE I

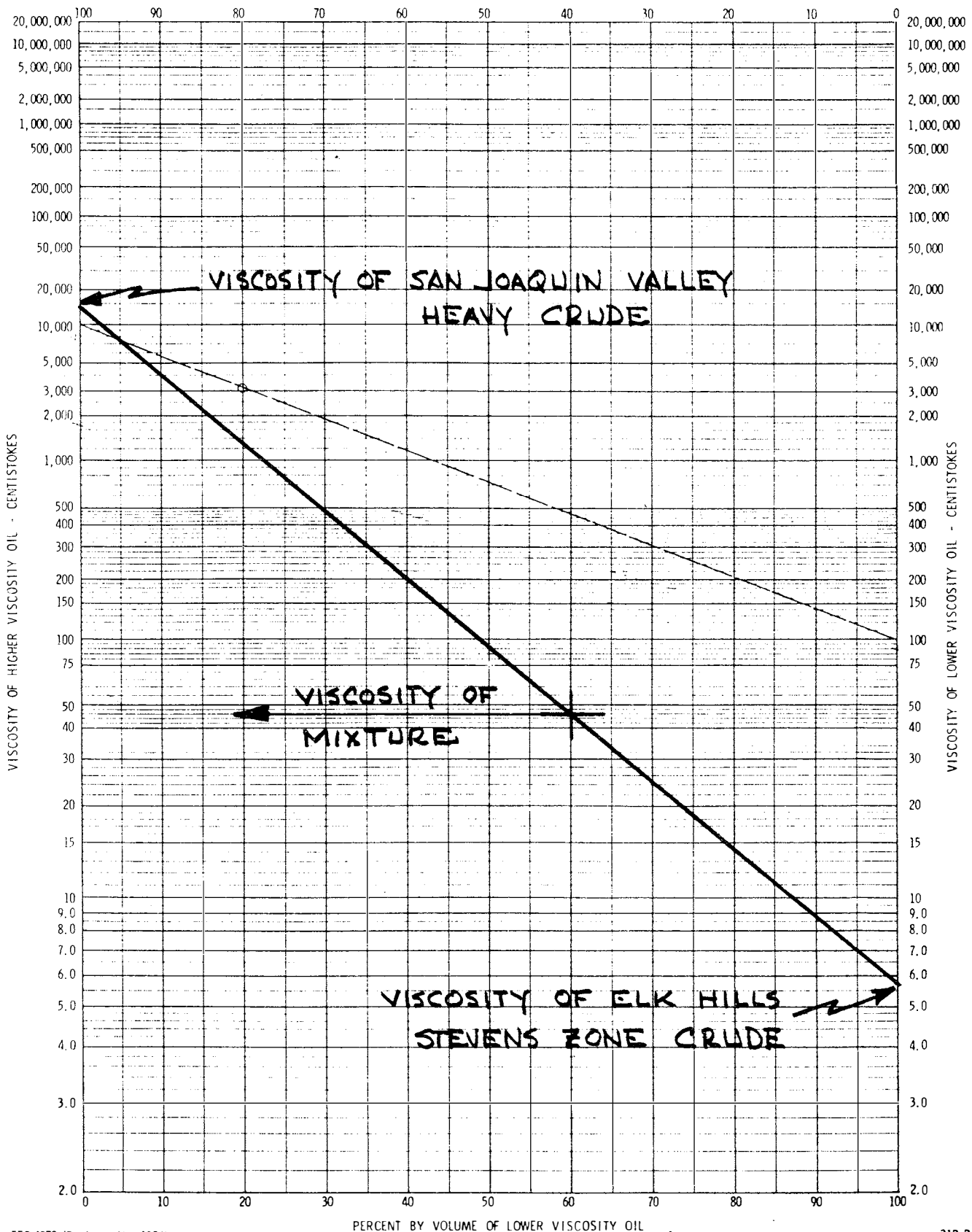
MIXTURE OF HEAVY CRUDE OIL
AND
ELK HILLS STEVENS ZONE CRUDE

<u>Crude</u>	<u>Gravity °API</u>	<u>Viscosity Centistokes At 60° F.</u>
Elk Hills Stevens Zone	36	5.7
Elk Hills Shallow Zone	25	45
San Joaquin Valley Heavy	14	14,000

8/10/78

VISCOSITY BLENDING CHART

PERCENT BY VOLUME OF HIGHER VISCOSITY OIL





Department of Energy
Washington, D.C. 20461

AUG 10 1978

MEMORANDUM FOR JOHN B. FARMAKIDES
CHAIRMAN, COMMITTEES AND BOARDS

FROM: PETER A. ANTONELLI *P.A.*
OFFICE OF FUELS REGULATION, ERA

SUBJECT: DISPOSITION OF ALASKAN NORTH SLOPE CRUDE OIL

During the public hearing concerning Naval Petroleum Reserve #1 (Elk Hills) on August 1, 1978, Dr. Richard F. Hill requested that I furnish for the public record certain specific information concerning the disposition of Alaskan North Slope Crude Oil (ANS). The chart below shows the destination of ANS crude oil for the period January through May 1978. As can be seen in the chart, as the shipments of ANS crude oil increase the refinery receipts into PAD I through IV also increase.

Domestic Refinery Receipts of
Alaskan North Slope Crude Oil
(MB/D)

	<u>Total ANS</u> <u>Crude</u>	<u>PAD V</u> <u>Receipts</u> (ex Calif.)	<u>California</u> <u>Receipts</u>	<u>PAD I-IV</u> <u>Receipts</u>
1978				
January	668	202	308	158
February	717	199	335	183
March	837	193	360	284
April	923	215	376	332
May	1,186	198	490	498

Source: DOE Entitlements Program Reporting Form ERA-49

cc:

CDR Roger Martin
Officer in Charge
Naval Petroleum Reserves
in California

Mr. Richard Russell ✓
Engineer-in-Charge of EIS Contracts
Officer in Charge of Construction,
Elk Hills

D. Report of the Presiding Board

Following the public hearings, the Presiding Board prepared a report based upon its review of the draft environmental impact statement and the hearing record. The Board's report identifies those unresolved issues raised at the hearings which the Board deemed to be critical to future decisions concerning the operations and presents the Board's recommendations for the treatment of these issues in the final environmental impact statement in a manner which will promote informed decision-making. The Board does not, however, attempt to resolve those remaining issues or to render judgements concerning the operations of the Elk Hills petroleum reserve.

The full text of the Board's report follows.



Department of Energy
Washington, D.C. 20545

September 11, 1978

Mrs. Ruth Clusen
Assistant Secretary for Environment
Department of Energy
Washington, D.C. 20545

Dear Mrs. Clusen:

Consistent with notice of hearing issued on Friday, June 23, 1978 (43 F.R. 27230) public hearings were held on the Draft Environmental Impact Statement "Petroleum Production at Maximum Efficient Rate, Naval Petroleum Reserve No. 1 (Elk Hills) Kern County, California", DOE/EIS-0012-D, on August 1, 1978. The hearings were conducted by the undersigned Presiding Board in conformance with the procedures set forth in the notice.

Following review of the Draft Environmental Impact Statement and of the record compiled, the Board has identified some issues which may be critical to future decision making. The attached report sets forth these issues as well as the Board's recommendations concerning their treatment in the final impact statement.

In addition, the Board has compiled a record of the hearings, consisting of the transcripts, and the written statements, documents and exhibits submitted by private persons, organizations and Government agencies, including the written comments submitted after the close of the hearings in response to Board request. In accordance with the notice, this hearing record and the Board's report is being transmitted to the Department's public document rooms.

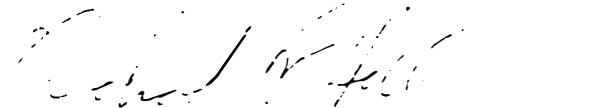
Further, in accordance with the notice of hearing and the mandate to this Board, this report is limited to those unresolved issues relating to DOE/EIS-0012-D which the Board determined critical to future decision making regarding

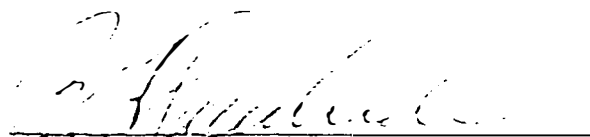
MER production at Elk Hills Petroleum Reserve. This Board has neither undertaken to resolve the issues raised nor to render judgements concerning such issues. We trust, however, that their identification and our recommendations on how that should be addressed will assist the decision making process.

Respectfully,

THE PRESIDING BOARD


Philip F. Gustafson


Richard F. Hill


John B. Farmakides

Enclosure:
AS stated

CODE	INIT	DATE
H40	B	7/2
H41		

STATEMENT
IDENTIFYING VIEWS AND ISSUES ON
THE DRAFT ENVIRONMENTAL IMPACT STATEMENT
NAVAL PETROLEUM RESERVE NO. 1, DOE/EIS-0012-D
by the
PRESIDING BOARD
September 11, 1978

I. Introduction

The notice of hearing issued June 23, 1978, 43 Fed. Reg. 27230, provided that a public hearing would be held on August 1, 1978, in connection with the Draft Environmental Impact Statement, DOE/EIS-0012-D (DEIS) on the Petroleum Production At Maximum Efficient Rate, Naval Petroleum Reserve No. 1, (Elk Hills), Kern County, California. The hearings were held in the afternoon and evening in Bakersfield, California in accordance with the notice and were conducted by the Presiding Board (Board) established for this proceeding in accordance with the rules of procedure set forth in the notice.

Comments received on the DEIS were not extensive, only seven statements were made by individual citizens, local government agencies and private organizations.^{1/} The Board has reviewed

^{1/} W.T.Houghton, Coordinator of Strategic Planning, Chevron, U.S.A, Inc.; Stephen J. Pehanich, Asst. V.Pres., Calif. Independent Producers Assoc.; Stephen L. Wright, City Mgr., City of Taft, Calif.; Melvin Krause, Asst. Planner, Kern County Air Pollution Control District; John F. Bergquist, Sr. Supply Planning Engr., Southern Calif. Gas Co.; Keith Bridwell, Mgr. of Supply, Beacon Oil Co.; John Zaletel, Bakersfield, Calif., private citizen

the impact statement in light of the comments made, including the responses to the comments submitted by the technical staff convened for this hearing.^{2/}

In accordance with the notice of hearing, the Board has identified only those issues which it considered to be critical to future decision making involving the MER production at the Naval Petroleum Reserve. In identifying these issues the Presiding Board does not presume to judge their merits and does not undertake to render judgement concerning the course of the operation. This report, along with copies of the transcript, oral and written comments submitted to the Board at the hearing, and the list of exhibits attached hereto (Appendix A, including information and documentation submitted by the staff to questions raised) constitute the record of this public hearing. Concurrent with the submission of this report and record to the Assistant Secretary for Environment, Department of Energy (DOE), it is being sent to the Director, Office of NEPA Coordination for placement in the Department's public document rooms, and to the Officer In Charge Of Construction, Naval Facilities Engineering Command.

^{2/} CDR Roger Martin, Officer in Charge, Naval Petroleum Reserves in Calif.; Joseph Lagler, Field Project Mgr., Naval Petroleum Reserves in Calif.; Peter Antonelli, Dir. of Crude Oil Supply & Allocation Div., ERA, DOE; Richard Russell, Engineer-in-Charge of EIS Contracts, Officer in Charge of Construction, Elk Hills; William Van Horn, URS Company - EIS Contractor, San Mateo, Calif.

II Unresolved Issues

The one primary issue underlying several comments and statements made at the hearing relates to the discussion of alternatives in the DEIS affecting the need for producing yet more petroleum in a region which is identified as suffering from a "glut" of petroleum. A second issue raised by the local government agencies relates to the need, stemming from socio-economic impacts of MER production, for assistance in alleviating "boomtown" stress. A third issue relates to whether the discussion of air quality impact is adequate.

A. The first issue can be expressed in three questions:

1. "Whether production of crude oil from Elk Hills should be kept to a minimum because of an overabundance of crude oil in California."

This question in turn is composed of two parts: (a) is there such a large supply of crude oil that some wells are shut-in and some producers (especially small producers) are receiving low prices? (b) if the crude oil supply in California is excessive, would decreasing the supply of Elk Hills crude (because it is relatively light) cause an increase in other California production (generally much heavier) or cause an increase in imports?

Relative to the first part of the question, the DEIS states

(page p-2) that "(i)n the past year, Alaskan North Slope Oil, California offshore oil development, and beginning production at Elk Hills have created a surplus of crude oil in California" and then notes that "(p)resently there is no easy way to transport this (excess) oil" out of California.

Stephen J. Pehanich, Assistant Vice President of the California Independent Producers Association (CIPA), states that "(i)ndependent producers in California and especially in the San Joaquin Valley have been and will continue to be adversely affected by increased Elk Hills production" (TR I-50) and "(s)ome California producers in the San Joaquin Valley are still shut-in and some are receiving as much as \$1.00 below federal ceiling price levels" (TR I-51). However, Mr. Pehanich states that CIPA "does not place the entire blame on Elk Hills but rather sees it as a combination of unique California forces" (TR I-51).

However, William T. Houghton, Coordinator of Strategic Planning for Chevron, U.S.A., does not believe that there is a surplus of crude oil in California because the excess above California refining capacity is being shipped by tankers through the Panama Canal and tankers are available for any projected additional supplies in California (TR I-48). In addition, Keith Bridwell, Manager of Supply for Beacon Oil Company, states "no California crude oil has, to the best of our knowledge, been shut in because of Elk Hills," (TR II-8).

The crux of this part of the question may be in the CIPA survey data and "evidence of shut-in wells since the entitlements program", which was to be supplied for the hearing record by Mr. Pehanich (TR I-55). In any event, this subject should be discussed in greater detail in the Final Environmental Impact Statement (FEIS).

The second part of this question -- would decreasing the supply of Elk Hills crude cause an increase in other California production ? -- is controversial because of uncertainty as to the ability of California refineries to process the high sulfur crude from both Alaska and California and because of the uncertainty as to the need or desirability of light Elk Hills crude as a diluent to facilitate the movement of some San Joaquin Valley heavy crude through pipelines.

Mr. Bridwell points out that Alaskan North Slope crude averages 26/27 degrees API gravity with 1% sulfur and other California crude in typically 12 to 18 degrees API gravity with more than 1% sulfur whereas Elk Hills crude averages 31/32 degrees API gravity and about 1/2% sulfur. He concludes that because of its superior quality and environmental acceptability, Elk Hills crude "does not cause problems for California and North Slope crudes" (TR II-9). Mr. Houghton, however, compares Elk Hills crude to low

sulphur foreign crudes (Indonesian) and concludes that, because of the "very low sulfur" in Indonesian crudes, Elk Hills crude would first "replace some of the high sulfur foreign crudes" (TR I-37) and "incremental Elk Hills production will displace Alaskan North Slope crude" (TR I-38).

As to the diluent question, Mr. Houghton states that "light Elk Hills crude, acting as a diluent, presently facilitates the movement of some San Joaquin Valley heavy crude through unheated pipelines" and Chevron has developed "a rough yardstick" that "two barrels of Stevens zone crude will allow you to carry (one barrel of) heavy San Joaquin crude through (an) unheated pipeline" (TR I-40). However, Mr. Pehanich states that he is not "aware of Elk Hills oil being mixed with heavier oils from this area in the transportation of those oils outside of this region)" (TR I-57). Mr. Houghton agreed to supply additional information for the record on this matter (TR I-42, see Exhibit #2c). This issue should be discussed in the FEIS.

2. "Whether it would be better to develop the MER capability of Elk Hills but produce at a minimum level and keep Elk Hills as a part of the developing national Strategic Petroleum Reserve."

Mr. Peter Antonelli, Director of Crude Oil Supply and Allocation Division, Economic Regulatory Administration, Department of Energy, stated that the question "was raised before the strategic petroleum reserve people in Washington and I think

the most valid answer that they gave to that was that the type of oil they are contemplating putting into the reserve is of a different nature than the oil that is in the Elk Hills reserve, and they would have had to make major changes to their program in order to accommodate the quality of oil that is coming out of the Elk Hills reserve." This issue should be discussed in the FEIS.

3. "Whether operation of Elk Hills should be modified to supply available natural gas to the deficient California market now rather than reinjecting it for reservoir maintenance."

California, like the U.S. in general, is suffering from severe curtailments of natural gas (a deficiency of approximately 465 MMcf/day or 9% of total demand for California in 1976). John Bergquist, Senior Supply Planning Engineer for Southern California Gas Company, stated that "with the gas supply situation which currently exists in Southern California, any prospective sale of gas from Elk Hills Reserve becomes very important" (TR III-3) and "if it is decided that Elk Hills gas may be produced and sold, these new gas supply volumes would be of considerable benefit to SoCal's residential and industrial customers particularly during the next 3 to 4 years" (TR II-5).

Alternative in the DEIS to "sell all associated gas and inject additional water" would supply about 360 MMcf/D of gas to the California market (DEIS v-5). This alternative would supply some 77% of the 1976 curtailment.

This alternative would require water flooding of the oil reservoirs. Commander Martin stated that they have initiated a three well pilot water flood program at Elk Hills to determine the viability of water flooding at Elk Hills. The available results of this pilot program should be discussed in the final statement in terms of balancing the alternatives of gas and water injection.

B. The second issue relating to the question of "boomtown" stress was raised by Steven Wright, City Manager of Taft, California. He questioned the adequacy of the DEIS as to the discussion and evaluation of assistance, presumably federal assistance, needed by the City of Taft in meeting the socio-economic impact from the influx of workers and families. The number of new housing starts in Taft and those projected within the next 18 months should be addressed as an impact. Any increase in the size of Taft may require added services, such as police, fire, schools, hospitals, sewage, water, etc. Mechanisms available for assisting in coping with, or in providing financial assistance to meet such necessities should be explored and treated in the final statement.

In addition, due to the uncertainties of some of the effects of increased production at Elk Hills, Mr. Wright noted that the City of Taft may find itself with a number of new vacant houses, and plans and facilities to accommodate added population which would become unnecessary. It is this concern with the uncertainty of commitment towards accommodating increased population (including the financial risk) which local institutions may be unable to assume. This question applies to the other nearby communities as well, including, to a lesser extent, Bakersfield. This issue should be identified in the FES and such solutions or mitigative measures as may be possible should be described and discussed.

C. The issue of air quality was raised by Mr. Melvin Krause of the Kern County Planning Commission. He stressed the need to identify air quality impacts more quantitatively and, in his terms, more realistically than is currently being done in the statement. While the Board believes over-all that the DEIS addresses these issues satisfactorily, some areas could be meaningfully improved. Thus, the final statement should explore in greater detail the air quality impact within Kern County by using more current data on type and movement of traffic in the area, and from the impacts of drilling muds and other wastes generated by the operation of the Elk Hills facility. Mr. Krause noted that the

Planning Commission, meeting for purposes of establishing future compliance with air quality regulations, requires knowledge of all proposed activities in the county and, in the San Joaquin Valley, so that projections and shifts in air pollution allocation can be made on a sound basis. Thus, in order for Kern County to develop accurate air quality projections and plans for state and federal requirements, it is necessary that the impacts of MER production at Elk Hills be quantified to the maximum extent possible. This information should be included in the FEIS.

Another part of the air quality issue relates to the recognition and discussion of the tradeoff, regionally, between oil extraction from Elk Hills, refining of the oil in the region, and agricultural production in the surrounding valley. The effects of SO_2 on agricultural production are being documented from current research programs of DOE and EPA. Available results from such research should be included and evaluated relative to the effect on agriculture of increased SO_2 emissions from Elk Hills operating at MER. Although less information of any quantitative nature is available for other emissions to air from petroleum extraction and refining, a discussion of possible impacts seems appropriate; particularly of NO_x emissions which may increase significantly with increased production. The plan presented for air quality improvement in the future by the Elk Hills

operation indicates, even with increased production, a net improvement for hydrocarbons and SO₂ emissions, but clearly indicates a substantial increase in NO_x emissions with no mitigative measures proposed. It is recommended that the FEIS consider and discuss the possibility of cleaning up NO_x with present techniques or perhaps with some practical change in operating characteristics of the site.

The monitoring of hydrocarbons and other airborne effluents attributable to Elk Hills was raised as an issue by Mr. Zaletel. The present monitoring network and program emphasizes direct monitoring of residential areas rather than of the Elk Hills reserve itself. The discussion in the FEIS on this point should be augmented to clarify the decision to directly monitor residential areas in preference to the emission sources at Elk Hills.

APPENDIX A

DOE/EIS-0012-D
Public Hearing
August 1, 1978

Exhibits and Written Statements

Ex. #1	Briefing materials used at hearing by Commander Roger Martin, Officer in Charge of the Naval Petroleum Reserves in California	(Tr. 16, Vol. I)
#2 (a)	Statement by W. T. Houghton, Coordinator of Strategic Planning, Chevron, U.S.A. Inc. on the DEIS, August 1, 1978	(Tr. 19, Vol. I)
(b)	Copy ltr. to Sen. H. M. Jackson by Chevron, U.S.A. Inc. attaching Chevron's responses to the Committee on Energy and Natural Resources questionnaire pertaining to West Coast crude oil surplus	(Tr. 49, Vol. I)
(c)	Letter from W. T. Houghton, Chevron to Officer in Charge of Construction, Naval Facilities Engineering Command Contracts, Elk Hills	(Tr. 42, Vol. I)
#3	Testimony presented by Stephen J. Pehanich, Asst. V.Pres., Calif. Independent Producers Assoc., August 1, 1978	(Tr. 50, Vol. I)
#4	Comments in conjunction with testimony given at hearing by Stephen L. Wright, City Mgr., City of Taft, Calif.	(Tr. 19, 23, Vol. I)
#5	Comments in conjunction with testimony on DEIS by Melvin Krause, Asst. Planner, Kern County Air Pollution Control District, 7/24/78	(Tr. 28, Vol. I)
#6	Memorandum from Peter A. Antonelli Office of Fuels Regulation, ERA, furnishing chart of disposition of Alaskan North Slope crude oil, requested by Dr. Hill	(Tr. 35, Vol. I)

APPENDIX A (cont'd)

Ex. #7	Statement by John F. Bergquist, Senior Supply Planning Engineer, Southern Calif. Gas Co. (SOCAL)	(Tr. 1, Vol. II)
#8	Statement by Keith Bridwell, Mgr. of Supply, Beacon Oil Co., 8/1/78	(Tr. 1, Vol. II)
#9	Draft report "Identification of Existing Hydrocarbon Emissions and Potential as Candidates for Offsets - Crude Oil Transport and Production of Petroleum At Maximum Efficient Rate - Naval Petroleum Reserve No. 1 (Elk Hills), Kern County, Calif.", July 1978, submitted by Leo G. Bellarts, Jr., Dir., Pipeline Engineering, Dept. of the Navy, Elk Hills	

XI. COMMENTS TO DRAFT ENVIRONMENTAL IMPACT STATEMENT

A. Introduction

The Draft Environmental Impact Statement for Production at Maximum Efficient Rate at Naval Petroleum Reserve Number 1 was made available for public review during June 1978 and announced in the Federal Register on June 23, 1978. Copies of the report were distributed to numerous federal, state, and local agencies, to appropriate elected officials and public interest groups. In addition, copies were distributed to various public libraries in the vicinity of the Naval Petroleum Reserve and to libraries in San Francisco, Sacramento, and at the Department of Energy.

Letters commenting on the Draft report were received from 20 agencies at the federal, state and local levels of government. Included in this chapter will be copies of each letter received, followed by a section which summarizes the comments contained in each letter, with an appropriate response. The letters will be numbered 1 to 20 and the comments referenced by a letter in the margin.

B. Agencies, Organizations, and Individuals Who Submitted Written Comments to the Draft Environmental Impact Statement.

LETTER NUMBER

FEDERAL

1	Advisory Council on Historic Preservation
2	Department of Agriculture, Soil Conservation Service
3	Department of the Army, Sacramento District Corps of Engineers

LETTER
NUMBER

FEDERAL

- 4 Department of the Interior, Fish and Wildlife Service
- 5 Department of Transportation, U. S. Coast Guard
- 6 Environmental Protection Agency

STATE

- 7 and 7' The Resource Agency
- 8 Air Resources Board
- 9 Department of Conservation, Division of Oil and Gas
- 10 Department of Fish and Game
- 11 Department of Parks and Recreation
- 12 Energy Resources Conservation and Development
Commission
- 13 Solid Waste Management Board
- 14 State Lands Commission
- 15 State Water Resources Control Board
- 16 Business and Transportation Agency, Department of
Transportation

REGIONAL

- 16 Southern California Association of Governments

LOCAL

- 17 Kern County Air Pollution Control District
- 18 Kern County Planning Department
- 19 Natural History Museum, Los Angeles County
- 20 City of Taft
- 21 Mr. Kreines, consultant to city of Taft

C. Copies of Written Comments

Following are the written comments received on the Draft Environmental Impact Statement.

Advisory Council on
Historic Preservation
1522 K Street N.W.
Washington, D.C. 20005

August 1, 1978

Captain John Dick-Peddie
Office in Charge of Construction, Elk Hills
P. O. Box 40
San Bruno, California 94066

Dear Captain Dick-Peddie:

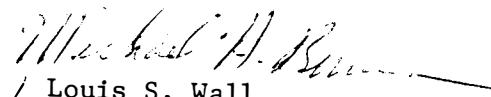
On July 3, 1978, the Council received and reviewed the draft environmental statement (DES) for the Petroleum Production at Maximum Efficient Rate, Naval Petroleum Reserve No. 1, Elk Hills, Kern County, California.

The Council notes from its review that while cultural resource studies to date indicate no properties included in or known to be eligible for inclusion in the National Register of Historic Places will be affected the possibility exists for previously unknown cultural resources to be identified during further project planning and/or construction. Accordingly, the Council wishes to remind the Department of Energy that should it subsequently be determined cultural properties included in or eligible for inclusion in the National Register will be affected by the undertaking, it is required to afford the Council an opportunity to comment pursuant to Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470f, as amended, 90 Stat. 1320), in accordance with the "Procedures for the Protection of Historic and Cultural Properties" (36 CFR Part 800).

a

Should you have any questions or require additional assistance in this matter, please contact Michael H. Bureman of the Council staff at P. O. Box 25085, Denver, Colorado 80225, or at (303) 234-4946, an FTS number.

Sincerely yours,


Louis S. Wall
Assistant Director, Office of
Review and Compliance, Denver

XI-3

The Council is an independent unit of the Executive Branch of the Federal Government charged by the Act of October 15, 1966 to advise the President and Congress in the field of Historic Preservation

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

2828 Chiles Road, Davis, CA 95616

2

August 23, 1978

Captain John Dick-Peddie
Office in Charge of Construction, Elk Hills
P. O. Box 40
San Bruno, California 94066

Dear Captain Dick-Peddie:

We acknowledge receipt of the draft environmental impact statement for Petroleum Production at Maximum Efficient Rate, Naval Petroleum Reserve No. 1 (Elk Hills), Kern County, California, that was addressed to Soil Conservation Service on June 15, 1978, for review and comment.

We have reviewed the above statement and have the following comments.

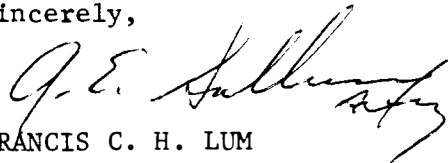
- 1) Provision for erosion control and water management during construction was not considered. We suggest that the proposed erosion control measures be included in the final EIS.
- 2) The EIS makes no mention of maintaining or improving natural drainage courses that may be traversed by pipelines and/or access roads. We suggest that consideration be given in the final EIS.
- 3) The amount of prime land to be lost or modified was not addressed since the location of future pipelines has not been determined. We suggest that the effects of alternative pipeline routes on prime lands be considered when selecting routes.
- 4) Provision for stockpiling or properly disposing of topsoil was not considered. We suggest provisions be made to stockpile the soil to be utilized later in the revegetation effort.

a

Other than those items mentioned above, we find no conflict with any Soil Conservation Service on-going or planned programs or projects.

We appreciate the opportunity to review and comment on this proposed project.

Sincerely,



FRANCIS C. H. LUM
State Conservationist

cc: R. M. Davis, Administrator, USDA, SCS, Washington, D. C. 20250
Director, Office of Federal Activities (Mail Code A-104),
Environmental Protection Agency, Room 537, West Tower,
401 M Street, S.W., Washington, D.C. 20460





DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
650 CAPITOL MALL
SACRAMENTO, CALIFORNIA 95814

3

REPLY TO
ATTENTION OF

SPKED-W

6 July 1978

Officer in Charge of Construction
Naval Facilities Engineering
Command Contracts
Elk Hills
San Bruno, California 94066

Dear Sir:

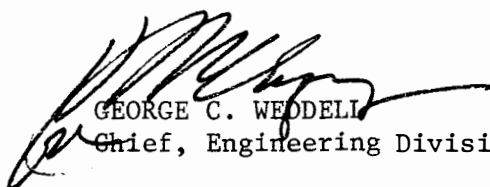
This is in response to a letter from the Department of Energy dated 15 June 1978 concerning the Department's draft Environmental Impact Statement, DOE/EIS-0012-D, Petroleum Production at Maximum Efficient Rate, Naval Petroleum Reserve No. 1 (Elk Hills), Kern County, California.

We have reviewed the draft statement, and the proposals presented will not conflict with flood control or other programs within our jurisdiction.

a

Thank you for the opportunity to review this environmental statement.

Sincerely yours,


GEORGE C. WEODELI
Chief, Engineering Division

CODE	INIT.	DATE



United States Department of the Interior

4

FISH AND WILDLIFE SERVICE
LLOYD 500 BUILDING, SUITE 1692
500 N.E. MULTNOMAH STREET
PORTLAND, OREGON 97232

September 15, 1978

In reply refer to:
AFA-SE

Captain John Dick-Peddie
Officer-in-Charge of Construction
Naval Facilities Engineering Command
Elk Hills P.O. Box 40
San Bruno, California 94066

Dear Captain Dick-Peddie:

After reviewing the draft EIS on Petroleum Production at Maximum Efficient Rate, Naval Petroleum Reserve No. 1 (Elk Hills), Kern County, California, we are concerned about the welfare of two animals that are listed under the Endangered Species Act as endangered species -- the blunt-nosed leopard lizard and the San Joaquin kit fox. Because of our concern over these species, we are requesting that formal Section 7 consultation be initiated as specified in the "Interagency Cooperation Regulations" (Title 50, Part 402).

a

In addition to the above animals, there are plants in the area which have been proposed for final rulemaking as threatened or endangered. Although the plants are not presently covered under provisions of Section 7 of the Act, we are concerned about the effects of the project on them also. In anticipation of their eventual listing you may elect to seek informal consultation on them at the same time.

b

We await your request.

Sincerely yours,

R. Kahler Martinson
R. Kahler Martinson
Regional Director



DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
U.S. COAST GUARD (G-WS/73)
WASHINGTON, D.C. 20590
PHONE: (202) 426-2262

5

12 JUL 1978

- Mr. Robert J. Catlin
Director
Office of NEPA Affairs
Department of Energy
Washington, D. C. 20545

Dear Mr. Catlin:

This is in response to your letter of 15 June 1978 concerning a draft environmental impact statement regarding Petroleum Production at Maximum Efficiency Rate, Elk Hills Naval Petroleum Reserve, Kern County, California.

The concerned operating administrations and staff of the Department of Transportation have reviewed the material submitted. We have no comments to make nor do we have any objection to this statement.

a

The opportunity to review this draft statement is appreciated.

Sincerely,

FOR THE COMMANDANT
J. Schubert
Commandant
U.S. Coast Guard
Marine
Systems
Commandant



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IX

215 Fremont Street
San Francisco, Ca. 94105

Project # D-DOE-KO3007-CA

Captain Dick Peddie
Officer in Charge of Construction
Naval Facilities Engineering Command
Contact, Elk Hills
P.O. Box 40
San Bruno CA 94066

SEP 18 1978

Dear Captain Peddie:

The Environmental Protection Agency has received and reviewed the draft environmental statement for the PETROLEUM PRODUCTION AT MAXIMUM EFFICIENT RATE NAVAL PETROLEUM RESERVE NUMBER 1, ELK HILLS, KERN COUNTY, CALIFORNIA.

EPA's comments on the draft environmental statement have been classified as Category ER-2. Definitions of the categories are provided on the enclosure. The classification and the date of EPA's comments will be published in the Federal Register in accordance with our responsibility to inform the public of our views on proposed Federal actions under Section 309 of the Clean Air Act. Our procedure is to categorize our comments on both the environmental consequences of the proposed action and the adequacy of the environmental statement.

EPA appreciates the opportunity to comment on this draft environmental statement and requests three copies of the final environmental statement when available.

If you have any questions regarding our comments, please contact Betty Jankus, EIS Coordinator, at (415)556-6695.

Sincerely,

*Paul De Falco, Jr.*for Paul De Falco, Jr.
Regional Administrator

Enclosure

cc: Council on Environmental Quality

Radiation Comments

1. (DEIS, Appendices)

Appendix C includes statements about EPA's responsibility for air, i.e., Clean Air Act and Amendments but does not discuss the EPA responsibility to evaluate radioactive emissions from all sources. a

2. Section H and Appendix C describe risk assessment; however, there is no discussion of the estimated health effects from exposure to radiation. Both oil and gas contain natural occurring radionuclides, and the recovery of the oil and gas brings the radionuclides into contact with the biosphere. The population exposures from oil and natural gas, at present, are believed to be low (oil being the lower); however, the storage of propane and butane can cause radiation exposure to site personnel and population exposures are caused by the consumption of the gas. These exposures have been estimated, but there is no discussion in the DEIS. In addition, it appears that the time between production and use might be very short for the Elk Hills Facility (page 1-47) which would increase the population exposures. The FEIS should address these issues. b

Water Comments

1. (DEIS Section I-24)

The FEIS should describe the most probable routes, including frequencies of travel by route, over which gas liquids will be transported to market by trucks. In addition, all navigable waters which could be impacted by a spill on these routes should be identified (i.e., road drainage system discharging into the Santa Clara River). The existence or development of any contingency plans to prevent spills on roads from entering navigable waters should be discussed and available for review. c

2. (DEIS Section I-27)

What is the estimated quality (including estimated concentrations for each constituent) of the water proposed for disposal through evaporation and/or percolation ponds? Should the quality of the freshwater in the Tulare Formation prove to be better than the water d

to be disposed of through percolation ponds, how will the ponds be sited to avoid percolation into the higher quality shallow aquifers?

3. (DEIS Section IV-21)

The DEIS indicates that toxic materials are among the components of drilling muds. Since some of the drilling muds will be disposed of through application on banks of roadways and a potential for contaminated runoff does exist, a list of all potential components of drilling muds and an estimate of the quantity of muds to be applied to road banks should be provided in the FEIS.

e

4. (DEIS Section I-40)

In the "moth balling" procedures, the pipeline will be filled with corrosion inhibitors. The FEIS should delineate which corrosion inhibitors will be used and how the integrity of the pipeline will be monitored to insure that the corrosion inhibitors will not leak into the groundwater system.

f

5. (DEIS Section I-30)

It is indicated that 60 percent of Kern County's irrigation water comes from groundwater. The FEIS should clarify what percentage of this groundwater is drafted from aquifers under existing and planned Elk Hills petroleum operations.

g

6. (DEIS Section IV-10)

Construction of new facilities and percolation/evaporation ponds will increase the potential for erosion. The FEIS should address erosion control measures which will be employed in the design of the new facilities and ponds.

h

7. (DEIS Section J-10)

An estimate of the quality of the hydrostatic test water, including estimated concentrations for each constituent present, should be included in the FEIS.

i

8. (DEIS Section J-14)

Slow percolation would reduce the rate of entry of pollutants into the groundwater, but the overall quantity of pollutants potentially impacting the groundwater will remain the same. The advantages of slow percolation ponds over lined evaporation ponds with respect to protection of the shallow groundwater aquifers should be more thoroughly discussed in the FEIS. j

Air Comments

The DEIS inadequately assesses the air quality impact of the proposed action.

1. (DEIS pg. II-17; Appendix H)

The DEIS should provide the most recent existing air quality data for carbon monoxide (CO), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), and total suspended particulates (TSP). These ambient concentrations should then be compared to the National Ambient Air Quality Standards (NAAQS), and the number of violations and the potential for violation should be discussed. Ambient levels should be provided for each averaging time/pollutant for which data is available. k

2. Predicted ambient levels should be made for all criteria pollutants affected by the project. While the oxidant (O_x) analysis is adequate, predictions need to be made for each criteria pollutant and averaging time, for design year and design year plus 20 years with and without the project. l

3. Ambient air is defined as "that portion of the atmosphere, external to buildings to which the general public has access." (40 CFR 50.1(e).) The DEIS indicates that the "Reserve is not open to public access" (page 0-17). Does the Reserve effectively bar the public from entering Reserve properties? If there is not a complete and effective means of prohibiting public access from Reserve properties maximum concentrations must be determined within the Reserve. Provided that a complete and effective measure is used to bar the public from Reserve access, a minimum requirement is the inclusion of Elk Hills Road in the impact analysis for all pollutants and each corresponding averaging time. Kern m

county is a nonattainment area for O_x, CO, SO₂ and TSP. Any increase in emissions is likely to exacerbate the situation and should be analyzed for the impact on ambient air pollution levels and the NAAQS's. The FEIS should address these issues.

4. (DEIS Section IV-16,17)

The standard sentence indicating that CO, SO₂ and TSP emissions are small enough to be excluded from NSR and therefore will not interfere with the attainment or maintenance of ambient air quality standards, is not acceptable justification. The FEIS should provide existing ambient levels, existing and future emissions and future ambient levels with and without the project.

n

5. (DEIS Section IV-1)

The emissions inventory should include the "other potential sources". The combined effect of several negligible sources with the major sources may prove to be very significant. The annual average modeling for NO₂ should have also included the Elk Hills Road. The FEIS should address these issues.

o

6. The 60 percent conversion factor for nitric oxide (NO) to NO₂ is not acceptable for estimating maximum concentrations. It has been EPA's policy to use 100 percent conversion of NO to NO₂ for determining maximum NO₂ concentrations. (Letter May 30, 1975; Frank Covington, Director, Air and Hazardous Materials Division to Kern County Health Department.)

p

7. The modeling input data should be included in the appendix of the FEIS in a format that is easy to follow so that EPA can perform an analysis if desired. Specific data not presented for the Valley Model includes: ambient temperature and pressure and the mixing depth used; was the Reserve modeled as an area source or specific point sources; what were the coordinates of the area/point sources(s), coordinates of the receptors; was plume rise calculated, and if yes, how? The wind speed, direction and frequency data, ground elevation of source and receptors, half-life used, should all be described in the FEIS.

q

8. Five (5) 250,000-barrel crude oil tanks will be constructed at the Elk Hills tank farm in the south-central part of Reserve No. 1, which was covered in a separate EIS. Since these tanks are part of the same development program, they will be considered by the EPA as part of the total project. The EPA will also consider oil wells drilled on the reserve as part of a five-year drilling plan which began in 1974 as part of the proposed project rather than as existing sources of emissions. r
9. The application of EPA's Prevention of Significant Deterioration of Air Quality (PSD) regulations to the proposed project was not discussed. Petroleum storage and transfer facilities with a capacity exceeding 300,000 barrels are subject to PSD for each pollutant for which potential emissions from the source will be 100 tons/year or greater. According to the emissions estimates in the EIS, the proposed project is subject to PSD for NO₂ and carbon monoxide (CO). The primary PSD requirement, application of the Best Available Control Technology (BACT) to the emissions source, has not been proposed or discussed for these two pollutants. The FEIS should discuss these issues. s
10. Although the EIS states that all hydrocarbon emissions from the project will be offset, these emission reductions are not identified. The FEIS should address this issue. t
11. Emissions due to rail transportation associated with the project have not been quantified. For each pollutant for which the proposed project is a major source under New Source Review or PSD, secondary emissions from the trains must be considered in the EPA's review. The FEIS should address this issue. u
12. Fugitive particulate emissions due to vehicular travel on new dirt roads associated with the project have not been quantified. Mitigation measures must be discussed in the FEIS. v
13. Hydrocarbon emissions from process wastewater which has come into contact with oil and is held in evaporative ponds should be included in emissions estimates and should be addressed in the FEIS. w
14. All new oil and gas loading facilities will be equipped with vapor recovery systems. Unless these systems have x

a hydrocarbon recovery efficiency of 100 percent, the remaining hydrocarbon emissions from the loading racks should be estimated in the FEIS.

Miscellaneous Comments

1. (DEIS Section IV-17)

Transportation Emissions gives an estimate of 200 trucks per day, yet the emission section, page 0-15 uses the figure 187 trucks per day. This discrepancy should be resolved.

y

2. (DEIS Section IV-15)

Second paragraph, "Appendix N" should be changed to "Appendix O".

z

3. (DEIS Section 0-17)

Third paragraph justifies the exclusion of Elk Hills Road from modeling for annual average concentrations with the statement "since the public could not be exposed to concentrations over an annual period along the roadway". The NAAQS were established to protect the public health and welfare. They pertain to ambient air regardless of the length of time the public may be exposed to harmful levels. The FEIS should address this discrepancy.

aa

4. (DEIS Section G-5)

LAER (Lowest Achievable Emission Rate) is the requirement for new or modified sources in nonattainment areas. (Section 173(2) CAA.)

bb

5. (DEIS Section G-6)

For purposes of PSD, a new or modified source is subject to PSD if it is one of 28 specified source categories which emit or have the potential to emit more than 100 tons/year or any new or modified source emitting more than 250 tons/year. (43 FR 26403 Section 52.21(b)(1)(i).)

cc

6. The Air Quality Section needs to discuss Kern County as a nonattainment area for TSP, CO, SO₂ and O_x. Kern County Air Pollution Control District, the lead agency for development of the Nonattainment Plan (NAP) should be contacted to ensure the proposed action is considered in the NAP development.

dd

OFFICE OF THE SECRETARY
RESOURCES BUILDING
1416 NINTH STREET
95814

(916) 445-5656

Department of Conservation
Department of Fish and Game
Department of Forestry
Department of Navigation and
Ocean Development
Department of Parks and Recreation
Department of Water Resources

EDMUND G. BROWN JR.
GOVERNOR OF
CALIFORNIA



Air Resources Board
California Coastal Commission
California Conservation Corps
Colorado River Board
Energy Resources Conservation and
Development Commission
Regional Water Quality Control Boards
San Francisco Bay Conservation and
Development Commission
Solid Waste Management Board
State Coastal Conservancy
State Lands Commission
State Reclamation Board
State Water Resources Control Board

THE RESOURCES AGENCY OF CALIFORNIA
SACRAMENTO, CALIFORNIA

SEP 8 1978

Mr. James Liverman
U. S. Department of Energy
Washington, D. C. 20545

Dear Mr. Liverman:

The State of California has reviewed the draft environmental impact statement, "Petroleum Production at Maximum Efficient Rate, Naval Petroleum Reserve No. I (Elk Hills)", submitted through the Office of Planning and Research in the Governor's Office.

This review fulfills the requirements of Part II of Office of Management and Budget Circular A-95 and the National Environmental Policy Act of 1969. It was coordinated with the Departments of Conservation, Fish and Game, Navigation and Ocean Development, Parks and Recreation, Water Resources, Food and Agriculture, Health, and Transportation; the Air Resources, Solid Waste Management, and State Water Resources Control Boards; and the Coastal, Energy, State Lands, and Public Utilities Commissions.

All comments received from the reviewing State agencies are attached to this letter. We appreciate having been given the opportunity to review this document.

Sincerely,

A handwritten signature in dark ink, appearing to read 'L. Frank Goodson'.

L. FRANK GOODSON
Assistant Secretary for Resources

Attachments

cc: Director of Management Systems
Office of Planning and Research
1400 Tenth Street
Sacramento, CA 95814
(SCH 78071014)

Memorandum

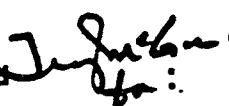
7

To : Huey D. Johnson
Secretary for Resources

and : Captain John Dick-Peddie
Officer in Charge of Construction
Elk Hills

Date : August 4, 1978

Subject : Draft EIS for Petroleum
Production at Maximum
Efficient Rate SCH #
78071014

From : Air Resources Board 
Harmon Wong-Woo, Chief
Stationary Source Control Division

Introduction

The Navy proposes to produce crude oil from the California Elk Hills Naval Petroleum Reserve #1 at a maximum efficient rate (MER) of 260,000 barrels of oil per day (BOPD) and to build a conveyance system to move the oil to market. Three alternatives to move crude oil out of the production field by pipeline were discussed in the previous EIS titled "Crude Oil Transport Alternatives From Naval Petroleum Reserve No. 1, Tupman, California." The most probable alternative is the connection to the SOHIO pipeline at Rialto, San Bernardino County.

The present DEIS concentrates on the production phase which includes the drilling of 307 new wells, the modifications to existing gas and oil collection facilities, and the construction of: (1) two 100 million cubic feet per day low temperature gas processing plants consisting of natural gas fired compressors as well as process heaters; (2) two gas fired compressor stations; (3) two Lease Automatic Custody Transfer (LACT) systems, each of which consists of a washing unit, settling unit, handling tank, and LACT pump; (4) truck and railroad tank car loading facilities; (5) eight tank settings including the storage of crude from production wells and gas/oil separation; and (6) pipelines delivering wet gas to the existing Chevron gas processing plant located at McKittrick, about nine miles west of the Reserve, and returning dry gas to the Reserve for injection.

As a result of the project, gas processing plants will handle up to 354 million cubic feet per day of gas and recover up to 1.5 million gallons of gas liquids (including propane, butane, pentane and heavier hydrocarbons) per day. All gas liquids will be transported to market via trucks and railroad cars.

To achieve the MER of 260,000 BOPD, up to 360 million cubic feet per day of gas and 200,000 BPD of water are planned to be reinjected into the underground formation through injection wells.

Specific Comments

1. On page I-18, the DEIS states that the new field compressors are to have engines with a total capacity of from 8,000 to 10,000 horsepower and on page I-20, the DEIS mentions that a new compressor station is to be constructed

August 4, 1978

at Section 35R for injection of the returned dry gas. However, in the Air Quality Impacts Section, the DEIS does not include emissions from these sources. The air impacts could be significant if gas fired reciprocating engines were used.

2. The DEIS indicates that petroleum liquids produced from the gas processing plant will be stored in storage tanks and will be loaded for truck and railroad car shipment. However, the DEIS does not estimate air emissions from the storage tanks, loading facilities, and trains. In calculating air emissions from truck traffic, the DEIS should consider the average distance that trucks will travel within Kern County rather than the average distance from the gas plants to the nearest state highways. b
3. On page I-37, the DEIS states that the flare will be equipped with pilot lights of continuous burning gas, but in the Air Quality Impact Section, the DEIS does not include emissions from pilot lights and from flaring gases. c
4. On page I-28, it is stated that an additional 35 megawatts of electricity will be provided by Pacific Gas and Electric Company, yet the DEIS does not address air emissions from power generation, which could be significant. Based on a power plant burning 0.5% sulfur fuel oil, SO_x and NO_x emissions are estimated to be 182.7 lbs/hr, and 87.5 lbs/hr respectively. d
5. The DEIS indicates that during the construction phase all emissions will be temporary and are not expected to cause significant impacts off the Reserve, but provide no data to support this statement. The FEIS should quantify air emissions from the construction phase since the project will require the use of diesel powered equipment, which is capable of emitting large quantities of NO_x. e
6. The DEIS states that 60 million cubic feet per day of gas is expected to be produced at Chevron's McKittrick gas processing plant, which currently processes 18 million cubic feet per day of gas, but air emissions from additional pumps and process heaters due to increased throughput are not mentioned in the future air emissions inventory. f
7. Appendix H of the DEIS which discusses air quality data in the San Joaquin Valley Air Basin should include 1976 and 1977 data. g
8. The DEIS should list the diameter and average vapor space height of the fixed roof storage tanks and the vapor recovery control efficiency. Without such information, the breathing losses from the tanks, both with and without vapor recovery, cannot be verified. In addition, the DEIS incorrectly defines turnover factor as annual throughput/tank capacity. According to the Environmental Protection Agency publication, AP-42, the turnover factor is a function of the number of turnovers per year which is defined as annual throughput/tank capacity. Based on the data in the DEIS, the turnover factor should be 0.5 rather than the reported 0.25. h

9. Fugitive emissions from gas service control valves were underestimated. According to the recently published KVB study titled "Control of Hydrocarbon Emissions from Stationary Sources in the California South Coast Air Basin," a factor of 0.25 lbs/day/device should be used, replacing the DEIS reported factor of 0.10 lbs/day/control valve. i
10. In the Hydrocarbon Impacts Section, page IV-12, the DEIS states that "the major reduction in existing emissions will be the flaring of gases currently vented at the 35R gas plant during upset conditions. Another major reduction in existing THC and NMHC emissions will be the inclusion of all Shallow Zone stock tanks into the vapor recovery system." These emissions reductions cannot be accepted as tradeoff credits for the following two reasons: First, venting of hydrocarbons into the atmosphere is not allowed under permit and should be minimized to the lowest level. Second, the liquid stored in Shallow Zone stock tanks has a Reid vapor pressure greater than 1.5 pounds per square inch. Under Kern County APCD Rule 411, these tanks are required to be equipped with vapor loss control devices and therefore no reduction credits should be allowed. As a result, the project may result in a net increase of hydrocarbon emissions of greater than 250 pounds per day. Therefore, the FEIS should perform an analysis on ozone impacts. Emissions from the 1.25 million barrels capacity Elk Hills Tank Farm (addressed in the transportation phase EIS) should also be included in the model study. The DEIS also states that the Department of Energy has initiated a study to identify all possible hydrocarbon emission offsets in the basin both on and off the NPR-1. Results of this study should be included in the FEIS. j
11. The modeling study addressing NO_x and NO₂ (nitrogen dioxide) concentrations has the following deficiencies:
 - (i) Meteorological data were taken from the National Climatic Center for a Bakersfield station. The DEIS should provide justification to demonstrate that the meteorological data from this specific station in Bakersfield will be representative of the Reserve.
 - (ii) In determining the maximum ground level concentrations, a total of 12 meteorological conditions out of a possible 384 combinations were examined. However, the DEIS does not address the criteria for the selection. k
 - (iii) The DEIS should discuss the reason for the choice of 60 percent conversion of NO (nitric oxide) to NO₂ which may not be true within the Reserve.
 - (iv) Since the estimated maximum ground level concentration of NO₂ along the Elk Hills Road exceeds the state 1-hour NO₂ standard, the District new source review rule will likely require the additional NO_x emissions to be offset. The final EIR should discuss the nature, location, and quantity of emission offsets which will be considered.

Mr. Johnson
Captain Dick-Peddie

-4-

August 4, 1978

The practice of the ARB in assessing air quality impacts is similar to the approach taken in the DEIS in that we utilize similar dispersion models in our preliminary analysis, to see if applicable standards are expected to be exceeded. If they are expected to be exceeded, we conduct a further analysis, employing numerical modeling to more accurately assess the impacts. I recommend this further analysis be performed in this case and that the scope of the analysis be expanded to include the entire Reserve.

The final EIS should address the federal ambient air quality standard for NO₂ on an annual basis.

cc: Rick Nevis
Kern County APCD

REPORT INQUIRY

NOTICE OF INTENT 07/03/78
DEPARTMENT REVIEW

GOVERNOR'S OFFICE
OFFICE OF PLANNING AND RESEARCH
STATE CLERKINGHOUSE
1400 11TH STREET ROOM 121
SACRAMENTO (916) 445-0613

DEPARTMENT REVIEW MUST BE COMPLETED AND THIS FORM
FORWARDED (WITH OR WITHOUT COMMENTS) TO YOUR AGENCY
SECRETARY BY 06/22/78.

TOTAL AGENCY COMMENTS (OR COMMENTS OF DEPARTMENTS,
BOARDS OR COMMISSIONS NOT WITHIN AN AGENCY) MUST
BE FORWARDED TO THE RESOURCES AGENCY BY 08/07/78

RESOURCES AGENCY COMPILATION OF COMMENTS MUST BE
FORWARDED TO DPR BY 08/28/78

SCM NUMBER 78071014 SPONSOR'S PROJECT TITLE
PETROLEUM PRODUCTION AT MAXIMUM EFFICIENT RATE

IMPACT AREA (CITY, COUNTY)
DERN COUNTY

PROJECT SPONSOR
U.S. DEPARTMENT OF ENERGY
WASHINGTON D.C.
WASHINGTON 20545

FUNDING AGENCY

FUNDING AGENCY PROGRAM TITLE

FUNDING REQUESTED
FEDERAL
STATE
LOCAL
OTHER
TOTAL

PROJECT CONTACT
JAMES LIVERMAN
WASHINGTON D. C.

PROJECT DESCRIPTION
OPERATION OF COLLECTION, DISTRIBUTION, AND INJECTION SYSTEMS
FOR OIL, GAS, AND WATER. OPERATION OF EXISTING AND NEW GAS P
ROCESSING FACILITIES OF UP TO 30,000 B/D OF PRODUCED WASTEWATER,
TER, OPERATION OF ELECTRIC POWER DISTRIBUTION SYSTEM,

QUAD GROUP DETAIL MAG NO CODE TYPE QUAD GROUP DETAIL MAG NO CODE TYPE QUAD GROUP DETAIL MAG NO CODE TYPE QUAD GROUP DETAIL MAG NO CODE TYPE

DEPARTMENT LEVEL REVIEW
AIR RESOURCES BOARD
HEALTH PROTECTION SYSTEM
ENERGY COMMISSION
SOLID WASTE MGMT BOARD
DISTRICT CL
PUBLIC UTILITIES COMM
CALTRANS - TRANS PLANNING
COASTAL ZONE CONS COMM
DIV OF STATE LANDS
DEPT OF NAV-OCEAN DEVELOP
ENERGY COMMISSION
PUBLIC UTILITIES COMM
DEPT OF FOOD AND AGRICULT
CALTRANS - TRANS PLANNING
CONSERVATION DEPT
DEPT OF FISH AND GAME
DEPT OF PARKS-RECREATION
DEPT OF WATER RESOURCES
ST WATER RESOURCES UNCL B

PROJECT REVIEW

NO COMMENTS ()
COMMENTS ATTACHED ()
MEETING DESIRED WITH SPONSOR ()

ENVIRONMENTAL REVIEW
ENVIRONMENTAL IMPACT STATEMENT

NO COMMENT ()
EIS IS ADEQUATE ()
COMMENTS ATTACHED ()

MEETING DESIRED WITH SPONSOR ()

DEPARTMENT SIGNOFF

NAME: Harmon Wong-Woo, Chief
TITLE: Stationary Source Control Division
DEPARTMENT ARB
TELEPHONE 445-0650
ADDRESS 1102 Q. Street
DATE: 7/19/78

DEPART SEAL

AIR RESOURCES BOARD

1102 Q STREET
P.O. BOX 2815
SACRAMENTO, CA 95812



Mr. James Liverman
U.S. Department of Energy
Washington, D.C. 20545

Dear Mr. Liverman:

Subject: Draft EIS for Petroleum Production at Maximum
Efficient Rate, Naval Petroleum Reserve No. 1
(Elk Hills)

After a reevaluation of our position on this subject, we have concluded that our comment cited at the bottom of page 6 of the September 8, 1978 letter from L. Frank Goodson of the Resources Agency of California to yourself should be amended to read as follows:

"In the Hydrocarbon Impacts Section, page IV-12, the DEIS states that 'the major reduction in existing emissions will be the flaring of gases currently vented at the 35R gas plant during upset conditions.' These emissions reductions may be acceptable as trade-off credits, however the reductions could not be used to determine whether an air quality impact analysis (AQIA) would be required under Kern County's New Source Review (NSR) Rule. a

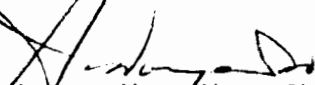
The determination as to whether an AQIA is required for a modification is dependent on whether there are any hours or days during which the modification will increase emissions beyond 25 lbs/hr or 250 lbs/day for any air contaminant for which there is a state or national ambient air quality standard (except carbon monoxide, for which the limits are 250 lbs/hr and 2500 lbs/day). To enable that determination to be made, the DEIS should identify the frequency and extent of intermittent sources of emissions such as venting. The DEIS should also quantify the emissions resulting from flaring operations, since oxides of nitrogen emissions from this source can be significant. If it is determined that an AQIA will be required, the tradeoffs associated with the flaring operations may be used to help demonstrate that there is no net adverse air quality impact on an annual basis." b

September 20, 1978

Furthermore, we have concluded that the use of vapor recovery systems on the Shallow Zone stock tanks represents an acceptable trade-off measure under Kern County Air Pollution Control District rules and regulations. C

If you have any further questions regarding this matter, please contact Gary Rubenstein at (916) 445-0734.

Sincerely,



Harmon Wong-Woo, Chief
Stationary Source Control Division

cc: Huey D. Johnson
Captain John Dick-Peddie
Richard Grix, OPR
Rich Nevis
Kern County APCD

Memorandum

8

To : L. Frank Goodson
Projects Coordinator
The Resources Agency

Date : July 13, 1978

James Liverman
U.S. Department of Energy
Washington D. C. 20545

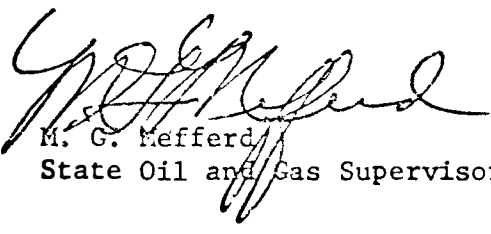
Subject: SCH 78071014
Elk Hills DEIR
Petroleum Production MER

From : Department of Conservation — Division of Oil and Gas
Sacramento

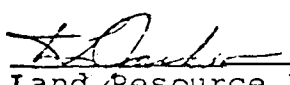
The Division of Oil and Gas has reviewed the subject draft by the U. S. Department of Energy. The following comments are offered for your consideration:

The report presents several scenarios for producing the various pools, including pressure maintenance by both gas and water injection. One scheme involves the sale of associated gas from the Stevens and shallow zones and the injection of inert gas for pressure maintenance in the Stevens. The inert gas would be generated by combustion of some 45 MMCF/D of the produced gas. The report does not discuss the very important benefits that could be derived from the combustion and inert gas generation. For instance, the combustion of 45 MMCF/D of 1,000 BTU/CF gas in a gas turbine power plant could generate nearly 200 megawatts of electric power. Part of this power could be used to drive the compressors for injecting the inert gas and for operating other machines, such as well pumping units. The waste heat in the turbine exhaust (inert gas) could be recovered in a steam generator and used to power other machines, such as steam turbines, pumps, or oil and gas treating and processing. If the pressure and temperature of the steam were adequate and the plant properly located, the steam could be injected for thermal recovery in the shallow Tulare tar sands. a

Inert gas pressure maintenance combined with electric power generation and waste heat recovery is an attractive and efficient scheme with many potential benefits. This scenario should be seriously evaluated for integration into the Elk Hills operations..


M. G. Mefferd
State Oil and Gas Supervisor

APPROVED:


Land Resource Protection Unit
DATE: July 17, '78

Memorandum

9

To : Huey D. Johnson
Secretary for Resources
1416 Ninth Street, Room 1311
Sacramento, CA 95814

Date: August 4, 1973

Attn: L. Frank Goodson
Projects Coordinator

From : Department of Fish and Game

Subject: SCH 78071014 - Draft Environmental Impact Statement - Petroleum Production
at Maximum Efficient Rate - Naval Petroleum Reserve No. 1 (Elk Hills),
Kern County

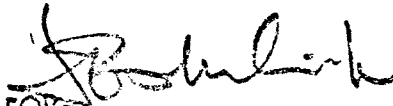
We have reviewed the subject Draft Environmental Impact Statement and find it inadequate. The inadequacy is in the lack of discussion of measures to avoid adverse impacts on wildlife.

The report is quite clear and accurate in its description of loss of wildlife which will occur if the project is performed as described. This is particularly true as it relates to rare and endangered species. The predictable losses of San Joaquin Kit Foxes, Blunt-Nosed Leopard Lizards and rare plants are not acceptable as an unavoidable loss.

We request that the existing wildlife management plan for the reserve be revised to include specific measures to protect and enhance rare and endangered species resident on the Elk Hills Naval Petroleum Reserve. There should also be a reactivation of the annual meetings to coordinate wildlife management on the area. No meetings of this group have been held since 1971. Future meetings should include specialists in the field of rare and endangered species from the California Department of Fish and Game and the U. S. Fish and Wildlife Service.

a

Should you or the project sponsor have any questions, please contact George D. Nokes, Regional Manager, Region 4, 1234 East Shaw Avenue, Fresno, CA 93710, telephone (209) 222-3761.


FOR Director

Memorandum

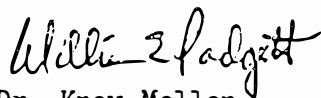
10

Date : August 30, 1978**To** : Mr. L. Frank Goodson
Project Coordinator
Resources Agency**From** : Department of Parks and Recreation**Subject** : Petroleum Production, Elk Hills
SCH 78071014

The California Office of Historic Preservation would appreciate the opportunity of consulting with the Department of Energy concerning the eligibility of archeological sites Ker - 659, - 660, - 661, and - 662 for inclusion on the National Register of Historic Places and the adequacy of the identification survey.

This opportunity should be afforded the State Historic Preservation Officer under the National Historic Preservation Act of 1966, Executive Order 11593 and the Advisory Councils Procedures (36 CFR, Part 800).

Please contact Mr. William Seidel concerning this matter at (916) 445-8006.



Dr. Knox Mellon
State Historic Preservation Officer
Office of Historic Preservation

Memorandum

(11)

To : L. Frank Goodson
Resources Agency
Room 1311
1416 - 9th Street
Sacramento, CA 95814

Date : August 1, 1978

From : Energy Resources Conservation - James Walker
and Development Commission
1111 Howe Avenue
Sacramento, 95825



Subject: PETROLEUM PRODUCTION AT MAXIMUM EFFICIENT RATE, NPR NO. 1 (ELK HILLS) DEIS
SCH No. 78071014

Introduction

Pursuant to Public Law No. 94-258, the Naval Petroleum Reserves Production Act of 1976, the Naval Petroleum Reserves were opened up for production at maximum efficient rates consistent with sound engineering practices, for a period of six years. It is anticipated peak production would be 260,000 barrels per day of crude oil in 1981 with approximately 50 mmcf of dry gas and 310 mmcf of associated gas (after liquid extraction) also being produced. This gas, along with 198,000 bpd of water, would be injected into crude oil production zones for pressure maintenance. Twenty-eight thousand barrels of water will be mined daily from brackish ground waters for the water flooding. The remainder will be waste water separated from the crude oil. Should the reinjected natural gas be replaced, an additional 300,000 bpd (38 acre feet) of water would be needed.

Discussion

The California Energy Commission is very concerned at the Department of Energy's apparent disregard of the need for selling natural gas production from the Elk Hills facilities. Not to consider the impact of having up to 360 mmcf being produced but not available for public use, even on an emergency basis, is irresponsible.

Granted the DEIS does discuss several alternatives, including three which would provide for the sale of natural gas production, one can hardly adequately discuss three important alternatives on a total of five pages.

There were no discussions on the environmental effects of water injection versus natural gas injection or even whether full pressure maintenance programs would be achievable using water exclusively. Economically, the incentive for gas sale is there. With gas prices ranging from \$1.75 (NEB) to \$4 (cost to California for Alaska gas) per mcf, a minimum of \$630,000 per day would be generated from the sale of the natural gas, while the replacement water costs would

L. Frank Goodson
August 1, 1978
Page 2

be in the order of \$1,000 per day. It is the Commission's understanding that there is 150,000 acre feet of unallocated water in the California Aqueduct being held by Nichol Enterprises, (805) 832-6963. This is sufficient water to meet project make-up water injection needs for 10 years. If water is available, the DOE should reconsider the sale of natural gas and at the same time, the use of this water in the context of social, economic and environmental goals. With the sale of natural gas, sulfur dioxide emissions would be reduced between 40 and 90 tons per day, not to mention the social benefits of having an assured additional supply of gas to meet the potentially critical short-term natural gas supply needs during the early 1980's.

The DEIS quotes extensively that the law requires NPR-1 to be developed under the maximum and efficient rate and then goes on to state this means without detriment to the ultimate recovery. In order to do this, the DOE has flatly stated that the natural gas must be reinjected to maintain pressure for crude oil production. Section 7420, Definitions of the Naval Petroleum Reserves Act found in DEIS Appendix A, further defines maximum and efficient rate to include economic development. With the minimum loss in sales of \$630,000 per day, is the DOE really following the mandate of Congress?

California is currently facing an oil glut, and it will continue to do so for the foreseeable future. As a result, it has been stated that up to 100,000 bpd of California crude oil production is now shut in. Even though steps are being taken to alleviate the oil glut, the question which still remains in many minds is, "Where will the Elk Hills oil production be utilized, and how will it get there?". The Naval Petroleum Reserves Act states that all or any part of the petroleum produced may be sold or placed in strategic storage facilities. Whether the crude were to be used immediately or stored for future use would directly affect the oil glut as well as the environmental impact of the production. Neither this DEIS nor the earlier DEIS, which discussed modes of transportation, address this issue.

An additional alternative which merits discussion is reversing the order of production and produce the available gas for sale and continue to hold the crude oil and associated natural gas in reserve. Assuming that NPR-1 petroleum production would be utilized in California, this alternative would reduce the impact of additional crude oil supplies on an already burdened market, but would provide needed natural gas during the critical mid-1980's when California's current sources become depleted and before new sources can come on stream.

Recommendation

It is the recommendation of the California Energy Commission that the Department of Energy do the following:

L. Frank Goodson
August 1, 1978
Page 3

1. Thoroughly re-examine the alternatives of injecting produced natural gas versus total water flooding to maintain pressure for crude oil production. **a**
2. Determine or estimate to what market place the NPR-1 crude oil production would go. **b**
3. Expand the discussion on alternatives and also add an alternative to produce available natural gas first. **c**
4. Include a discussion on the impact of not making 360 mmcf/d of natural gas available for sale during the critical mid-1980's. **d**

JAMES A. WALKER
Executive Director

JAW/SWM;nwb

Memorandum

12

To : Mr. L. Frank Goodson
Projects Coordinator
Resources Agency

Date : August 30, 1978

From : **STATE SOLID WASTE MANAGEMENT BOARD**

Subject: Approval of State Comments

We have approved the attached comments subject to the following addition:

Discussion on page I-28 (top) indicates that potentially hazardous waste is being spread along the Reserve's roadbanks as a soil amendment. We believe this is not an environmentally acceptable method of waste disposal. All wastes generated as a result of well drilling and development activities should be disposed of at the on-site Class II-1 facilities or hauled away to an acceptable disposal site.

a

Memorandum

(13)

To : L. Frank Goodson
Projects Coordinator
Resources Agency
1416 Ninth Street, Room 1311
Sacramento, California 95814

Date : August 1, 1978

File No.:

From : EXECUTIVE OFFICE
1807 13th Street, Sacramento 95814

Subject: Draft EIS/Petroleum Production at Maximum Efficient Rate - Elk Hills

The following constitute the comments of the staff of the State Lands Commission relative to the above document.

General Comment

The document is much too general and incomplete to effectively evaluate the project. The document provides little quantitative information and fails to provide a completely objective analysis of the project. As an example, the liberal use of the terms "some" and "many" provide little or no information.

Specific Comments

1. The project description is so qualitative, it fails to provide adequate information about the project. Specific instances of this are found throughout the project description. For example:

Page 1-8, paragraph 1, "some additional compressors"

Page 1-25, paragraph 2, "some liquid storage capacity"

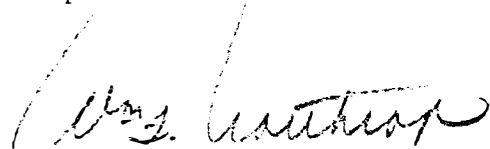
Page 1-27, paragraph 1, "Additional ponds"

These and other similar inferences should be quantified, as they presently provide the reviewer with little useful information.

2. On Page 1-24, it states that the storage and loading facilities at 35R plant are adequate only for existing production. To what extent will new facilities be required? Further, how many will be needed and what will their capacities be?
3. Page 1-41. The discussion of Historical Risks contains unnecessary extraneous information. What does the discussion about navigable waters have to do with the project at Elk Hills?

4. Page 1-43, last paragraph. Define "earthquake country". d
5. Page 11-24, fourth paragraph. The statement regarding impact on vegetation conflicts with a similar statement in the project description. This paragraph indicates that vegetation has not returned to normal and that erosion is a serious problem in some areas where construction activity has occurred. This conflicts with the statement in the project description which states that no mitigation of earth moving is necessary since vegetation reinstates itself adequately. This conflict should be rectified in the Final EIS. e
6. Page II-25, Wildlife. The opening statement states that the work done was mainly literature survey. Yet, in other paragraphs it refers to field surveys. Were there field surveys? f
7. Page II-31, paragraph 2. As a point of clarification, the China Lake Naval Weapons Center is located in desert, not in mountains. g
8. Page IV-21, paragraph 3. There is reference in this paragraph to a "proposed water delivery". This needs to be elaborated on. If the increased water delivery and appurtenant facilities are a portion of or necessary to the project, the impacts need to be discussed. h
9. Page IV-30, paragraph 2. A mitigation measure referred to herewithin is the analysis required by CEQA. Activities wholly within federal land do not require CEQA analyses. i
10. Page IV-50, paragraph 3. It is stated here that P.G.&E. may not be able to supply additional power to the project. Assuming that P.G.&E. cannot provide the electrical capacity required by this project, what impact would occur? j
11. The impact discussion fails to address the potential impacts upon oil production in the State and Alaska if this project is approved. At the very least, the conclusions from Appendix P and reference to Appendix P should be included. k

12. Page V-13, paragraph 2 under Comparative Effects. A statement is made that "hydrocarbon emissions would be from 2 to 5 1/2 times as great as the comparable NPR-1 case." Please explain this statement, especially how were these numbers determined. Additionally, it can probably be assumed. I
that if price were allowed to use demand would diminish, possibly removing the need of Elk Hills production at the MER. This aspect should be addressed.
13. Alternatives: The alternative section fails to recognize other energy sources as alternatives to production at the MER at Elk Hills. Additionally, conservation seems to be a very viable alternative. m
These oversights should be rectified in the final EIS.
14. Page VI-1. The discussion of any probable adverse environmental effects which cannot be avoided should probably be implemented, is incomplete. n
The discussion fails to analyze the impact on California and other oil production.


WILLIAM F. NORTHROP
Executive Officer

Memorandum

14

To : 1. Huey D. Johnson
Secretary for Resources
Resources Agency, 13th Floor
Resources Building

Date: AUG 8 1973

In Reply Refer
To: 420:SH

Attn: L. Frank Goodson

(916) 322-9873

2. U. S. Department of Energy
Washington DC
Washington 20545

From: STATE WATER RESOURCES CONTROL BOARD
Division of Planning and Research
P. O. Box 100, Sacramento, California 95801

Subject: REVIEW OF NOTICE OF INTENT: SCH 78071014--DRAFT EIS, PETROLEUM
PRODUCTION AT MAXIMUM EFFICIENT RATE AT NAVAL PETROLEUM
RESERVE NO. 1 (NPR-1) (ELK HILLS), KERN COUNTY

Introduction:

We have coordinated the review of the subject environmental document with the Hydrogeologic/Geotechnical Section of the State Board and the California Regional Water Quality Control Board, Central Valley Region.

This project involves the drilling of new oil wells; the withdrawal of oil, gas, and water from new and existing production wells; and the injection of gas and water into new and existing injection wells. As such, this project has the potential for significant impacts on the quality and quantity of surface and groundwater. The major environmental concerns of the State Board are the impacts on water quality from oil and gas wastes, wastewater spills, the disposal problems created by the petroleum-related wastes generated by the project, and the potential for changes in the quantity, quality, and distribution of surface and groundwaters.

Recommendation:

The final environmental impact statement should address the following comments.

General Comments:

1. The final EIS should describe the surface and groundwater resources of the Reserve and the surrounding area in greater detail. These resources should be plotted on a map or maps of appropriate scale to provide a basis for impact evaluation. The plots should show the location of any streams (including ephemeral streams), surface and groundwater resources, and all water wells on the Reserve and in the nearby area.

1. Huey D. Johnson
2. U. S. Department of Energy

-2-

2. The draft EIS in its discussion of water resources (pp. II-22 and II-23; Appendix J) indicates that the surface and groundwaters are of poor quality, and states that the cause of the degradation is not completely known. It is probable that the waste disposal practices in the area by the petroleum industry could have adversely affected water quality. The petroleum wastes from settling ponds, spills, and from drilling muds that have been disposed of along roadways in the Reserve all have potential for adversely affecting water quality in the Reserve. High quality groundwater occurs immediately north and east of the Reserve, and may extend into the Reserve near Tupman. In fact, wells supplying the West Kern County Water District are located approximately 1.5 miles northeast of the Reserve. b
3. The final EIS should include a map showing the distribution of the major soil types throughout the Reserve to permit a better assessment of impacts due to erosion and spills. Such a map would also complement and clarify the soils discussion in the draft EIS (pp. II-9 through II-12). c
4. The draft EIS (pp. II-22 and II-23) describes the quality of the groundwaters underlying NPR-1 to be of poor quality and being highly mineralized with total dissolved solids (TDS) concentrations averaging 5,000 mg/l. It is also stated that waters of this quality are generally considered unusable. The United States Environmental Protection Agency (EPA), in its March 21, 1978 draft Regulations for the Underground Injection Control Program, considers aquifers containing less than 10,000 mg/l TDS in geographic areas where no underground injection has occurred as designated underground sources of water to be protected. As such, the proposed regulations would require states to protect the source to the maximum extent feasible from actual or potential contamination caused by underground injection practices. On this basis, the potential usefulness of the shallow groundwater must be reconsidered. d
5. The discussion of groundwater resources in the draft EIS (pp. II-22 and II-23) should be expanded in the final EIS to include the possibility of hydraulic continuity between the Reserve and the San Joaquin Valley. If the basin adjacent to the Reserve is hydraulically continuous with the Reserve, elimination of Reserve brines and wastes should result in an improvement in basin water quality once the basin is flushed out. If this is the case, the water quality of the basin should be protected from the infiltration of Reserve wastes. e

1. Huey D. Johnson
2. U. S. Department of Energy

-3-

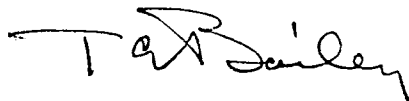
6. The final EIS should describe the impact on the existing freshwater supply of the consumptive use of 260,000 gpd of water during the construction of the NPR-1 facilities. The draft EIS (p. IV-20) states that no significant impacts should occur due to the freshwater supply from the West Kern County Water District. However, the withdrawal of water without its return to the usable water cycle will aggravate the existing groundwater overdraft in an already water deficient basin. f
7. The draft EIS does not discuss the effects of groundwater withdrawal for well operation and maintenance on land subsidence. The draft EIS does describe the subsidence aspects of petroleum extraction in detail (pp. IV-2 through IV-11), and should discuss the potential for land subsidence due to other causes in a similar manner. g
8. The draft EIS (pp. IV-21, D-8 and D-9, and J-3 and J-4) indicates that the construction and the operation of the NPR-1 facilities will not have an adverse impact on the water quality of groundwaters underlying the Reserve because of their poor quality. As stated previously, these waters can be classified as potential sources for drinking waters according to EPA. Thus, any impacts on the quality of these waters should be reassessed. If the potential impacts can be considered adverse, either alternative design or operation procedures, or suitable mitigation measures should be considered. h
9. Oil, gas liquid, and wastewater spills represent a major threat to land and water uses throughout the Reserve. The final EIS should ensure that all areas of the Reserve are protected from these spills. The discussion of risk assessment in the draft EIS (pp. I-40 through I-49) indicates that contingency catch basins are strategically located throughout the Reserve to contain oil spills from all sources. The final EIS should include a map showing the locations of these catch basins and their relation to areas of transfer, processing, and storage of oil and gas. In addition, the final EIS should consider the necessity of preventing percolation of any retained spills through underlying soils to potentially usable groundwater. i
10. The final EIS should describe the waste disposal practices to be followed by this project in more detail. In a section on waste disposal (pp. I-26 through I-28) the draft EIS indicates that the waste material generated by well drilling and production is disposed of along the banks of roadways. All wastes of this kind (e.g., drilling muds) should be disposed of at one of the two existing Class II-1 disposal sites on the Reserve or be hauled away by a solid waste disposal company. j

1. Huey D. Johnson -4-
2. U. S. Department of Energy

Specific Comments:

1. The draft EIS (page I-23) describes a proposal to mine approximately 28,000 B/D of supplemental water from the southern or western area of the Reserve for pressure maintenance injection. This water would be injected into the Shallow Zone and the Stevens Zone along with 170,000 B/D of water separated from oil. Due to chemical incompatibility of some of the produced water with the zone water, it is proposed to evaporate/percolate 30,000 B/D of the mixed produced water which could impact potentially usable groundwater. The final EIS should discuss the possibility that twin wastewater lines from the Lease Automatic Custody Transfer (LACT) system to the various wells could eliminate this problem and relieve the necessity of groundwater mining. k
2. The draft EIS, under Gathering and Processing Systems, describes a total of about 100,000 barrels per day of water separated from oil at the top of page I-23 and 170,000 barrels per day at the bottom of page I-23. This possible discrepancy should be clarified in the final EIS. l
3. The final EIS, in its discussion on the impact criteria for water resources, should consider the existing and potential beneficial uses of a particular water body when determining if substantial degradation has occurred. The draft EIS (p. J-7) appears to consider substantial degradation to have occurred only if the existing beneficial uses of the water body were severely hampered. m

If you have any questions concerning these comments, please contact Steve Hayes at (916) 322-9873.



Thomas E. Bailey
Assistant Chief

cc: California Regional Water Quality Control
Board, Central Valley Region
3201 S Street
Sacramento, CA 95816

Memorandum

(15)

To : Management Systems Officer
State Clearinghouse

Date: July 27, 1978

File : SCH No. 78071014
6-Ker-119-General

From : DEPARTMENT OF TRANSPORTATION
District 06 - Planning & Programs

Subject:

This memorandum replies to your Notice of Intent, Department Review, SCH No. 78071014, dated 7-3-78, forwarding for our comments a copy of the Draft Environmental Impact Statement, Petroleum Production at Maximum Efficient Rate, Naval Petroleum Reserve No. 1 (Elk Hills).

The present 20 tank trucks per day transporting liquid petroleum products to various Southern California markets is expected to increase to 200 tank trucks per day when production reaches maximum efficient rate (MER) by 1981. The projected increased traffic will probably be routed over State Route 119 from Naval Petroleum Reserve No. 1 to Interstate Route 5. At the present time, the State highways in this area are operating at an acceptable level of service. With the added burden of heavy truck traffic from the new facilities, the capacity of State Route 119 will be reached before 1985. Furthermore, the structural quality of the pavement section is not designed to support the expected truck traffic generated during the peak of the MER production. This peak is expected within 5 years after the open-up date (July 3, 1976). The present structural section on State Route 119 is based on a Traffic Index (T.I.) of 8.5, while the increased truck traffic will require a T.I. of 10.5-11.0.

R.L. Binger

R. L. Binger
District Planning
& Programs Engineer

RMN/BT:sjb
CC:RLB/JDH



18

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600 South Commonwealth Avenue • Suite 1000 • Los Angeles • California • 90005 • 213/385-1000

DIR. NAVAL PETROLEUM
RESERVE
WASHINGTON, D.C.

DATE: August 11, 1978

TO: Robert J. Catlin, Director
Office of NEPA Affairs
Department of Energy
Washington, D. C. 20545

FROM: Metropolitan Clearinghouse

RE: DEI Statement/Petroleum Production
SCAG File Number: MC-8266-ED

Pursuant to Part II of OMB Circular A-95 we have disseminated information on the DEIS for the Petroleum Production at Maximum Efficient Rate Project, Naval Petroleum Reserve No. 1 at Elk Hills to cities, counties and some special agencies in the SCAG region. Should any comments be received as the result of this notification, the comments will be transmitted to you immediately.

The SCAG staff has also reviewed the DEIS for consistency of the proposal with adopted regional plans, programs and policies. The comments are:

SCAG has adopted a policy of encouraging the production of natural gas at Elk Hills and making it available for intra-state sale. Because of the region's critical air quality concerns, the production and utilization of natural gas should be of the highest priority. At some future time when the west coast oil surplus situation is resolved or Elk Hills' crude oil can be marketed outside of California, the production of oil at MER at Elk Hills would appear to become a more reasonable option. Until this time, the possibilities of injecting water or field-generated inert gas to maintain reservoir pressure should be more carefully considered.

a

Notification of these comments will be included in the SCAG Executive Committee agenda for September. Should the Committee wish to comment further, we will send their comments to you immediately.

Clearinghouse Official

LK:mdc

1700 Flower Street
P. O. Box 997
Bakersfield, California 93302
Telephone (805) 861-3682

KERN COUNTY HEALTH DEPARTMENT
AIR POLLUTION CONTROL DISTRICT

LEON M. HEBERTSON, M.D.
Director of Public Health
Air Pollution Control Officer



August 8, 1978

17

Captain John Dick-Peddie
Office in Charge of Construction, Elk Hills
P.O. Box 40
San Bruno, California 94066

Dear Captain Dick-Peddie:

Project: DRAFT ENVIRONMENTAL IMPACT STATEMENT
PETROLEUM PRODUCTION AT MAXIMUM EFFICIENT RATE
NAVAL PETROLEUM RESERVE No.1 (Elk Hills, Kern County, California)

AIR QUALITY IMPACT DISCUSSION

1. Existing air quality
2. Expected project emissions
3. Mitigation measures
4. Alternatives to the project
5. Growth inducing impacts

Satisfactory Unsatisfactory

X	
X	
	X
	X
N/A	

SUMMARY OF AIR QUALITY IMPACTS

1. No increase in emissions
2. Small incremental increase in emissions
3. Significant increase in emissions
4. Adverse air quality impact
5. Indeterminate
6. No comment

X

Page Two

Project: PPR-NO. 1

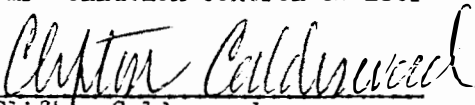
Comments: The proposed project appears to have resulted in a violation of the 1 hour California Ambient Air Standard for NO_2 . As a result of this apparent violation at the public roadway, it appears that the finding required in Rule 210.1 of the Rules & Regulations of the Kern County Air Pollution Control District (APCD) can not be made. Unless the problem stated hereinabove can be mitigated, it may be the case that an Authority to Construct required pursuant to Rule 201(a) can not be granted. **a**

In addition, it is highly desirable to state the air quality impacts in lbs/hr or tons/yr for each alternative in the DMS. **b**

Should you or your staff have any questions, please telephone our office at (805) 861-3682.

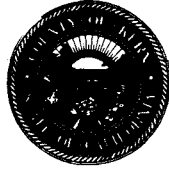
Sincerely,

Leon M. Hebertson, M.D.
Air Pollution Control Officer


Clifton Calderwood
Assistant Chief Air Sanitation Officer

KERN COUNTY PLANNING DEPARTMENT

18



1103 Golden State Avenue
BAKERSFIELD, CALIFORNIA-93301
Telephone (805) 861-2615

July 24, 1978

File: EIR Misc.
Elk Hills

Robert J. Catlin, Director
Office of NEPA Affairs
Assistant Secretary for Environment
Department of Energy
Washington, D.C. 20545

Re: Draft EIS, DOE/EIS-0012-D, Petroleum Production
at Maximum Efficiency Rate, Naval Petroleum
Reserve No. 1, Kern County, California

Gentlemen:

This office has reviewed the above-referenced document transmitted to us by cover letter dated June 15, 1978. The Draft EIS made careful reference to the various environmental concerns and existing land uses within that portion of Kern County which the project is situated. The Draft EIS appears to be adequate in this respect. Based upon the submitted information and upon other environmental data available, the following planning staff concerns are presented and should be addressed by your department during finalization of the EIS.

1. No indication is made to tertiary recovery methods to be utilized for hydrocarbon withdrawal when the Stevens and Caneros zones are not capable of flowing productions. If additional steam generators and injection water would be necessary, indicate this and discuss significant effects related to such recovery methods. (Page 1-10) a
2. A description of where drilling muds and related materials are disposed of and the impacts of such disposal is needed. Would there be any significant effect caused by disposal of these materials? b
3. No discussion of air pollutant emissions from refinery operations of Elk Hills crude within the San Joaquin Valley Air Basin is apparent. It would appear that a thorough discussion of impacts related to the overall maximum efficiency rate project, including secondary effects, is lacking. (Page IV-II) c
4. On Page II-31, the discussion omits the Naval Weapons Center, also in Kern County. d

Re: Draft EIS - Naval Petroleum Reserve

Page 2

5. On Page II-37, the discussion omits State Route 99. e
6. Page II-39 states that the AADT of State Route 58 @ State Route 99 was 29,000 in 1976. We suggest a check of this figure since the 1977 AADT for the intersection is 22,000; the 1976 figure reported by Cal Trans was 21,000. f
7. The discussion on Page II-48 needs to be updated in regard to the legislation adopted pursuant to the recently voter approved Jarvin-Gann initiative. g
8. On Page IV-17, the transportation emissions discussion lacks assessment of VMT emissions attributed to commuter traffic and to a potential 200 trucks per day in the San Joaquin Valley Air Basin and in the EPA-designated Kern AQMA. Emissions due to high VMT between Bakersfield and the site must be addressed. Mitigation of air pollution from high VMT in this case is strongly suggested. h
9. The discussion on Page IV-18 in regards to increased power consumption fails to address cumulative effects in regard to air emissions throughout the Pacific Gas & Electric service area. i
10. Particulate matter emissions, especially the impacts of particles of one micron and smaller from the entire spectrum of facility construction, operation, transportation, and refining of hydrocarbons within the air basin should be discussed. j
11. Suggested air quality mitigation includes a provision that prior to construction, the Kern County Air Pollution Control District shall verify the DOE's ambient and project operation and construction air pollution emission estimates, identify air quality sensitive activities and areas within the AQMA; verify the DOE's analysis, present conditions to be incorporated into the project's overall operation plan and into the proposed Kern Air Quality Maintenance Plan. k
12. It is strongly suggested that the project not be constructed or operated as planned until sufficient evidence is presented to support a finding of adequacy for the measures proposed by the DOE to deal with the issue of decommissioning. l
13. On Page IV-19, first full paragraph presents a quasi trade-off for air pollution emissions. This trade-off should be explained, quantified with sample calculations and presented for acceptance to the Kern County Air Pollution Control District. m
14. Page IV-20 should present the amount of installed energy (preferably in MWe) necessary to deliver the necessary 260,000 GPD from its origin to n

Re: Draft EIS - Naval Petroleum Reserve

Page 3

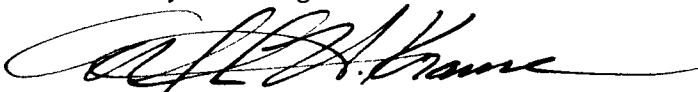
the project site. Discussion of significant effects related to the anticipated overall project energy consumption is needed.

15. The discussion on Page IV-26, second paragraph under the heading Wildlife would appear not correct. The question of wildlife-caring capacity of habitat before and after construction has not been assessed. Displacement of fauna from construction sites to other sites already inhabited at an optimum ecological balance would appear to upset that balance. o
16. The data presented on Page IV-31, Table 4-2 should also be presented on a plot plan of sufficient scale to permit competent review of the proposed action. p
17. Discussion of operation on Page IV-40 should also discuss cumulative effects to road systems in light of on-going and proposed residential development in Rosedale and Southwest Bakersfield. A graph of time versus total VMT attributed to the project should be presented. Mitigation is needed to reduce transportation impacts - i.e., mass transit between Bakersfield and project site. The EIS does not discuss cumulative effects due to VMT. The EIS does not discuss overall expense to the County and State for road maintenance, increased accident potential, traffic control and air pollution emission surveillance. q
18. The discussion on effects to law enforcement would appear to not exemplify the effects anticipated due to 1,635~~+~~ construction workers. r
19. Page IX-1 - the EIS's treatment of economic benefits is very tenuous. The document does not provide a logical quantification of economic facts to justify why increased employment and economic activity is beneficial in a region with existing low unemployment and relatively inflation resistant economy. For example, how is increased domestic production a benefit to Kern County and its regional economic setting if a present west coast oil surplus situation is not resolved by the DOE? s
20. The EIS fails to compare viable energy recovery alternatives to oil. The NEPA does not appear to allow the DOE to relax its mandated discussion of viable alternatives to the project because of a subsequent public law (No. 94-258). t

Should additional relevant data be developed during the processing of this EIS, we may submit additional comments at that time. Thank you for the opportunity to participate in the preparation of this document. It is requested that you submit a copy of the Final EIS for our files.

Very truly yours,

TED HILTON, Planning Director



By: MELVIN H. KRAUSE, Assistant Planner

XI-43

mmh

cc: Kern County Air Pollution Control District



August 4, 1978

Officer in Charge of Construction
Naval Facilities Engineering
Command Contracts
Elk Hills
San Bruno, California 94066

Dear Sir:

I have reviewed the draft environmental impact statement on maximum efficient petroleum production at Naval Petroleum Reserve No. 1 in the Elk Hills, Kern County, California (DOE/EIS-0012-D). The statement was forwarded to me because I have just completed a major paleontologic environmental impact statement on an area near McKittrick, California-just west of the Elk Hills.

I find the impact statement totally deficient in regard to impact upon paleontologic resources. They are totally ignored in Section IV, even though given passing mention in Section II - 3. - e. (p. II-13). Paleontologic resources are accorded the same protection under the law as other cultural resources.

The paleontologic resources of the Elk Hills area are potentially very important and construction and drilling activities could result in major negative impacts if not properly mitigated. From my recent studies in the area, I offer the following brief discussion of three potential sources of important paleontologic materials in order of increasing probability of occurrence.

FOSSILIFEROUS ASPHALT DEPOSITS

Even though no asphalt deposits have ever been reported from the Reserve area, there is a slight, but distinct, possibility that they may be present under a thin veneer of alluvium. Known asphalt deposits extend from near McKittrick to near Maricopa. Several of them contain extremely important and valuable fossil remains from the Pleistocene. The activities as proposed in the EIS will not impact any known deposits, but the area is poorly studied.

Giles W. Mead, Director
Leon G. Arnold, Assistant Director
Gurdon Woods, Assistant Director

NATURAL HISTORY MUSEUM LOS ANGELES COUNTY

Los Angeles County Museum of Natural History • 900 Exposition Boulevard • Los Angeles, California 90007 • tel (213) 746-0410
George C. Page Museum • Hancock Park • 5801 Wilshire Boulevard • Los Angeles, California 90036 • tel (213) 933-7451

FOSSILS IN ALLUVIUM

In the EIS, the alluvial deposits are described as being of Holocene (Recent) age. We recently found Late Pleistocene fossil vertebrates in similar alluvium just west of McKittrick. Woodring et al (1952) and Maher et al. (1975) indicate that the alluvium in the Elk Hills may be partially of Pleistocene age. I believe there is a high probability that Pleistocene fossils do occur in the alluvium within the Reserve.

FOSSILS IN THE TULARE FORMATION

The Tulare Formation in the Elk Hills is potentially a very important source of vertebrate fossils, but it has never been systematically explored for them. The few existing records are the result of accidental finds by workmen and by geologists not engaged in a systematic search for fossils. Woodring et al. (1932) record the following localities for fossil vertebrates: western part of sec. 4, T. 31S., R. 24E; southwestern part of sec. 32, T. 30S, R. 24E.; near well #110, sec. 35, T. 30S., R. 24E.; and near well #75 sec. 35, T. 30S., R. 24E. Most of the fossils from the former two localities are of rodents and rabbits, rarely found by non-specialists. The Tulare Formation appears to straddle the Pliocene-Pleistocene boundary, a poorly understood period of geologic time in western North America. The apparent abundance of fossil vertebrates (at least in the eastern part of the Reserve), plus the stratigraphic position of the Tulare Formation make the Elk Hills Reserve a very important and sensitive paleontologic resource. In addition to the vertebrates, Woodring et al. (1932) reported silicified wood from the SW 1/4, sec. 19, T. 30S., R. 23E. Other fossil vertebrate and invertebrate localities are known from outcrops of the Tulare Formation outside the Reserve.

I recommend and urge that the Environmental Impact Statement be amended to include impact on paleontologic resources. This should include the following:

a

1. A comprehensive literature survey.
2. A field survey to determine the actual extent and distribution of fossil deposits.
3. Recommended mitigation procedures which would allow preservation or salvage of paleontologic resources without unduly hampering development.

Sincerely,



William A. Akersten, PhD
Curator
George C. Page Museum

WAA:jeb

Robert J. Catlin, Director
Office of NEPA Affairs
Assistant Secretary for Environment
Department of Energy
Washington, D. C. 20545

City Council
Bakersfield, California
Dr. Lawrence G. Barnes

Dr. David Whistler
Dr. Theodore Downs

CITY OF TAFT



STEPHEN L. WRIGHT, City Manager

CIVIC CENTER • 209 E. KERN ST. • TAFT, CALIFORNIA 93268 • 805-763-3144

20

August 10, 1978

Mr. John B. Farmakides
Chairman of the Board
of Contract Appeals
U.S. Department of Energy
Washington, D.C. 20545

Gentlemen:

The following comments are made to the United States Department of Energy in response to the request for comments on the Draft Environmental Impact Statement, DOE/EIS-0012-D, Petroleum Production at Maximum Efficient Rate, Naval Petroleum Reserve Number 1, (Elk Hills) Kern County, California. These written comments are made in conjunction with my verbal statements made at the Public Hearing held August 1, 1978, in the City of Bakersfield. As stated at that time, these comments are a City staff viewpoint of the Draft EIS and will also be presented to the Taft City Council for their review. As also stated at the Public Hearing, oil production provides primary commercial and industrial base of this community and the proposed project at NPR-1 has been highly supported on a community-wide basis. The City's full support and cooperation towards making the project most effective and towards providing adequate community services to the population to be served are our primary goals.

The comments noted herein focus on two primary concerns. First, the analysis of the local impacts of the project and their mitigating measures seem to have been reviewed at a relatively superficial level with the Taft socioeconomic conditions being combined with that of the Bakersfield metropolitan area. This combining of separate urban areas eliminates a primary distinction which the City believes should be made. Second, the relatively low level of documentation and age of the data which is utilized in this report does not accurately reflect the current conditions within the community. The changes which are noted herein may well be a reflection of current activities of the Department of Energy at NPR-1 and tends to support the City's contention that the relative impacts of the project on the Taft area may be much greater than is suggested in this report. The following comments relate to specific sections of the draft EIS which highlight the concerns noted above.

XI-46

COUNCIL: MYRON SMITH, MAYOR

GLENN D. BLACK

DONALD M. BRAUN

KEN DeTILLA

KEN FULLER

<u>Section/Page</u>	<u>Comment</u>	
II H 2 /II-36	An assumption is made that the Taft population is declining. Statistics confirmed by the California State Department of Finance are as follows for the City of Taft:	a
	1976 4,514	
	1977 4,594	
	1978 4,714	
	These figures reflect only the growth that has occurred within the corporate limits of the City. Commensurate or higher growth may also have occurred in the unincorporated areas surrounding Taft.	
II H 3 /II-37	The Draft EIS suggests (without documentation) that vacancy rates in housing in high. Housing in Taft is currently at a premium and buyers and renters alike are being turned away due to the housing shortage.	b
	Documented statement reveals only 24 permits between 1970 and 1974 to suggest decline in new construction. City records show that since 1974 there have been:	
	99 single family homes	
	37 multi family units	
	42 mobile homes	
	1 annexation (83 acres) completed	
	1 annexation (80 acres) nearing completion	
	3 subdivisions currently underway representing 76 single family homes	
II H 5 /II-43&44	Neither regional or local description reflects boundaries or activities of the Westside Park and Recreation District which includes all of NPR-1 and 2 within its boundaries.	c
IV H 1 /IV-36&37	Mitigation measures suggested to offset the potential adverse socioeconomic impacts stated on pages IV-35 and 36 are both superficial and unrealistic. The types of mitigation efforts on a governmental level that are suggested take a considerable amount of advanced planning effort to implement. The small City economy and municipal budget makes available an extremely small amount of funds to provide for day-to-day planning let alone the impacts of a \$600 million NPR-1 project. In addition, it is already evident that the impacts of the Elk Hills project are significantly being felt in Taft, therefore the City's ability to plan in advance has been limited.	d

The City intends to react to and plan for the changes

and adverse impacts as much as possible, however, the Federal Government and the U.S. Department of Energy should also have a direct responsibility to aid in the mitigation of the adverse impacts that may be caused by this project. The Draft and Final EIS should address that responsibility.

IV H 2,3/
IV-38,39

Throughout the Draft EIS there seems to be an unspoken assumption that when the Taft labor force, housing market, etc. is exhausted, reliance upon surplus available labor and housing in the Bakersfield metropolitan area will offset any additional demand. Little attention seems to have been given to the proximity of Taft to NPR-1 as compared with Bakersfield and therefore its relative desirability as a residential site for a significant percentage of the Elk Hills work force. The City of Taft is concerned that this primary assumption may be incorrect and that Taft may well attract a larger percentage of employee/residents than assumed and therefore incur a greater socioeconomic and housing impact than is stated in the Draft EIS. Current construction and economic activity trends seems to bear this out and the Draft and Final EIS should address this possibility in greater detail. e

IV H 6/IV-50,51

This section suggests that "Costs to state and local governments are minor" and that may be true in a relative sense. However, for a small city such as Taft to provide local governmental services to a population and commercial/industrial infrastructure which may proportionately expand by a significant percentage in the course of 2-5 years, the costs may indeed be great. The Draft EIS has overlooked this probability and seems to overlook the relative impact that the project will have on Taft throughout the entire report. Again, the Federal Government and the Department of Energy should have a direct responsibility in both accurately assessing and mitigating the various local impacts created by this project. f

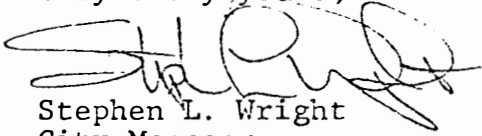
The above comments relate only to those local activities and conditions which are of direct concern to the Taft municipal government. Other sections in the Draft EIS relating to such local issues as Education, Public Utilities, Transportation and Recreation should also be given equal attention when considering the relative impact upon the Taft area. One of the City's primary concerns is the community's ability to adequately react to the changes which will occur as a result of the proposed project. Not only the City, but also the U.S. Department of Energy should be concerned and responsible for the planning and coping with this impact. The Draft and Final EIS should respond to these concerns and recommend a cooperative working relationship between the Federal and Local agencies so that local services can be adequately

Mr. John B. Farmakides
August 10, 1978
page 4

and responsibly supplied to the citizens of this community.

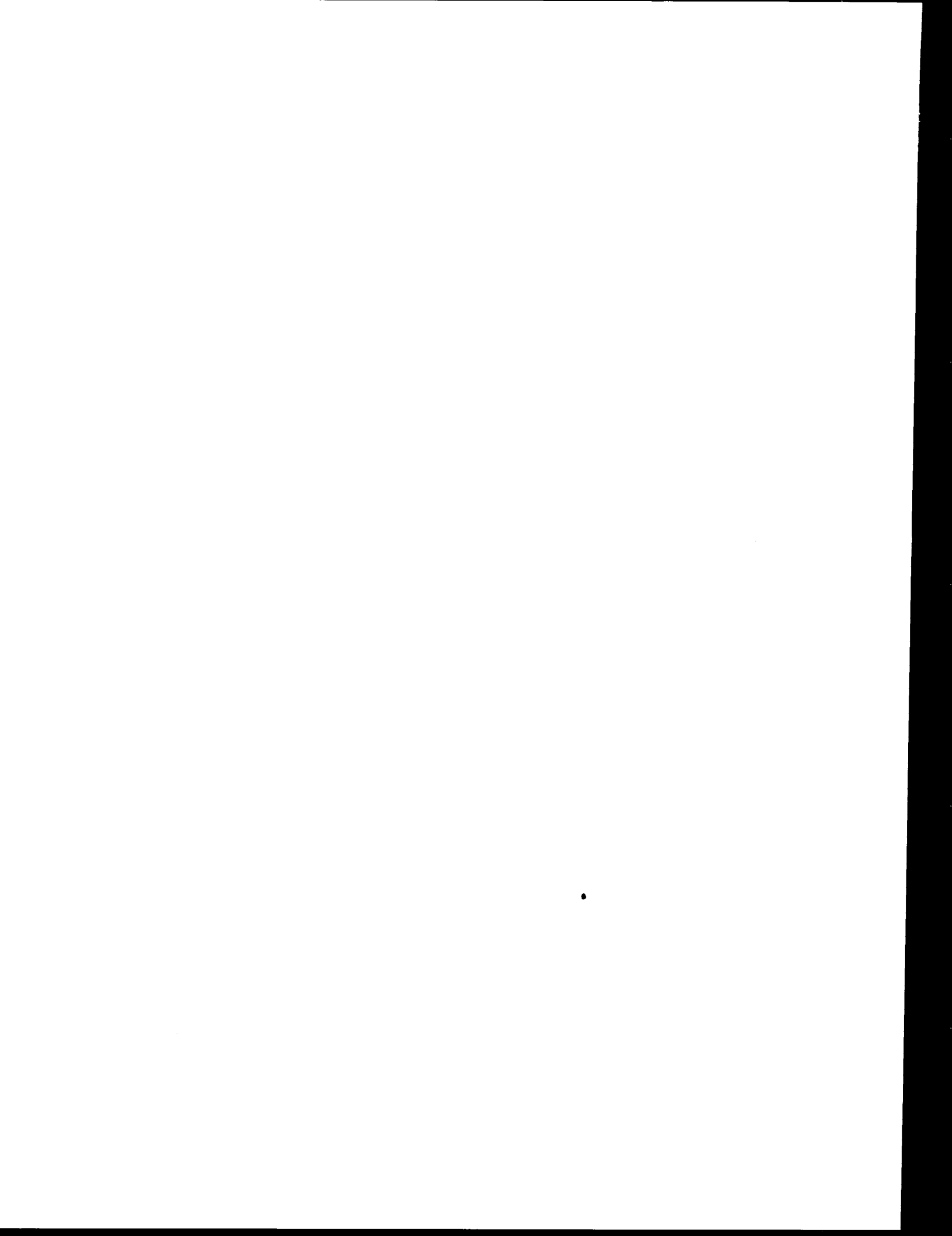
If further information or documentation is needed, please feel free to contact this office.

Very truly yours,

A handwritten signature in dark ink, appearing to read 'Stephen L. Wright', with a large, stylized initial 'S' and 'W'.

Stephen L. Wright
City Manager

SLW:cw



TED KREINES, AIP
58 Paseo Mirasol
Tiburon, Ca. 94920
Tel.: 415/435-9214

February 26, 1979

Captain John Dick-Peddie
OICC Elk Hills
Western Division
NAVFAC
P. O. Box 40
San Bruno, CA 94066

Dear Captain Dick-Peddie:

Thank you for your continued cooperation with the Elk Hills Impact Study I am conducting for the City of Taft. In accordance with your offer made to City Manager Steve Wright, City Planner Mark Balkovek and myself on December 22, 1978, I would like to bring to your attention our concern about the following items in the Final Environmental Impact Statement on Elk Hills MER:

- 1) Page II-34: the estimated work force in oil production
alone in 1978 was 4232 in Kern County. All oil employees
totaled 9000. 1
- 2) Page II-35, under b. Local, the first paragraph describing
the importance of oil production and employment to Taft
and the Greater Taft Area, is obsolete relative to data
which I submitted to Mr. Vovakis of URS in January 1979. 2
This information is now being forwarded to you in the form
of my Memorandum #2 to my client, the City of Taft. It
shows that oil alone is responsible for at least 3176
employees, many of which I have not been able to count in
my survey.
- 3) Page II-36, under b. Local, we question the discussion of
the population size and changes in the Greater Taft Area,
and once again refer you to an unfinished memorandum which
is attached, Memorandum #3 to the City of Taft. Therein
we describe changes in population and the confusion over
what constitutes the "Greater Taft Area." I direct your 3
attention specifically to page 8, where we cite census
data for the Greater Taft Area for the years 1960 and 1970.
It can be seen that population did not decline but in fact
has gained substantially, primarily because of development
in the census tract 33.01. More importantly, the City of
Taft did not lose population either, and this can be verified

by Figure 3 on page 3, or by checking with census tract 35 as shown, again, on page 8. In both cases, the City of Taft is shown to be increasing in population. Also, Greater Taft has more than 12,000 persons, depending on how you wish to describe it. Most importantly, the projections for 1980 are not verified by most of the projections that I have seen, which is documented in several places in Memorandum #3. The attempt to characterize the Greater Taft Area as one that is *declining* in population is not reinforced by most of the data. Furthermore, the reference in the second paragraph of this section to the population being lower-middle to middle class is just not consistent with the facts that we have at our disposal. We took a very careful survey of these people, and describe them with the data offered on page 16.

- 4) On page II-37, the discussion under b. Local indicates 99 single family units were constructed between 1974 and 1978. There were another 126 units added in the form of mobile homes and apartments during the same four year period. Once again, these data were made available to Mr. Vovakis at URS last month. At the end of this paragraph, it is indicated that 85% of local housing is classed as sub-standard. We are not aware of the study that would so classify so much of housing on the Westside as sub-standard, but we do recognize the need for some substantial improvement assistance for housing.

THE ABOVE INFORMATION POINTS TO A DILEMMA NOT MENTIONED IN THE FINAL EIS, BUT REFERRED TO IN DISCUSSIONS WITH THE URS COMPANY: WHEN ATTEMPTING TO GET ASSISTANCE FROM THE KERN COUNTY COMMUNITY DEVELOPMENT DEPARTMENT, THE CITY OF TAFT IS TOLD THAT:

- 1) THE HOUSING IS BAD ON THE WESTSIDE, BUT IT ISN'T AS BAD AS OTHER AREAS IN KERN COUNTY, AND FURTHERMORE...
- 2) THE INCOMES AND EMPLOYMENT RATE WITHIN THAT AREA DO NOT JUSTIFY ANY FEDERAL ASSISTANCE.

WE THEREFORE NEED CORRECT DATA TO CHARACTERIZE OUR PROBLEM IN ORDER FOR US TO APPLY TO THE CORRECT AGENCY FOR SOME FORM OF IMPACT ASSISTANCE DUE TO ELK HILLS PRODUCTION.

- 5) Page II-38, no streets within City of Taft are mentioned, and our concern is that they will be impacted by Elk Hills traffic, both trucks and workers' automobiles. Similarly, the table (2-2) on page II-39 shows no Taft streets.
- 6) Page II-40 discusses the Kern County Sheriff's Department but not the Taft Police Department. In regard to the Deputy Sheriff, we note the inclusion of keeping out "grazing sheep" as part of his duties. We would impress upon you that law enforcement activities are more demanding than what this paragraph seems to indicate.

In fact, the following data applies to the City of Taft Police Department increase in activity since Elk Hills open-up:

	<u>Arrests</u>	<u>Citations</u>
1970	235	1284
1971	182	1226
1972	166	701
1973	208	1052
1974	293	1931
1975	507	2215
1976	459	1024
1977	443	2289
1978	645	1721

While it is impossible to determine whether this increase in activity was due to the open-up of Elk Hills or not, we believe that the point is made, for the City Police Department as well as Kern County Sheriff, that increased Elk Hills employment will lead to increased police services demand.

- 7) Page II-40 indicates that the Kern County Fire Department is well established in both Bakersfield and Taft. Our concern is that there is no discussion of the City of Taft Fire Department. When increased responses to demands upon the Kern County Fire Department at Taft are received, what will be the added pressure on the City of Taft to serve other unincorporated areas? Even if the Kern County Fire Department is increased sufficiently to serve the additional growth at Elk Hills, there still will be a deficit in the ability of the County Fire Department to serve other unincorporated areas. 7

- 8) On an unmarked page, under 3) Mitigation Measures, the Final EIS mentions that "significant land use or environmental impacts would be regulated by the California Environmental Quality Act." We do not see the California Environmental Quality Act (CEQA) as capable of "regulating" any land use or environmental impacts. All CEQA does is to disclose to decision makers what such impacts might be. We also wonder about the "operational structure" which would minimize land use impact. While we agree there is such a structure, we're not sure that it would act to minimize impacts. In fact, there is a distinct possibility such a structure in the City of Taft would react to growth in a positive way, thereby exacerbating impact. We interpret "mitigation measures" to mean actual, tangible measures which can be taken by local government to ameliorate the affects of any impacts. CEQA simply does not do this, and we do not know of any "bail out" program which will help the City of Taft in the event that the City over-reacts. 8

- 9) Page IV-39, the first paragraph mentions a "lack of tax base from government activities." We believe that this is even greater evidence that the federal government must somehow compensate for impacts within the local area. We believe that the EIS should mention that in every other case, the federal government provides for impact assistance in some way, such as:

- a) payments in lieu of taxes
- b) subventions to the state on BLM lands
- c) ad valorem taxation on leaseholds, such as those in NPR-2

If there is no way for the federal government to compensate the local area for impacts, shouldn't the EIS indicate that this is a severe socioeconomic burden on the Westside, and the City of Taft in particular?

- 10) Page IV-39, the next paragraph indicates that the Taft City Council "could ensure that subcontracts provide for maximum employment of local surplus labor and minimum burden on municipal and county infrastructure," but we're not sure such a requirement could be enforced. People own land, they are approached by those who are in a position to develop it, and unless a city wishes to face litigation on property rights issues, the ability to develop land cannot be abrogated.

- 11) Page IV-39, the next paragraph indicates that the Kern County Council of Governments (COG) might be a good vehicle through which infrastructure, construction and diversification of planning could occur. We agree, but we would also note that given the *ex post facto* nature of this EIS, we will need to move swiftly. This would indicate that the city itself, commonly the recipient of such impact assessment grants anyway, would be the proper agent for dealing with the federal government, receiving the monies necessary to mitigate impacts and to plan and construct such facilities as found necessary.

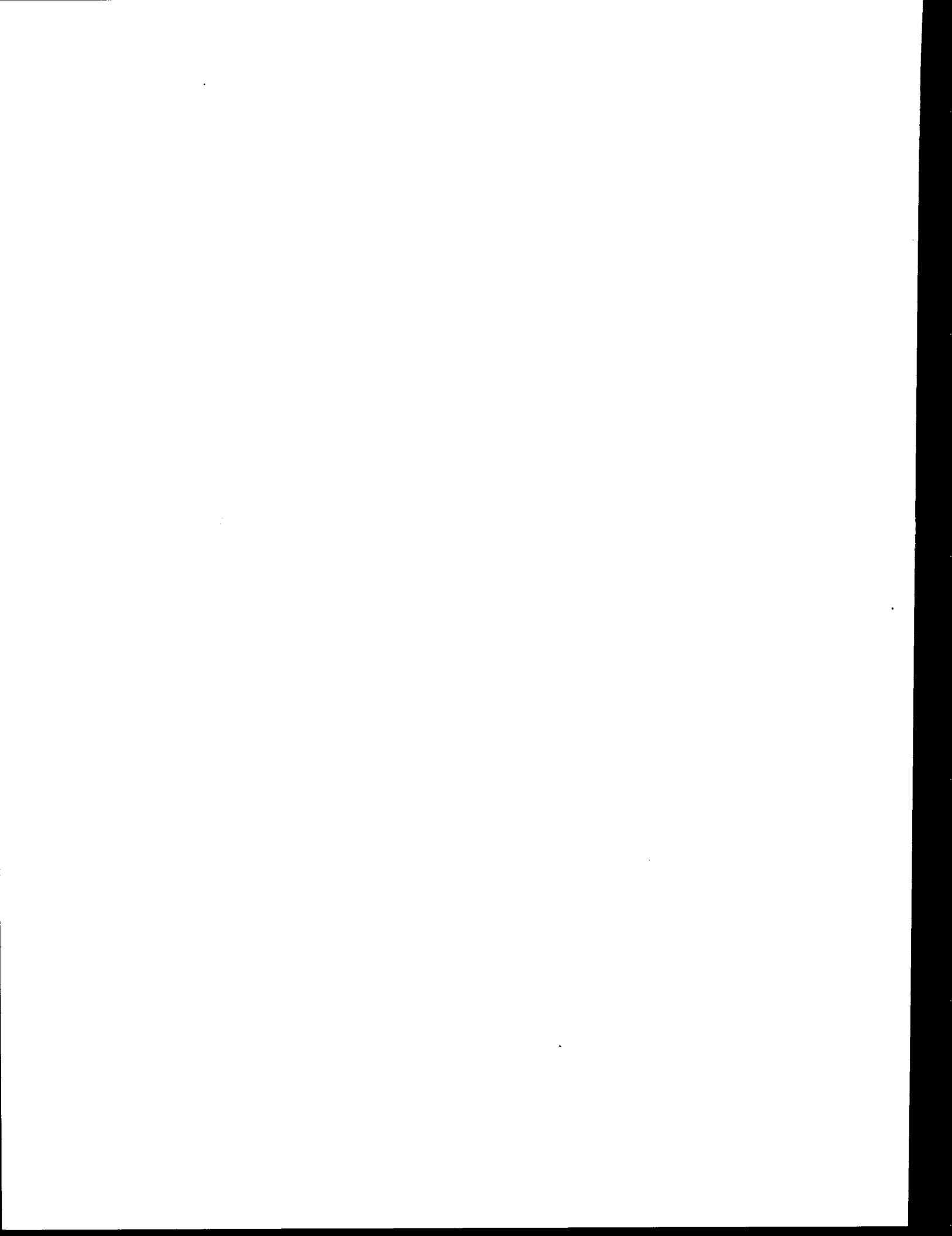
- 12) On page IV-40, under b. Operations-Related, we find the discussion of employment in-migration inadequate. Our Memorandum #2, which is attached, discusses this phenomenon in detail. The major deficiency in the URS analysis lies in the fact that in-migration can be predicted, contrary to the statement in the last paragraph of that section. Furthermore, we predict a larger degree of in-migration than does the Final EIS. Finally, in-migration of labor in specific industries such as oil production and their related services which is less than the new labor required for the project, means that some labor is coming from other Kern County oil production projects. All the data we have been able to uncover indicates that Kern County is consistently growing in terms of oil production employees. This means that oil employees will not be *borrowed* from other projects to serve Elk Hills, but rather will be *imported* from jobs elsewhere. Therefore, the total amount of labor required for Elk Hills can be considered *net immigration*.

- 13) Page IV-40, under 3. Housing, a. Construction-Related, the figures for the Bakersfield metropolitan area include areas as far removed from Taft as Ridgecrest, a full day's journey away, thereby putting much of this housing in a completely different market. More importantly, no mention is made of the local housing market in Taft. We continue to maintain that this market is severely impacted, and therefore shows a no or low vacancy rate. Under b. Operation-Related, it is noted that 400 to 500 housing units will be needed, but only half of these would be commuting from the Bakersfield area. Where will the other half of those units locate? If they are to occur in Taft, under conditions of an impacted housing market, how can Taft provide for them? If the City of Taft responds to the housing demands, and if the infrastructure is "over burdened" as you indicate on page IV-39, who will help improve the infrastructure in order to accomodate the additional population in the City of Taft? 13
- Our primary concern in this point is that there has been no discussion on the local housing market in Taft, which is severely impacted.
- 14) On page IV-41, the EIS states that there is "no means to quantify this impact" as related to regional travel patterns in the area. On the contrary, there are established techniques to do this, amongst which is the very simple method of assigning the additional traffic created by the project according to the current assignment of traffic in the area. Therefore, if 40% of the traffic goes to Taft in 1974, it is safe to assume that 40% of the additional traffic might go to Taft in 1978 or 1980. The only reason that these percentages would change, and we believe they will, would be if the locational patterns of the population were changing. This is the primary point with which we take issue with the Final EIS: where the future growth will go. 14
- 15) Page IV-41 indicates that "1700 to 2500" daily trips by construction workers will be made while Elk Hills is being built. The paragraph goes on to state that "most of these workers would be expected to live within the City of Bakersfield while the rest would reside in other neighboring communities." We believe that this analysis should be more specific and estimate which neighboring communities would house these construction workers. Most importantly, we would like to know how many of those construction workers are seen to be living on the Westside, and in the City of Taft specifically. 15
- 16) Under the first paragraph of IV-42, Operation, the EIS indicates an increase of 152 trips due to new employees. We would find that figure very low, regardless of the three-shift breakdown, especially when vendors and the concentration of workers during the day shift are considered. We suggest that you break out the rationale for the number 152. 16

- 17) Page IV-45 indicates that substantial truck traffic would be created to link the NPR-1 gas plants and the railroad siding east of Taft. The assumption is that all of this traffic would occur on roads outside of the City of Taft. However, we question whether the same traffic pattern will always be followed. We also question whether some of these trips will not head through Taft on their way to or from their destination in order to take care of other functions, including lunch, a stop at the bank, etc. In addition, there will be automobile traffic related to the location of the railroad spur which will be funnelled through the local Taft street system. We would like a breakdown of how this traffic will impact the City of Taft, especially in view of our already deteriorated street system. 17
- 18) Page IV-46, under Mitigation, several recommended measures are discussed in the first paragraph. All of them are "soft" advisory-type programs, and none involve the expenditure of hard dollars. Isn't this a place where the federal government, either through the Department of Energy or the Department of Transportation, can contribute dollars to help ease a problem? Shouldn't these programs be mentioned and the amount of dollars indicated? 18
- 19) Page IV-46, under Police Services, implied that all of the impacts will be on the Sheriff's Department of Kern County. We maintain that the City of Taft will grow as a result of Elk Hills and that this growth will require growth in police services for three reasons: 19
- a) construction related employment will recreate in Taft
 - b) some of the operations-related employment will live in Taft
 - c) all employees, whether construction, operations or vendors visiting Elk Hills, sooner or later end up using Taft establishments and creating, as indicated earlier, greater police activity
- Some estimate of this increased activity should be made, if only based upon the data offered under the earlier points.
- 20) XI-116 indicates a comment from the City of Taft questioning the California Department of Finance population estimate. We have discussed our concern for use of numbers which do not show actual growth in the City of Taft, since we have properly represented them with documented data. We think that this entire presentation of documented data should be a part of your Final EIS. 20
- 21) Under the same group of comments from the City of Taft, b., the Final EIS notes that the "text has been revised to include the more current data." We would once again direct your attention to comments made in other portions of this letter which indicate that all the current data made available to the URS Corporation have not been incorporated into the Final EIS. Attached to this letter are the type of data which we feel should be abstracted and attached to your document. 21

- 22) Page XI-116 suggests that housing construction is "strongly influenced by national and state economic conditions and interest rates." This has never been the situation in Taft as far as we've been able to tell, since Taft is a "mini-economy" unto itself. For example, when Chevron U.S.A., Inc. evacuated its 11-C camp, interest rates were low and new housing were high in the State of California. However, due to the evacuation of 11-C, no building took place in the localized market of Taft. We conclude, on the other hand, that now that the demand is evident, building will occur in Taft *regardless* of interest rates or macro-economic conditions. This point goes on to mention building activity "prior to July 1976" as not attributable to the Elk Hills open-up. We are not aware of an upsurge in building activity prior to 1976. In fact, the material provided Mr. Vovakis of the URS Company indicates that most of the building activity occurred subsequent to Elk Hills open-up. 22
- 23) On page XI-117, under comment d., the text notes that "the government is willing to cooperate with local governments to identify and deal with local impacts of this project." We are aware of your intent to assist with this problem, but we do not have any indication, especially from the Department of Energy, that any impact assistance will be made available to the City of Taft. Therefore, the statement that there is a government "willingness" is not substantiated with any documentation. Only the final sentence, alluding to your cooperation with us in this effort is held out as hope that some tangible relief will be made available to the City of Taft. We would request something stronger than a kind assumption here. 23
- 24) Under e., on the same page, you indicate in the Final EIS that growth will occur somewhere, but primarily in Bakersfield, as opposed to the City of Taft. We would once again point to the necessity for acknowledging that either way, there will be a total in-migration of labor to serve Elk Hills. If, in effect, we are "stealing" employees from Oildale and Stockdale to work in Elk Hills, their jobs will be replaced by others who will have to come into Kern County from other points outside that area. The total effect is substantially greater in-migration than that reported in the Final EIS. Furthermore, the VMT consequences of a travel pattern heavily oriented toward Bakersfield is not adequately discussed in the Final EIS. 24

We hope that you will take these comments in a positive light, since it is our wish to set the record straight for future applications for energy impact assistance from the city to the federal government. This is our one chance to tell you of the serious work we have done in this regard, and to present our data which we feel will substantiate different findings than those made in your Final Environmental Impact Statement.



If you have any questions concerning the sources and methods used to furnish this data to you, please do not hesitate to call upon me. I certainly appreciate your attention and cooperation in this matter.

Sincerely,

A handwritten signature in cursive script that reads "Ted Kreines".

Ted Kreines, AICP

Attachments

cc: Steve Wright, City Manager,
City of Taft

TK:dd

D. Responses to Comments

Following are responses to written comments received on the Draft Environmental Impact Statement (DEIS).

1. Advisory Council on Historic Preservation

a. C The Council wishes to remind the Department of Energy that should it be determined cultural properties included in or eligible for inclusion in the National Register will be affected by the undertaking, it is required to afford the Council an opportunity to comment pursuant to Section 106 of the National Historic Preservation Act of 1966.

R In the event that previously unknown cultural resources are discovered in the course of this project, the Department of Energy will inform the Advisory Council on Historic Preservation and request comments in accordance with the National Historic Preservation Act of 1966.

2. U. S. Department of Agriculture, Soil Conservation Service

a. C Provisions for erosion control and water management during construction was not considered in the Draft Environmental Impact Statement, including maintaining and improving natural drainage courses which may be crossed by pipelines or roads and stockpiling or disposing of topsoil. Impacts on prime agricultural lands were not addressed.

R The Reserve routinely follows sound erosion and sediment control practices during and after the various construction activities associated with this project. At road or pipeline crossings of natural drainageways, culverts are installed to protect the drainageway. Special slope stabilization measures are provided where conditions warrant. Other construction activities are similarly evaluated and appropriate erosion control methods applied. Topsoil removed during construction activities is stockpiled and reapplied to the surface at the conclusion of the activity to the maximum extent feasible. The activities associated with increased oil production will not directly impact prime agricultural lands. Section I.D. of the report has been expanded to include erosion and sediment control practices.

3. U. S. Department of the Army, Sacramento District Corps of Engineers

a. C The project does not conflict with flood control or other programs within our jurisdiction.

R No response is necessary.

4. U. S. Department of the Interior, Fish and Wildlife Service
- a. C We are concerned about the welfare of two animals that are listed under the Endangered Species Act as endangered species--the blunt-nosed leopard lizard and the San Joaquin kit fox. Because of our concern over these species, we are requesting that formal Section 7 consultation be initiated as specified in the "Interagency Cooperation Regulations" (Title 50, Part 402).
- R The government recognizes the possibility of impacting these endangered species in the area and will fund an independent study to determine any impacts on these species. This study is scheduled to start sometime in the Spring of 1979. Coordination as required by law will be initiated. Also see discussion on page III-4.
- b. C In addition to the above animals, there are plants in the area which have been proposed for final rulemaking as threatened or endangered. Although the plants are not presently covered under provisions of Section 7 of the Act, we are concerned about the effects of the project on them also. In anticipation of their eventual listing you may elect to seek informal consultation on them at the same time.
- R Except for the cotton eriogonum (Eriogonum gossypinum) which is located in N $\frac{1}{2}$ Section 31, T30S, R24E, and in N $\frac{1}{2}$ SW $\frac{1}{4}$ Section 7, T31S, R24E, no existing endangered species are known to exist in the Petroleum Reserve. Therefore, additional studies outside of the preliminary surveys (late November 1976 and January 1978) are not anticipated and are not required by law.
5. U. S. Department of Transportation, U. S. Coast Guard
- a. C We have no comments to make nor do we have any objection to the statement.
- R No response is necessary.
6. U. S. Environmental Protection Agency (EPA)
- a. C Appendix C includes statements about EPA's responsibility for air, i. e., Clean Air Act and Amendments but does not discuss the EPA responsibility to evaluate radioactive emissions from all sources. Potential adverse health effects to both occupational workers and the general public due to radionuclides present in oil and gas (particularly those concentrated in the gas fractions) should be discussed in the Final Environmental Impact Statement (FEIS).
- b.

- R New material has been added to the text under Section I. H. Risk Assessment, which addresses the subject of risks from radioactive elements in petroleum products and how to deal with them.
- c. C The Final Environmental Impact Statement should describe the most probable routes, including frequencies of travel by route, over which gas liquids will be transported to market by trucks. In addition, all navigable waters which could be impacted by a spill on these routes should be identified (i.e., road drainage system discharging into the Santa Clara River). The existence or development of any contingency plans to prevent spills on roads from entering navigable waters should be discussed and available for review.
- R As discussed in an addition to Appendix C. 1. f. (LPG and Liquid Fuels Transport), Natural Gas Liquids (NGL) will likely be delivered largely to buyers within a 250 mile radius of Elk Hills by both rail and truck. However, under present bidding practices, it is impossible to identify with any certainty what mode of transport will be used and what routes followed, so that identification of navigable waters is in turn impractical. However, a section has been added in the Risk Assessment section pertaining to the possible environmental consequences of a spill of Natural Gas Liquids into perennial streams such as might be found on transport routes from Elk Hills.
- d. C What is the estimated quality (including estimated concentrations for each constituent) of the water proposed for disposal through evaporation and/or percolation ponds? Should the quality of the freshwater in the Tulare Formation prove to be better than the water to be disposed of through percolation ponds, how will the ponds be sited to avoid percolation into the higher quality shallow aquifers?
- R It is not likely that the quality of groundwater underlying Elk Hills has been degraded to any significant degree by operations of the petroleum industry. The quality of the water found in Tulare aquifers underlying Naval Petroleum Reserve-1 (NPR-1) is similar to that found in these same members regionally. The reference to high quality groundwater (including that used for irrigation) occurring near Elk Hills is not pertinent, as this water is contained in the Kern River gravels of uppermost Tulare age. Although the Upper Tulare formations underlie portions of Naval Petroleum Reserve-1, these zones are not equivalent to the Kern River gravels but are much older. The possibility of adversely affecting the Tulare aquifer underlying Naval Petroleum Reserve-1 does not exist in that no potable waters are found within these sands on the west side of the San Joaquin Valley.

- e. C The Draft Environmental Impact Statement indicates that toxic materials are among the components of drilling muds. Since some of the drilling muds will be disposed of through application on banks of roadways and a potential for contaminated runoff does exist, a list of all potential components of drilling muds and an estimate of the quantity of muds to be applied to road banks should be provided in the Final Environmental Impact Statement.
- R The practice of disposal of drilling muds on roadway banks has ceased and henceforth all such muds will be discharged to an approved Class II-1 disposal site at the Reserve.
- f. C In the "moth balling" procedures, the pipeline will be filled with corrosion inhibitors. The Final Environmental Impact Statement should delineate which corrosion inhibitors will be used and how the integrity of the pipeline will be monitored to insure that the corrosion inhibitors will not leak into the groundwater system.
- R Details have not yet been developed for moth-balling and probably will not be developed for most of the Elk Hills facilities until such time as needed.
- g. C It is indicated that 60 percent of Kern County's irrigation water comes from groundwater. The Final Environmental Impact Statement should clarify what percentage of this groundwater is drafted from aquifers under existing and planned Elk Hills petroleum operations.
- R Please see response to letter 6, part d.
- h. C Construction of new facilities and percolation/evaporation ponds will increase the potential for erosion. The Final Environmental Impact Statement should address erosion control measures which will be employed in the design of the new facilities and ponds.
- R See Response to Letter 2, Comment a.

- i. C An estimate of the quality of the hydrostatic test water, including estimated concentrations for each constituent present, should be included in the Final Environmental Impact Statement.
- R Test waters will be disposed of in percolation/evaporation ponds on the Reserve. These waters will not enter any waterway.
- j. C Slow percolation would reduce the rate of entry of pollutants into the groundwater, but the overall quantity of pollutants potentially impacting the groundwater will remain the same. The advantages of slow percolation ponds over lined evaporation ponds with respect to protection of the shallow groundwater aquifers should be more thoroughly discussed in the Final Environmental Impact Statement.
- R Please see response to letter 6, part d.
- k. C The Draft Environmental Impact Statement should provide the most recent existing air quality data for carbon monoxide (CO), nitrogen dioxide (NO₂), sulfur dioxide (SO₂) and total suspended particulates (TSP). These ambient concentrations should then be compared to the National Ambient Air Quality Standards (NAAQS), and the number of violations and the potential for violation should be discussed. Ambient levels should be provided for each averaging time/pollutant for which data is available.
- R Air quality data has been obtained for the 1976 and 1977 calendar years and has been included in Appendix H. A comparison of the data with the air quality standards reveals the following:
- (1) Frequent violations of the 1 hour oxidant standard occur throughout the San Joaquin Valley Air Basin.
 - (2) Total suspended particulate levels are high throughout the air basin and appear to be caused by rural fugitive dust. Agricultural operations are the most likely source of these fugitive emissions.
 - (3) In Kern County, only downtown Bakersfield has carbon monoxide levels in excess of the 8 hour ambient air quality standards. Background levels in the vicinity of the Elk Hills area are believed to be low.
 - (4) Concentrations of nitrogen dioxide appear to be low throughout Kern County with the exception of downtown Bakersfield where vehicle traffic accounts for higher levels.

- (5) With the exception of the Oildale Fire Station, all sulfur dioxide levels in the San Joaquin Valley Air Basin are better than State and Federal standards. The sulfur dioxide levels at the Oildale Fire Station are due to sulfur dioxide emissions from sources in the Kern River oil field. Due to possible interferences with ozone and particulates, only two (2) values during 1977 were probably in excess of 0.05 ppm averaged over 24 hours.
- (6) Various monitoring sites in Kern County exhibited 24 hour particulate sulfate levels in excess of $25 \mu\text{g}/\text{m}^3$. However, no samples were obtained in excess of $25 \mu\text{g}/\text{m}^3$ which occurred when ozone levels were greater than 0.2 ppm.

In addition to the monitoring data supplied by governmental monitoring programs, Appendix O (This Appendix replaces the material presented in the Draft Environmental Impact Statement.) also contains reference to air quality data obtained near the Reserve. Measurements at this site indicate that State and Federal ozone standards are violated. High total suspended particulate concentrations are also encountered which is believed to result from natural fugitive sources and agricultural activities.

1. C Predicted ambient levels should be made for all criteria pollutants affected by the project. While the oxidant analysis is adequate, predictions need to be made for each criteria pollutant and averaging time, for design year and design year plus 20 years with and without the project.
- R Dispersion modeling estimates were made for NO_x concentrations as described in Appendix O. The emissions of carbon monoxide were deemed insignificant and based on the dispersion model results for nitrogen dioxide, it was shown that little impact would be anticipated from the carbon monoxide emissions.

The design year for the analysis was assumed to be 1985, at which time the Elk Hills facility was presumed to be producing at the maximum production rate. As indicated in the Final Environmental Impact Statement (refer to Figure I-4), the production rate is expected to decrease in time following the point of maximum production. It is estimated the production level will be approximately one-third the design year value under continuous production for 20 years. As a result, the overall emission levels from the facility will also decrease.

Another factor to consider is that the Naval Petroleum Reserves Act (P. L. 94-258) authorized production at the Elk Hills Reserve at the maximum efficient rate (MER) for a period not to exceed 6 years following enactment (The enactment date was April 5, 1976.). At the conclusion of the 6 year period, the President may extend the period of production for additional periods not to exceed 3 years each. In order to request an extension, the President must require an investigation to determine the necessity for continued production and then submit a copy of the report made to him on such investigation together with a certificate that continued production is in the National interest. This report and certificate must be supplied to Congress at least 180 days prior to the expiration of the production period.

Based on the above requirements, the President will have to request 5 extensions if production is to continue for 20 years. If production should cease before 20 years, the emissions from the installation at that time would be very small quantities of fugitive hydrocarbon vapors. If the President requests the necessary extensions, forecast production levels in 20 years would be less than 100,000 barrels per day or roughly one-half the maximum production. Consequently, as production diminishes, it can be expected that air pollution emissions will drop proportionally.

- m. C Ambient air is defined as "that portion of the atmosphere, external to buildings to which the general public has access." (40 CFR 50.1(e).) The Draft Environmental Impact Statement indicates that the "Reserve is not open to public access" (page 0-17). Does the Reserve effectively bar the public from entering Reserve properties? If there is not a complete and effective means of prohibiting public access from Reserve properties maximum concentrations must be determined within the Reserve. Provided that a complete and effective measure is used to bar the public from Reserve access, a minimum requirement is the inclusion of Elk Hills Road in the impact analysis for all pollutants and each corresponding averaging time. Kern County is a non-attainment area for O_x , carbon monoxide, sulfur dioxide and total suspended particulates. Any increase in emissions is likely to exacerbate the situation and should be analyzed for the impact on ambient air pollution levels and the National Ambient Air Quality Standards. The Final Environmental Impact Statement should address these issues.

R (1) Question of Public Access

Aside from the Elk Hills Road right-of-way, the Reserve is not open to public access. The public will be prohibited access to the

Reserve through the use of signs and night patrols by the Kern County Sheriff. In this regard, previous experience has shown that posted prohibitions against entry are effective measures to bar the public from the Reserve.

(2) Critical Receptors for Impact Analysis

The public has access near the proposed facility on the Elk Hills Road. This roadway was identified through the use of screening models in the Draft Environmental Statement as a critical point for impact analysis since it was shown that violations of the short-term 1 hour State standard for nitrogen dioxide were possible. In addition the boundary to Naval Petroleum Reserve-1 was also used as a critical receptor site.

Subsequent modeling analysis was conducted which provided a more detailed examination of the air quality impact at these critical receptors for all pollutants and averaging times. The results of this analysis are presented in Appendix O.

(3) Non-Attainment Provisions

The anticipated emissions from the development of Elk Hills at the maximum efficient rate production rate were included in the Air Quality Maintenance Planning effort conducted by Kern County. In addition the project will undergo new source review which will also consider the potential exacerbation of the non-attainment situation. The modeling analysis described in Appendix O indicates that all air quality standards will be maintained.

- n. C The standard sentence indicating that carbon monoxide, sulfur dioxide and total suspended particulate emissions are small enough to be excluded from NSR and therefore will not interfere with the attainment or maintenance of ambient air quality standards, is not acceptable justification. The Final Environmental Impact Statement should provide existing ambient levels, existing and future emissions and future ambient levels with and without the project.
- R The air quality data for 1976 and 1977 for the San Joaquin Valley Air Basin has been included in Appendix H (see response to comment Environmental Protection Agency - 1). Existing and future emission sources and levels have been detailed in the modeling study described in revised Appendix O. The future ambient levels, both with and

without the project, at the critical receptor sites are also provided in Appendix O.

o. C The emissions inventory should include the "other potential sources". The combined effect of several negligible sources with the major sources may prove to be very significant. The annual average modeling for nitrogen dioxide should have also included the Elk Hills Road. The Final Environmental Impact Statement should address these issues.

R The emissions inventory has been upgraded to reflect the other potential sources related to the proposed project. These sources include the following:

- (1) The Elk Hills Road
- (2) Rail loading and railroad operation
- (3) Truck transport of liquid products from the Reserve
- (4) Fugitive hydrocarbon emissions not collected by the vapor recovery system
- (5) Fugitive dust emissions from vehicle travel on unpaved roads

p. C The 60 percent conversion factor for nitric oxide (NO) to Nitrogen dioxide is not acceptable for estimating maximum concentrations. It has been EPA's policy to use 100 percent conversion of nitric oxide to nitrogen dioxide for determining maximum nitrogen dioxide concentrations. (Letter May 30, 1975; Frank Covington, Director, Air and Hazardous Materials Division to Kern County Health Department.)

R The conversion factor of 100 percent for nitric oxide to nitrogen dioxide has been used in the detailed air quality analysis presented in Appendix O. However, based on recent studies (see reference below), this conversion factor is judged to be very conservative, especially for the case of modest nitric oxide emissions in rural settings which are characterized by low to moderate ozone levels.

Cole and Summerhays* of the EPA recently discussed the application of reactive plume models to the estimation of short-term nitrogen dioxide concentrations and identified the major shortcomings in

*Cole, H. S. and J. E. Summerhays, "The application of reactive plume models to the estimation of short-term nitrogen dioxide concentrations," Paper 78-72.4, Presented at the Air Pollution Control Association Annual Meeting, Houston, Texas, 1978.

existing techniques for estimating the nitrogen dioxide impact of point source NO_x emissions. For the case of total conversion (100 percent), although the method is simple, it will greatly overestimate nitrogen dioxide concentrations when the oxidizing potential of the atmosphere is low. As an example, Cole and Summerhays note that if the maximum NO_x concentration is found to be 0.30 ppm and the concurrent ambient ozone concentration is 0.1 ppm, the total conversion method would yield a nitrogen dioxide maximum concentration of 0.3 while the available ozone could only convert about 0.1 ppm (33 percent of the NO_x to nitrogen dioxide). Cole and Summerhays go on to state that while the total conversion methods has been widely used in the past, it is recommended only as an initial screening technique.

An alternative method for estimating maximum nitrogen dioxide levels is the ozone limiting technique, also described by Cole and Summerhays. The procedure is given as follows:

- (1) A standard dispersion model is used to calculate $[\text{NO}_x]_{\text{max.}}$ (100 percent conversion).
- (2) $[\text{NO}_x]_{\text{max.}}$ is separated into two components:
 - a. Thermal conversion part. For combustion sources this is estimated to be equal to $0.1 [\text{NO}_x]_{\text{max.}}$
 - b. The remaining NO subject to conversion by O_3 is equal to $0.9 [\text{NO}_x]_{\text{max.}}$
- (3) If $[\text{O}_3]$ ambient greater than $0.9 [\text{NO}_x]_{\text{max.}}$, then assume that all of the NO is converted to NO_2 , i.e., 100 percent conversion.
 If $[\text{O}_3]$ ambient less than $0.9 [\text{NO}_x]_{\text{max.}}$, then set $[\text{NO}_2]_{\text{max.}} = [\text{O}_3]_{\text{amb}} + 0.1 [\text{NO}_x]_{\text{max.}}$
- (4) $[\text{NO}_2]_{\text{max.}}$ computed for the point source is added to the NO_2 background.

As discussed in Appendix H, average daily maximum ozone values for the San Joaquin Valley Air Basin ranged from 0.09 to 0.21 ppm for 1977. The ambient data reported at Taft, which is located within 10 miles of Naval Petroleum Reserve-1, indicates maximum oxidant (ozone) values on the order of 0.12 ppm. This value appears to be consistent with other data from small urban areas in the San Joaquin Valley Air Basin.

Mathematical modeling of worst case future NO_x emissions indicates a maximum ground level concentration of 0.26 ppm on the Elk Hills Road. Utilizing the ozone limiting method yields the following:

- (1) $[\text{NO}_x]_{\text{max.}} = 0.24 \text{ ppm}$
- (2) Thermal conversion portion
 - a. $[\text{NO}_2]_{\text{thermal}} = 0.1 \times 0.24 = 0.024 \text{ ppm}$
 - b. Subject to conversion by $\text{O}_3 = 0.9 \times [0.25] = [0.23] \text{ ppm}$
- (3) $[0.23]$ greater than $[\text{O}_3] = 0.12$ (from existing data) then
 $[\text{NO}_2]_{\text{max.}} = 0.12 + 0.024 = 0.144 \text{ ppm}$
- (4) A background concentration of 0.05 ppm is assumed (note existing sources have been included in $[\text{NO}_2]_{\text{max.}}$ estimates)
then $[\text{NO}_2]_{\text{max.}} = 0.144 + 0.05 = 0.194 \text{ ppm}$

As indicated by comparison of this value with the air quality standards, the proposed project will not violate the State short-term 1 hour limit of 0.25 ppm.

Another approach for estimating $\text{NO} \rightarrow \text{NO}_x$ conversion is suggested by Angle, et al.*, in which the NO_2/NO_x ratio was studied downwind of a internal combustion (IC) natural gas compressor installation. Experimental measurements showed the NO_2/NO_x ratio to fall below the theoretical curve which was developed from considerations of plume chemistry.

*Angle, R. P., H. S. Sandher and W. J. Schnityler, "A preliminary field study of nitrogen oxides in the exhaust plume from a compressor installation," Paper 78-28.6, presented at the Air Pollution Control Association Annual Meeting, Houston, Texas, 1978.

The results indicate the NO_2/NO_x ratio is a function of plume travel time, and that after 1 minute, theoretical conversion is on the order of 40 percent while measured values were in the range of 5 to 30 percent. Under low wind speed conditions, the NO_x sources at Naval Petroleum Reserve-1 are roughly 1 minute plume travel time from the Elk Hills Road. This implies a conversion on the order of 40 percent, or maximum NO_2 concentrations of approximately $0.4 \times 0.24 = 0.10$ ppm, based on the theoretical model. Since the theoretical results were shown to be higher than the measured concentrations, this value shows general agreement with the result obtained by the ozone limiting method.

- q. C The modeling input data should be included in the appendix of the Final Environmental Impact Statement in a format that is easy to follow so that EPA can perform an analysis if desired. Specific data not presented for the Valley Model includes: ambient temperature and pressure and the mixing depth used; was the Reserve modeled as an area source or specific point sources; what were the coordinates of the area/point source(s), coordinates of the receptors; was plume rise calculated, and if yes, how? The wind speed, direction and frequency data, ground elevation of source and receptors, half-life used, should all be described in the Final Environmental Impact Statement.
- R Appendix 0 has been replaced with a more detailed presentation of the air quality modeling study which includes the presentation of data requested above.
- r. C Five (5) 250,000-barrel crude oil tanks will be constructed at the Elk Hills tank farm in the south-central part of Reserve No. 1, which was covered in a separate Environmental Impact Statement. Since these tanks are part of the same development program, they will be considered by the EPA as part of the total project. The EPA will also consider oil wells drilled on the reserve as part of a five year drilling plan which began in 1974 as part of the proposed project rather than as existing sources of emissions.
- R The evaporative hydrocarbon emissions from the five (5) 250,000-barrel crude oil tanks have been included as a component of the project. As indicated in the Environmental Impact Statement prepared for the Elk Hills/SOHIO Pipeline Connection Conveyance System (September 1977), these tanks utilize best available control technology for crude oil storage which has been determined to be floating roof tanks with a metallic shoe seal and an independent secondary seal.

Based on previous calculations, the storage tank emissions will be 39 lbs per hour under worst case conditions. Emissions from the wells drilled on the Reserve as part of the proposed project are estimated to be approximately 20 lbs per hour (including well cellars). These emissions have been incorporated into the analysis of the proposed project.

- s. C The application of EPA's Prevention of Significant Deterioration of Air Quality (PSD) regulations to the proposed project was not discussed. Petroleum storage and transfer facilities with a capacity exceeding 300,000 barrels are subject to PSD for each pollutant for which potential emissions from the source will be 100 tons/year or greater. According to the emissions estimates in the Environmental Impact Statement, the proposed project is subject to PSD for nitrogen dioxide and carbon monoxide. The primary PSD requirement, application of the Best Available Control Technology (BACT) to the emissions source, has not been proposed or discussed for these two pollutants. The Final Environmental Impact Statement should discuss these issues.

R (1) Petroleum Storage and Transfer

The design philosophy of the Elk Hills gas plant complex with regard to emissions has been dictated not only by environmental considerations, but also by the recent rapid increase in product values. In terms of hydrocarbon vapor recovery, each plant utilizes one gas gathering/vapor recovery compressor driven by a 2,000 horsepower piston-type, supercharged IC engine. (The emissions from this engine are listed in the emissions inventory contained in Appendix O.) Part of the duty load of the compressor is the recovery of fugitive vapors from the product storage and loading area (gasoline, butane and propane). This vapor recovery system assures that the petroleum products storage area and product loading operations conform to BACT requirements. (In addition, the design features of the five (5) 250,000-barrel crude oil tanks (see preceding comment) have been identified as BACT for crude oil storage.)

Each truck and trailer loading facility will be capable of loading one truck and trailer simultaneously. A vapor return line will transfer displaced vapors from the truck or trailer being loaded back to the pressure vessel storage facility. Any excess vapor will be transferred to the LTS unit for reprocessing via the compressor described above. All product will be contained with the exception of a small amount trapped between the valve on the end of the loading arm and the valve on the truck. When the lines are disengaged from the truck a maximum of 0.6 lb of propane will be released to the atmosphere. Lesser amounts of butane and gasoline will be released when the loading lines are disengaged. The vapor recovery for the system is in excess of 90 percent by weight.

(2) BACT for NO_x and CO from Combustion Sources

The major sources of NO_x and CO emissions from the proposed project are the internal combustion engines used for natural gas compression. These units are fueled by natural gas and operate continuously under a high load factor. Each LTS plant will have three gas injection compressors driven by 5,500 horsepower piston-type supercharged engines manufactured by Ingersoll-Rand, Model Number 616 KVR, in addition to the gas gathering/vapor recovery compressor described above. The emission characteristics of these engines, as provided by the manufacturer, are listed below as incorporated into Appendix O.

ENGINE	SIZE (hp)	FUEL	FUEL RATE (SCFH)	EXHAUST VOLUME (SCFM)	EMISSION RATES (LBS/HR)			
					NO _x	HC	CO	SO ₂
616 KVR	5,500	Natural Gas	64,770	14,000	132.2	26.7	10.9	0.2
412 KVS	2,000	Natural Gas	24,572	5,300	73.2	12.3	3.0	0.1

A recent publication^{*} has addressed NO_x control techniques for a variety of combustion sources including

*EPA, "Preliminary Environmental Assessment of Combustion Modification Techniques: Vol. II, Technical Results, Publication No. EPA-600/7-77-119b, October, 1977.

large bore IC engines. As noted in this report, the EPA plans to issue new source performance standards for stationary IC engines. When promulgated, these standards will offer a base line for identifying BACT for control of large bore, stationary IC engines.

Based on a preliminary draft of the NSPS for IC engines, EPA has proposed that after 30 months following promulgation, the NO_x standard for dual fuel IC engines will be 600 ppm and for natural gas fired engines will be 700 ppm. Following another 30 month period, EPA will propose the NSPS for NO_x be reduced to 500 ppm for both fuels. EPA believes the standards to be proposed can be achieved using conventional control approaches and will not require post combustion control devices such as catalytic converters.

In addition to the NSPS at the Federal level, the State of California has drafted a model rule which will soon be released for public review and comment. According to industry representatives, the proposed control levels are such as to essentially require catalytic converters on all large bore high performance stationary IC engines.

A number of design and operational adjustments affect the emissions from IC engines as shown in Table 1. For commercially available engines, the design parameters are fixed. Consequently, the discussion of BACT is limited, at the present time, to operational adjustments and combustion modification techniques which have the potential to influence emission characteristics and to flue gas treatment. For IC engines, the modifications and adjustments which have been identified for NO_x control include:

- a. Retard ignition
- b. Increase air/fuel ratio
- c. Decrease air/fuel ratio
- d. Exhaust gas recirculation
- e. Decrease manifold temperature
- f. Stratified charge cylinder (design change)
- g. Derate engine
- h. Increase speed
- i. Water injection
- j. Exhaust gas treatment catalytic converters scrubbers

TABLE 1

DESIGN AND OPERATIONAL ADJUSTMENTS WHICH
AFFECT EMISSIONS FOR IC ENGINES

DESIGN	OPERATIONAL ADJUSTMENT
Surface to volume ratio	Air-to-fuel ratio
Bore and stroke	Torque (mean effective pressure)
Valve overlap	Speed
Displacement/cylinder	Spark timing
Strokes/power cycle	Fuel injection timing
Chamber design	Fuel properties
Compression ratio	Lubrication and maintenance
Air charging:	
Naturally aspirated	
Blower scavenged	
Turbocharged	
Fuel charging:	
Direct injection	
Indirect injection	
Carburetted	
Engine cooling	

A brief summary of these techniques is presented in Table 2. As can be seen from the table, the reduction of air inlet temperature is the only technique which has gained commercial status and is widely used. All other identified methods, some offering significant NO_x reductions, are either in the prototype or experimental stages, or the research and development effort is inactive (as of 1977). Furthermore, many of the identified techniques, while reducing NO_x , lead to significantly higher operation and maintenance costs and increased emissions of other pollutants, namely CO and HC.

The postulated effects of combustion conditions on emissions from IC engines is shown in Table 3. The combustion conditions considered include reduced peak temperature, reduced residence time at high temperature, reduced local O_2 concentration and increased local O_2 concentration in the combustion chamber and increased water concentration. These effects can be used to postulate the overall effect of combustion controls for NO_x on emissions from IC engines as shown in Table 4. This table shows that the various combustion/control modifications are likely to increase CO and HC (both as vapor phase and organic particulates) emissions. The exception to this is for increased air/fuel ratio changes. A summary of the incremental changes in emissions from IC engines due to applied NO_x controls is given in Table 5. The primary conclusion that can be drawn from this presentation is that the use of NO_x combustion controls on IC engines can have significant effects on HC emissions and that different NO_x reduction techniques elicit different effects.

Furthermore, based on the analysis of proven technology, few techniques are currently available which can be identified as BACT for large bore stationary IC engines. A summary of the technological status of control measures for these engines is given in Table 6. At present, only fine tuning, manifold air cooling and air/fuel ratio changes are available as viable NO_x control techniques.

Emerging technology indicates that improved engine design and flue gas treatment may become important in the future. This technology is still in the developmental stages.

The cost impact of NO_x controls for large bore IC engines is identified in Table 7. In general, the identified NO_x control measures lead to increased fuel consumption and larger capital costs. Specific costs for NO_x controls on IC engines are presented in Table 8. These estimates reflect annual costs in the range of \$0.67 - \$2.01 per KW for existing engines (conventional engines). Costs associated with new engines utilizing fine tuning and changes to the air/fuel ratio

Table 2. Summary of Control Techniques for IC Engines Firing Natural Gas

Control Method/ Range	NO _x Reduction	Effect On		Extent Used	R&D Status
		Operation/ Maintenance	Efficiency/ Fuel Consumption		
Leaner settings of A/F ratio by either reducing fuel input (essentially de-rating) or by increasing the air input (through installation or replacement of turbo-charger)	Reductions of up to 4.5% NO _x for 1% decrease in A/F ratio reported. Turbo-charged and gas-fired units show greatest decreases.	None	Slight increase in efficiency	Not used; prototype only	Include in combustion chamber redesign
Internal recirculation by retarding valve timing, increasing back pressure, or reducing scavenging in 2-stroke engines; or external recirculation, up to 12%, of exhaust gases to the intake manifold (preferably with intercooling of exhaust gases)	Up to 37% reported	Increased fouling of valves and flow passages, increased smoke generation, and contamination of lubrication oil possible	Increase in fuel consumption from 1% up to 8% reported	Only on experimental engines	Inactive; emphasis on chamber redesign for new units
Adjust throttle or governor setting to restrict engine power output in existing engines, or equip new engines with smaller capacity pump or carburetor	0.25% to 0.92% per 1 percent derate	Increase in HC and CO emissions	About 10% increase in bsfc	Not used for NO _x control	Inactive

Continued

Table 2 con't.

Control Method/ Range	NO _x Reduction	Effect On		Extent Used	R&D Status
		Operation/ Maintenance	Efficiency/ Fuel Consumption		
Up to 26% recirculation of exhaust gas	30% reported	- No data available -		Only on experimental combustors	Inactive; emphasis on H ₂ O injection, can design
Staged combustion by fuel rich burning in antechamber, prior to completion of combustion at lower temperatures in main chamber	Approximately 60%	None	Fuel consumption increased by 5% to 8% in one design	None at present	Evaluation for new unit design
Water induction 0.94 kg H ₂ O/kg fuel	70%	Increases CO and HC emissions/ rapid buildup of scale	No data	Experimental/not used	Inactive
For engines with turbochargers, reduce air inlet temperatures typically from 330K down to about 310K	Up to 2.3% per 1K (1.0F) air temp decrease	Heat exchanger using air, cold water supply, or cooling tower required	Up to 1.3% increase in energy consumption	Widely used in large turbocharged engines	

Table 3. POSTULATED EFFECTS OF COMBUSTION CONDITIONS ON EMISSIONS FROM IC ENGINES AND GAS TURBINES

Combustion Condition	CO	HC	Sulfate	Organics
Reduced peak temperature	Possibly increased	Possibly increased	Unknown effect; potentially increased because SO ₃ favored at lower temperatures; potentially decreased because of decreased trace metal volatilization and deposition	Possibly increased
Reduced residence time at temperature	Possibly increased due to incomplete combustion	Possibly increased due to incomplete combustion	Possibly decreased because of decreased trace metal volatilization and subsequent deposition	Possibly increased due to incomplete combustion
Reduced local O ₂ concentration	Possibly increased due to incomplete combustion	Possibly increased due to incomplete combustion	Decreased	Possibly increased due to incomplete combustion
Increased local O ₂ concentration	Reduced	Reduced	Increased	Possibly reduced .
Increased local H ₂ O concentration	No effect	No effect	Possibly increased	No effect

Combustion Condition	Particulate		Trace Metals	
	Size Distribution	Mass Emissions	Segregating	Nonsegregating
Reduced peak temperature	Probably no effect	Possibly increased	Possibly slightly increased due to decreased volatilization and internal deposition	No effect
Reduced residence time at temperature	Trend to larger sizes due to incomplete vaporization and combustion of fuel droplets	Possibly increased due to incomplete combustion	Possible slight increase due to decreased volatilization and subsequent internal deposition	No effect
Reduced local O ₂ concentration	Trend to larger sizes due to incomplete combustion of fuel droplets	Possibly increased due to incomplete combustion	Possible slight increase due to decreased formation of less volatile metal oxides, resulting in less internal deposition	No effect
Increased local O ₂ concentration	Trend to smaller sizes	Possibly reduced	Possible slight decrease due to increased oxide formation and subsequent internal deposition	No effect
Increased local H ₂ O concentration	Probably no effect	Probably no effect	No effect	No effect

Table 3 con't.

Combustion Modification	Particulate		Trace Metals	
	Size Distribution	Mass Emissions	Segregating	Nonsegregating
Retard ignition	Possible trend to larger sizes due to incomplete combustion	Possibly increased due to incomplete combustion	Possible slight decrease due to reduced internal deposition	No effect
Increase air/fuel ratio	Possible trend to smaller sizes	Possibly decreased	Possible slight decrease due to reduced internal deposition	No effect
Decrease air/fuel ratio	Possible trend to larger sizes due to incomplete combustion	Possibly increased due to incomplete combustion	Possible slight increase	No effect
Exhaust gas recirculation	Possible trend to larger sizes due to incomplete combustion	Possibly increased due to incomplete combustion	Possible slight increase	No effect
Decrease manifold air temperature	Probably no effect	Possible increase	Possible slight increase due to decreased internal deposition	No effect
Stratified charge cylinder design	Possible trend to larger sizes	Possibly increased due to incomplete combustion	Possible slight increase due to decreased internal deposition	No effect
Derate	Probably no effect	Possible increase	Possible slight increase	No effect
Increase speed	Possible trend to larger sizes	Possible increase due to incomplete combustion	Possible slight increase	No effect
Water Injection	Possible trend to larger sizes	Possible increase due to incomplete combustion	Possible slight increase	No effect

Table 4. POSTULATED OVERALL EFFECT OF COMBUSTION NO_x CONTROLS ON EMISSIONS FROM IC ENGINES

Combustion Modification	Resulting Combustion Condition	CO	Vapor Phase HC	Sulfate	Organics
Retard ignition	Reduced peak temperature; reduced time at temperature	Possibly increased due to incomplete combustion	Possibly increased due to incomplete combustion	Potentially decreased due to decreased metal catalyst internal deposition	Possibly increased due to incomplete combustion
Increase air/fuel ratio	Reduced peak temperature; increased local O ₂ concentration	Decreased	Decreased	Increased	Possibly decreased
Decrease air/fuel ratio	Reduced peak temperature; reduced local O ₂ concentration	Possibly increased	Possibly increased	Decreased	Possibly increased due to incomplete combustion
Exhaust gas recirculation	Reduced peak temperature; reduced local O ₂ concentration	Possibly increased	Possibly increased	Decreased	Possibly increased due to incomplete combustion
Decrease manifold air temperature	Reduced peak temperature	Possible increase	Possible increase	Unknown effect: possible increase because SO ₃ favored at lower temperatures; possible decrease due to decreased catalytic oxidation	Possible increase
Stratified charge cylinder design	Reduced peak temperature; reduced residence time at temperature; reduced local O ₂ concentration	Possibly increased due to incomplete combustion	Possibly increased due to incomplete combustion	Potentially decreased	Possibly increased due to incomplete combustion
Derate	Reduced peak temperature	Possible increase	Possible increase	Unknown effect	Possible increase
Increase speed	Reduced residence time at temperature	Possible increase due to incomplete combustion	Possible increase due to incomplete combustion	Possible decrease due to decreased catalyst deposition	Possible increase due to incomplete combustion
Water injection	Reduced peak temperature; reduced local O ₂ concentration; increased local H ₂ O concentration	Possibly increased due to incomplete combustion	Possibly increased due to incomplete combustion	Potentially decreased	Possible increase due to incomplete combustion

Table 5. EVALUATION OF INCREMENTAL EMISSIONS DUE TO NO_x CONTROLS APPLIED TO IC ENGINES

NO _x Control	Incremental Emission						
	CO	Vapor Phase HC	Sulfate	Particulate	Organics	Segregating Trace Metals	Nonsegregating Trace Metals
Retard Ignition	++	+	0	++	+	0	0
Increase A/F Ratio	0	++	++	0	0	0	0
Decrease A/F Ratio	++	++	0	+	+	+	0
Exhaust Gas Recirculation	+	+	0	++	+	+	0
Decrease Manifold Air Temperature	0	++	+	0	0	+	0
Stratified Charge Cylinder Design	+	+	0	+	+	+	0
Derate	++	++	+	0	0	+	0
Increase Speed	+	+	0	+	+	+	0
Water Injection	+	++	0	+	+	+	0

Key: ++ denotes having high potential emissions impact
 + denotes having intermediate potential emission impact, data needed
 0 denotes having low potential emissions impact

Table 6. STATUS OF CONTROL TECHNOLOGY FOR STATIONARY IC ENGINES

Equipment/ Fuel Category	Current Technology				Emerging Technology		Comments
	Available Control Technique	Achievable NO _x Emission Level ng/J (lb/10 ⁶ Btu)	Estimated Differential Annual Cost /	Operational Impact	Near Term 1977-1982	Far Term 1983-2000	
IC engines	Fine tuning; changing A/F	1,070-1,290 (2.5 - 3.0)	\$0.70-2.00/kW (\$0.5-1.5/ BHP)	5-10% in- crease in fuel con- sumption; misfiring; poor load response	Include mod- erate con- trol in new unit design	Advanced head designs	Technology still being tested

Table 7. COST IMPACTS OF NO_x CONTROLS FOR LARGE BORE ENGINES

Control	Cost Impact
Retard	Increased fuel consumption
Air-to-fuel changes	Increased fuel consumption
Derate	Fuel penalty, additional hardware, and increased maintenance associated with additional units
Manifold air cooling	Increased cost to enlarge cooling system, and increased maintenance for cooling tower water treatment
Combinations of above	Initial, fuel, and maintenance
Control techniques	Increases as appropriate

Table 8. COST OF NO_x CONTROLS FOR IC ENGINES

New or Existing Equipment	Emission Level (ng/J)	Control Technique ^a	Earliest Year Available	Differential Control Costs		Effect on Fuel Consumption
				Initial Investment (\$/kW)	Annual Cost (\$/kW)	
Existing ^b	1,053	Fine Tuning, Changing A/F	--	--	0.67-2.01	10% increase
New ^b	1,338	Fine Tuning, Changing A/F	1980	--	0.54-1.30	5% - 10% increase
	737	Advanced Design	1983	13.40-26.80	2.70-5.40	--

^aSee Section 4 for control technique characterization.

^bThe uncontrolled emissions level is assumed to be 1,504 ng/J.

are anticipated to fall in the range of \$0.54 - \$1.30 per KW and will reflect a 5 - 10 percent increase in fuel consumption. New engines of advanced design available after 1983 are expected to experience annual costs in the range of \$2.70 - \$5.40 per KW in addition to substantial increased initial capital investment.

Flue gas scrubbing represents another potential control approach for stationary large bore IC engines. However, no information is available on experimental or practical use of this technique for the control of NO_x from combustion engines.

The use of catalytic converters for control of NO_x emissions from large bore IC engines is still in the experimental stages. At present, Gulf Oil is proposing to use catalytic conversion on a 1000 horsepower compressor fired with NPG or methane with an anticipated 92 percent removal of NO_x . Associated with catalytic control is the use of ammonia injection as a means of reducing NO to N_2 and water vapor in a catalyst bed. Again, these control techniques are still in the experimental stages. Conversations with engine manufacturers indicate that for conventional, naturally aspirated engines, the control technology is currently available to achieve the new source performance standards which will be proposed both in California and at the National level. For supercharged engines, however, it appears that considerable technical difficulties stand in the way of cost effective control measures. This may imply a shift toward the lower efficiency, naturally aspirated engines if suitable control approaches cannot be identified for the high performance engines. This in turn, will mean higher costs in terms of capital costs and energy utilization.

Summarizing the above discussion, BACT for large bore IC engines is currently limited to fine tuning, changes in the air/fuel mixture and manifold air cooling on turbocharged engines. Each of these techniques results in higher operating costs and increased specific fuel consumption. Future technological innovations will probably be directed toward improved engine design and possibly flue gas treatment using catalytic converters.

At present the California Air Resource Board has identified the operational modifications described above as reasonably available control measures for stationary internal combustion engines. In the future, other approaches such as catalytic converters and ammonia injection may become available.

- t. C Although the Environmental Impact Statement states that all hydrocarbon emissions from the project will be offset, these emission reductions are not identified. The Final Environmental Impact Statement should address this issue.
- R Emission reduction offsets for hydrocarbons have been identified for the venting which occurs at the existing 35R gas processing plant. These emission offsets total 1616 lbs per hour for total hydrocarbons and 637 lbs per hour for non-methane hydrocarbons. Based on the projected emissions from the proposed project, there will be a net decrease on the order of 921 lbs per hour of total hydrocarbons and 478 lbs per hour of non-methane hydrocarbons (also refer to response to letter 7, part j).
- u. C Emissions due to rail transportation associated with the project have not been quantified. For each pollutant for which the proposed project is a major source under New Source Review or PSD, secondary emissions from the trains must be considered in the EPA's review. The Final Environmental Impact Statement should address this issue.
- R Railroad emissions were estimated based on the following assumptions:
- (1) Average emission factors (AP-42)

Particulates	25 lbs/10 ³ gal.
SO ₂	57 lbs/10 ³ gal.
CO	130 lbs/10 ³ gal.
HC	94 lbs/10 ³ gal.
NO ₂	370 lbs/10 ³ gal.
Aldehydes	5.5 lbs/10 ³ gal.
Organic Acids	7 lbs/10 ³ gal.
 - (2) Specific fuel consumption of diesel locomotive - 50 gal./hr
 - (3) Average daily locomotive usage within Kern County - 12 hrs
 - (4) Total fuel consumption per day - 50 x 12 = 600 gal./day

(5) Emission Estimates:

Particulates	0.6 lbs/hr
SO ₂	1.4 lbs/hr
CO	3.25 lbs/hr
HC	2.4 lbs/hr
NO ₂	9.3 lbs/hr
Aldehydes	0.1 lbs/hr
Organic Acids	0.2 lbs/hr

These emissions will occur during railroad operations and will be distributed throughout the county (line source). As a result, the impact due to rail transport will be insignificant at specific receptor sites.

v. C Fugitive particulate emissions due to vehicular travel on new dirt roads associated with the project have not been quantified. Mitigation measures must be discussed in the Final Environmental Impact Statement.

R Fugitive particulate matter emissions are characteristic of construction projects and may have a significant impact on local air quality. Building and road construction are the prevalent construction categories with the highest emission potential.

Dust emissions can vary substantially from day to day depending on the level of activity, the specific operations and the prevailing weather conditions. A large portion of the emissions result from equipment traffic over temporary roads at the construction site.

The quantity of dust emissions from construction operations are proportional to the land area being worked and the level of activity. Also, by analogy to the parameter dependence observed for other similar dust sources, it is probable that emissions from heavy construction operations are directly proportional to the silt content of the soil and inversely proportional to the square of the soil moisture, as represented by Thornthwaite's precipitation - evaporation index.

Based on field measurements of suspended dust emissions from apartment and shopping center construction projects, EPA has developed an approximate emission factor for construction operations of:

1.2 tons per acre of construction per month of activity.

The land requirements of the major elements of the proposed project are listed below:

(1) New wells @ 2 acres per well (not all active at same time)	612 acres
(2) Gas processing plants	40 acres
(3) Tank settings (new)	4 acres
(4) Temporary roads to well sites	380 acres
(5) New railroad spur	200 acres
(6) Staging areas for miscellaneous construction	29 acres

The uncontrolled emission rate from the above activities is estimated below.

<u>SOURCE</u>	<u>RATE</u>
New Wells (assume 10 percent under construction at any one time)	200 lbs/hr
Gas processing plants	13 lbs/hr
Tank settings	1 lb/hr
Temporary roads	126 lbs/hr
New railroad spur	67 lbs/hr
Staging areas	<u>10 lbs/hr</u>
Total fugitive particulate emission rate	417 lbs/hr

These emissions will be distributed over the areas involved in construction. As indicated in the Final Environmental Impact Statement (p. IV-18) mitigating measures have been included in contracts for construction work which would reduce the fugitive emission rate substantially.

- w. C Hydrocarbon emissions from process wastewater which has come into contact with oil and is held in evaporative ponds should be included in emissions estimates and should be addressed in the Final Environmental Impact Statement.

R Five percolation ponds at Naval Petroleum Reserve-1 have been identified which receive water containing possible oil contamination. These wastewaters evolve from both Stevens and Shallow Zone production. Although future wastewater quantities are expected to increase, no new ponds are planned for the project. The total surface area of the ponds is 31,000 ft². Based on an emission factor of 0.1 lbs/ft² day proposed by KVB, Inc., the total hydrocarbon emissions from the ponds is estimated to be 3100 lbs/day (131 lbs/hr). This level of emissions is projected to continue into the future.

x. C All new oil and gas loading facilities will be equipped with vapor recovery systems. Unless these systems have a hydrocarbon recovery efficiency of 100 percent, the remaining hydrocarbon emissions from the loading racks should be estimated in the Final Environmental Impact Statement.

R There are three liquid products that will be transported by truck (and eventually railcar): propane, butane and natural gasoline consisting of pentane and higher hydrocarbons. Propane and butane are pressurized due to their low boiling points while the gasoline product will be stored and transported at atmospheric pressure.

For pressure tanks, vapor losses can occur when excessive internal pressures result in relief valve venting. This is not a normal occurrence and in general the tanks can be considered closed systems. Fugitive emissions are also associated with pressure tanks and related equipment but with proper system maintenance they are insignificant. Correlations do not exist for estimating vapor losses from pressure tanks or from the transfer of pressurized liquid products such as propane and butane.

The vapor recovery system for the product storage and loading areas has been described in response to part s. of letter 6. Based on data supplied by the equipment manufacturer, the efficiency of the vapor recovery system will be greater than 90 percent. For propane, small quantities, less than 0.6 lbs, escape when the loading arm is removed from the truck. This is the portion that is trapped between the valve on the end of the loading arm and the truck valve. Based on an average of 93 truck fills per day, the propane loading losses are estimated to be on the order of 56 lbs/day (2.3 lbs/hr). For butane, considerably less material is lost and emissions are estimated to be on the order of 0.1 lbs per filling operation or 0.27 lbs/hr on a daily basis.

For gasoline, emission rates during loading and transport can be estimated using published emission factors. The daily peak quantity of gasoline product from the Reserve plants is estimated at 260,000 gallons. For an average truck capacity of 7,500 gallons, approximately 35 truck filling operations will be conducted per day.

Based on AP-42, the emissions from loading of hydrocarbon liquid can be estimated (within 30 percent) using the following expression:

$$L_L = 12.46 \frac{SPM}{T}$$

where L_L = loading loss, lb/10³ gallons of liquid loaded

S = Saturation factor

T = Bulk temperature of the liquid (or)

P = True vapor pressure of the liquid; psia

M = Molecular weight of the vapors, lbs/lb-mole

Assuming submerged loading with vapor balance service, the S factor will be approximately equal to 1. The vapor recovery system is assumed to have an efficiency of 90 percent.

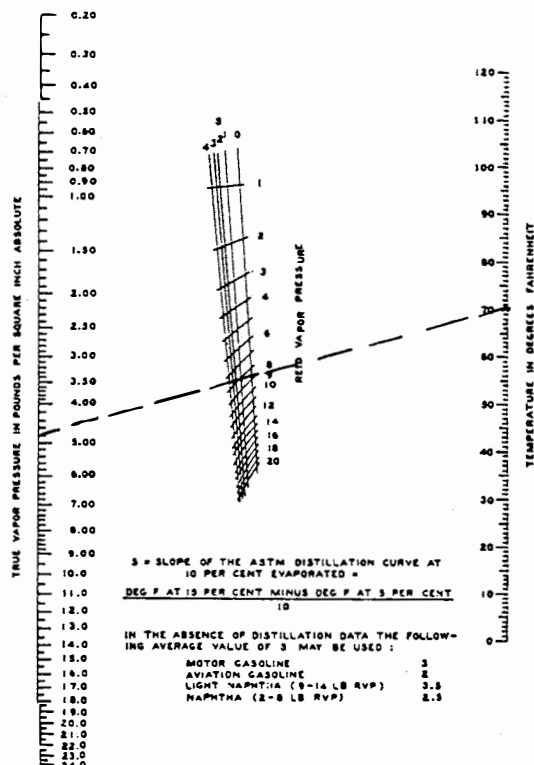
Values for the other parameters are:

Reid vapor pressure = 8.2 (Same value as Stevens Zone Crude)

Temperature = 70°F

True vapor pressure = 4.8 psia (see figure below)

Molecular weight = 50 (assumed)



From the above, the uncontrolled emission factor can be calculated such that

$$L_L = (12.46)(1.0)(4.8)(50)/(460 + 70) = 5.6 \text{ lbs/1000 gal.}$$

Using the 90 percent collection efficiency factor for the vapor recovery system gives a controlled emission factor of:

$$L_{LC} = 5.6(1 - 0.9) = 0.56 \text{ lbs/1000 gal.}$$

Based on the loading of 260,000 gallons of gasoline per day, the emission rate from the loading operation is estimated

$$\text{Emission rate} = \frac{0.56 \text{ lbs}}{1000 \text{ gal.}} \times \frac{260,000 \text{ gal.}}{\text{day}} \times \frac{\text{day}}{24 \text{ hr}} = 6 \text{ lbs/hr}$$

These emissions have been reflected in the Environmental Impact Statement.

The transit loss of hydrocarbon vapors is estimated by $L_T = 0.1 PW$; where L_T = Transit loss, $\text{lb/week} \cdot 10^3 \text{ gal.}$

P = True vapor pressure, psia

W = Density of the condensed vapors lb/gal.

For gasoline, the values of the above parameters were estimated as follows:

$$P = 4.8 \text{ psia}$$

$$W = 5.2 \text{ lbs/gal.}$$

This results in the following estimate for transit emission:

$$L_T = (0.1)(4.8)(5.2) \text{ lbs/week} \cdot 10^3 \text{ gal. transported}$$

$$L_T = 2.5 \text{ lbs/week} \cdot 10^3 \text{ gal.}$$

On a daily basis, 260,000 gallons are transported. This gives an emission rate of

$$\begin{aligned}\text{Emission rate during transit} &= \frac{2.5 \text{ lbs}}{\text{week} \cdot 10^3 \text{ gallons}} \times 260,000 \text{ gallons} \\ &= 4 \text{ lbs/hour}\end{aligned}$$

These emissions will be released as the trucks are in transit and consequently, the air quality impact is anticipated to be small.

- y. C Transportation emissions gives an estimate of 200 trucks per day, yet the emission section, page 0-15 uses the figure 187 trucks per day. This discrepancy should be resolved.
 - R A review of projected truck traffic indicates the future volume will be approximately 150 trucks per day.
- z. C Second paragraph, "Appendix N" should be changed to "Appendix 0".
 - R The appropriate section of the Environmental Impact Statement text has been modified.
- aa. C Third paragraph justifies the exclusion of Elk Hills Road from modeling for annual average concentrations with the statement "since the public could not be exposed to concentrations over an annual period along the roadway". The NAAQS were established to protect the public health and welfare. They pertain to ambient air regardless of the length of time the public may be exposed to harmful levels. The Final Environmental Impact Statement should address this discrepancy.
 - R The revised modeling analysis presented in Appendix 0 provides a detailed analysis of projected air quality levels resulting from the project and including sources off the Reserve. It is recognized that the NAAQS were established to protect human health and welfare and the proposed project will be constructed and operated in such a manner as to comply with these limits. In this regard, reference to the short-term nature of potential public exposure along the Elk Hills Road in the vicinity of the gas processing plant has been deleted.
- bb. C LAER (lowest Achievable Emission Rate) is the requirement for new or modified sources in non-attainment areas. (Section 173(2) CAA.)
 - R The appropriate section of the Environmental Impact Statement text has been modified.

- cc. C For purposes of the PSD, a new or modified source is subject to PSD if it is one of 28 specified source categories which emit or have the potential to emit more than 100 tons/year or any new or modified source emitting more than 250 tons/year. (43 FR 26403 Section 52.21 (b) (1) (i).)
- R The appropriate section of the Environmental Impact Statement text has been modified.
- dd. C The Air Quality Section needs to discuss Kern County as a non-attainment area for TSP, CO, SO₂ and O_x. Kern County Air Pollution Control District, the lead agency for development of the Non-Attainment Plan (NAP) should be contacted to ensure the proposed action is considered in the NAP development.
- R Based on present classifications, the following attainment status exists in the San Joaquin Valley Air Basin, Kern County region:
- TSP - San Joaquin Valley Air Basin does not meet primary air quality standards.
- SO₂ - Kern County does not meet primary air quality standards. The initial designation made by EPA only included the Kern River Oil Field as non-attainment for SO₂. The State California Air Resources Board subsequently classified the entire county as non-attainment based on computer projections of future growth potential. Recent analysis by the California Air Resources Board with better models and data do not predict non-attainment in these areas now or in the future. In addition, all air quality monitors demonstrate attainment status. However, as far as is known, no actions have been taken to re-classify the Kern County area outside of the Kern River Oil Field as attainment.
- Ozone- San Joaquin Valley Air Basin does not meet primary air quality standards.
- CO - Only the San Joaquin Valley Air Basin portion of Kern County has been classified as non-attainment for CO. This non-attainment status is based on CO concentrations experienced in Bakersfield.
- NO₂ - Kern County (San Joaquin Valley Air Basin portion) has been classified attainment.

In terms of non-attainment planning and SIP revisions, the Kern County Health Department was contacted to inquire whether or not the proposed project at Elk Hills was included in the planning efforts. According to Mr. Larry Landis, the Elk Hills project has been included in the development of non-attainment plans. In this regard, the following considerations have been taken:

- TSP - Primary emphasis of the current planning efforts focus on the control of fugitive dust sources. The impact of the Elk Hills project is anticipated to be small with the exception of nearby impacts due to construction activities. As identified in the Final Environmental Impact Statement, mitigating measures will be taken to minimize particulate matter emissions from construction activities.
- HC - The Kern County Health Department retained Grunwald, Crawford and Associates to provide assistance in preparation of possible control measures for hydrocarbon emissions. This study included consideration of the Elk Hills project. A county-wide emission inventory was prepared for the base year (1975) and emissions were projected for 1982, 1987 and 1990. The emission rate from the Elk Hills project was projected to increase in proportion to the production rate from the facility. Control measures identified in the report included scenarios for vapor control on existing and new storage tanks (90 percent control). Overall, the Elk Hills project is included in the HC plan development documentation and the representative from Grunwald, Crawford and Associates suggested the estimates were conservative since they did not include consideration of the Kern County new source review requirements.
- SO₂ - The current planning effort is based on analysis to demonstrate that existing regulations are sufficient to prevent violation of the NAAQS.
- CO - The carbon monoxide problem is traffic related and is limited to the Bakersfield metropolitan area. Carbon monoxide emissions from the Elk Hills project are not considered to be a significant factor in the non-attainment planning effort, since primary and secondary traffic projections due to the project are relatively small.
- Ozone- The control strategy for ozone has been directed toward reactive hydrocarbons. The proposed project has been included in the development of emission inventories and control strategies (refer to above discussion on hydrocarbons).

7. and 7'. State of California, Air Resources Board

- a. C On page I-18, the Draft Environmental Impact Statement states that the new field compressors are to have engines with a total capacity of from 8,000 to 10,000 horsepower and on page I-20, the Draft Environmental Impact Statement mentions that a new compressor station is to be constructed at Section 35R for injection of the returned dry gas. However, in the Air Quality Impacts Section, the Draft Environmental Impact Statement does not include emissions from these sources. The air impacts could be significant if gas fired reciprocating engines were used.
- R A revised emission inventory has been incorporated into the text and in Appendix O.
- b. C The Draft Environmental Impact Statement indicates that petroleum liquids produced from the gas processing plant will be stored in storage tanks and will be loaded for truck and railroad car shipment. However, the Draft Environmental Impact Statement does not estimate air emissions from the storage tanks, loading facilities, and trains. In calculating air emissions from truck traffic, the Draft Environmental Impact Statement should consider the average distance that trucks will travel within Kern County rather than the average distance from the gas plants to the nearest state highways.
- R
 - (1) Storage tanks and loading facilities - refer to response to letter 6, parts s. and x.
 - (2) Rail transport - refer to response to letter 6, part u.
 - (3) Truck traffic - refer to response to letter 18, part h. The travel distance for truck traffic has been increased to 193 miles reflecting the average distance the liquid products are transported to market either in or through Kern County.
- c. C On page I-37, the Draft Environmental Impact Statement states that the flare will be equipped with pilot lights of continuous burning gas, but in the Air Quality Impact Section, the Draft Environmental Impact Statement does not include emissions from pilot lights and from flaring gases.
- R Based on EPA's Compilation of Emission Factors (AP-42), virtually no particulates, smoke or hydrocarbons result when using elevated smokeless flares and because the gas temperatures do not usually exceed 1200°F, significant quantities of nitrogen oxides are not formed. Consequently, emissions from the gas pilot lights and gas flaring were determined to be negligible. In terms of hydrocarbon emissions, however, an efficiency of 98 percent was assumed which resulted in estimated emissions of 33 and 13 lbs/hr for THC and NMHC respectively.

- d. C On Page I-28, it is stated that an additional 35 megawatts of electricity will be provided by Pacific Gas and Electric Company, yet the Draft Environmental Impact Statement does not address air emissions from power generation, which could be significant. Based on a power plant burning 0.5 percent sulfur fuel oil, SO_x and NO_x emissions are estimated to be 182.7 lbs/hr, and 87.5 lbs/hr respectively.
- R The air emissions due to power requirements are addressed on Page IV-18 of the Draft Environmental Impact Statement, although not specifically quantified. As noted, the power would be supplied by the Pacific Gas and Electric Company system which is tied into the western U. S. distribution grid. As a result, it is impossible (and unrealistic) to identify a specific location from which the additional power will originate. Due to the distributed nature of electric power generation, however, significant impacts are not expected in any particular air basin. The potential emissions of 182.7 and 87.5 lbs/hr for SO_x and NO_x respectively, have been incorporated in the impact statement discussion.
- e. C The Draft Environmental Impact Statement indicates that during the construction phase all emissions will be temporary and are not expected to cause significant impacts off the Reserve, but provide no data to support this statement. The Final Environmental Impact Statement should quantify air emissions from the construction phase since the project will require the use of diesel powered equipment, which is capable of emitting large quantities of NO_x .
- R For purposes of estimating emissions from construction equipment, the following items are assumed to be present and in use at the proposed construction site: 2 motor graders, 4 wheeled loaders/scrapers and 8 miscellaneous items.

Emission factors based on EPA publication AP-42 for these equipment items are presented below.

ITEM	PARTICULATE (LBS/HR)	CO (LBS/HR)	EXHAUST HYDROCARBONS (LBS/HR)	NO_2 (LBS/HR)	ALDEHYDES (LBS/HR)	SO_2 (LBS/HR)
Motor Grader	0.061	0.215	0.054	1.05	0.012	0.086
Wheeled Loader	0.172	0.553	0.187	2.40	0.041	0.182
Misc.	0.139	0.414	0.157	2.27	0.031	0.143

Using the above emission factors, the maximum hourly emission rate was estimated based on the assumption that all equipment is operating at the same time.

<u>POLLUTANT</u>	<u>MAXIMUM EMISSION RATE (lbs/hr)</u>
NO ₂	29.9
Exhaust HC's	2.1
Aldehydes	0.4
SO ₂	2.1
CO	6.0
Particulates	1.9

These emissions are characteristically distributed over the construction areas and as a result, the impacts, even near the site are anticipated to be insignificant. Furthermore, the equipment will be in operation on an intermittent basis which will have the effect of reducing any potential long term impacts.

- f. C The Draft Environmental Impact Statement states that 60 million cubic feet per day of gas is expected to be produced at Chevron's McKittrick gas processing plant, which currently processes 18 million cubic feet per day of gas, but air emissions from additional pumps and process heaters due to increased throughput are not mentioned in the future air emissions inventory.
- R No new construction is planned for the Chevron McKittrick plant. The existing installation was originally designed to process 60 million cubic feet of gas per day. However, as the production from existing oil recovery effort dwindled, the quantity of gas processed by the plant has fallen to 18 million cubic feet per day. Since the plant is sized to handle considerably more than this quantity, the development of Naval Petroleum Reserve-1 at MER included the utilization of the existing capacity at the Chevron McKittrick plant rather than the construction of new additional gas handling capacity on the Reserve. No significant increase in emissions from the McKittrick plant is expected.

- g. C Appendix H of the Draft Environmental Impact Statement which discusses air quality data in the San Joaquin Valley Air Basin should include 1976 and 1977 data.
- R Air quality data for 1976 and 1977 have been incorporated in Appendix H.
- h. C The Draft Environmental Impact Statement should list the diameter and average vapor space height of the fixed roof storage tanks and the vapor recovery control efficiency. Without such information, the breathing losses from the tanks, both with and without vapor recovery, cannot be verified. In addition, the Draft Environmental Impact Statement incorrectly defines turnover factor as annual throughput/tank capacity. According to the Environmental Protection Agency publication, AP-42, the turnover factor is a function of the number of turnovers per year which is defined as annual throughput/tank capacity. Based on the data in the Draft Environmental Impact Statement, the turnover factor should be 0.5 rather than the reported 0.25.
- R Refer to response to letter 7, part j.
- i. C Fugitive emissions from gas service control valves were underestimated. According to the recently published KVB study titled "Control of Hydrocarbon Emissions from Stationary Sources in the California South Coast Air Basin," a factor of 0.25 lbs/day/device should be used, replacing the Draft Environmental Impact Statement reported factor of 0.10 lbs/day/control/valve.
- R The emission factor in the analysis was changed to 0.25 lbs/valve/day. The corrected emissions were reflected in the estimates provided in the revised Tables in Appendix O. These changes are also reflected in the text.
- j. C In the Hydrocarbon Impacts Section, page IV-12, the Draft Environmental Impact Statement states that "the major reduction in existing emissions will be the flaring of gases currently vented at the 35R gas plant during upset conditions. Another major reduction in existing THC and NMHC emissions will be the inclusion of all Shallow Zone stock tanks into the vapor recovery system." These emissions reductions cannot be accepted as tradeoff credits for the following two reasons: First, venting of hydrocarbons into the atmosphere is not allowed under permit and should be minimized to the lowest level. Second, the liquid stored in Shallow Zone stock tanks has a Reid vapor pressure greater than 1.5 pounds per square inch. Under Kern County APCD Rule 411, these tanks are required to be equipped with vapor loss control devices and therefore no reduction credits should be allowed. As a result, the project may result in a net increase of hydrocarbon emissions of greater than 250 pounds per day. Therefore, the Final Environmental Impact Statement should perform an analysis on ozone impacts. Emissions

from the 1.25 million barrels capacity Elk Hills Tank Farm (addressed in the transportation phase Environmental Impact Statement) should also be included in the model study. The Draft Environmental Impact Statement also states that the Department of Energy has initiated a study to identify all possible hydrocarbon emission offsets in the basin both on and off the Naval Petroleum Reserve-1. Results of this study should be included in the Final Environmental Impact Statement.

7'. The above comment was amended by the California Air Resources Board in their letter of September 20, 1978 (letter 7'.), to read as follows:

- a. C "In the Hydrocarbon Impacts Section, page IV-12, the DEIS states
- b. that 'the major reduction in existing emissions will be the
- c. flaring of gases currently vented at the 35R gas plant during upset conditions.' These emissions reductions may be acceptable as trade-off credits, however the reductions could not be used to determine whether an air quality impact analysis (AQIA) would be required under Kern County's New Source Review (NSR) Rule.

"The determination as to whether an AQIA is required for a modification is dependent on whether there are any hours or days during which the modification will increase emissions beyond 25 lbs/hr or 250 lbs/day for any air contaminant for which there is a state or national ambient air quality standard (except carbon monoxide, for which the limits are 250 lbs/hr and 2500 lbs/day). To enable that determination to be made, the DEIS should identify the frequency and extent to intermittent sources of emissions such as venting. The DEIS should also quantify the emissions resulting from flaring operations, since oxides of nitrogen emissions from this source can be significant. If it is determined that an AQIA will be required, the tradeoffs associated with the flaring operations may be used to help demonstrate that there is no net adverse air quality impact on an annual basis.

"Furthermore, we have concluded that the use of vapor recovery systems on the Shallow Zone stock tanks represents an acceptable trade-off measure under Kern County Air Pollution Control District rules and regulations."

- R Considerable emissions reductions are anticipated through the control of process surges at the existing 35R gas processing plant. Operating data for the period June 1 through September 15, 1978 (107 days), have indicated that approximately 70.6×10^6

cubic feet of gas were vented under process upset conditions or supply surges which could not be accommodated by the existing gas plant. These gas flows are delivered from 3 major gas streams which have an average molecular weight of 22.6 lbs per lb mole. Based on the measured volumetric release, the mass emissions of total hydrocarbons is estimated to be 38,560 lbs per day (1,625 lbs/hr).

These emissions occur on a frequent basis. The greatly increased gas handling capacity which will be provided by construction of the two LTS plants will eliminate the overloading on the existing 35R gas plant. This will result in a total hydrocarbon emission reduction of approximately 1,625 lbs per hour. Assuming 85 percent of the emissions are methane (mole percent), the non-methane emissions from venting at the existing 35R gas plant are estimated to be approximately 650 lbs per hour.

While installation of vapor recovery systems on the Shallow Zone tanks is eligible as an offset, sufficient offsets can be obtained by provision of flare stacks for the presently vented gases at the existing 35R gas plant. The new sources of hydrocarbon emissions and offsets are shown in Table 4-1.

- k. C The modeling study addressing NO_x and NO_2 (nitrogen dioxide) concentrations has the following deficiencies:
- (i) Meteorological data were taken from the National Climatic Center for a Bakersfield station. The Draft Environmental Impact Statement should provide justification to demonstrate that the meteorological data from this specific station in Bakersfield will be representative of the Reserve.
 - (ii) In determining the maximum ground level concentrations, a total of 12 meteorological conditions out of a possible 384 combinations were examined. However, the Draft Environmental Impact Statement does not address the criteria for the selection.
 - (iii) The Draft Environmental Impact Statement should discuss the reason for the choice of 60 percent conversion of NO (nitric oxide) to NO_2 which may not be true within the Reserve.
 - (iv) Since the estimated maximum ground level concentration of NO_2 along the Elk Hills Road exceeds the State 1 hour NO_2 standard, the District new source review rule will likely require the additional NO_x emissions to be offset. The final

Environmental Impact Report should discuss the nature, location and quantity of emission offsets which will be considered.

The practice of the ARB in assessing air quality impacts is similar to the approach taken in the Draft Environmental Impact Statement in that we utilize similar dispersion models in our preliminary analysis, to see if applicable standards are expected to be exceeded. If they are expected to be exceeded, we conduct a further analysis, employing numerical modeling to more accurately assess the impacts. I recommend this further analysis be performed in this case and that the scope of the analysis be expanded to include the entire Reserve.

The final Environmental Impact Statement should address the federal ambient air quality standard for NO₂ on an annual basis.

- R
- (1) Meteorological Data: The revised analysis presented in Appendix O has utilized meteorological data obtained from the McKittrick area. It is anticipated that this data is representative of the Naval Petroleum Reserve-1 area.
 - (2) Criteria for selection of Worst Case Meteorological Conditions: Worst Case meteorological conditions have been identified in Appendix O and were used as input to the Texas Episodic Model to predict maximum 1 hour ambient concentrations. The criteria for selection was based on previous experience using the model and knowledge of local meteorology.
 - (3) Selection of NO-NO₂ conversion rate: The analysis was modified to consider 100 percent conversion. Refer to response to letter 6, part p. for further discussion of this issue.

8. California, Department of Conservation, Division of Oil and Gas

- a. C
- The report does not discuss the very important benefits that could be derived from the combustion and inert gas generation. For instance, the combustion of 45 MMCF/D of 1,000 BTU/CF gas in a gas turbine power plant could generate nearly 200 megawatts of electric power. Part of this power could be used to drive the compressors for injecting the inert gas and for operating other machines, such as well pumping units. The waste heat in the turbine exhaust (inert gas) could be recovered in a steam generator and used to power other machines, such as steam turbines, pumps, or oil and gas treating and processing. If the pressure and temperature of the steam were adequate and the plant properly located, the steam could be injected for thermal recovery in the shallow Tulare tar sands.

Inert gas pressure maintenance combined with electric power generation and waste heat recovery is an attractive and efficient scheme with many potential benefits. This scenario should be seriously evaluated for integration into the Elk Hills operations.

- R An economic analysis has been performed covering the use of the produced natural gas in methods other than injection for reservoir pressure maintenance. This analysis indicates that the current method of operation at Naval Petroleum Reserve-1 will yield the maximum hydrocarbon recovery from the field. The Department of Energy believes that alternate uses for Elk Hills natural gas will be considered when the reservoir pressures have stabilized and/or there is excess gas from the pressure maintenance program. A water flood program for pressure maintenance has begun. To the extent that this program is successful excess gas may become available, but such success will most likely not become apparent for two years.

9. California, Department of Fish and Game

- a. C We request that the existing wildlife management plan for the Reserve be revised to include specific measures to protect and enhance rare and endangered species resident on the Elk Hills Naval Petroleum Reserve. There should also be a reactivation of the annual meetings to coordinate wildlife management on the area.
- R Please see the response to letter 4, part a. The government has conducted informal meetings with the California Department of Fish and Game about wildlife on the Reserve. If the Department of Fish and Game would like to establish formal annual meetings with the government, this can be arranged by contacting the Reserve.

10. California, Department of Parks and Recreation

- a. C The California Office of Historic Preservation would appreciate the opportunity of consulting with the Department of Energy concerning the eligibility of archeological sites Ker - 659, - 660, - 661, and - 662 for inclusion on the National Register of Historic Places and the adequacy of the identification survey. This opportunity should be afforded the State Historic Preservation Officer under the National Historic Preservation Act of 1966, Executive Order 11593 and the Advisory Councils Procedures (36 CFR, Part 800).
- R The four sites are located near the stream bed of the Buena Vista Creek to the west of the proposed petroleum products pipeline. The nearest site is 1,750 feet from the pipeline alignment. The sites are very obscure. Consultations with the State Historical Preservation Office have been initiated.

11. California, Energy Resources Conservation and Development Commission
- a. C It is the recommendation of the California Energy Commission that the
 - b. Department of Energy do the following:
 - c.
 - d.
 - 1. Thoroughly re-examine the alternatives of injecting produced natural gas versus total water flooding to maintain pressure for crude oil production.
 - 2. Determine or estimate to what market place the NPR-1 crude oil production would go.
 - 3. Expand the discussion on alternatives and also add an alternative to produce available natural gas first.
 - 4. Include a discussion on the impact of not making 360 mmcf of natural gas available for sale during the critical mid-1980's.
- R
- 1. An economic analysis has been performed covering the subject of the sale of produced natural gas as an alternative of injecting it to maintain reservoir pressure. The results of this analysis indicate that the current method of operation at Naval Petroleum Reserve-1 will yield the maximum hydrocarbon recovery from the field. A water flood program has been initiated. If successful, it will allow for the sale of gas by 1981.
 - 2. The Department of Energy believes that marketing of the Naval Petroleum Reserve-1 natural gas will be considered when the reservoir pressures have stabilized and/or there is excess gas available from the pressure maintenance program. As noted in the previous response, gas may be available for sale as early as 1981.
 - 3. The Department of Energy has initiated a program of water flooding for reservoir pressure maintenance. To the extent that this program is successful, excess natural gas may be marketed, but the success will most likely not become apparent for two years.
 - 4. Discussions of crude oil marketing have been revised, as seen in Appendix P.
12. California, Solid Waste Management Board
- a. C Discussion on page I-28 (top) indicates that potentially hazardous waste is being spread along the Reserve's roadbanks as a soil amendment. We believe this is not an environmentally acceptable method of waste disposal. All wastes generated as a result of well drilling and development activities should be disposed of at the on-site Class 11-1 facilities or hauled away to an acceptable disposal site.

R Please see response to letter 6, part e.

13. California, State Lands Commission

- a. C The project description is so qualitative, it fails to provide adequate information about the project. Specific instances of this are found throughout the project description. For example:

Page 1-8, paragraph 1, "some additional compressors"

Page 1-25, paragraph 2, "some liquid storage capacity"

Page 1-27, paragraph 1, "Additional ponds"

These and other similar inferences should be quantified, as they presently provide the reviewer with little useful information.

R Quantification has been made, as indicated in Appendix O. In addition, please see response to letter 6, part w.

- b. C On Page 1-24, it states that the storage and loading facilities at 35R plant are adequate only for existing production. To what extent will new facilities be required? Further, how many will be needed and what will their capacities be?

R The text has been modified to indicate the new facilities and capacities required.

- c. C Page 1-41. What does the discussion about navigable waters have to do with the project at Elk Hills?

R The Federal Water Pollution Control Act of 1972 (Section 502(7)) broadened the definition of "navigable waters" to include all waters of the United States and brought all waterways under the jurisdiction of the federal government with respect to pollution control.

- d. C Page 1-43, last paragraph. Define "earthquake country".

R Text has been changed to reflect definition.

- e. C Page 11-24, fourth paragraph. The statement regarding impact on vegetation conflicts with a similar statement in the project description. This paragraph indicates that vegetation has not returned to normal and that erosion is a serious problem in some areas where construction activity has occurred. This conflicts with the statement in the project description which states that no mitigation of earth moving is necessary since vegetation reinstates itself adequately. This conflict should be rectified in the final Environmental Impact Statement.

- R The project description stated that natural revegetation was found to be the best method for site restoration. However, this took place following regrading of disturbed areas and application of erosion control techniques. The discussion on construction and restoration under the project description has been expanded to describe these routine practices.
- f. C Page II-25, Wildlife. The opening statement states that the work done was mainly literature survey. Yet, in other paragraphs it refers to field surveys. Were there field surveys?
- R The wildlife surveys took place at the same time as the vegetation surveys, late November 1976 and January 1978. The text on page II-25 to II-28 reflects the outcome of these surveys and literature reviews. The government is planning to undertake an extensive wildlife survey in Spring of 1979 to ascertain possible impacts to endangered species in the Reserve.
- g. C Page II-31, paragraph 2. As a point of clarification, the China Lake Naval Weapons Center is located in desert, not in mountains.
- R Text has been clarified.
- h. C Page IV-21, paragraph 3. There is reference in this paragraph to a "proposed water delivery". This needs to be elaborated on. If the increased water delivery and appurtenant facilities are a portion of or necessary to the project, the impacts need to be discussed.
- R Construction and operation impacts are discussed in the text (pages IV-20 to IV-23) and in Appendix J.
- i. C Page IV-30, paragraph 2. A mitigation measure referred to herewithin is the analysis required by CEQA. Activities wholly within federal land do not require CEQA analyses.
- R The discussion relates to secondary industrial development taking place outside federal lands as a result of the increased oil production at Elk Hills. Such development would be subject to local land use controls and the provisions of CEQA.
- j. C Page IV-50, paragraph 3. It is stated here that Pacific Gas and Electric may not be able to supply additional power to the project. Assuming that Pacific Gas and Electric cannot provide the electrical capacity required by this project, what impact would occur?
- R The well pump motors would continue to operate on natural gas instead of switching over to electric powered motors.

- k. C The impact discussion fails to address the potential impacts upon oil production in the State and Alaska if this project is approved. At the very least, the conclusions from Appendix P and reference to Appendix P should be included.
 - R Such discussions are included on page IV-1 of the text.
- l. C Page V-13, paragraph 2 under Comparative Effects. A statement is made that "hydrocarbon emissions would be from 2 to 5 1/2 times as great as the comparable NPR-1 case." Please explain this statement, especially how were these numbers determined. Additionally, it can probably be assumed that if price were allowed to use demand would diminish, possibly removing the need of Elk Hills production at the MER. This aspect should be addressed.
 - R Hydrocarbon emission data were drawn from the report referenced on page V-11: "Draft Environmental Impact Statement for the Cumulative Production/Consumption of the Crude Oil Price Incentive Rulemakings, Federal Energy Administration DES77-7, August 1977." Production of Naval Petroleum Reserve-1 at MER is presently mandated by Congress.
- m. C Alternatives: The alternative section fails to recognize other energy sources as alternatives to production at the MER at Elk Hills. Additionally, conservation seems to be a very viable alternative. These oversights should be rectified in the final Environmental Impact Statement.
 - R This discussion has been added in Section V. I. New Technology Alternative.
- n. C Page VI-1. The discussion of any probable adverse environmental effects which cannot be avoided should proposal be implemented, is incomplete. The discussion fails to analyze the impact on California and other oil production.
 - R This topic is addressed in Appendix P.
- 14. California, Water Resources Control Board, Division of Planning and Research
 - a. C The final Environmental Impact Statement should describe the surface and groundwater resources of the Reserve and the surrounding area in greater detail. These resources should be plotted on a map or maps of appropriate scale to provide a basis for impact evaluation. The plots should show the location of any streams (including ephemeral streams), surface and groundwater resources, and all water wells on the Reserve and in the nearby area.

- R The Reserve and the adjacent area do not have any continuously flowing streams. Each ravine and canyon on and off the Reserve can be represented as an ephemeral stream. These ephemeral streams are numerous and, to some extent in this area, change flow path irregularly. Mapping of all such possible streams is impractical and would serve no useful purpose. Currently the Reserve does not have any water wells on the Reserve. All water is brought into the Reserve by pipeline. However, the government is planning to drill two or more wells in the 9G region for injection in the 2G and 3G regions. The source water for these wells is saline.
- b. C The draft Environmental Impact Statement in its discussion of water resources (pp. II-22 and II-23; Appendix J) indicates that the surface and groundwaters are of poor quality, and states that the cause of the degradation is not completely known. It is probable that the waste disposal practices in the area by the petroleum industry could have adversely affected water quality. The petroleum wastes from settling ponds, spills, and from drilling muds that have been disposed of along roadways in the Reserve all have potential for adversely affecting water quality in the Reserve. High quality groundwater occurs immediately north and east of the Reserve, and may extend into the Reserve near Tupman. In fact, wells supplying the West Kern County Water District are located approximately 1.5 miles northeast of the Reserve.
- R Please see response to letter 6, part d.
- c. C The final Environmental Impact Statement should include a map showing the distribution of the major soil types throughout the Reserve to permit a better assessment of impacts due to erosion and spills. Such a map would also complement and clarify the soils discussion in the draft Environmental Impact Statement (pp. II-9 through II-12).
- R The Reserve is composed of only two major soil types, the Panoche Series and the Kettleman Series. Unfortunately, a map showing the distribution of these soil types on the Reserve is unavailable.
- d. C The draft Environmental Impact Statement (pp. II-22 and II-23) describes the quality of the groundwaters underlying Naval Petroleum Reserve-1 to be of poor quality and being highly mineralized with total dissolved solids (TDS) concentrations averaging 5,000 mg/l. It is also stated that waters of this quality are generally considered unusable. The United States Environmental Protection Agency (EPA), in its March 21, 1978 draft Regulations for the Underground Injection Control Program, considers aquifers containing less than 10,000 mg/l TDS in geographic areas where no underground injection has occurred as designated underground sources of water to be

protected. As such, the proposed regulations would require states to protect the source to the maximum extent feasible from actual or potential contamination caused by underground injection practices. On this basis, the potential usefulness of the shallow groundwater must be reconsidered.

- R The EPA draft, "Regulations for the Underground Injection Control Program," sets the upper limits of drinking water at the unusually high figure of 10,000 mg/liter TDS. At the present time this is a proposal only and has not yet been adopted. In the event of adoption, the state agencies will review individual cases and may allow injection of wastewater into aquifers containing waters of less than 10,000 mg/liter TDS. There are no definite plans for such injection at Elk Hills. In the event such operations become desirable, they will be governed by the appropriate state agency.
- e. C The discussion of groundwater resources in the draft Environmental Impact Statement (pp. II-22 and II-23) should be expanded in the final Environmental Impact Statement to include the possibility of hydraulic continuity between the Reserve and the San Joaquin Valley. If the basin adjacent to the Reserve is hydraulically continuous with the Reserve, elimination of Reserve brines and wastes should result in an improvement in basin water quality once the basin is flushed out. If this is the case, the water quality of the basin should be protected from the infiltration of Reserve wastes.
- R Please refer to response to letter 6, part d.
- f. C The final Environmental Impact Statement should describe the impact on the existing freshwater supply of the consumptive use of 260,000 gpd of water during the construction of the NPR-1 facilities. The draft Environmental Impact Statement (p. IV-20) states that no significant impacts should occur due to the freshwater supply from the West Kern County Water District. However, the withdrawal of water without its return to the usable water cycle will aggravate the existing groundwater overdraft in an already water deficient basin.
- R The 260,000 gal./day of fresh water used for construction is equivalent to 0.8 acre feet per day. If this figure is used in the Final Environmental Impact Statement, it puts the fresh water consumption into better perspective.
- g. C The draft Environmental Impact Statement does not discuss the effects of groundwater withdrawal for well operation and maintenance on land subsidence. The draft Environmental Impact Statement does describe the subsidence aspects of petroleum extraction in detail (pp. IV-2 through IV-11), and should discuss the potential for land subsidence due to other causes in a similar manner.

- R The section that examines subsidence (pp. IV-2 through IV-11) for petroleum extraction also covers the extraction of all liquids and gases from the oil bearing strata. With respect to saline groundwater withdrawal (9G section) and injection (2G and 3G sections), there is a potential for subsidence if excessive withdrawal of groundwater occurs in the shallow water zone which is composed mostly of alluvial sediment. The most probable location of this subsidence is at the flanks of the shallow water zone. The magnitude of the subsidence in these areas is largely unknown because of the many unperceived factors about the physical properties of the soil and about the regional structure of the formation. However, the subsidence resulting from groundwater withdrawal is felt to be small. Recognizing the potential for subsidence, the government has made an agreement with the California Department of Water Resources to monitor subsidence in the area. Although the main intent is to monitor the subsidence caused by petroleum withdrawal, the monitoring program will detect subsidence resulting from groundwater.
- h. C The draft Environmental Impact Statement (pp. IV-21, D-8 and D-9, and J-3 and J-4) indicates that the construction and the operation of the Naval Petroleum Reserve-1 facilities will not have an adverse impact on the water quality of groundwaters underlying the Reserve because of their poor quality. As stated previously, these waters can be classified as potential sources for drinking waters according to EPA. Thus, any impacts on the quality of these waters should be reassessed. If the potential impacts can be considered adverse, either alternative design or operation procedures, or suitable mitigation measures should be considered.
- R Please see responses to letter 6, part d. and letter 14, part d.
- i. C Oil, gas liquid and wastewater spills represent a major threat to land and water uses throughout the Reserve. The final Environmental Impact Statement should ensure that all areas of the Reserve are protected from these spills. The discussion of risk assessment in the draft Environmental Impact Statement (pp. I-40 through I-49) indicates that contingency catch basins (CCBs) are strategically located throughout the Reserve to contain oil spills from all sources. The final Environmental Impact Statement should include a map showing the locations of these catch basins and their relation to areas of transfer, processing and storage of oil and gas. In addition, the final Environmental Impact Statement should consider the necessity of preventing percolation of any retained spills through underlying soils to potentially usable groundwater.

R There are 51 permanent CCBs scattered at strategic locations over 26,000 acres of the Reserve. Displaying the approximate location of these CCBs on a map in the Final Environmental Impact Statement is seen of little value because topographic features could not be included. Large-scale topographic maps showing the exact locations of all CCBs are available for inspection at the OICC in San Bruno, California. A note on the number of CCBs has been incorporated in the text. Spills of oily materials within the Reserve are promptly cleaned up following procedures outlined in the Spill Prevention Control and Containment plan presently in effect. The likelihood of any but trace quantities of oil entering groundwaters is slight when such procedures are followed. (See also page I-41 of the final Environmental Impact Statement.) Accidental spills of saline wastewater could, because of the rapid percolation of water into the sandy soil of the Reserve, possibly reach fresh water aquifers at the site. However, these fresh water aquifers are limited to the first few hundred feet of strata and are highly mineralized (page II-22 of the final Environmental Impact Statement), hence are unlikely to be further degraded by such a spill

j. C The final Environmental Impact Statement should describe the waste disposal practices to be followed by this project in more detail. In a section on waste disposal (pp. I-26 through I-28) the draft Environmental Impact Statement indicates that the waste material generated by well drilling and production is disposed of along the banks of roadways. All wastes of this kind (e. g., drilling muds) should be disposed of at one of the two existing Class II-1 disposal sites on the Reserve or be hauled away by a solid waste disposal company.

R Please refer to response to letter 6, part e.

k. C The draft Environmental Impact Statement (page I-23) describes a proposal to mine approximately 28,000 B/D of supplemental water from the southern or western area of the Reserve for pressure maintenance injection. This water would be injected into the Shallow Zone and the Stevens Zone along with 170,000 B/D of water separated from oil. Due to chemical incompatibility of some of the produced water with the zone water, it is proposed to evaporate/percolate 30,000 B/D of the mixed produced water which could impact potentially usable groundwater. The final Environmental Impact Statement should discuss the possibility that twin wastewater lines from the Lease Automatic Custody Transfer (LACT) system to the various wells could eliminate this problem and relieve the necessity of groundwater mining.

- R On page I-23, correct 170,000 B/D to 70,000 B/D, this is a typographic error. In addition, the 30,000 B/D of mixed water referred to on page I-23 which may require disposal is, in part, water that mixes underground (i.e., injected water and connate water) and cannot be separated. The statement is made that twin wastewater systems would obviate the need for supplemental water; however, regardless of the efficiency with which produced water is handled and conserved for injection, supplemental water is generally always required in a waterflood operation. This is particularly true in the early stages of a waterflood project when the volume of produced water is limited.
1. C The draft Environmental Impact Statement, under Gathering and Processing Systems, describes a total of about 100,000 barrels per day of water separated from oil at the top of page I-23 and 170,000 barrels per day at the bottom of page I-23. This possible discrepancy should be clarified in the Final Environmental Impact Statement.
- R Correct 170,000 B/D to read 70,000 B/D on page I-23. This is a typographic error.
- m. C The final Environmental Impact Statement, in its discussion on the impact criteria for water resources, should consider the existing and potential beneficial uses of a particular water body when determining if substantial degradation has occurred. The draft Environmental Impact Statement (p. J-7) appears to consider substantial degradation to have occurred only if the existing beneficial uses of the water body were severely hampered.
- R No potential use for the brackish Lower Tulare Zone water is known at this time other than limited industrial applications such as oil field waterflooding projects.
15. California, Department of Transportation
- a. C The present 20 tank trucks per day transporting liquid petroleum products to various Southern California markets is expected to increase to 200 tank trucks per day when production reaches maximum efficient rate (MER) by 1981. The projected increased traffic will probably be routed over State Route 119 from Naval Petroleum Reserve No. 1 to Interstate Route 5. At the present time, the State highways in this area are operating at an acceptable level of service. With the added burden of heavy truck traffic from the new facilities, the capacity of State Route 119 will be reached before 1985. Furthermore, the structural quality of the pavement section is not designed to support the expected truck traffic generated during the peak of the MER production. This peak is expected

within 5 years after the open-up date (July 3, 1976). The present structural section on State Route 119 is based on a Traffic Index of 8.5, while the increased truck traffic will require a Traffic Index of 10.5-11.0.

- R Future truck traffic carrying liquid petroleum products from Naval Petroleum Reserve-1 is expected to range from 50 to 150 per day after the railroad tank car loading facility is completed early in 1980. The maximum value will occur during the winter half of the year. A brief review of existing traffic on State Route 119 suggests that State Route 119 currently operates at level of service C or better (i.e., at less than 70 percent of capacity). The above increase in truck traffic would undoubtedly have an appreciable impact on the level of service for State Route 119, probably reducing it to the C-D range (i.e., 70 to 85 percent of capacity) during the winter half of the year. The adequacy of the structural section of the highway would be affected by the addition of the peak truck operations. It should be pointed out, however, that according to classification counts taken by the California Department of Transportation in 1977, the size and number of trucks now using this section of State Route 119 have already exceeded the Traffic Index of 8.5. The present Traffic Index of 10.0 clearly indicates an existing condition of overstress of the structural section, which additional traffic would aggravate. Presuming that production at Naval Petroleum Reserve-1 would continue for as much as 20 years, the liquid petroleum and corresponding truck traffic would decrease with time and the net result on the present Traffic Index of 10.0 would be an increase to a new value of from 10.3 to 10.6.

16. Southern California Association of Governments

- a. C Southern California Association of Governments has adopted a policy of encouraging the production of natural gas at Elk Hills and making it available for intrastate sale. Because of the region's critical air quality concerns, the production and utilization of natural gas should be of the highest priority. At some future time when the west coast oil surplus situation is resolved or Elk Hills' crude oil can be marketed outside of California, the production of oil at maximum efficient rate at Elk Hills would appear to become a more reasonable option. Until this time, the possibilities of injecting water or field-generated inert gas to maintain reservoir pressure should be more carefully considered.
- R Please see response to letter 11, part a., b., c. and d.

17. Kern County Air Pollution Control District

- a. C The proposed project appears to have resulted in a violation of the 1 hour California Ambient Air Standard for NO₂. As a result of this apparent violation at the public roadway, it appears that the finding required in Rule 210.1 of the Rules and Regulations of the Kern County Air Pollution Control District cannot be made. Unless the problem stated hereinabove can be mitigated, it may be the case that an Authority to Construct required pursuant to Rule 201(a) cannot be granted.
- R The preliminary analysis presented in the Draft Environmental Impact Statement showed that the State of California 1 hour standard of 0.25 ppm would be violated on the Elk Hills Road. This result suggested that further study and a more refined analysis be undertaken to evaluate (1) the cause of this violation and (2) identification of possible mitigative measures which could be taken to prevent violations.

The report describing the more detailed analysis is presented in Appendix O of the Final Environmental Impact Statement. This material replaces the initial screening analysis and indicates that air quality standards will not be violated on or near the Elk Hills Road.
- b. C In addition, it is highly desirable to state the air quality impacts in lbs/hr or tons/yr for each alternative in the Draft Environmental Impact Statement.
- R The air quality impacts for each alternative have been quantified in terms of the increase or decrease in emission levels compared with the base case emissions as estimated for the proposed project. In addition, for several of the alternatives the emission reductions off the Reserve have been estimated. These changes have been included in the revised text of Chapter V of the Final Environmental Impact Statement.

18. Kern County Planning Department

- a. C No discussion of tertiary recovery methods appears in the Draft Environmental Impact Statement.
- R Production at NPR-1 can proceed using current operations for the next 15 years or more. No plans exist at this time for the use of any tertiary recovery methods.

- b. C Further discussion on drilling mud disposal is needed.
R Please see response to letter 6, part e.
- c. C No discussion of the impacts from the use of crude oil from NPR-1 (e.g., refinery operations) is apparent.
R The crude oil from NPR-1 will replace other crude oils (especially imported crude oils) in uses (such as oil refineries) which already exist and have on going impacts.
- d. C On Page II-31, the discussion omits the Naval Weapons Center, also in Kern County.
R The China Lake Naval Weapons Center is mentioned as one of the land uses in the second paragraph on page II-31.
- e. C On Page II-37, the discussion omits State Route 99.
R The text has been revised to include State Route 99.
- f. C Page II-39 states that the AADT of State Route 58 @ State Route 99 was 29,000 in 1976. We suggest a check of this figure since the 1977 AADT for the intersection is 22,000; the 1976 figure reported by CALTRANS was 21,000.
R Table 2-2 on Page II-39 has been revised to reflect 1977 traffic volumes.
- g. C The discussion on Page II-48 needs to be updated in regard to the legislation adopted pursuant to the recently voter approved Jarvis-Gann initiative.
R The discussion on Public Finance has been revised to reflect the fiscal year 1978-79 budget, the first after Proposition 13.
- h. C On Page IV-17, the transportation emissions discussion lacks assessment of VMT emissions attributed to commuter traffic and to a potential 200 trucks per day in the San Joaquin Valley Air Basin and in the EPA-designated Kern AQMA. Emissions due to high VMT between Bakersfield and the site must be addressed. Mitigation of air pollution from high VMT in this case is strongly suggested.
R Vehicle emissions, both on and off the Reserve, were estimated based on the EPA composite emission factor for California and a base year of 1979 (without inspection and maintenance). The assumptions and calculations used to obtain the vehicle emission estimates are presented below.

(1) Truck Traffic

a. Assumptions

1. Reserve travel - 15 miles/truck
2. Off-Reserve travel - 193 miles/truck based on average distance to market

b. Emission factors for trucks

CO	28.7 grams/mile
HC	5.2 grams/mile
NO _x	20.4 grams/mile
SO ₂	2.8 grams/mile
Particulates	1.86 grams/mile

c. Emission Calculations - Reserve

$$\text{HC: } 150 \frac{\text{trucks}}{\text{day}} \times \frac{15 \text{ miles}}{\text{truck}} \times \frac{5.2 \text{ grams}}{\text{mile}} = 11,700 \frac{\text{grams}}{\text{day}}$$

$$\text{CO: } 64,600 \frac{\text{grams}}{\text{day}}$$

$$\text{NO}_x: 45,900 \frac{\text{grams}}{\text{day}}$$

$$\text{SO}_2: 6,300 \frac{\text{grams}}{\text{day}}$$

$$\text{Particulates: } 4,200 \frac{\text{grams}}{\text{day}}$$

Off-Reserve Emissions

$$\text{HC: } 151,000 \frac{\text{grams}}{\text{day}}$$

$$\text{CO: } 831,000 \frac{\text{grams}}{\text{day}}$$

$$\text{NO}_x: 591,000 \frac{\text{grams}}{\text{day}}$$

$$\text{SO}_2: 81,000 \frac{\text{grams}}{\text{day}}$$

$$\text{Particulates: } 53,800 \frac{\text{grams}}{\text{day}}$$

d. Summary of Emissions from Trucks

POLLUTANT	EMISSIONS (lbs/hr)		
	RESERVE	OFF-RESERVE	TOTAL
HC	1.1	13.8	14.9
CO	5.9	76.3	82.2
NO _x	4.2	54.2	58.4
SO ₂	0.6	7.4	8.0
Particulates	0.4	5.0	5.4

(2) Automobile Traffic

a. Assumptions

1. Construction Phase - 2,500 vehicle trips per day
2. Operation Phase - 800 vehicle trips per day
3. Assume each trip is 30 miles - 7.5 miles on Reserve
22.5 miles off Reserve

b. Emission Factors (Composite emission factors for California, 1979)

CO: 62.6 grams/vehicle mile

HC: 7.1 grams/vehicle mile

NO_x: 3.4 grams/vehicle mile

c. Estimated Emissions

1. Construction Phase

POLLUTANT	EMISSIONS (lbs/hr)		
	RESERVE	OUTSIDE	TOTAL
CO	71.8	287.3	359.1
HC	8.2	32.6	40.8
NO _x	3.9	15.6	19.5

2. Operations Phase

POLLUTANT	EMISSIONS (lbs/hr)		
	RESERVE	OUTSIDE	TOTAL
CO	23.0	91.9	114.9
HC	2.6	10.4	13.0
NO _x	1.3	5.0	6.3

(3) Air Quality Impact

The air quality impact of the anticipated traffic volumes has been estimated using the Caline-II model assuming worst case conditions exist. These conditions are assumed to be :

- All Traffic on Single Roadway
- Truck Traffic is distributed over 24 Hours
- Peak Auto Traffic 1,500 vehicle/hr
- Wind Direction parallel to Roadway
- Wind Speed 3 MPH/Class D stability
- Roadway width of 60 ft.

Based on the above parameters and assumptions the estimated CO concentrations due to the increased vehicle travel from the proposed facility are given below

MIXING CELL CONCENTRATIONS	PREDICTED CO CONCENTRATIONS (PPM)		
	DISTANCE PERPENDICULAR TO ROADWAY (FEET)		
	30	150	350
7.1 ppm	4.0 ppm	2.2 ppm	0.5 ppm

The above values represent the maximum 1 hour CO concentrations in the roadway vicinity. Based on previous studies, the maximum 8 hour average value is assumed equal to 60 percent of the maximum 1 hour value.

This results in 8 hour average values on the order of 4 ppm in the immediate vicinity of the roadway and 2 ppm at a distance of 30 feet from the shoulder. These estimates are well below the 8 hour standard of 9 ppm. Since traffic will disperse from the construction site, the above estimates are very conservative due to the assumption that all vehicles travel on a single access road.

Based on the above considerations, it does not appear necessary to identify specific mitigating measures for vehicle generated air pollution related to the proposed Elk Hills project. However, car pooling and ride sharing should be encouraged when and where possible to reduce potential emissions and conserve energy.

- i. C The discussion on Page IV-18 in regards to increased power consumption fails to address cumulative effects in regard to air emissions throughout the Pacific Gas and Electric service area.

R Please refer to response to letter 7, part d.

- j. C Particulate matter emissions, especially the impacts of particles of one micron and smaller from the entire spectrum of facility construction, operation, transportation and refining of hydrocarbons within the air basin should be discussed.

R Fine particulate matter, usually defined as particles less than 2-10 microns in diameter are important in terms of health and visibility impact. At present, however, the Air Quality Standards address total suspended particulates which includes all particles collected on a glass fiber filter in a high volume sampling device.

As has been noted in the Draft Environmental Impact Statement, all combustion sources associated with existing and proposed stationary sources on the Reserve utilize natural gas. As a result, particulate emissions, even in the small size fraction, are not significant. For example, the emission factor for particulate emissions from natural gas fired equipment is on the order of 5-15 lbs per million cubic feet of gas consumed. The fuel consumption of the 5,500 horsepower natural gas compressor engines is approximately 65,000 scfh. On this basis, the particulate emissions from each large compressor are on the order of 1 lb per hour. On the basis of dispersion modeling, these emission rates are not expected to have significant air quality impact.

In terms of construction and transportation, the most significant source of particulate emissions is fugitive dust. Based on available technical data, fugitive dust is predominantly composed of larger particles (on a mass basis) and consequently, are not necessarily significant in terms of human health impact or visibility impairment. Mitigating measures that have been proposed to reduce fugitive emissions include:

- °Wetting down construction areas
- °Paving heavy traffic roads and service areas
- °Housekeeping considerations

k. C Suggested air quality mitigation includes a provision that prior to construction, the Kern County Air Pollution Control District shall verify the DOE's ambient and project operation and construction air pollution emission estimates, identify air quality sensitive activities and areas within the AQMA; verify the DOE's analysis, present conditions to be incorporated into the project's overall operation plan and into the proposed Kern Air Quality Maintenance Plan.

R All necessary permits and reviews will be obtained in accordance with local, state and federal requirements. The proposed project has been incorporated into the Air Quality Maintenance Plan recently developed for Kern County.

l. C It is strongly suggested that the project not be constructed or operated as planned until sufficient evidence is presented to support a finding of adequacy for the measures proposed by the DOE to deal with the issue of decommissioning.

R Please refer to response to letter 20, comment d.

m. C On Page IV-19, first full paragraph presents a quasi trade-off for air pollution emissions. This trade-off should be explained, quantified with sample calculations and presented for acceptance to the Kern County Air Pollution Control District.

R Please refer to response to letter 7, part j.

n. C Page IV-20 should present the amount of installed energy (preferably in MWe) necessary to deliver the necessary 260,000 GPD from its origin to the project site. Discussion of significant effects related to the anticipated overall project energy consumption is needed.

R The water for construction use will be supplied by the West Kern County Water District from five existing wells in the Tupman area. The estimate of the quantity of water required during construction has been revised to 500,000 gallons per day. The amount of energy needed to deliver this quantity of water is 130 KW(e). This water will be required only during construction, which will be completed in 1979.

- o. C The discussion on Page IV-26, second paragraph under the heading Wildlife would appear not correct. The question of wildlife-carrying capacity of habitat before and after construction has not been assessed. Displacement of fauna from construction sites to other sites already inhabited at an optimum ecological balance would appear to upset that balance.
- R The carrying capacity of every area within the Reserve was not determined in this or any study known. Therefore, a potential may exist which could upset the ecological balance. Text changes have been incorporated to reflect this possibility.
- p. C The data presented on Page IV-31, Table 4-2 should also be presented on a plot plan of sufficient scale to permit competent review of the proposed action.
- R The project elements listed in Table 4-2 have been coded to indicate their location within sections of the Reserve.
- q. C Discussion of operation on Page IV-40 should also discuss cumulative effects to road systems in light of on going and proposed residential development in Rosedale and Southwest Bakersfield. A graph of time versus total VMT attributed to the project should be presented. Mitigation is needed to reduce transportation impacts - i.e., mass transit between Bakersfield and project site. The Environmental Impact Statement does not discuss cumulative effects due to VMT. The Environmental Impact Statement does not discuss overall expense to the County and State for road maintenance, increased accident potential, traffic control and air pollution emission surveillance.
- R The new residential development referred to may provide housing for some Elk Hills employees in which case the cumulative impacts would be the same as these cited in the report. There are no present plans for mass transit although some Elk Hills employees use car pools on a voluntary basis.
- r. C The discussion on effects to law enforcement would appear to not exemplify the effects anticipated due to 1,635+ construction workers.
- R According to Captain Cleier of the Kern County Sherrif's Department, there has been an increase in thefts of oil securing equipment and other law enforcement problems in the area around Elk Hills in the past year, but it is not possible to establish how much of this may be attributable to the increase in construction activity at Elk Hills. The Sheriff's Department has increased its nightly patrol of the Reserve from one to two men. This service is provided under contract to the federal government. In addition, increases in patrols are anticipated for areas outside the Reserve.

- s. C Page IX-1 - the Environmental Impact Statement's treatment of economic benefits is very tenuous. The document does not provide a logical quantification of economic facts to justify why increased employment and economic activity is beneficial in a region with existing low unemployment and relatively inflation resistant economy. For example, how is increased domestic production a benefit to Kern County and its regional economic setting if a present west coast oil surplus situation is not resolved by the DOE?
- R DOE has adjusted its entitlements program to ensure an equitable market for west coast oil. The surplus situation existing on the west coast has been alleviated as a result of this adjustment and other economic factors. Appendix P has been updated to reflect more recent information.
- t. C The Environmental Impact Statement fails to compare viable energy recovery alternatives to oil. The NEPA does not appear to allow the DOE to relax its mandated discussion of viable alternatives to the project because of a subsequent public law (No. 94-258).
- R A discussion of alternative energy sources has been added to Section V of the Final Environmental Impact Statement.
19. Los Angeles County Natural History Museum
- a. C The DEIS is deficient with regard to protection of paleontologic resources, which in the Elk Hills area are potentially very important. The Environmental Impact Statement should include a study including a field survey on possible fossil deposits and methods of mitigation which would permit preservation or salvage of paleontologic resources without unduly hampering development.
- R The government will undertake a separate study at the Reserve to identify possible paleontologic resources at the site and appropriate mitigation measures.
20. City of Taft
- a. C An assumption is made that the Taft population is declining. California Department of Finance estimates for 1976-1978 indicate growth within the corporate limits from 4,514 to 4,714.
- R The statement on Page II-36 refers to the entire westside area of Kern County. Department of Finance estimates indicate some recent growth in Taft and the surrounding area.
- b. C The Draft Environmental Impact Statement suggests that housing vacancy rates in Taft are high. Housing in Taft today is at a premium. Data on building permits is out-of-date.

- R Again, the statement refers to the westside. The text has been revised to include the more current data. It should be noted, however, that housing construction is strongly influenced by national and state economic conditions and interest rates, as well as by local economic stimulants. In addition, the increased building activity prior to July 1976 cannot be attributed to Elk Hills since that is the date that open up of the Reserve occurred.
- c. C The westside park and recreational district is not included in the text and map.
- R The intent of this section is to show actual recreational facilities and not district boundaries.
- d. C Mitigation measures suggested for socio-economic impacts are "superficial and unrealistic." The impacts of this project on Taft will be significant. The federal government should provide assistance to mitigate adverse impacts.
- R The section of the text has been expanded. There are no federal programs currently available for impact assistance which are directly applicable to this situation. However, the government is willing to cooperate with local governments to identify and deal with local impacts of this project. We understand the City of Taft has hired a consultant to analyze the impacts of increased oil production on the City of Taft. The results of this study are not available, however, at time of writing. The Officer in Charge of Construction of the Naval Facilities Engineering Command and the Naval Petroleum Reserve have been cooperating in this study.
- e. C The Draft Environmental Impact Statement seems to assume that the Bakersfield metropolitan area will absorb the housing and labor requirements of this project and that the impact on the City of Taft will be minimal.
- R The proximity of Bakersfield (20 miles) and the availability of the greater amenities and opportunities that this metropolitan area offers are the basis of this assumption. Most employees would be willing to commute the longer distance for these amenities. A portion of the labor force, however, will prefer the nearness and atmosphere of Taft, and this preference will have an impact on the City of Taft because of its smaller size.
- f. C The discussion of costs to state and local governments resulting from this project does not consider the relative impacts to the City of Taft. The federal government should help in mitigating these impacts.
- R Please see response to comments d. and e. above.

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May 10, 1979

Mr. Richard T. Russell
OICC Elk Hills
Naval Facilities Engineering Command,
Western Division
San Bruno, California 94066

125/14

Dear Mr. Russell:

URS Company is pleased to submit responses to the second round of comments raised by the City of Taft in their letter of February 26, 1979, concerning the Final Environmental Impact Statement for Petroleum Production at Elk Hills at the Maximum Efficient Rate. In preparing these responses, I made a visit to the City of Taft on April 26, 1979. In addition I contacted many individuals in Taft and Bakersfield to obtain information. A list of persons contacted for this study is attached to this report.

In general, I found that although the City of Taft and potential impacts of the Elk Hills project on the city are discussed throughout the FEIS, the treatment is at a general level. More detail could have been devoted in the FEIS to the City of Taft. In responding to the questions raised by the city, I have attempted to provide sufficient documentation to allow for an assessment of the impacts on the City of Taft.

In summary, my findings from this study are as follows:

1. After an extended dormant period, the City of Taft is experiencing moderate economic revitalization. This is evident from current home-building activity, population increases within the city limits, and expansion of commercial outlets.
2. Insofar as the City's principal economic activity is providing support to the petroleum industry, it is concluded that this economic revitalization is related to increased activity by the Petroleum industry, including, but not limited to the opening of Elk Hills for production in 1976. Secondary and tertiary recovery activities from other westside producers have also contributed to this economic expansion.
3. Activities at Elk Hills will produce socio-economic impacts on the City of Taft in the following areas:

Mr. Richard T. Russell
Page 2
May 10, 1979

- a) increased retail sales;
- b) increased business for petroleum-related industries;
- c) demand for housing; although only about 30% of Elk Hills employees live in Taft and the Westside area. This number contributes significantly to the tight housing market that the City is experiencing.
- d) The activities at Elk Hills will result in minor to moderate traffic flows through the City of Taft. Associated with this traffic will be increased noise, air pollution, accidents, citations, and parking demands. In addition, this traffic will increase wear and tear on city streets.
- e) The cumulative effects of new housing, increased population and more traffic will result in minor impacts on police and fire services and may necessitate some expansion of these services.

Taft is a small community and has less ability to absorb change. While most of the socio-economic impacts related to Elk Hills will occur in Bakersfield, the effects will be felt more in Taft because of its smaller size.

I hope this submittal will adequately respond to the issues raised by the City of Taft and will allow government reviewers of the FEIS and others to understand the scope and intensity of the socio-economic impacts associated with Elk Hills production on the City of Taft.

Sincerely yours,



Ernest H. Vovakis
Senior Planner

bjm
Enclosures

21. Mr. Kreines, consultant to the city of Taft

C. 1) Page II-34: The estimated work force in oil production alone in 1978 was 4232 in Kern County. All oil employees totaled 9000.

R. This is not inconsistent with The Final Environmental Impact Statement.

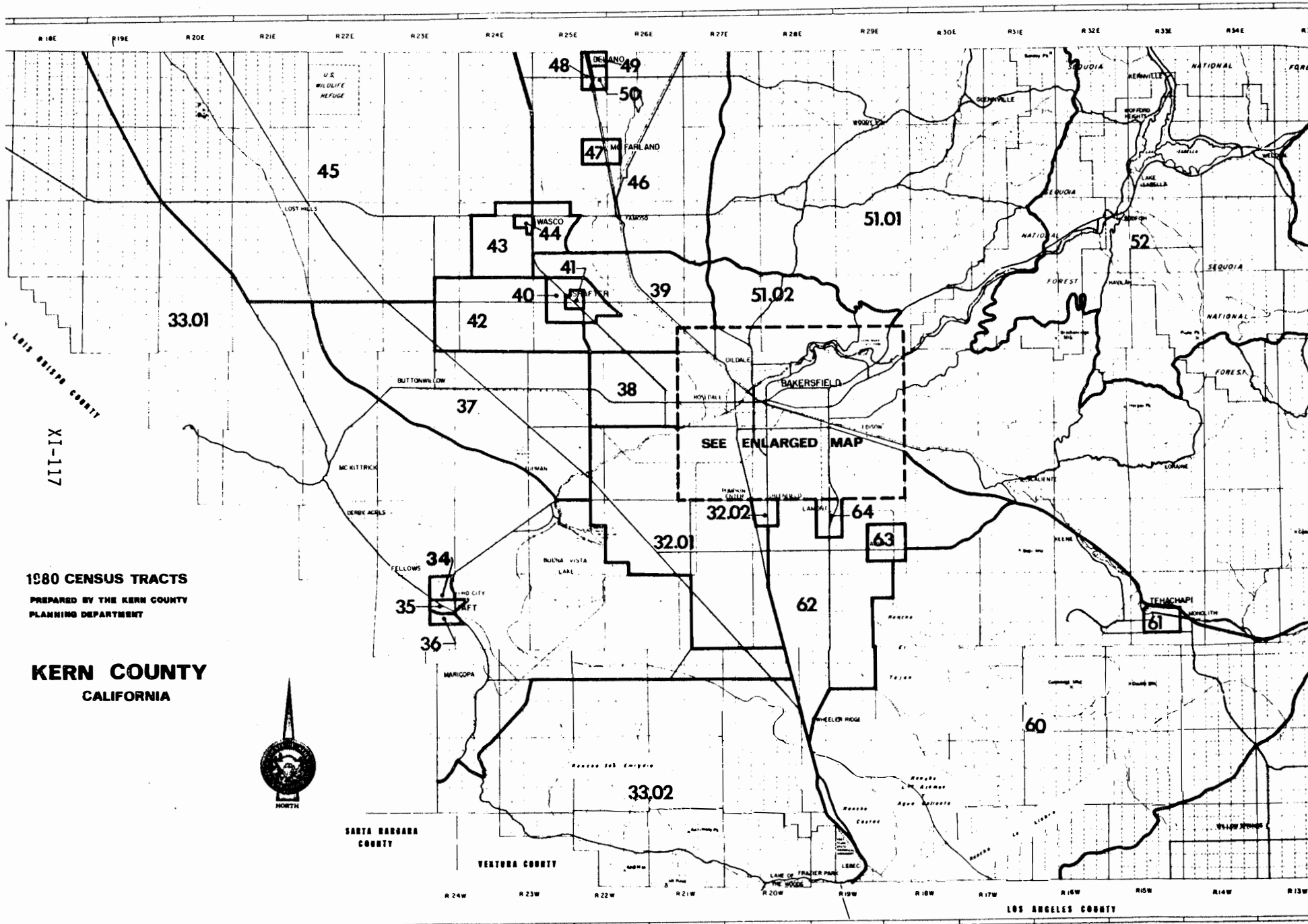
C. 2) Page II-35, under b. Local, the first paragraph describing the importance of oil production and employment to Taft and the Greater Taft Area, is obsolete relative to data which I submitted to Mr. Vovakis of URS in January 1979. This information is now being forwarded to you in the form of my Memorandum #2 to my client, the City of Taft. It shows that oil alone is responsible for at least 3176 employees, many of which I have not been able to count in my survey.

R. The version of memorandum #2, submitted in January 1979, was preliminary, with much of the data indicated as incomplete or preliminary. Since then, URS Company has obtained a second version of this memorandum, presumably the final version.

This memo sets forth a methodology for predicting future employment in the "Greater Taft Area" based on estimating "direct employment" or export employment, defined as oil and gas extraction, and deriving by use of ratios, "indirect employment", which are those industries supporting oil production, and "induced employment", covering all other employment. We find the analysis highly speculative, for the following reasons:

1. The Greater Taft Area is defined to include census tracts 33.01, 34, 35, and 36. (see map). We do not agree with the inclusion of census tract 33.01 in this analysis. It covers a vast area along the west-side of Kern County and takes in agricultural lands and several small communities many miles from Taft.
2. Direct employment in future years is estimated on the basis of an employer survey. This method is likely to yield biased and unrealistic results.
3. The use of two multipliers, one for indirect employment and one for induced employment is not consistent with economic base theory. The multipliers themselves are questionable because they are selected from a given point in time in an industry which is highly cyclical. To quote from The Economic Practices Manual, prepared by The California Office of Planning and Research (page 49):

"The economic-base model is not a well accepted projection method. The export/non-export ratios and multipliers of a community most likely will not remain constant because of changes in population, technology, tastes, and the economic structure. There are also limitations to this tool in the short-run as well: the multiplier may not be stable because of time-lags in the indirect and induced effects. Also, the aggregation of all industries into two sectors, export and service, is a rather large assumption."



1980 CENSUS TRACTS
PREPARED BY THE KERN COUNTY
PLANNING DEPARTMENT

KERN COUNTY
CALIFORNIA



SANTA BARBARA
COUNTY

VENTURA COUNTY

LOS ANGELES COUNTY

4. As noted in memorandum #2, this method does not tell us the location of the new employment generated as a result of Elk Hills production, particularly in the indirect categories.

In conclusion, it is undeniable that the economy of Taft and its surrounding area is strongly dependent upon the oil industry, not only in Elk Hills, but including other production in the westside. We find no basis, however, for revising our estimate on Page II-35 of the FEIS that "...The petroleum industry can support approximately 2000 workers within the greater Taft area."

A recent survey of Elk Hills employees has revealed that of 440 total employees (excluding construction employees), 305 or 69% lived in the Bakersfield metropolitan area, and the remainder, 135, lived in Taft and other westside communities.

- C. Page II-36, under b. Local, we question the discussion of the population size and changes in the Greater Taft Area, and once again refer you to an unfinished memorandum which is attached, Memorandum #3 to the City of Taft. Therein we describe changes in population and the confusion over what constitutes the "Greater Taft Area". I direct your attention specifically to page 8, where we cite census data for the Greater Taft Area for the years 1960 and 1970. It can be seen that population did not decline but in fact has gained substantially, primarily because of development in the census tract 33.01. More importantly, the City of Taft did not lose population either, and this can be verified by Figure 3 on page 3, or by checking with census tract 35 as shown, again, on page 8. In both cases, the City of Taft is shown to be increasing in population. Also, Greater Taft has more than 12,000 persons, depending on how you wish to describe it. Most importantly, the projections for 1980 are not verified by most of the projections that I have seen, which is documented in several places in Memorandum #3. The attempt to characterize the Greater Taft Area as one that is declining in population is not reinforced by most of the data. Furthermore, the reference in the second paragraph of this section to the population being lower-middle to middle class is just not consistent with the facts that we have at our disposal. We took a very careful survey of these people, and describe them with the data offered on page 16.
- R. Census data for tracts 34, 35, and 36 for 1950-70 indicate an overall declining population trend for this area. These tracts comprise Taft and the surrounding unincorporated areas of Ford City, Taft Heights, and South Taft. Population projections have been published recently by the Kern County Planning Department (Population and Housing Report, 1978). This report forecasts a continuation of the downward trend. According to planning department staff, these projections are current and assume increased oil production at Elk Hills.

POPULATION DATA AND PROJECTIONS

CENSUS TRACTS 34, 35, and 36

1950	13,148	}	Census data
1960	12,436		
1970	12,206		
1980	11,950	}	Kern County Population Projections
1990	10,350		
2000	9,000		

These figures provide the basis for the statement in the FEIS concerning the long-term decline of the west-side area. However, aggregate figures for 10 year periods may obscure sub-areas where the direction is different from that of the area as a whole. Population estimates for the City of Taft, covering only the incorporated area (and excluding Ford City, Taft Heights, and South Taft) show growth since the 1970 census, particularly since 1974.

POPULATION ESTIMATES, CITY OF TAFT
(incorporated area only)

<u>Date</u>	<u>Population</u>	<u>Source</u>
April 1, 1970	4285	U.S. Bureau of the Census
Jan. 1, 1971	4300	California Dept. of Finance Estimate
Jan. 1, 1972	4320	California Dept. of Finance Estimate
Jan. 1, 1973	4300	California Dept. of Finance Estimate
Jan. 1, 1974	4220	California Dept. of Finance Estimate
Jan. 1, 1975	4440	California Dept. of Finance Estimate
Jan. 1, 1976	4540	California Dept. of Finance Estimate
July 1, 1976	4533	U. S. Bureau of the Census Estimate
Jan. 1, 1977	4590	California Dept. of Finance Estimate
Jan. 1, 1978	4740	California Dept. of Finance Estimate
Jan. 1, 1979	4860	California Dept. of Finance Estimate

These figures represent growth for the City of Taft, which is not evident in the examination of the decennial census data. The Department of Finance figures for 1978 and 1979 are the latest revisions, published in May, 1979, and they indicate an annual growth rate of 3%, which exceeds the growth of Kern County as a whole (approximately 2% per year).

There is currently some housing construction occurring within the city, with over 200 units on the drawing boards. There is evidence of some commercial revitalization within the city. The city's basic industry, however, remains petroleum production and services.

It must be concluded, therefore, that the current activity has been stimulated by an upward swing in the petroleum industry cycle in western Kern County, and that Elk Hills production is one of the components of this stimulation. This growth is regarded as short term in nature and not as a reversal of the longer-term downward trend of this area.

- C. 4) On page II-37, the discussion under b. Local indicates 99 single family units were constructed between 1974 and 1978. There were another 126 units added in the form of mobile homes and apartments during the same four year period. Once again, these data were made available to Mr. Vovakis at URS last month. At the end of this paragraph, it is indicated that 85% of local housing is classed as sub-standard. We are not aware of the study that would so classify so much of housing on the Westside as sub-standard, but we do recognize the need for some substantial improvement assistance for housing.
- R. The building permit data supplied to URS Company lists 6 multi-family units and 5 mobile homes added during the period 1974-78.
- C. 5) Page II-38, no streets within City of Taft are mentioned, and our is that they will be impacted by Elk Hills traffic, both trucks and worker's automobiles. Similarly, the table (2-2) on page II-39 shows no Taft streets.
- R. The roads listed on Page II-38 and on Table 2-2 on II-39 are those for which the California Department of Transportation or Kern County conduct traffic counts.

Construction and operation activities at Elk Hills will create impacts on the City of Taft's road system. Some of the truck traffic transporting liquid petroleum products will pass through town and take route 166 to interstate 5. Reserve employees will make use of commercial outlets in Taft, including restaurants and banks. This increased activity will result in additional traffic on Taft's streets and competition for parking spaces. The increased traffic volume will mean more air pollution and noise, and wear and tear on city streets. It will also increase the risks of accidents.

- C. 6) Page II-40 discusses the Kern County Sheriff's Department but not the Taft Police Department. In regard to the Deputy Sheriff, we note the inclusion of keeping out "grazing sheep" as part of his duties. We would impress upon you that law enforcement activities are more demanding than what this paragraph seems to indicate.

In fact, the following data applies to the City of Taft Police Department increase in activity since Elk Hills open-up:

	<u>Arrests</u>	<u>Citations</u>
1970	235	1284
1971	182	1226
1972	166	701
1973	208	1052
1974	293	1931
1975	507	2215
1976	459	1024
1977	443	2289
1978	645	1721

While it is impossible to determine whether this increase in activity was due to the open-up of Elk Hills or not, we believe that the point is made, for the City Police Department as well as Kern County Sheriff, that increased Elk Hills employment will lead to increased police services demand.

- R. The County Sheriff's Department is discussed in more detail because it has responsibility for law enforcement on The Reserve. The Taft Police Department is also mentioned. As noted in the response to comment r. of letter 18 (Kern County Planning Commission) on Page XI-III of the FEIS, the Sheriff's Department has increased its nightly patrol of the reserve from one to two men. In addition, the Sheriff's Department has reported a moderate increase in thefts of oil drilling supplies, but attribute this to all production activities on the Westside, and not only to Elk Hills. In general, the recent growth in the City of Taft, discussed in the response to Comment 3, can be expected to result in a minor impact on local police services.
- C. 7) Page II-40 indicates that the Kern County Fire Department is well established in both Bakersfield and Taft. Our concern is that there is no discussion of the City of Taft Fire Department. When increased responses to demands upon the Kern County Fire Department at Taft are received, what will be the added pressure on the City of Taft to serve other unincorporated areas? Even if the Kern County Fire Department is increased sufficiently to serve the additional growth at Elk Hills, there still will be a deficiency in the ability of the County Fire Department to serve other unincorporated areas.
- R. The City of Taft's Fire Department is discussed in the text in both the environmental setting section (page II-40) and the environmental impacts section (page IV-48). While sufficient fire-fighting support for Elk Hills can be expected from the Kern County Fire Department, it is conceivable that in the event of a large fire, the City of Taft could be requested to provide back-up for the county in the unincorporated areas.
- C. 8) On an unmarked page, under 3) Mitigation Measures, the Final EIS mentions that "significant land use or environmental impacts would be regulated by the California Environmental Quality Act". We do not see the California Environmental Quality Act (CEQA) as capable of "regulating" any land use or environmental impacts. All CEQA does is to disclose to decision makers what such impacts might be. We also wonder about the "operational structure" which would minimize land use impact. While we agree there is such a structure, we're not sure that it would act to minimize impacts. In fact, there is a distinct possibility such a structure in the City of Taft would react to growth in a positive way, thereby exacerbating impact. We interpret "mitigation measures" to mean actual, tangible measures which can be taken by local government to ameliorate the affects of any impacts. CEQA simply does not do this, and we do not know of any "bail out" program which will help the City of Taft in the event that the City over-reacts.

- R. This statement appears on page IV-32 of The Final Environmental Impact Statement and refers to any major industrial development which may occur in the Elk Hills area as a result of increased oil production at the Reserve. At present, petroleum and liquid petroleum products produced at Elk Hills are transported out of the area for refining and marketing. This statement recognized the possibility that some processing facilities may be attached to the area. Strictly speaking, the California Environmental Quality Act does not create a regulatory process, although it does provide the means to identify impacts of projects and methods to eliminate or mitigate such impacts. Potential governmental programs which may provide mitigation assistance are discussed in the response to comment 9.
- C. 9) Page IV-39, the first paragraph mentions a "lack of tax base from government activities". We believe that this is even greater evidence that the federal government must somehow compensate for impacts within the local area. We believe that the EIS should mention that in every other case, the federal government provides for impact assistance in some way, such as:
- a) payments in lieu of taxes
 - b) subventions to the state on BLM lands
 - c) ad valorem taxation on leaseholds, such as those in NPR-2

If there is no way for the federal government to compensate the local area for impacts, shouldn't the EIS indicate that this is a severe socioeconomic burden on the Westside, and the City of Taft in particular?

- R. In order for federal funds to be allocated to Taft or any locality for impact assistance, a specific program and administering apparatus must be established by Congress to dispense such assistance. Both URS Company and Taft's consultant, Mr. Ted Kreines have reviewed existing federal programs and identified several, which do not apply to the Taft-Elk Hills situation. In a memo to the City of Taft, Mr. Kreines reviewed programs administered by the Department of Energy, the Economic Development Administration of the Department of Commerce, The Department of Housing and Urban Development, and the Department of Defense. Another program in the "non-applicable" category was established by Section 601 of the Power Plant and Industrial Fuel Use Act of 1978. This program, for which the Farmers Home Administration of the Department of Agriculture issued proposed regulations in March 1979, provides assistance to areas impacted by coal and/or uranium development activities. Thus, the conclusion reached earlier by both URS Company and Mr. Kreines that no federal programs are presently available which could apply to the Taft situation, must be re-affirmed.

However, a bill of broad scope entitled the "Inland Energy Impact Assistance Act of 1979" has been introduced in Congress. This bill, which is directed at energy development not covered by other programs such as the Coastal Energy Impact Program, seems to be tailor-made for the City of Taft. The bill would provide \$150 million for each of the next five years to regions, states, and local governments for both planning and

capital needs arising from domestic energy development. Eligibility for assistance is based upon:

1. Energy resource development in the area;
2. Energy produced being consumed elsewhere;
3. Significant increases in population or employment;
4. The project will result in a deficit in public facilities, employment, or other dislocation in the local economy.

An energy impact plan, funded under this bill, is necessary in order for a community to receive impact assistance. This program would be administered by the Department of Commerce. It is recommended that the City of Taft follow the progress of this bill through Congress, since it seems to provide the best hope for any federal impact assistance.

- C. 10) Page IV-39, the next paragraph indicates that the Taft City Council "could ensure that subcontracts provide for maximum employment of local surplus labor and minimum burden on municipal and county infrastructure," but we're not sure such a requirement could be enforced. People own land, they are approached by those who are in a position to develop it, and unless a city wishes to face litigation on property rights issues, the ability to develop land cannot be abrogated.
- R. Concur. The applicability of this technique as a mitigation measure requires further legal research.
- C. 11) Page IV-39, the next paragraph indicates that the Kern County Council of Governments (COG) might be a good vehicle through which infrastructure, construction and diversification of planning could occur. We agree, but we would also note that given the ex post facto nature of this EIS, we will need to move swiftly. This would indicate that the city itself, commonly the recipient of such impact assessment grants anyway, would be the proper agent for dealing with the federal government, receiving the monies necessary to mitigate impacts and to plan and construct such facilities as found necessary.
- R. The Kern County Council of Governments was identified in the FEIS as vehicle to plan for economic diversification in western Kern County because: (1) it is comprised of representatives of county and local government; and (2) as a COG it is a funnel for federal and state grants to local governments. In the absence of direct federal impact assistance (please see response to comment 9, which concludes that no federal assistance programs are presently available, which are directly applicable to the City of Taft), existing federal and state programs, such as the sewerage construction program, will have to be utilized to provide needed infrastructure improvements. The COG could coordinate and expedite the planning required for such programs.

- C. 12) On page IV-40, under b. Operations-Related, we find the discussion of employment in-migration inadequate. Our Memorandum #2, which is attached, discusses this phenomenon in detail. The major deficiency in the URS analysis lies in the fact that in-migration can be predicted, contrary to the statement in the last paragraph of that section. Furthermore, we predict a larger degree of in-migration than does the Final EIS. Finally, in-migration of labor in specific industries such as oil production and their related services which is less than the new labor required for the project, means that some labor is coming from other Kern County oil production projects. All the data we have been able to uncover indicates that Kern County is consistently growing in terms of oil production employees. This means that oil employees will not be borrowed from other projects to serve Elk Hills, but rather will be imported from jobs elsewhere. Therefore, the total amount of labor required for Elk Hills can be considered net immigration.
- R. Memorandum #3, which attempts to develop future commutation patterns to the City of Taft is based on the employment forecasts developed in Memorandum #2. In view of our reservations about those forecasts, as expressed in the response to comment 2 above, we do not feel Memorandum #3 is useful for the FEIS. Also, this work is of a broader scope, covering all employment and the entire westside, including Census Tract 33.01. As indicated in the response to comment 2, we do not feel that inclusion of this tract is valid for purposes of this study. Also, in this regard, we note that the population figures given for Census Tract 33.01 in Figures 6 and 7 on page 8 of memorandum #3 appear to be in error. These figures belong to Census Tract 31.01, which lies in the southern Bakersfield area. A comparison of the Kern County Planning Department's figures for these two tracts suggests that this error would significantly affect the entire analysis.

<u>Census Tract</u>	<u>1960</u>	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>
31.01	425	3453	5550	7500	11000
33.01	5044	4380	4150	3700	3500

Source: Kern County Planning Department

- C. 13) Page IV-40, under 3. Housing, a. Construction-Related, the figures for the Bakersfield metropolitan area include areas as far removed from Taft as Ridgecrest, a full day's journey away, thereby putting much of this housing in a completely different market. More importantly, no mention is made of the local housing market in Taft. We continue to maintain that this market is severely impacted, and therefore shows a no or low vacancy rate. Under b. Operation-Related, it is noted that 400 to 500 housing units will be needed, but only half of these would be commuting from the Bakersfield area. Where will the other half of those units locate? If they are to occur in Taft, under conditions of an impacted housing market, how can Taft

provide for them? If the City of Taft responds to the housing demands, and if the infrastructure is "over-burdened" as you indicate on page IV-39, who will help improve the infrastructure in order to accomodate the additional population in the City of Taft?

Our primary concern in this point is that there has been no discussion on the local housing market in Taft, which is severely impacted.

- R. We concur that the open-up of Elk Hills will impact the Taft housing market. Although approximately 70% of Elk Hills permanent labor force is presently living in Bakersfield, the remainder, approximately 135 employees, are living in Taft and other westside locations. We would assume a similar distribution for the remaining new employees. The Kern County Planning Department estimated Taft's housing stock on July 1, 1977, to be 1900 units. Thus, the Elk Hills impact would affect a maximum of 7% of Taft's housing stock (assuming all 135 employees located in Taft). This is a significant impact.
- C. 14) On page IV-41, the EIS states that there is "no means to quantify this impact" as related to regional travel patterns in the area. On the contrary, there are established techniques to do this, amongst which is the very simple method of assigning the additional traffic created by the project according to the current assignment of traffic in the area. Therefore, if 40% of the traffic goes to Taft in 1974, it is safe to assume that 40% of the additional traffic might go to Taft in 1978 or 1980. The only reason that these percentages would change, and we believe they will, would be if the locational patterns of the population were changing. This is the primary point with which we take issue with the Final EIS: where the future growth will go.
- R. The complete sentence in question above reads:
- "The construction workers and their families would use the regional road network for trips not related to the Naval Petroleum Reserve, but there is no means to quantify this impact." (underlining added)
- The constant share method of assigning trips, described above, has inherent limitations, particularly when applied to a temporary population such as construction workers. None the less, this is not to deny that the Elk Hills project will have traffic impacts on the City of Taft; there will be such impacts. Please refer to response to comment 5 for a discussion of this issue.
- c. 15) Page IV-41 indicates that "1700 to 2500" daily trips by construction workers will be made while Elk Hills is being built. The paragraph goes on to state that "most of these workers would be expected to live within the City of Bakersfield while the rest would reside in other neighboring communities". We believe that this analysis should be

more specific and estimate which neighboring communities would house these construction workers. Most importantly, we would like to know how many of those construction workers are seen to be living on the Westside, and in the City of Taft specifically.

R. We have not undertaken a survey of the residential location of the construction force at Elk Hills and do not feel this is required for purposes of the FEIS for the following reasons:

1. The composition of the construction force is constantly changing (see figure 4-1 on page IV-35);
2. The impacts on traffic from construction workers will be short-term in duration and minor in effect on the regional road system.

However, the FEIS does allocate projected traffic volumes during peak construction periods to the regional road network (see figure 4-4 on page IV-43).

C. 16) Under the first paragraph of IV-42, Operation, the EIS indicates an increase of 152 trips due to new employees. We would find that figure very low, regardless of the three-shift breakdown, especially when vendors and the concentration of workers during the day shift are considered. We suggest that you break out the rationale for the number 152.

R. The figure refers to new, permanent employees at the reserve. Vendors are estimated to number 300 per day or 600 trips per day, and are mentioned in the last paragraph on page IV-42.

C. 17) Page IV-45 indicates that substantial truck traffic would be created to link the NPR-1 gas plants and the railroad siding east of Taft. The assumption is that all of this traffic would occur on roads outside of the City of Taft. However, we question whether the same traffic pattern will always be followed. We also question whether some of these trips will not head through Taft on their way to or from their destination in order to take care of other functions, including lunch, a stop at the bank, etc. In addition, there will be automobile traffic related to the location of the railroad spur which will be funnelled through the local Taft street system. We would like a breakdown of how this traffic will impact the City of Taft, especially in view of our already deteriorated street system.

R. Concur. Some of this traffic will inevitably find its way into the City of Taft, and this will produce a greater strain on the local street system. Please see response to comment 5 for further discussion.

C. 18) Page IV-46, under Mitigation, several recommended measures are discussed in the first paragraph. All of them are "soft" advisory-type programs, and none involve the expenditure of hard dollars. Isn't

this a place where the federal government, either through the Department of Energy or the Department of Transportation, can contribute dollars to help ease a problem? Shouldn't these programs be mentioned and the amount of dollars indicated?

R. Please refer to response to comment 9.

- C. 19) Page IV-46, under Police Services, implied that all of the impacts will be on the Sheriff's Department of Kern County. We maintain that the City of Taft will grow as a result of Elk Hills and that this growth will require growth in police services for three reasons:
- a) construction related employment will recreate in Taft.
 - b) some of the operations-related employment will live in Taft.
 - c) all employees, whether construction, operations or vendors visiting Elk Hills, sooner or later end up using Taft establishments and creating, as indicated earlier, greater police activity.

Some estimate of this increased activity should be made, if only based upon the data offered under the earlier points.

R. Please see response to comment 6.

- C. 20) XI-116 indicates a comment from the City of Taft questioning the California Department of Finance population estimate. We have discussed our concern for use of numbers which do not show actual growth in the City of Taft, since we have properly represented them with documented data. We think that this entire presentation of documented data should be a part of your Final EIS.

R. Please see response to comment 3.

- C. 21) Under the same group of comments from the City of Taft, b., the Final EIS notes that the "text has been revised to include the more current data". We would once again direct your attention to comments made in other portions of this letter which indicate that all the current data made available to the URS Corporation have not been incorporated into the Final EIS. Attached to this letter are the type of data which we feel should be abstracted and attached to your document.

R. Please see responses to comments 2 and 3.

- C. 22) Page XI-116 suggests that housing construction is "strongly influenced by national and state economic conditions and interest

rates". This has never been the situation in Taft as far as we've been able to tell, since Taft is a "mini-economy" unto itself. For example, when Chevron U.S.A., Inc. evacuated its 11-C camp, interest rates were low and new housing were high in the State of California. However, due to the evacuation of 11-C, no building took place in the localized market of Taft. We conclude, on the other hand, that now that the demand is evident, building will occur in Taft regardless of interest rates or macro-economic conditions. This point goes on to mention building activity "prior to July 1976" as not attributable to the Elk Hills open-up. We are not aware of an upsurge in building activity prior to 1976. In fact, the material provided Mr. Vovakis of the URS Company indicates that most of the building activity occurred subsequent to Elk Hills open-up.

- R. The statement quoted above is taken out of context. The complete sentence on page XI-113 of the FEIS reads:

"It should be noted, however, that housing construction is strongly influenced by national and state economic conditions and interest rates, as well as by local economic stimulants."
(underlining stimulants)

The relative importance of the various factors influencing housing construction will vary from place to place.

The data provided to URS Company indicates the following building permits issued for single-family dwellings in Taft:

1970	21	1975	21
1971	2	1976	
1972	2	January-June	34
1973	0	July-December	12
1974	1	1977	27
		1978	14

These figures are the basis of the statement in the FEIS that "... the increased building activity prior to July 1976 cannot be attributed to Elk Hills since that is the date that open-up of the reserve occurred." These figures show 56 building permits issued for single-family dwellings in the 2-1/2 years immediately preceding open-up, and 53 permits in the 2-1/2 years immediately following. This is a fairly consistent rate of construction. It is noted also that the years 1975-78 were, by coincidence perhaps, years of declining interest rates and national economic expansion.

- C. 23) On page XI-117, under comment d., the text notes that "the government is willing to cooperate with local governments to identify and deal with local impacts of this project". We are aware of your intent to assist with this problem, but we do not have any indication, especially from the Department of Energy, that any impact assistance will be made available to the City of Taft. Therefore, the statement that there is a government "willingness" is not substantiated with any documentation. Only the final sentence, alluding

to your cooperation with us in the effort is held out as hope that some tangible relief will be made available to the City of Taft. We would request something stronger than a kind assumption here.

R. Please see response to comment 9.

€. 24) Under e., on the same page, you indicate in the Final EIS that growth will occur somewhere, but primarily in Bakersfield, as opposed to the City of Taft. We would once again point to the necessity for acknowledging that either way, there will be a total in-migration of labor to serve Elk Hills. If, in effect, we are "stealing" employees from Oildale and Stockdale to work in Elk Hills, their jobs will be replaced by others who will have to come into Kern County from other points outside that area. The total effect is substantially greater in-migration than that reported in the Final EIS. Furthermore, the VMT consequences of a travel pattern heavily oriented toward Bakersfield is not adequately discussed in the Final EIS.

R. These issues have been covered in previous comments.

Persons Contacted for This Study:

Mark Boyd, Berry Holding Company, City of Taft
Rodney Nahama, California Independent Producers Association, Bakersfield
Ted Hilton, Kern County Planning Director, Bakersfield
John Folpmers, Kern County Planning Department, Bakersfield
Preston Hill, Gary Drilling Co., Bakersfield
Taft Chamber of Commerce
Jim McCutchen, Western Oil and Gas Association
California Department of Finance
Steven Wright, City Manager, Taft
Mark Balkovek , Planning Director, Taft
Capt. Cleier, Kern County Sheriff's Department
Sgt. Dale Glendenning, City of Taft Police Department
Capt. Kelly, City of Taft Fire Department
Capt. Byer, Kern County Fire Department, Taft substation
Chief Morrison, Fire Marshall, Kern County Fire Department
Joseph Lagler, Naval Petroleum Reserve No. 1, Elk Hills

APPENDICES

NOTE: ONLY APPENDICES C, H, O, AND P HAVE BEEN REVISED SINCE PUBLICATION OF THE DRAFT ENVIRONMENTAL IMPACT STATEMENT AND ARE INCLUDED IN THIS REPORT. PLEASE REFER TO THE DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE FULL TEXT OF THE OTHER APPENDICES.



Appendix C

Risk Assessment

1. General

Two major categories of risks have been identified: fire and/or explosion which threaten primarily personnel and property and secondarily the environment; and oil spills which threaten primarily the environment. This risk assessment will consider the degree to which these risks, and other more obscure ones which may be identified, occur at the NPR-1 site, and the measures which are currently taken to assure that these risks remain within the acceptable limits.

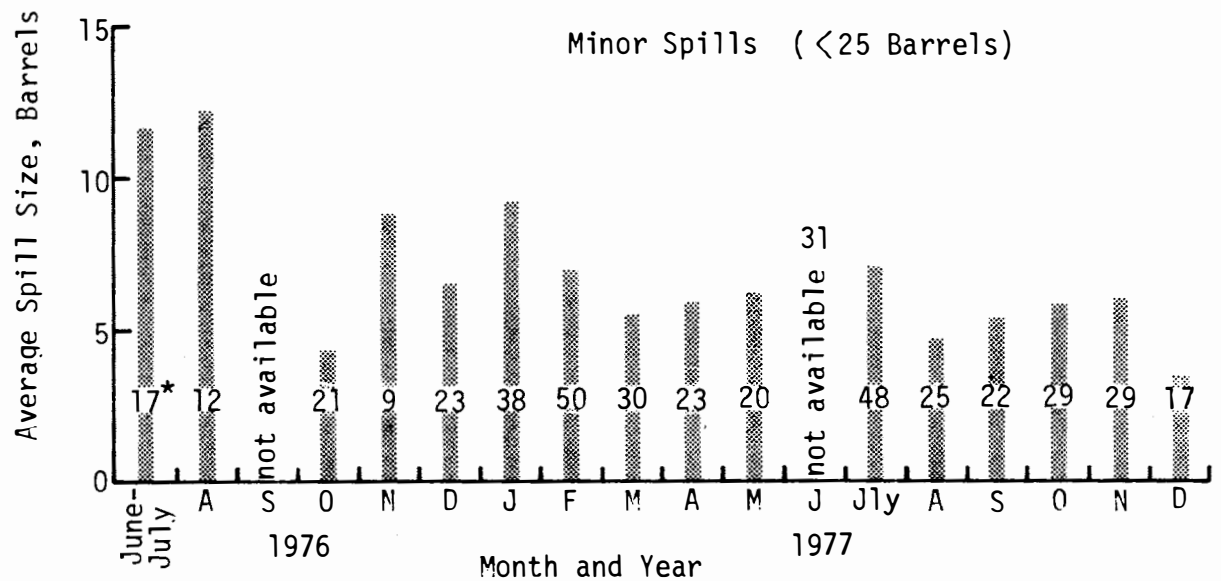
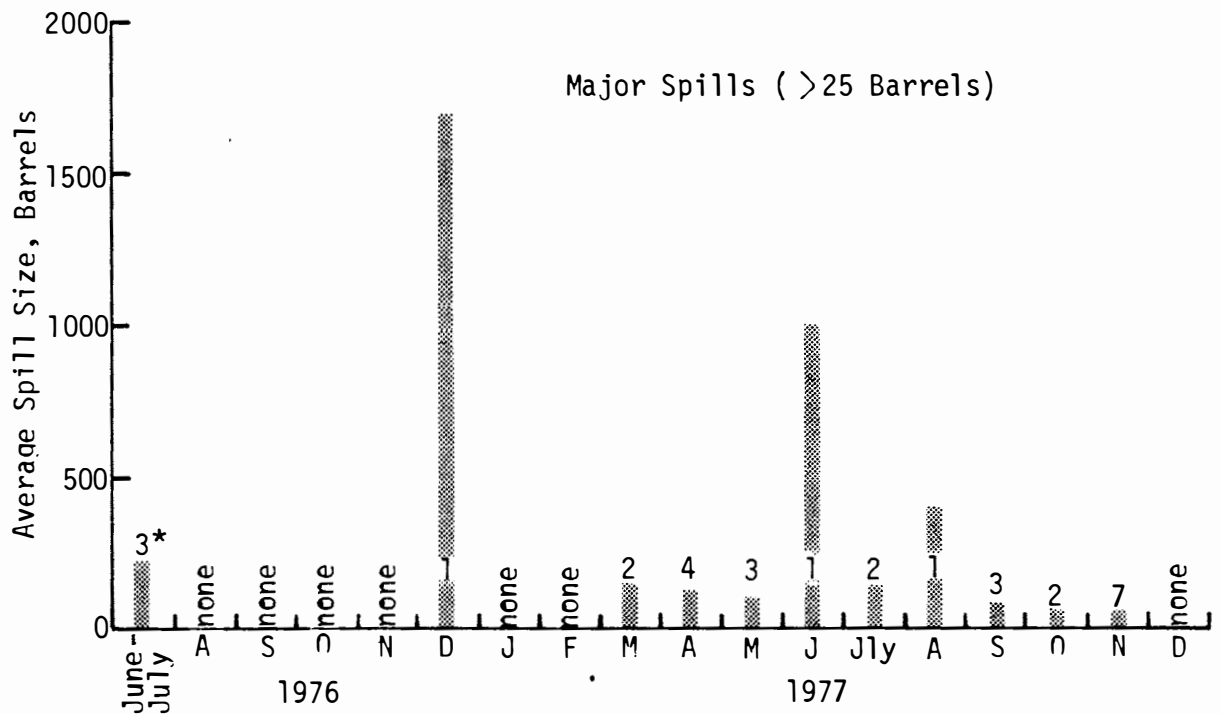
A production field in which large quantities of oil, gas, and natural gas liquids are handled in a variety of operations and processes is subject at all times to the possibility of fire, explosion or a combination of both. Since, these hazards are well recognized by operating personnel, the necessary precautions to prevent accidents are highly developed and the capability to cope with such accidents as do occur are likewise responsive. Despite the best of precautions, however, accidents do happen, sometimes with serious consequences. The degree of risk which is acceptable will be discussed later.

The transfer, processing, and storage of large quantities of crude oil inevitably results in some loss and in spills. Again recognizing the inevitability of such accidents in this type of operation, spill containment techniques have been highly developed and applied. Thus, for example, all large storage tanks are contained within berms which are capable of holding 110 percent of the tank's contents in the event of tank failure.

To protect against spills outside of diked areas, a series of secondary, and in some places tertiary, earthen dams have been emplaced at strategic points in ravines and other runoff channels such that any spilled oil will be contained within the boundaries of the facility. Thus, although spills occur with some regularity, they are usually contained, preventing further contamination and facilitating recovery.

Figure C-1 shows the total amount of oil spilled, by month, and for size groupings, from the inception of operations in July 1976 to September 1977. The number of such "minor spills" (defined as less than 25 barrels) has fluctuated widely from month to month, averaging 26. The total number of barrels spilled each month in minor spills also has fluctuated considerably although showing a decreasing trend in recent months. More importantly however during this time frame, production has increased from about 20,000 barrels per day, initially, to about 110,000 barrels per day. Thus the amount of oil spilled per unit of oil produced has dropped sharply with time. Further improvements can be anticipated as problems associated with the startup of this long dormant field are overcome and operator skills are improved. Two major problems which have been largely solved are the replacement of old pipes, gaskets, and equipment which failed and the introduction of an antifoam agent into the Stevens Crude to alleviate carry-over problems into the gas streams which initially plagued the operation. Specific problem areas will be discussed at greater length below.

Moderate or larger spills, that is greater than 25 barrels (1,050 gallons), occur less frequently and in a more random pattern (see Fig. C-1). The number of major spills per month (which averages over the entire period 0.8 per month) has not decreased appreciably as production expands. However, again in terms of oil spillage per unit production, the values have decreased markedly. With few exceptions the oil has been contained completely within diked areas and recovery of spilled oils approaches, overall, 50 percent. In no instance has oil spread beyond the limits of the facility.



*Number within or above bar indicates number of spills for that month.

Source: URS Company, 1978.

Figure C-1. Oil Spills at NPR-1, June 1976 - December 1977

A major oil spill, estimated at 15,000 barrels, was discovered on December 8, 1978 in the northeast corner of the Reserve. (No other spills of this magnitude have occurred in the recent history of NPR-1.) This spill which resulted from two separate pipeline leaks flowing for over four days, followed a dry drainage channel for about three miles, saturating the ground in the channel to a depth of four feet. The spill was not contained within the Reserve boundaries, contaminating some 10,000 ft² of private property. Despite the size of this spill and its proximity to the Reserve boundaries, it came no closer than 3000 feet of the nearby California Aqueduct; however it is believed that unless contaminated soil is removed, future rainstorms might carry trace amounts of oil to the boundaries of (but not into) the California Aqueduct.

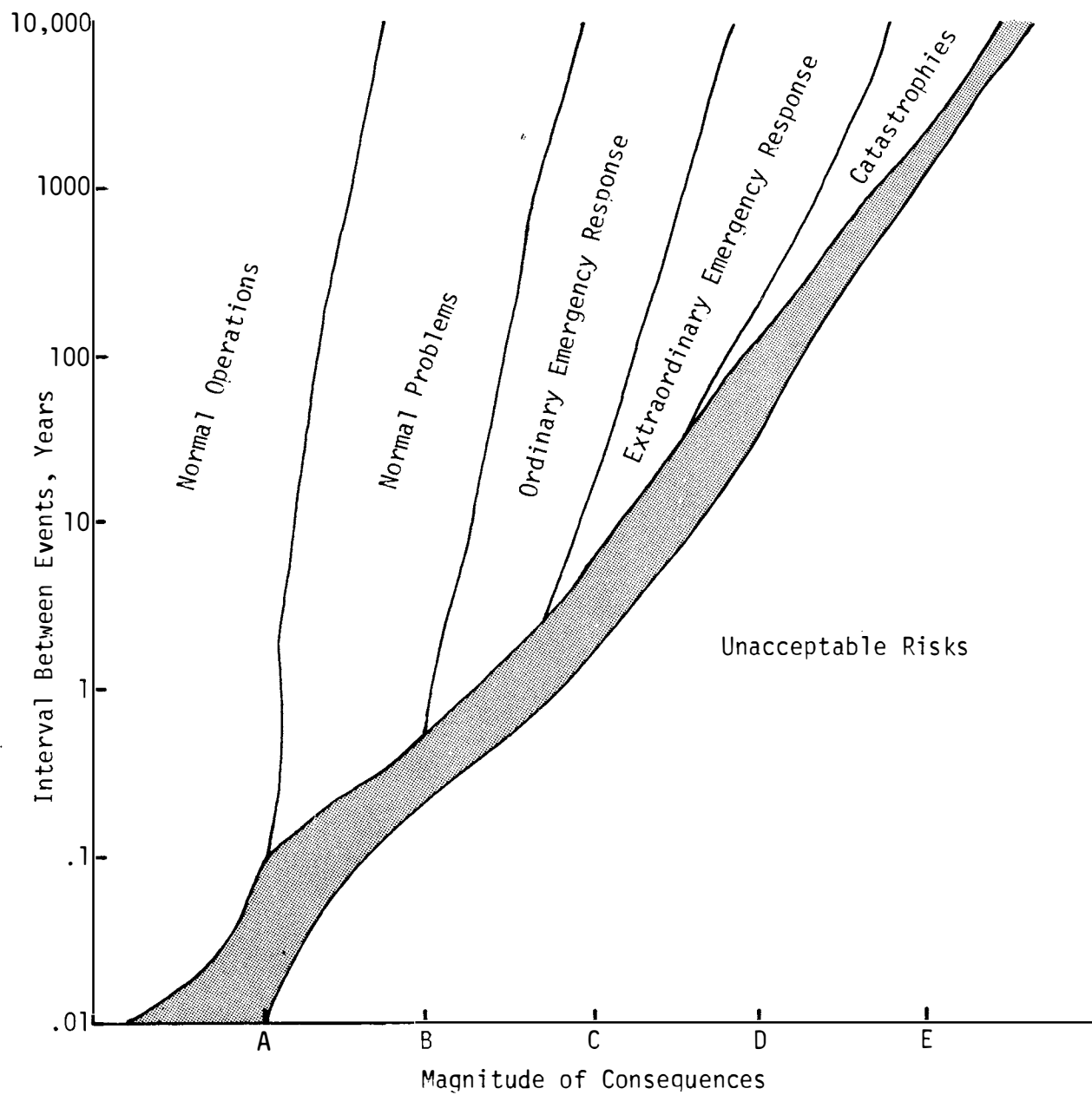
Overall, the environmental damage resulting from this spill was minimal. Corrective action was taken to replace the leaking (and defective) piping and to determine if other piping in the area also might need replacement. A study is also underway to determine if additional catch basins may be required on the north flank of the Reserve to control runoff in the event of a future major spill.

Limited data are available on the risks associated with the operations of a production facility such as NPR-1. The Division of Oil and Hazardous Materials of the Environmental Protection Agency in a report entitled "Petroleum Systems Reliability Analysis: A Program for Prevention of Oil Spill Using an Engineering Approach to a Study of Offshore and Onshore Crude Oil Petroleum Systems," (Ref. 1, EPA-R2-73-280B, August 1973, Volumes 1 and 2, J. E. Ritchie, Jr., et al.) analyzed over 8,000 spills in oil production fields to determine the source and cause of spills. This study found for 6,905 onshore spills of known origin, that 0.2 percent occurred in the drilling system, 61.9 percent in the gathering and distribution system, and 37.9 percent in the production system. Further, spill size could be distributed as follows:

<u>Spill Size</u>	<u>Relative Contribution From Reference</u>
Minor (less than 100 gal) *	3.2%
Moderate (100 to 10,000 gal)	82.2%
Major (greater than 10,000 gal)	14.6%

The major cause (approximately 80%) of spills were attributed to pipe failure. External corrosion caused an estimated 46 percent of spills from pipes, followed by leak or rupture of the pipe at 22 percent. Internal corrosion, which depends upon the characteristics of the oil being transferred, accounted for 8 percent of spills, while third party intervention, primarily road machinery, accounted for an additional 8 percent. Other causes were unidentified. Other components which were identified as contributing to spills included valves (5.6%), dump valves (3.0%), pumps (1.7%), check valves (1.5%), high level sensors (1.4%), stuffing boxes (1.3%), and couplings (1.1%). More important causes for failure of valves were malfunction and/or failure to operate. Minor causes included vandalism, live stock, sand cutting, and leaking.

Risk has two dimensions: frequency of occurrence (known or estimated) and magnitude of the consequences. Table 1-5 of Section I uses these two dimensions to rate the risks associated with fire/explosion, contaminating spills, and/or other risks, at NPR-1. (The table was developed based upon the best available information and incorporated the results of discussions with operating personnel at the Elk Hills facility.) Figure C-2 is a graphical representation of the relationship of frequency of occurrence and the magnitude of consequences. This representation assumes that accidents (whether fire, explosion, spills or whatever) will occur and must be anticipated as a part of the cost of the operation. However, if the accident occurs too frequently or if the consequences are too great, the risk must be deemed as unacceptable.



Source: URS Company, 1978.

Figure C-2. Model of Acceptable and Unacceptable Risks

Normal operations do entail problems and accidents, which even though they occur frequently, must be accepted. There are also anticipated operational difficulties, such as a gasket failure which leads to the release of oil, which also are acceptable if they do not occur too frequently. As the magnitude of the consequences increases, the risk remains still acceptable (even though not desirable) if the frequency of occurrence is not great. Thus, for example, fire can be anticipated as a serious problem, likely occurring randomly, yet a problem which can be controlled through a suitable fire protection system. Finally, it must be recognized that some risks, even though the consequences may be massive, are nonetheless inevitable: for example, earthquakes. Generally risks of this nature can be recognized and actions implemented to reduce either the frequency of the occurrence or the magnitude of the consequences. Thus in "earthquake country" structures may be designed, within the state of the knowledge, to withstand anticipated earthquake stresses, but, at the same time, the risk cannot be eliminated nor can the magnitude of the consequences be diminished to completely safe levels. In short then, a degree of risk must be assumed in any type of operation.

Unacceptable risks, then, are those which are likely to have very serious consequences, which occur at more than an acceptable frequencies, and finally, and most importantly, which are amenable to reduction, frequency, or magnitude, by appropriate planning and/or design. To this end the systems outlined in Section I.H. will be discussed or those risks identified as unacceptable or marginally acceptable (the grey area in the sketch above), that is category 3D or 4D. It is exemplary to note that no "E" ratings, that is, catastrophic events with heavy loss of life, property, or long-term environmental consequences, have been identified. The explanation is simple: in the NPR-1 operation the population at risk is low (normally only a limited number of operational personnel), and the NPR-1 facility is well isolated from navigable

waters. Thus what might be a catastrophe in an urban area or along a riverbank is of much less consequence within the boundaries of NPR-1.

2. Risks Associated with Present Operations

Present practices for reducing or controlling the risks associated with the systems and components listed in Table 1-5 will be discussed below. Some overlap can be expected in this discussion and, on occasion, new, as well as existing, facilities, will be covered.

a. Drilling System

The possibility of a blowout with release of gas and oil and, likely, resultant fire and/or explosion is always present in drilling operations. However, the incidence of such accidents is remarkably low and is often restricted to the loss of product and equipment. Standard safety practices apply to all drilling operations at NPR-1. A limited amount of rescue equipment, in the case of fire and/or explosion, is normally available to drilling crews. In the event of a blowout, oil driven by gas can spray over a rather appreciable areas but, with a few exceptions, such spray is unlikely to extend beyond the boundaries of the facility. Earthen dams downhill of potential spill sites are maintained to collect runoff from surface spills. Where the spill potential is significant a series of earthen dams may be used to provide secondary or even tertiary containment.

The occurrence of a blowout at 333-5G with subsequent fire and explosion at NPR-1 on October 25, 1977, with the death of three persons, appears to fall in the category of unforeseen and random events. As with any serious accident, causative factors related to improper operating practices have been identified and corrective measures implemented, thereby reducing the probability of such future occurrences at NPR-1.

b. Production System

Chronic spills at tank settings have plagued the NPR-1 operation since inception of production. However, the causes have been identified and corrective actions undertaken. One or more contingency catch basins are maintained in drainage channels below all tank settings, as well as below all production sites, to ensure that any spills will be contained within the facility. Fire and/or explosion at tank settings has not been a past problem but remains a possibility. However, the quantities of oil and gas involved are relatively small and the number of persons likely to be exposed is also small. Hence the level of risk is not excessive.

The casings of most producing wells are cathodically protected to inhibit external corrosion which could lead to blowout or spills. Some newly drilled wells are not now under cathodic protection, but will be brought into the existing or expanded cathodic protection system shortly. Since the NPR-1 oils (both Shallow Oil Zone and Stevens Zone), are considered noncorrosive, that is they do not contain hydrogen sulfide, internal corrosion is not a concern.

c. Gathering and Distribution System

All pipelines within NPR-1 run above ground and are supported on appropriate members where necessary. (The alkaline and corrosive nature of the soil was the major determinant in placing the gathering and distribution system above ground when the field opened.) Lines do run underneath roadways and are generally protected against damage from vehicles or heavy equipment. However their placement adjacent to roadways could result in their being broken in the case of a vehicle or equipment mishap. Lines are not identified by code so that in case of accident it might not be immediately obvious how serious the break might

be. Of particular concern is the high-pressure gas lines (at 450 psig) which, if ruptured in a third-party accident for example, could release large quantities of odorless gas. Accumulation of such escaped gas with subsequent ignition could lead to a massive detonation, but the likelihood of involvement of more than a few persons is most unlikely.

Several recent moderate or larger (defined in this discussion as greater than 25 barrels) spills resulting from intermediate tank storage overflow, were primarily attributable to switch failure. Such overflows have, however, been contained in diked areas or else within contingency catch basins. Upgrading of existing equipment can be expected to reduce the frequency of such overflows even further.

Several major spills, including one of 15,000 barrels, have been attributed to oil line failure. The spilled oil normally accumulates in pools near the point of discharge until discovered by some passing personnel who then initiates corrective action. The replacement of old and corroded sections of pipe is reducing the frequency of this type of spill. Contingency catch basins are designed to continue to provide sufficient protection for spills of this nature which occur in open, undiked terrain. In one very large spill of 15,000 barrels on the north flank of the Reserve, the capacity of existing catch basins was insufficient; consideration is being given to the need for additional catch basins in this area.

All oil spills at the Reserve are documented by the unit operator and larger ones reported as required by law. A Spill Prevention Control and Countermeasure Plan covering all aspects of oil spillage, and in accord with EPA requirements is in the process of being prepared for NPR-1.

d. Ancillary Systems

The present gas plant which is old and of relatively inefficient design has been successfully reactivated after years of disuse; problems arose, but none resulted in serious accident during this period. Storage tanks, predominately compressed gases, but including some oily materials, are contained within a diked area away from the operations area, and in case of tank failure, the contents of the ruptured tank would be diverted to a containment pond a considerable distance from inhabited areas.

All of the facilities, except the compressor room, are outdoor units where the buildup of explosive concentrations of gas are quite unlikely. The compressor room, which is enclosed within a light industrial type building, is equipped with a number of gas detectors any of which can initiate the following sequence: at 20 percent of the lower explosive limit (LEL) for methane, a ventilating fan switches on; if the levels continue to rise to 50 percent of LEL, the compressors shut down following a 1 minute delay, and gas within the system is vented through the nearby stack. This sequence, which follows good safety practice, appears adequate for all but the most catastrophic condition such as the massive failure of a compressor and the release of very large quantities of gas in a very short time.

The compressor station in the gathering/distribution system at area 3G is similar, but smaller, than that of the old gas plant. Similar operating difficult problems and protective devices are, or shortly will be, in use.

An existing concern has to do with the procedure for venting the large quantities of gas when the existing plant does shut down (which occurs periodically even in normal operations). The present stack allows unburned gas (a mixture of methane and higher fractions) to be

discharged to the air. Under adverse meteorological conditions, namely, no wind, and an inversion condition, this released gas could possibly accumulate at ground level (almost 20% of this gas consists of fractions which, unlike methane, are heavier than air) where any ignition source could set off an explosion. Potentially, such an explosion could kill operators and passersby and ignite one or more fires. As a part of the upgrading program a flare which will safely burn the discharged vapors will be installed. Until that time, the risk remains, albeit a small one.

New gas plants, either presently under construction or planned, will be of more efficient design (low temperature separation) and equipped with electronic instrumentation for both safety and efficiency. The compressor rooms will be enclosed and instrumented with safety devices in the same manner as the old one. They will have a "lit" flare. The new operations can be expected to be as safe and probably safer, after initial startup, as the present plant.

Propane, butane, and "natural gasoline" (C_5 fraction and higher) are stored adjacent to the present gas plant for sale. Approximately 150 tank trucks per day at maximum will enter the loading facility and then carry the product, over the highway system of southern California, to various markets. The existing truck loading facility is near the old gas plant. Traffic on the entrance road is restricted to reduce the possibility of accidents between tank trucks entering the intersection and other traffic. (Because the location of this existing facility is recognized as far from ideal, future plans call for locating the loading facility, for both of the new gas plants, in a more isolated area where access does not present the problems presently entailed.) All materials are stored and leave the facility in pressurized vehicles with the following working pressures: propane - 140 psig; butane - 65 psig; and "natural gasoline" - 20 psig. At these pressures, all

materials are liquid, but, if released to atmospheric pressure, will quickly vaporize, to form explosive mixtures which have the capability to detonate. Thus the operation of the truck loading facility, although presently unmarred by serious spills, fires or explosions, is inherently a high risk operation and is so treated.

Wet gas, as taken from the wellhead, always contains trace amounts of a radioactive gas, radon (^{222}Rn), which has a short half life, 3.82 days.* However, the radon is preferentially concentrated, in the gas plant, into the ethane and propane fractions. The "daughter" products, such as radium D (^{210}Pb) resulting from the radioactive decay are solids with half lives as long as 21 years. The radioactive decay produces alpha and beta particles, both of which are health hazards if ingested or inhaled, and gamma rays which are capable of passing through solid matter, including the human body where damage can occur. Studies (Ref. 9, 10, 11) have shown that radon (and its daughters) can produce slight, but possibly significant, short term (occupational) and longer term (to consumers) hazards to humans through several possible routes:

(a) Leakage of gases containing radon into the air; such leakage would be of most concern in the enclosed compressor rooms of the gas plants which are continuously manned.

(b) Buildup of daughter products (notably ^{210}Pb) in pipes, pumps, and valves producing measurable gamma levels (up to 8 mr** at equipment surfaces) which can affect nearby operating personnel.

(c) Inhalation of these deposited buildup daughter products when

*Half life is the period in which one-half of the initial radioactivity dissipates. Thus in four half lives (3.82 days x 4 = 15.3 days), the radioactive level will be 6.25% of the original level (i.e., $1/2 \times 1/2 \times 1/2 \times 1/2 = .0625$).

**mr = milliroentgen - a measure of radiation dose.

equipment is dismantled for repair or maintenance.

(d) Inhalation of radon-bearing combustion products resulting from burning the gas; only this route is likely to affect the general public and then only those cases where non-vented heating or cooling appliances are used in an enclosed structure.

Reference 9 concludes that occupational risks are minimal in gas separation plants if the hazards are recognized and simple protective action employed, namely: measure gamma radiation levels in equipment where radioactive (gamma) buildup is possible (primarily pumps) and if gamma measurements are significant (2 mr/hr continuous dose is the accepted occupational level), provide warning signs; ventilate compressor rooms well -- which is normal for explosion prevention purposes; and consider the use of standard radiological handling techniques when dismantling or cleaning out equipment suspected of containing radon-bearing deposits.

Risks to the consumer are best reduced by holding the gas (both natural and LPG) for a number of half lives (amounting to at least two weeks) so the radiation levels are significantly lowered prior to burning. If such is not feasible, the burning of the gas in non-vented equipment should be avoided.

The concentrations of ^{222}Rn in well head gas varies from field to field and from well to well within a given field. Hence, generalizations on the radon content of wet gas streams are difficult to make. However, it appears from what limited data are available that California wet gas is well within the normal limits reported from other gas producing areas in the nation (averages range from 5 - 100 pCi/l)* Yet LPG sold in

*Picocuries per liter

California (and primarily produced there) has the highest radon content of any state (Reference 10): California - 150 pCi/l; Texas - 100 pCi/l; most other states - 10 pCi/l). This high value for California LPG may be attributed to unusually high, wellhead levels but may also be a result of the separation processes used (which may preferentially concentrate the radon in the LPG fraction) and/or the rapid movement of the produced LPG to market.

The lease automatic custody transfer (LACT) facility in which water and residues are removed from the crude oil prior to transfer to the nearby tank farm, is subject to both spills and fire or explosion. However, the existing LACT facility has had no serious operating problems or fires, and spills are contained within common diked areas. LACT units, because of their vulnerability to fire, do have adequate water supplies for firefighting purposes as described elsewhere.

e. Support Systems

No abnormal risks are associated with the rather extensive electrical network which services the various operations of the facility. The freshwater system, which is used primarily in support of the firefighting system and for housekeeping, offers no particular risks.

Injection of water into the oil reservoirs to increase oil recovery is practiced throughout the facility and will become an increasingly important factor as the field nears depletion. Hence, water lines and tank storage will be developed and will be tied to the freshwater system for firefighting purposes. This brackish water system entails some risks. Breakage of a large aboveground water line is likely to be inconvenient but not dangerous. The failure of a large water storage tank, typically on a high elevation, could result in flooding of inhabited areas or in the scouring of terrain in a very damaging manner.

However, tank failure is unlikely except in very rare circumstances. Any major leakage of brackish water could, however, be detrimental to the environment because of the saline content. Further small leaks, lending to chronic contamination, can also have serious environmental consequences.

Gas, primarily methane, is injected into the Stevens Zone reservoir, after stripping off the higher fractions, to keep this zone pressurized for maximum oil recovery. Injection involves pressurizing the dry gas from the gas plant to about 3,500 psi, and returning it through above-ground pipelines to injection wells in the Stevens Zone. Such high pressure gaslines, when adequately designed, are indeed safe. However, rupture or other failure such as from third party accidents, can result in serious consequences because of the very high velocity of the escaping gas and the quantities which can be released in a very short time. Hence the risks associated with these lines is higher than with any other type of line on the facility. Presently these very high pressure lines are not segregated or otherwise identified from other lines carrying either lower pressure gas or oil.

f. Liquified Petroleum Gases and Liquid Fuels Transport

Proposed production of natural gas liquids (NGL) at NPR-1 is expected to roughly be double the productions of such materials within the state by 1980. Hence, a detailed analysis of the potential risk in transporting these compressed flammable gases by rail and by truck within the state was undertaken. Accident data for the principal natural gas liquids (NGL) that is, propane, butane, and natural gasoline, were found to be virtually nonexistent; better data are available for liquified petroleum gas (LPG), which represents reasonably well the NGL series. Even for LPG, however, the available data are sparse. Accidents are relatively well-documented, but not always in a uniform manner and

frequently as a subset to a larger grouping such as hazardous materials. Even less well documented are the quantities transported and the mileage over which the materials are transported. Hence, the derivation of an accident rate (basically, number of accidents over a unit of time divided by the quantity and distance transported over the same time) is difficult. In determining accident rates, great variations were found, especially for rail transport. The best information was found in a study conducted by the University of Southern California for the Department of Transportation on the transport of LPG by truck and by rail in the State of California.¹ In this report truck accident rates of 1.8 to 6.3 per 10^6 truck miles were reported which compared favorably with a second estimate² of 2.5 per 10^6 car miles. In contrast, the U.S.C. study quoted two rates for railroads: 15.4 per 10^9 car miles and 0.15 per 10^6 car miles. The Sandia report² provided a third estimate of 1.5 accidents per 10^6 car miles; however, this value was not well substantiated and was not given further consideration. To determine if a better value could be obtained for the accident rate per miles, a number of other sources were contacted, including the Southern Pacific Railway, the Materials Transportation Bureau of the Department of Transportation, and the Association of American Railroads.³⁻⁵ All contacts agreed that rail accident rates were most difficult to estimate, but all also agreed that rail accident rates were much lower than those for trucks. We finally used the rates quoted in the U.S.C. study but selected the higher (that is, more conservative) accident rate for rails, that is, 0.15 per 10^6 car miles.

We then determined likely routes for truck and rail transport of NGL to various markets in California (the analysis was restricted to the state), namely: Los Angeles (133 miles - highway; 218 - rail), Bakersfield (33 miles - highway; 50 miles - rail) and a maximum distance case (250 miles - highway; 350 miles - rail). The case for peak truck traffic was examined first (occurring in the winter half of the year after early 1980). NGL production, derived from reference 6, was then

allocated to each destination as shown in Table C-1.a. The road type for each destination was estimated and accident rates were determined as shown in Table C-1.b. providing an estimate of the annual number of accidents for truck and rail movement. During the six winter months, there is a probability of 9.9 total accidents and the accident rate calculated for this case is 2.4 accidents per million barrels of NGL transported.

A similar analysis, using the same distances and mileages, but including the summertime minimum transport of the NGL by truck, was then made (see Table C-2 for results). During this six month period, there is a probability of 2.9 to 3.3 total accidents and the accident rate was calculated to be 0.7 - 0.8 accidents per million barrels transported. By combining Tables C-1 and C-2, the probable annual number of accidents for trucks is 12.5 to 12.9 and for railroads it is 0.22. The overall accident rate on an annual basis was calculated to be about 1.6 accidents per million barrels transported.

Severity of accidents was determined from the U.S.C. report. Although these data are based on a limited number of accidents (about 40 each for rail and truck LPG carriers), the data shown in Table C-3 does indicate that accidents do occur both enroute and at fixed points but are, in a vast majority of cases, minor in nature. Truck accidents, because they have a higher probability of occurring in or along public areas, appear to cause more injuries and death than do rail accidents. Rail accidents, however, probably because of the larger quantities carried (average of 32,000 gallons vs. 8,000 for trucks) cause much heavier property damage for the worst case condition (that is, in fuel-air detonation), but are likely in areas more remote from the public.

A recent report provided by the Materials Transportation Bureau (Reference 8) gives for the period 1973 - 1977, the average number and variation of LPG incidents per year for the United States as:

Table C-1. Accident Likelihood for Transport of NGL
from Elk Hills at MER: Peak Winter Case

a. Traffic Routing Assumptions

Commodity	Trucks-Per Day						Rail-Per Day				
	1000 Gal.	Los Angeles	Bakersfield	Maximum Distance	Total		1000 Gal.	Los Angeles	Bakersfield	Maximum Distance	Total
PROPANE	504	55.3	17.1	5.0	77.5	.	56	.8	.8	---	1.7
BUTANE	312	7.8	16.7	22.5	46.9	.	78	---	1.2	1.2	2.3
NATURAL GASOLINE	130	7.1	10.1	4.1	21.3	.	130	1.8	2.8	.9	5.5
	946	70.3	43.9	31.6	145.7	.	264	2.7	4.8	2.1	9.5

b. Risk Assumptions and Accident Rate

	Los Angeles	Bakersfield	Maximum Distance		Los Angeles	Bakersfield	Maximum Distance
	Multi-Lane Freeway	2-Lane Rural	Mixed		----- Standard Road Bed* -----		
Predominant Road Type	Multi-Lane Freeway	2-Lane Rural	Mixed	.	----- Standard Road Bed* -----		
Length, Miles	133	33	250	.	218	50	350
Accident Rate/ 10 ⁶ miles	2.57	3.80	3.16	.	0.15*	0.15*	0.15*
Accidents/ Trip	341 x 10 ⁻⁶	126 x 10 ⁻⁶	790 x 10 ⁻⁶	.	38.0 x 10 ⁻⁶	12.8 x 10 ⁻⁶	57.8 x 10 ⁻⁶
Annual Number of Accidents	8.6	2.0	9.0	.	.04	.02	.04
			19.6	.			.10
				.			19.7

NOTE: (1) Totals may vary slightly because of rounding errors.

(2) Rail distances from point to point are longer, as noted above, than highway distances.

(3) Accident rates for LPG are used for all NGL products.

* Except on the 33.5 mile Sunset Railway track which has been assigned a value of 0.30 to account for its deteriorated condition.

Table C-2. Accident Likelihood for Transport of NGL
From Elk Hills at MER: Summer Case

a. Traffic Routing Assumptions

Commodity	Trucks-Per Day					Rail-Per Day				
	1000 Gal.	Los Angeles	Bakersfield	Maximum Distance	Total	1000 Gal.	Los Angeles	Bakersfield	Maximum Distance	Total
PROPANE	112-140	10.1-13.3	7.1-8.2	---	17.2-21.5	448-420	9.7	1.9	1.0	12.7
BUTANE	78-97.5	6.8-7.8	3.9-4.9	1.0-2.0	11.7-14.7	312-292.5	2.0	3.0	4.0	9.0
NATURAL GASOLINE	130	7.1	10.1	4.1	21.3	130	1.8	2.8	.9	5.5
	320-367.5	24.0-28.2	21.1-23.2	5.0-6.0	50.2-57.5	890-842.5	13.6	7.7	5.9	27.2

b. Risk Assumptions and Accident Rate

	Los Angeles	Bakersfield	Maximum Distance	Los Angeles	Bakersfield	Maximum Distance
	Multi-Lane Freeway	2-Lane Rural	Mixed	----- Standard Road Bed* -----		
Predominant Road Type						
Length, Miles	133	33	250	218	50	350
Accident Rate/ 10 ⁶ Miles	2.57	3.80	3.16	0.15*	0.15*	0.15*
Accidents/ Trip	341 x 10 ⁻⁶	126 x 10 ⁻⁶	790 x 10 ⁻⁶	38.0 x 10 ⁻⁶	12.8 x 10 ⁻⁶	57.8 x 10 ⁻⁶
Annual Number of Accidents	3.0 - 3.5	1.0 - 1.1	1.4 - 1.7	.19	.04	.12
			5.3 - 6.2			.34
						5.7 - 6.6

- NOTE: (1) Totals may vary slightly because of rounding errors.
(2) Rail distances from point to point are longer, as noted above, than highway distances.
(3) Accident rates for LPG are used for all NGL products.

* Except on the 33.5 mile Sunset Railway track which has been assigned a value of 0.30 to account for its deteriorated condition.

Table C-3. Frequency of Truck and Rail Accident by Type and Severity

a. Frequency by Type

TYPE	Trucks				Rail		
	Percentage	Severity			Percentage	Severity	
		Low	Major			Low	Major
En Route	39	82%	6%	.	18	86%	14%
Loading and Unloading	39	47	12	.	3	100	0
Leaks	20	78	0	.	79	100	0
Other	2	0	0	.	0	--	--
	100			.	100		

b. Consequences

<u>Severity</u>	<u>Consequences</u>	<u>Average Resultant Damage</u>					
		<u>Property, \$</u>		<u>Injury (Persons)</u>		<u>Death (Persons)</u>	
		<u>Truck</u>	<u>Rail</u>	<u>Truck</u>	<u>Rail</u>	<u>Truck</u>	<u>Rail</u>
Low	No Fire or Explosion	2,553	996	.35	0	.07	0
Severe	Fuel-Air Detonation	51,000	685,000	4.0	4.0	.25	0

SOURCE: Reference 1 and URS

Tank Truck:	24.6 ⁺	2.9
Railroad Tank Car:	78.4 ⁺	28.3

The number of rail accidents being more than three times that for highway accidents, the implication is that most LPG is carried by rail since it is well established that the unit accident rate is much greater for highway transport.

For these same incidents, the average annual number of injuries and deaths reported by MTB are:

	<u>Truck</u>	<u>Rail</u>
Injury	20.4	85.8
Death	4.8	2.2

Yet if the injuries and deaths for the worst year, which normally represent only one accident, are removed from the data, we find annual numbers of:

	<u>Truck</u>	<u>Rail</u>
Injury	9.8	5.0
Death	1.8	0.8

Obviously then, the rare incident (and the one which claims the headlines), skews the injury and death statistics greatly.

It was also found that California rail carriers for a two year period (1976-1977) had 30% fewer accidents involving hazardous materials (of which NGL accidents represent an appreciable number) than the national average for rails.⁵

NPR-1 production will represent only a fraction of all NGL transported by rail and truck within the state even at full production. Based on

reference 7, we estimate that Elk Hills by 1980 will represent about 57% of all NGL produced by gas processing plants but only about 31% of the NGL likely to be transported within the state. (This latter value of 31% is very rough and could rise considerably if NGL imports into the state--now appreciable--are reduced if Elk Hills NGL finds a market within the state.) Hence the incremental impact of Elk Hills produced NGL on the overall accident rate for such carriers within the state would be no more than proportional to the increase and might well be less if heavy reliance is placed upon rail transport with its lower accident rate. No values were found for the relative quantities of NGL transported by rail and by truck within the state; hence a more sophisticated analysis could not be undertaken.

A special concern with respect to the transport of NGL from Elk Hills relates to the projected use of the 35.5 mile Sunset Railway to track from the proposed rail and truck loading facility near Taft to its junction with Southern Pacific at Gosford. (Nine miles of Southern Pacific track between Gosford and Kern Junction, although deteriorated, is currently being renewed.) According to a recent visual inspection of this trackage (Reference 12) various deficiencies were identified and requirements for upgrading this trackage to meet federal standards were listed. Current traffic on the Sunset consists of three trains per week of from ten to sixteen cars each. Speeds are limited to 10 - 20 mph, dependent on the condition of the trackage. Currently, the trackage carries two to three hundred thousand gross tons per year of petroleum, mineral and farm products. With the movement of Elk Hills NGL, the annual value would rise to an estimated two million gross tons.

The survey concludes that: "although two million gross tons per year would be insignificant on new track in good condition, it would probably accelerate deterioration on marginal trackage." Further "at least eight grade crossings will require additional gates and flashing

lights . . . (because of) risks at unprotected grade crossings."

In view of this survey, the projected accident rate for rails of 0.15 per million car miles cannot be applied to this section of track. The previous estimate's of annual rail accidents has been revised to reflect this concern. However, no substantial differences in any of the three cases studied resulted from applying a substantially higher accident rate of 0.30 accidents per million car miles on the Sunset Railway segment. Nonetheless, the accident potential remains a concern in some cases. Because of the low population density along most of the trackage, even a serious accident would likely cause only property losses. Accidents involving loss of life and limb might occur at unprotected grade crossings or possibly between milepost 6.0 and 7.0 where the Sunset track runs about 0.6 miles east of the Lakeside Union School. However, the track in this area is in relatively good condition; and even if a derailment with subsequent release of tank car contents were to occur, sufficient time would likely be available to evacuate the school if it were occupied.

Responsibility for undertaking mandated upgrading of this trackage, as well as for accidents which might occur on it, rests, of course, on the owner and operator, that is the Sunset Railway Company.

References for Appendix C

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Appendix H

Air Quality Data

All construction associated with new oil production will occur in Kern County. However, since oxidants are a regional problem, data from Tulare, Fresno, and Kings counties are also presented in this baseline description. All four of these counties are within a single air basin -- the San Joaquin Valley.

An air basin is a region with distinctive meteorological and geographical characteristics. In recent years, control strategies appropriate to each basin have been established by the Basin Coordinating Councils or by the Air Resources Board. Figure H-1 illustrates the San Joaquin Air Basin. The Air Resources Board and each local district perform varying degrees of air quality and meteorological monitoring within each air basin. The air monitoring program, in particular, is geared to collect data on the existing air quality problems in each county. For example, the Bakersfield station is the only site in Kern County where all six major pollutants are measured whereas the Taft station monitors only particulates and the Delano station only oxidants.

Hydrocarbons are the primary pollutants to be emitted as a result of this project, and therefore, photochemical oxidants are the pollutant of greatest concern. The monitoring data presented herein are geared toward representing existing oxidant levels in the potentially affected counties (Kern, Kings, Tulare, and Fresno). Some data on particulates are presented as well since particulates are also a problem in the air basin.

SAN JOAQUIN VALLEY AIR BASIN

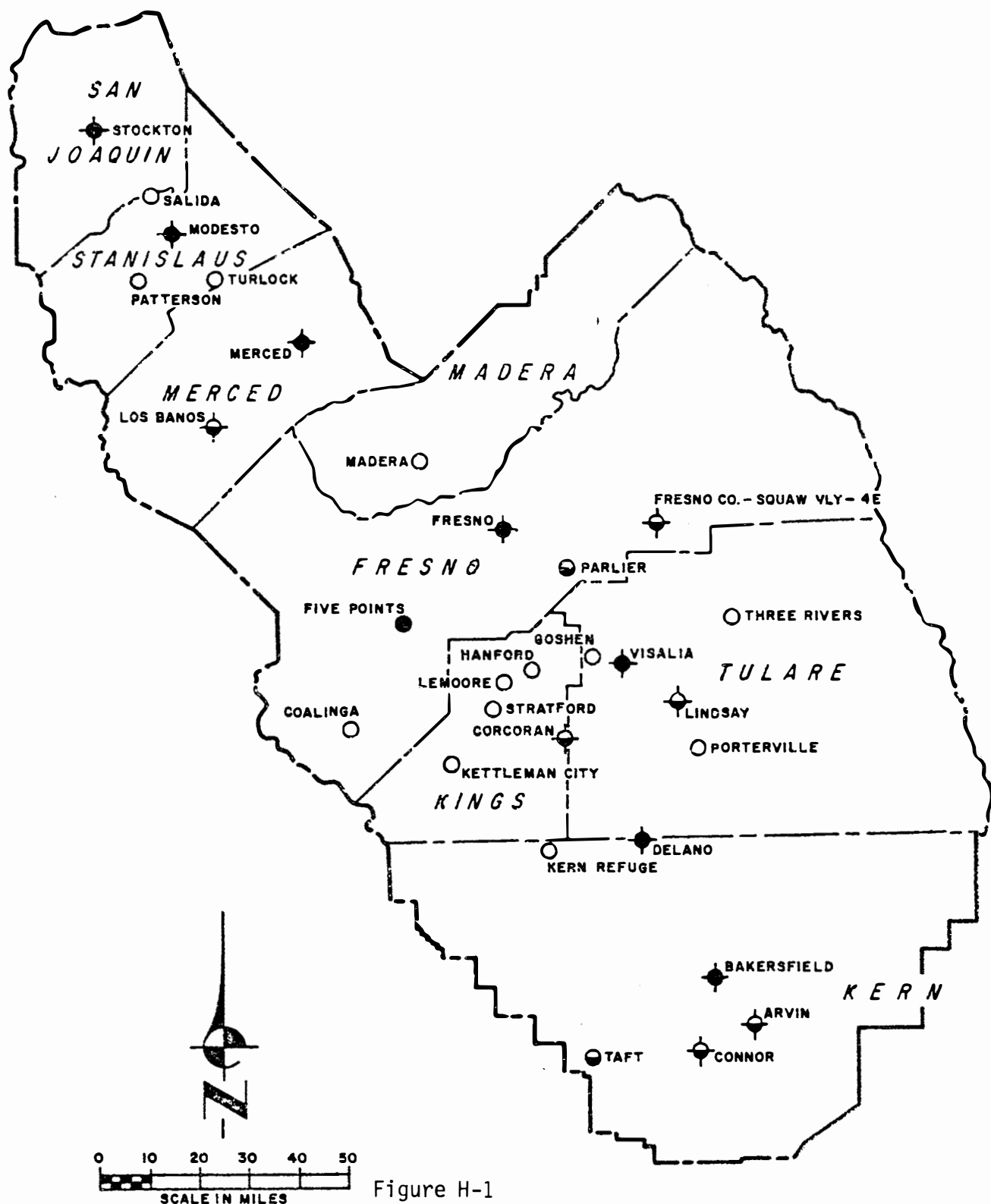


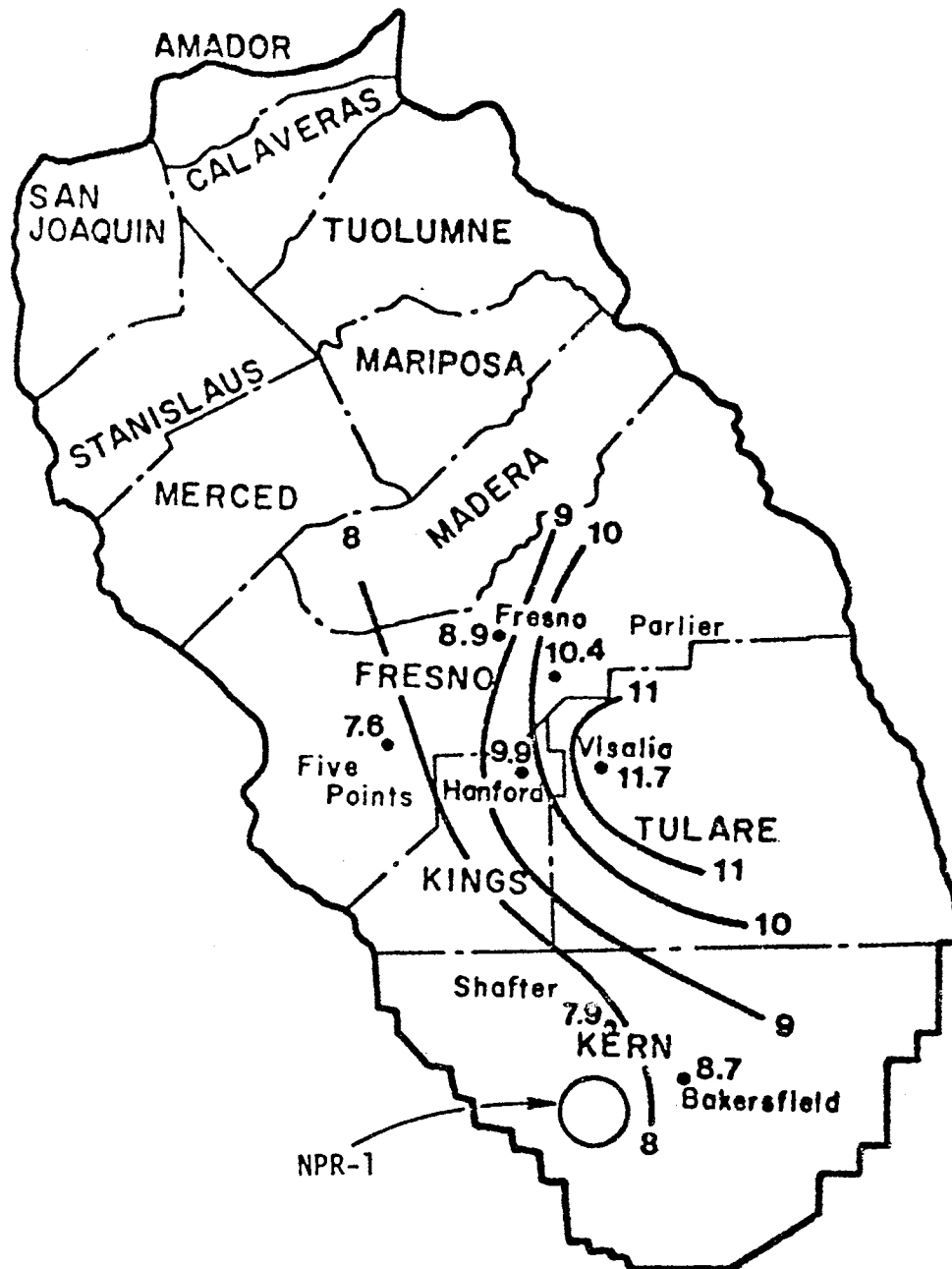
Figure H-1

1. San Joaquin Valley Air Basin

Figure H-2 presents the distribution of oxidants in the San Joaquin Valley Air Basin. The isopleths show that the distribution of photochemical oxidants within the air basin increase as one approaches the easterly portions of the valley. This is primarily attributable to the complex transport mechanisms that take place in the southern San Joaquin Valley. As described in the section on climate and meteorology, many days of high oxidants are characterized by winds from the north along the western edge of the valley and southerly winds along the eastern edge. The general result is transport of oxidant precursors from the western portion of the valley to the eastern portion.

Table H-1 presents the historical oxidant conditions at four stations within the area of the proposed pipeline route. The table clearly suggests that oxidants are a major problem at these locations. A new calibration technique introduced in June 1975, lowered all previous oxidant readings by 20 percent. As a result, the number of days that the standard was exceeded increased in 1975. In addition, the decrease may have been partially attributable to meteorological conditions and should not be interpreted as a significant change in air quality. Table H-2 presents the number of times that oxidant standards was exceeded by month in 1977. Table H-3 presents the 1977 annual summary of high hour oxidant concentrations and occurrences greater than 0.08 ppm in the San Joaquin Valley. As can be seen, the highest 1-hour oxidant concentration was 0.21 ppm in Bakersfield. The 1977 annual summary of oxidant occurrence with concentrations greater than or equal to 0.2 ppm is shown in Table H-4 and indicates that only the Bakersfield-16NE site experienced levels in excess of 0.2 ppm.

Figures H-3 and H-4 illustrate the daily and monthly variations at three selected San Joaquin Valley stations. Daily variations are similar



Source: California Air Resources Board, 1972, "Air Quality in San Joaquin Valley."

Figure H-2. Distribution of Oxidants in the San Joaquin Valley Air Basin (August 1972). Units in pphm.

Table H-1

NUMBER OF DAYS OXIDANT STANDARD EXCEEDED
AT SPECIFIED STATIONS PER YEAR FOR 1971-1977*

Station	1971	1972	1973	1974	1975	1976	1977
Bakersfield (Chester)	108	83	126	142	104	17	63
Fresno (Olive)	71	96	86	92	48	44	66
Parlier	--	134	114	129	120	74	128
Visalia	119	150	140	164	30	38	15

Source: California Air Resources Board. Quarterly Reports of Air Quality Data.

*Oxidant concentrations greater than 0.08 ppm.

Table H-2
NUMBER OF DAYS OXIDANT STANDARD EXCEEDED AT
SPECIFIED STATION BY MONTH FOR 1977

Month	Fresno (Olive)	Parlier	Visalia	Bakersfield (Chester)	Delano
January	0	0	0	0	0
February	4	5	4	3	5
March	0	0	0	0	0
April	3	6	0	2	1
May	2	3	2	1	1
June	12	25	0	14	1
July	11	20	2	12	4
August	12	27	3	19	0
September	11	20	1	5	0
October	11	20	3	6	1
November	0	2	0	0	0
December	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
	66	128	15	63	13
Annual 1-hr. Maximum (PPM)	.16	.16	.10	.13	.10

Source: California Air Quality Data, California Air Resources Board, 1977.

Table H-3

1977 ANNUAL SUMMARY OF HIGH HOUR OXIDANT CONCENTRATIONS AND OCCURRENCES
WITH CONCENTRATIONS GREATER THAN .08 ppm. BY BASIN AND STATION

BASIN, STATION	CONC.	HIGH 1-4PM CONC. (ppm)		JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC		ANNUAL		TOTAL HOURS REPORTED IN YEAR	
		FROM HIGH	END HIGH	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY		
SAN JOAQUIN VALLEY																															
Fresno																															
Five Points	U	.12	.12	0	0	0	0	0	0	3	1	3	1	38	7	68	11	56	13	9	4	38	11	0	0	0	0	205	48	6738	
Fresno-Co-Squaw Vly	U	.13	.13	0	0	-	-	-	-	-	-	6	2	78	15	85	14	124	22	36	11	91	19	12	3	0	0	432	86	9950	
Fresno-Herndon	U	.09	.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	3	0	0	11	3	1337		
Fresno-Olive	U	.16	.16	0	0	13	4	0	0	8	3	6	2	43	12	55	11	34	12	19	11	25	11	0	0	0	0	203	66	8570	
Fresno-Peach St	U	.15	.14	-	-	-	-	-	-	-	-	-	-	-	-	62	14	70	17	48	13	54	14	10	3	0	0	244	61	4153	
Parlier	U	.16	.16	0	0	17	5	0	0	15	6	11	3	101	25	87	20	176	27	108	20	84	20	6	2	0	0	605	128	8063	
Shaver Lake	U	.15	.14	0	0	0	0	0	0	1	1	0	0	31	10	106	16	198	21	44	10	28	10	-	-	-	-	408	68	5522	
Kern																															
Arvin	U	.17	.17	0	0	20	9	2	1	25	6	17	4	80	20	0	0	-	-	-	-	-	-	-	-	-	-	154	40	4153	
Bakersfield-Church	U	.14	.13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1	32	10	22	8	-	-	-	-	58	19	1198	
Bakersfield-Vineland	U	.17	.16	-	-	-	-	-	-	-	-	10	2	79	18	112	23	146	23	103	19	74	12	-	-	-	-	524	97	5189	
Bakersfield-16NE	U	.21	.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	145	14	70	13	55	10	-	-	-	-	270	32	1174	
Bakersfield-2712' O St	U	.13	.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	56	14	42	11	26	9	-	-	-	-	124	34	1235	
Bakersfield-Chester St	U	.13	.13	0	0	5	3	0	0	3	2	6	1	50	14	49	12	86	19	17	5	11	6	0	0	0	0	233	63	4177	
Callente	U	.17	.17	-	-	-	-	-	-	-	-	-	-	-	-	98	18	171	24	64	15	50	10	-	-	-	-	383	62	4010	
Conner	U	.11	.11	0	0	-	-	-	-	-	-	7	1	27	8	0	0	-	-	-	-	-	-	-	-	-	-	34	9	2083	
Delano	U	.10	.10	0	0	13	5	0	0	2	1	1	1	4	1	7	4	0	0	0	0	2	1	0	0	0	0	29	13	4680	
Edison-SE	U	.17	.15	-	-	-	-	-	-	-	-	-	-	-	-	57	11	106	16	93	18	44	11	-	-	-	-	290	56	1750	
Lamont	U	.15	.15	-	-	-	-	-	-	-	-	-	-	-	-	31	9	89	15	85	17	48	10	-	-	-	-	253	51	1829	
Taft-No. 10th St	U	.12	.11	0	0	0	0	0	0	0	0	0	0	0	0	6	2	51	10	3	1	-	-	-	-	0	0	60	13	7197	
Wheeler Ridge	U	.16	.15	-	-	-	-	-	-	-	-	-	-	-	-	144	21	223	26	123	18	82	12	-	-	-	-	572	77	2329	
Kings																															
Corcoran-El Rico	U	.09	.09	0	0	-	-	-	-	-	-	0	0	0	0	11	4	0	0	-	-	-	-	-	-	-	-	11	4	2543	
Hanford-Berry	U	.12	.12	-	-	14	4	0	0	-	-	-	-	40	7	53	9	60	17	30	11	9	2	-	-	-	-	206	50	2965	
Merced																															
Los Banos II	U	.16	.15	0	0	6	2	0	0	10	4	0	0	41	11	37	9	18	4	5	3	13	5	0	0	0	0	130	38	18468	
Merced	C	.12	.12	0	0	0	0	0	0	3	1	0	0	27	11	-	-	-	-	-	-	-	-	-	-	-	-	30	12	4206	
Merced 16th & S St	U	.15	.14	0	0	15	5	2	1	18	5	4	1	94	20	105	20	79	18	56	13	53	13	0	0	0	0	426	96	8829	
San Joaquin																															
Stockton-Hazelton	U	.16	.16	0	0	2	1	0	0	0	0	0	0	36	12	14	7	9	4	16	7	1	1	-	-	-	-	28	32	5901	
Union Island	U	.11	.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	8	4	9	3	0	0	0	0	17	7	2080	
Stanislaus																															
Modesto-J St	U	.14	.13	0	0	0	0	-	-	-	-	0	0	22	8	17	7	12	5	11	5	3	2	0	0	0	0	65	27	2125	
Turlock-Monte Vista	U	.18	.17	-	-	-	-	-	-	7	3	4	2	104	20	90	17	64	16	61	14	36	11	0	0	1	1	367	84	5279	
Tulare																															
Lindsay	U	.11	.11	0	0	-	-	-	-	-	-	3	1	38	12	41	13	59	15	13	7	24	8	0	0	0	0	128	56	6319	
Three Rivers	U	.14	.13	-	-	-	-	-	-	-	-	8	1	92	18	104	20	117	16	52	14	71	12	4	2	0	0	148	83	1891	
Visalia-Old Jail	U	.10	.10	0	0	8	4	0	0	0	0	5	2	0	0	2	2	3	3	1	1	6	3	0	0	0	0	25	15	8051	

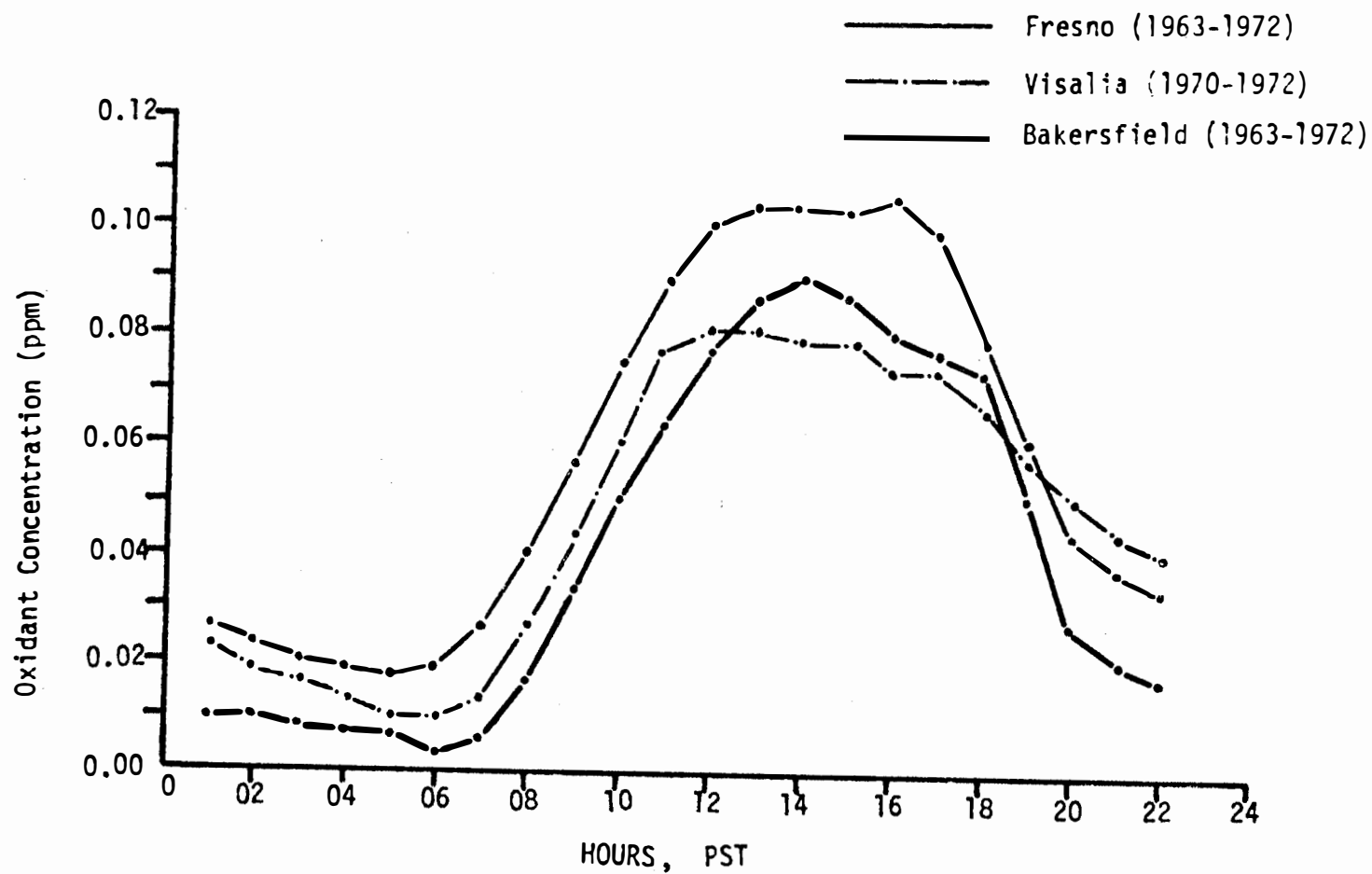
U Measured by U.V. Photometry
C Measured by Chemiluminescence

Table H-4

**1977 ANNUAL SUMMARY OF OXIDANT OCCURRENCES WITH CONCENTRATIONS
GREATER THAN OR EQUAL TO .20 ppm. BY BASIN AND STATION**

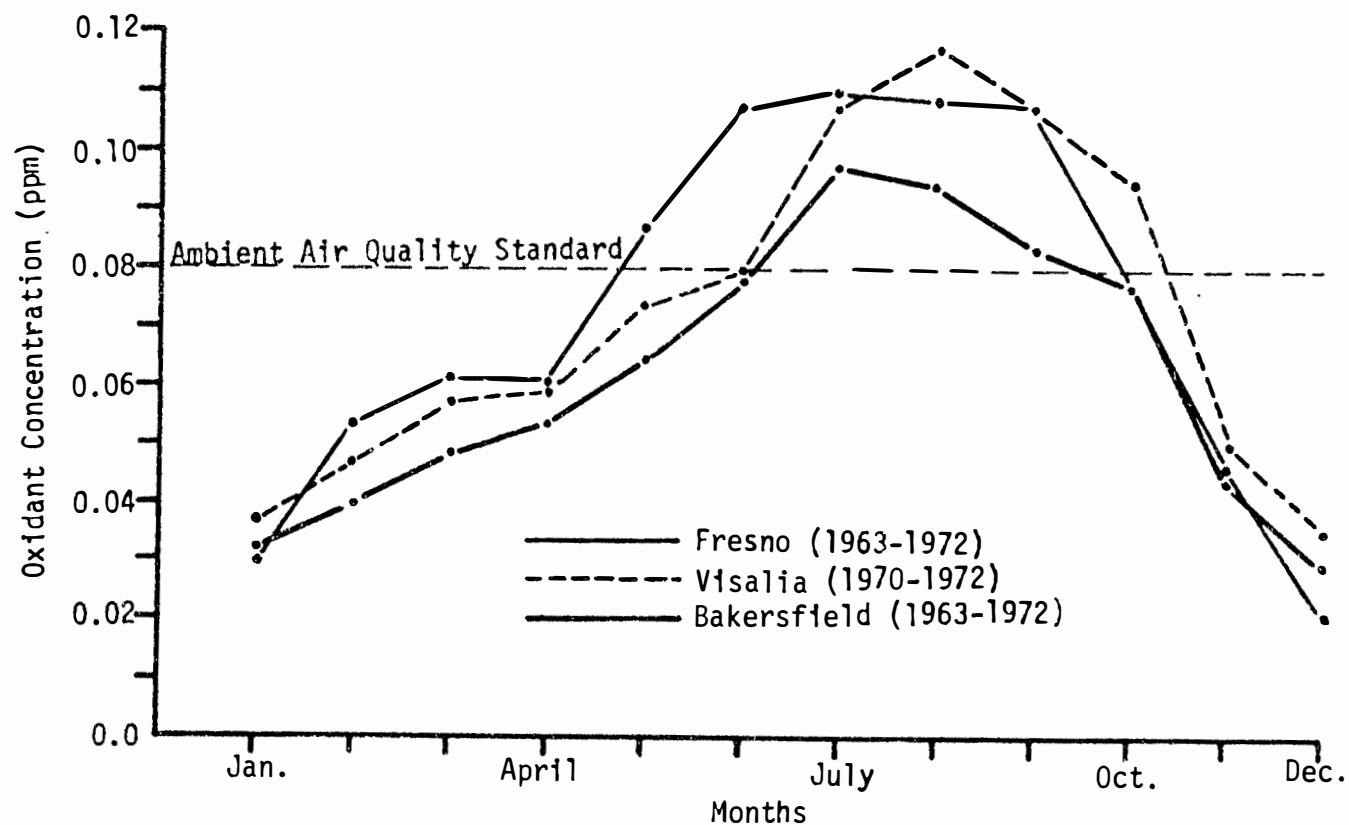
BASIN, STATION		JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC		ANNUAL		TOTAL HOURS REPORTED BY YEAR
		HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	
SAN JOAQUIN VALLEY																												
Kern																												
Bakersfield-16NE	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	0	0	0	0	-	-	-	-	2	1	1174

U Measured by U.V. Photometry
 K Measured by KI Method
 C Measured by Chemiluminescence



Source: California Air Resources Board

Figure H-3. Dirunal Oxidant Concentration Variation Averages for July, August, September 1972 at Three San Joaquin Valley Stations.



Source: California Air Resources Board

Figure H-4. Monthly Oxidant Concentration Variation Average of Daily Maximum One-Hour Concentrations at Three Project Area Stations.

for all three stations in that oxidant concentrations begin to increase quite rapidly in the mid-morning hours and drop sharply in the late afternoon. This is typical diurnal distribution of oxidants, portraying the dependence of oxidant concentrations on maximum solar intensity. The similar distributions at all three stations imply that oxidants are caused primarily by local (San Joaquin Valley) emissions.

The monthly variation in oxidant concentration (Fig. H-4) illustrates the pronounced change in levels that occur during the year. The late spring, summer, and early fall comprise the typical oxidant season of abundant sunshine and other meteorological factors most conducive to oxidant formation.

Table H-5 presents the 1977 Summary of 24-hour total suspended particulates for monitoring sites in the San Joaquin Valley. Particulate standards are frequently exceeded at many locations, primarily due to agricultural operations and the mineral industry's extraction processes.

Table H-6 presents the 1977 Annual Summary of high carbon monoxide concentrations and occurrences within an 8-hour moving average of greater than 9 ppm for monitoring stations in the San Joaquin Valley. Violations of the 8-hour standard occurred predominantly in Bakersfield and Fresno. Carbon monoxide levels in Kern County were generally low indicating the lack of significant motor vehicle traffic outside the metropolitan areas.

The 1977 Annual Summary of nitrogen dioxide concentrations and occurrences with concentrations at or above 0.25 ppm in the San Joaquin Valley is shown in Table H-7. The highest NO_2 concentrations were measured in Bakersfield (Chester Street Station) with a value of 0.17 ppm for the second-highest one hour average. This value is considerably below the 1-hour state standard of 0.25 ppm. In terms of the annual average concentration, the Bakersfield site also represented the highest

Table H-5

1977 ANNUAL SUMMARY OF 24-HOUR TOTAL SUSPENDED PARTICULATE

BASIN, COUNTY, STATION	TOTAL NUMBER OF SAMPLES IN YEAR	NUMBER OF SAMPLES			CONCENTRATIONS ($\mu\text{g}/\text{m}^3$)				
		$\geq 100 \mu\text{g}/\text{m}^3$	$> 100 \mu\text{g}/\text{m}^3$	$> 200 \mu\text{g}/\text{m}^3$	HIGH	2ND HIGH	LOW	ANNUAL GEOMETRIC MEAN	GEOMETRIC STANDARD DEVIATION
SAN JOAQUIN VALLEY									
Fresno									
Coalinga	55	21	2	0	184	159	22	81.8	1.7
Five Points	54	32	17	1	301	240	37	106.6	1.7
Fresno-Cal State	47	28	10	0	232	218	37	109.1 †	1.6
Fresno-Olive	57	42	24	1	272	255	35	128.1	1.6
Parlier	52	38	19	0	256	239	54	125.8	1.5
Kern									
Bakersfield - Armory	15	13	12	2	298	295	71	186.6 †	1.5
Bakersfield - Cheater St.	65	55	36	7	337	292	62	154.9	1.5
Bakersfield -Greenfield School	30	28	21	8	636	377	36	202.2 †	1.7
Bakersfield - Foothill High	33	27	21	5	285	230	30	154.0 †	1.7
Bakersfield - Fruitvale Ave.	32	26	19	4	559	267	42	155.2 †	1.7
Bakersfield - H.D. Flower	60	41	23	2	268	262	42	127.3	1.6
Bakersfield - Mt. Vernon Sch.	15	13	13	7	374	327	52	186.1 †	1.9
Bakersfield - O Street	16	15	14	10	793	446	73	266.3 †	1.6
Kern City Golf Course	14	13	12	3	278	271	66	218.6 †	1.7
Kern Refuge	48	15	3	1	283	196	25	78.6	1.6
Olddale - Fire Station	14	13	12	5	301	357	77	219.3 †	1.5
Taft-No. 10th St.	57	35	14	0	228	225	29	103.2	1.6
Kings									
Corcoran-Chittenden	13	10	9	2	375	296	71	165.4 †	1.7
Hanford-Health Dept.	21	17	12	3	320	293	52	149.9 †	1.6
Kettleman City-Hwy 41	27	20	14	5	396	327	25	124.5 †	2.3
Lemoore	16	10	5	0	211	168	35	99.2 †	1.8
Stratford	30	21	9	0	230	226	32	106.0 †	1.8
Madera									
Madera Library	1	0	0	0	81	-	81	-	-
Merced									
Los Banos	31	4	0	0	128	120	29	64.1 †	1.5
Merced	49	21	2	0	191	153	21	84.7 †	1.6
Merced 18th & 8 St.	55	29	9	0	208	196	27	96.2	1.6
San Joaquin									
New Jerusalem	17	5	0	0	112	111	15	54.1 †	1.9
Stockton-Hazelton	48	4	0	0	109	106	13	52.2	1.7
Stanislaus									
Modesto-J. St.	60	31	8	3	301	284	47	101.1	1.5
Modesto-Oakdale Rd.	57	18	3	0	195	167	21	72.1	1.6
Patterson	20	5	0	0	141	135	30	63.9 †	1.7
Salida	31	9	2	0	183	161	24	67.6 †	1.8
Turlock	35	12	1	0	156	148	26	72.2 †	1.5
Tulare									
Goshuen	59	48	35	5	302	295	50	149.2	1.5
Porterville	38	26	14	0	238	216	51	117.4 †	1.6
Porterville-S. Main	20	16	10	0	231	225	89	141.9 †	1.3
Three Rivers	59	20	5	0	226	161	21	76.4	1.6
Visalia-Old Jail	58	42	23	3	394	266	41	127.6	1.6

1977 ANNUAL SUMMARY OF HIGH CARBON MONOXIDE CONCENTRATIONS AND OCCURRENCES
WITH AN 8 - HOUR MOVING AVERAGE OF GREATER THAN 9 ppm

* Measured by Flame Ionization Detection (FID).

Table H-7

**1977 ANNUAL SUMMARY OF NITROGEN DIOXIDE CONCENTRATIONS AND OCCURRENCES
WITH CONCENTRATIONS AT OR ABOVE .25 ppm**

H-14

BASIN, COUNTY, STATION	CONCENTRATIONS (ppm)			JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC		ANNUAL		TOTAL HOURS REPORTED IN YEAR
	HIGH 1 HOUR	2ND HIGH 1 HR	ANNUAL AVG. ALL HRS	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	HR	DY	
SAN JOAQUIN VALLEY																														
Fresno																														
Fresno-Olive *	.16	.16	044	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7200
Kern																														
Bkrsfld-Chester St	.12	.12	0334	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	1931
Bkrsfld-Chester St *	.12	.12	0524	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6098
Delano *	.13	.13	0374	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	3355
Merced																														
Merced-18th & S St *	.12	.12	024	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8738
San Joaquin																														
Stockton-Hazelton St *	.18	.15	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	--
Union Island *	.07	.07	0164	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	--
Stanislaus																														
Modesto-J St	.10	.10	0274	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	1910
Modesto-J St *	.13	.13	0414	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6506
Tulare																														
Visalia-Old Jail *	.12	.12	027	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	--

* Measured by Chemiluminescent method.
+ Not statistically representative

value with a mean of 0.052 ppm. This value is in violation of the Federal NO₂ ambient air quality standard, although the annual average value may not be statistically representative.

Table H-8 presents the 1977 Annual Summary of average and high sulfur dioxide concentrations (ppm) for various sites in the San Joaquin Valley. As can be seen, violations of the annual SO₂ standard occurred at the Oildale Fire Station near Bakersfield (reported annual average of 0.043 ppm) although this value may not be statistically representative due to the small number of samples obtained during the year. There were no violations of the national 3-hour or State 1-hour SO₂ standards throughout the air basin. A further analysis of the peak 24-hour average concentrations in excess of 0.05 ppm for 1977 in the San Joaquin Air Basin is shown in Table H-9. As indicated, the preponderance of values in excess of 0.05 ppm occurred at the Oildale Fire Station. Of the SO₂ values, the 2 were considered to be probable due to the potential interference at other times from high oxidant and TSP concentrations.

The 1977 Annual summary of 24-hour average particulate sulfate values in the San Joaquin Air Basin is presented in Table H-10. Although the total number of samples at any station is low and as a result may not be statistically representative for an entire year, the result indicates a number of samples in the Kern County area were in excess of 25 µg sulfate per cubic meter. None of the samples were obtained under conditions of high ozone (≥ 0.2 ppm) concentrations.

Table H-11 presents current hydrocarbon emissions in the San Joaquin Valley. Emissions due to petroleum-related operations represent a significant portion of total emissions, particularly in Kern County.

Future trends in air quality in the San Joaquin Air Basin are generally similar to those in many other regions of California. It is expected

Table H-8

**1977 ANNUAL SUMMARY OF AVERAGE AND HIGH
SULFUR DIOXIDE CONCENTRATIONS (ppm)**

BASIN, COUNTY, STATION	METHOD *	HIGH 1-HOUR	HIGH 3-HOUR	ANNUAL AVERAGE	HIGH 24-HOUR CONCENTRATIONS												TOTAL HOURS REPORTED IN YEAR
					JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
SAN JOAQUIN																	
Fresno																	
Five Points	CU	.05	.050	.007	.000	.000	.013	.015	.018	.033	.013	.025	.019	.014	.011	.011	6331
Fresno-Olive	PF	.04	.040	-	-	-	-	-	-	-	-	.011	.010	.032	-	.004	--
Kern																	
Arvin	FP	.04	.027	.002†	.000	.004	.000	.005	.011	.010	-	-	-	-	-	-	3493
Bakersfield-2717 O St	PF	.12	.080	.019†	-	-	-	-	-	-	-	-	-	-	.033	.048	955
Bakersfield-Chester	FP	.06	.057	.005†	.016	.013	.009	.012	-	-	-	-	-	-	-	-	1987
Bakersfield-Chester	PF	.09	.063	-	-	.004	.012	.015	.012	.012	.016	.018	.019	.019	.031	.030	--
Bakersfield-College	PF	.15	.110	.030†	-	-	-	-	-	-	-	-	-	-	-	.064	404
Bakersfield-Health Dept	PF	.11	.097	.016†	-	-	-	-	-	-	-	-	-	-	.029	.036	1032
Bakersfield-Mt. Vernon	PF	.09	.080	.015†	-	-	-	-	-	-	-	-	-	-	-	.033	676
Bakersfield-Nat. Guard	PF	.03	.030	.012†	-	-	-	-	-	-	-	-	-	-	-	.017	224
Kern City Golf Course	PF	.15	.077	.011†	-	-	-	-	-	-	-	-	-	-	.030	.037	1169
Oildale Fire Station	PF	.17	.147	.043†	-	-	-	-	-	-	-	-	-	.073	.092	.080	1459
San Joaquin																	
Union Island	PF	.02	.020	.002†	-	-	-	-	-	-	-	.002	.008	.007	.003	-	1684

* CU Indicates Coulometric Method
 FP Indicates Flame Photometric Method
 PF Pulsed Fluorescence

† Not statistically representative

Table H-9

OCCURRENCES OF 24-HOUR SO₂
CONCENTRATIONS IN EXCESS OF .05 PPM
1977

Date	Station	SO ₂ 24 Hr Avg* (ppm)	Oxidant ^A Max-hour (ppm)	TSP# 24 Hr Avg (ug/m ³)	Excess	Probable Excess
SAN JOAQUIN VALLEY AIR BASIN						
October 23	Oildale	.073	<.10			
24	Oildale	.063	<.10			
25	Oildale	.065	<.10			
26	Oildale	.058	<.10			
November 2	Oildale	.056	<.10	≥ 100		yes
3	Oildale	.092	<.10	357	x	
9	Oildale	.059	<.10	258	x	
10	Oildale	.071	<.10			
11	Oildale	.070	<.10			
12	Oildale	.051	<.10	276	x	
16	Oildale	.056	<.10			
21	Oildale	.073	<.10	276	x	
25	Oildale	.053	<.10			
27	Oildale	.051	<.10	160	x	
30	Oildale	.064	<.10	250	x	
December 2	Oildale	.066	<.10	≥ 100		yes
3	Oildale	.056	<.10	243	x	
5	Oildale	.077	<.10			
10	Oildale	.080	<.10			
11	Bkrsfld-College	.054	<.10			
11	Oildale	.077	<.10			
12	Oildale	.060	<.10			
13	Oildale	.054	<.10	230	x	
					8 Excesses 2 Probable	

*Average of at least 18 hours

^AOxidant concentrations shown as "<.10" were obtained at a nearby station

[#]TSP concentrations shown as "≥ 100" or "≥ 100" were obtained at a nearby station

Table H-10

1977 ANNUAL SUMMARY OF 24-HOUR PARTICULATE SULFATE

SAN JOAQUIN COUNTY, STATION	TOTAL NUMBER OF SAMPLES IN YEAR	ANNUAL AVERAGE CONCENTRATION µg/m ³	HIGHEST 24-HOUR AVERAGE CONCENTRATION µg/m ³	NUMBER OF SAMPLES ≥15 µg/m ³	NUMBER OF SAMPLES ≥15 µg/m ³ COMBINED WITH OZONE ≥2.0 ppm
SAN JOAQUIN VALLEY					
Fresno					
Coalinga	4*	9.4	19.1	0	0
Five Points	4*	8.9	18.6	0	0
Fresno-Cal State	4*	12.3	25.5	1	0
Fresno-Olive	52	6.0	27.0	1	0
Parlier	4*	10.1	22.2	0	0
Kern					
Bakersfield-Chaster	66	12.2	64.8	4	0
Bakersfield-College	5*	22.2	28.2	2	0
Bakersfield-Federal Building	2*	18.2	24.4	0	0
Bakersfield-Foothill High	33*	11.9	29.3	1	0
Bakersfield-Fruitvale Ave.	32*	13.6	26.9	3	0
Bakersfield-Greenfield School	30*	11.9	29.8	1	0
Bakersfield-Health Department	15*	15.4	33.2	2	0
Bakersfield-H.D. Flower	12*	20.0	23.7	4	0
Bakersfield-Mt. Vernon	15*	15.6	28.3	2	0
Bakersfield-National Guard Armory	15*	13.5	24.4	0	0
Bakersfield-2717 W Street	16*	18.4	29.1	3	0
Kern City Golf Course	15*	14.5	19.9	0	0
Kern Refuge	14*	8.5	18.4	0	-
Olindale Fire Station	14*	21.8	32.1	2	0
Taft-No. 10th Street	16*	12.3	30.0	1	0
Kings					
Lenore	1		23.1	0	-
Stratford	1		7.6	0	-
Madera					
Madera-Library	1		15.7	0	0
Merced					
Los Banos	4*	2.5	12.2	0	0
Merced	3*	10.4	18.5	0	0
Merced-13th & B Street	56	5.5	22.4	1	0
San Joaquin					
New Jerusalem	3*	3.4	21.8	0	-
Stockton-Hazeltown	3*	9.3	17.5	0	0
Stanislaus					
Modesto-J Street	6*	7.9	14.2	0	0
Modesto-Oakdale Road	4*	5.3	9.2	0	0
Patterson	3*	4.8	6.0	0	-
Salida	2*	6.3	8.0	0	-
Turlock	3*	7.2	12.6	0	0
Tulare					
Goshen	1		7.9	0	-
Porterville-S. Main	1		8.0	0	-
Three Rivers	1		4.2	0	0
Visalia-Old Jail	4*	16.0	27.4	1	0

* Sampling not conducted through entire year
 - O₃/O₃ not measured in area

** May not be representative of year's average

Table H-11

1975 AIR POLLUTANT EMISSIONS IN THE SAN JOAQUIN VALLEY
Tons/Day

EMISSION SOURCES	ORGANIC GASES (HYDROCARBONS)							
	Fresno Co. Reactive* Total		Kern Co. Reactive Total		Tulare Co. Reactive Total		Kings Co. Reactive Total	
PETROLEUM								
Production	8.5	15.9	82.3	154	-	-	1.3	2.4
Refining	-	-	17.9	18.6	-	-	3.9	4.1
Marketing	6.1	6.4	10.5	11.1	3.2	3.3	0.4	0.4
SUBTOTAL	14.7	22.3	111	183	3.2	3.3	5.6	6.9
OTHER STATIONARY SOURCES	28.6	50.5	26	42	21.1	31.9	13.7	25
MOBILE SOURCES	49.4	54.2	35.4	38.8	22.2	24.3	11.3	12.4
TOTAL	92.7	127	173	263	46.5	59.5	30.6	44.2

*Reactive hydrocarbons are Class II and III hydrocarbons as defined by the Air Resources Board.

Source: California Air Resources Board

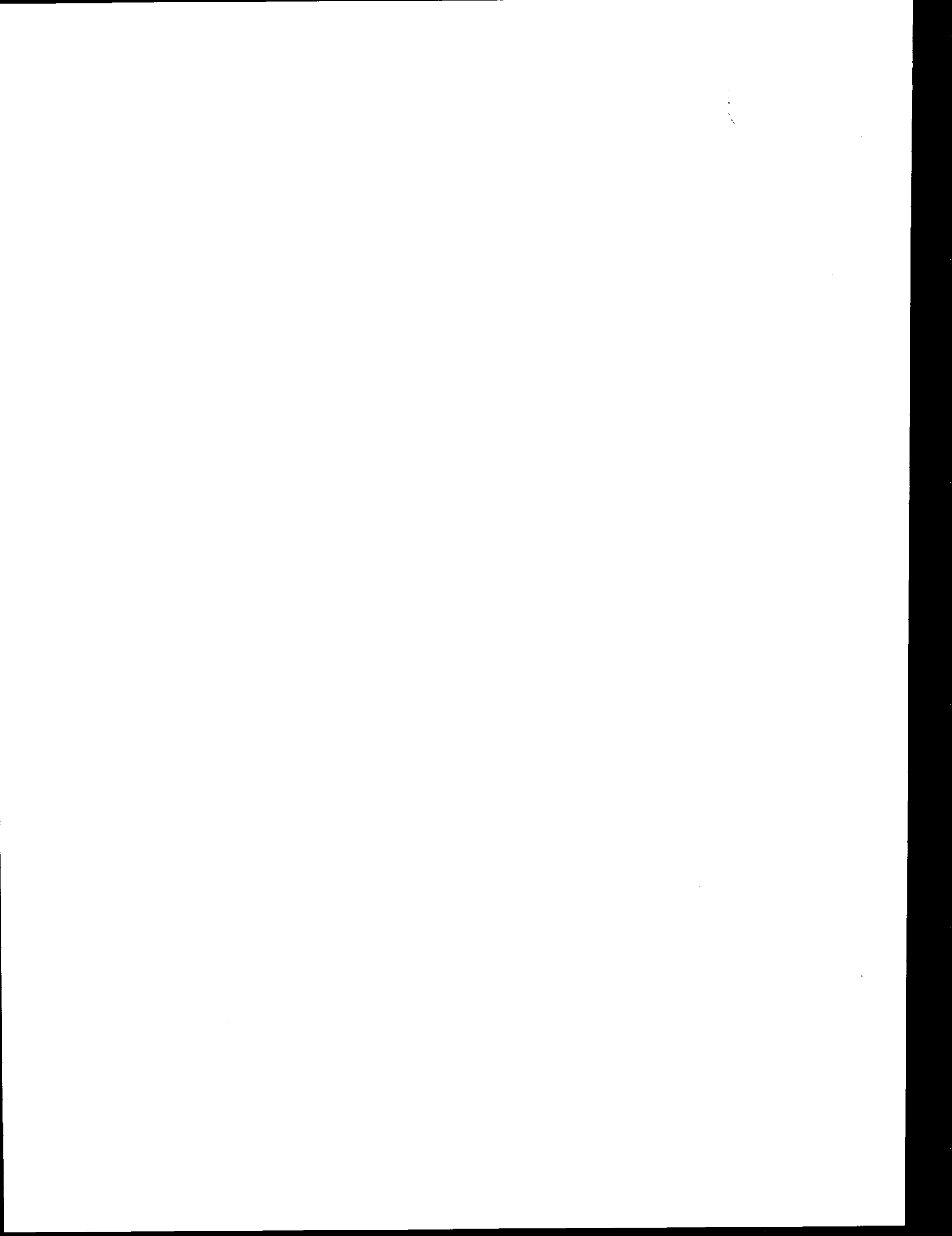
that oxidant levels will drop as more automobiles become equipped with devices to control oxidant precursors. However, this drop will eventually be offset by increasing population if present driving and growth trends continue. The current efforts of the air quality maintenance planning effort in Kern County are designed to deal with this situation. A potential future problem in the San Joaquin Valley involves the increase of sulfur dioxide concentrations. New sources of air pollution such as increased dependence on oil steam injectors at reclaimed oil wells may create an SO₂ problem in the future. Recent Air Resources Board studies have described significant crop damage caused by air pollution, possibly through synergistic effects between oxidants and SO₂.

Appendix L

Wildlife Management Plan

No Change from Draft EIS

(Note: This appendix is the full text of a plan signed in 1963 by the California Department of Fish and Game, Bureau of Sports Fisheries and Wildlife, and Naval Petroleum Reserves in California.)



APPENDIX 0

AIR QUALITY IMPACTS

Prepared By:

SCIENCE APPLICATIONS, INC.
La Jolla, California

February 23, 1979



1. INTRODUCTION

The United States Department of Energy (D.O.E.), in a unit operation with Chevron, U.S.A., is planning to produce crude oil at the maximum efficient rate (MER) in the Naval Petroleum Reserve No. 1 (NPR-1), located at Elk Hills, Kern County, CA. Associated projects include the increase in production capacity of one Gas Processing Plant, the construction of two new Gas Processing Plants, the construction of five compressor stations, and the addition of a new railroad tank car loading facility.

This report presents an assessment of the air quality impact to be expected from the proposed project. The method of analysis consists of application of EPA approved air quality dispersion models. Details on the meteorological data and source parameters used as input to the models are presented in this report. The model calculations are discussed and the results are summarized in terms of impact for each pollutant affected. Additional discussion is provided concerning the compliance of this expansion with the Clean Air Act of 1977.



2. DESCRIPTION OF PROPOSED PROJECT

Public Law 94-258, dated 5 April 1976, directed the U.S. Government to bring NPR-1 up to production at the maximum efficient rate consistent with sound engineering practices for a period not to exceed six years after the date of enactment of this law. NPR-1 is targeted for producing a maximum of 240,000 barrels of oil per day. This increase in oil production requires an expansion of existing facilities at NPR-1, as well as the construction of new facilities. A listing of these facilities follows in this report.



3. METHODS OF ANALYSIS

The quantification of the air quality impact from the proposed new gas-fired equipment is accomplished through the application of mathematical models which relate meteorological conditions and source emissions to resultant air quality levels. Mathematical models approved by the Environmental Protection Agency (EPA) have been employed. In this section, a discussion of the air quality models used, the air quality standards which must be met, and the data base requirements will be presented.

3.1 AIR QUALITY DISPERSION MODELS

Computerized air quality dispersion models are used to predict ground-level ambient air quality levels resulting from present and proposed gas-fired equipment operation. Both short-term episode potential and year-long average air quality consequences are analyzed. The Climatological Dispersion Model (CDM) is the model used for annual average calculations. The Texas Episodic Model (TEM) is used to determine short-term concentrations, typically 1-hour, 3-hour, and 24-hour averaged concentrations. These models are both recommended for this purpose in EPA's recent guidelines.⁽¹⁾ The computed concentrations are compared with applicable air quality standards to determine if the calculated values satisfy these standards.

The air quality standards applicable to these projects are the State and National ambient air quality standards shown in Table 1. These standards impose constraints on both long- and short-term air quality levels. The primary pollutant emissions are sulfur dioxide (SO_2), nitric oxide (NO), and particulates. Lesser pollutants are hydrocarbons (HC) and carbon monoxide (CO). Criterion also exist for contaminants formed by secondary processes including photochemical oxidants (O_x), nitrogen dioxide (NO_2), and sulfates.

There is no ambient standard for nitric oxide. The standards are written in terms of NO_2 . When no NO to NO_2 conversion data are available, very conservative air quality impact studies use the unrealistic assumption of total conversion of NO to NO_2 . A more realistic value has been suggested using data obtained by the California Air Resources Board (CARB). These data indicate that the ratio* of NO_2 to NO_x in the Bakersfield area falls within a range from 0.14 to 0.62 with an average value of approximately 0.33. These ratios are substantiated by analogous data obtained by Getty Oil Company in McKittrick, with an average value of about 0.56. As would be expected, maximum conversion levels occur during the warm, sunny, summer season and minimums during winter. In addition, limited summer field measurements obtained at a Southern California power plant⁽⁴⁾ indicate that the values derived from the above analysis of CARB data are reasonable. Despite the evidence that a conversion ratio of 80 percent would be realistic and still conservative, this air quality impact assessment has been performed using the extremely conservative assumption that conversion is 100 percent: all NO is assumed to be NO_2 .

* $\text{NO}_2/(\text{NO} + \text{NO}_2)$

TABLE 0-1
AMBIENT AIR QUALITY STANDARDS

POLLUTANT	AVERAGING TIME	CALIFORNIA STANDARDS ¹		NATIONAL STANDARDS ²		
		CONCENTRATION ³	METHOD ⁴	PRIMARY ^{3 5}	SECONDARY ^{3 6}	METHOD ⁷
Oxidant (Ozone)	1 hour	0.10 ppm (200 ug/m ³)	Ultraviolet Photometry	240 ug/m ³ (0.12 ppm)	Same as Primary Standards	Chemiluminescent Method
Carbon Monoxide	12 hour	10 ppm (11 mg/m ³)	Non-Dispersive Infrared Spectroscopy	—	Same as Primary Standards	Non-Dispersive Infrared Spectroscopy
	8 hour	—		10 mg/m ³ (9 ppm)		
	1 hour	40 ppm (46 mg/m ³)		40 mg/m ³ (35 ppm)		
Nitrogen Dioxide	Annual Average	—	Saltzman Method	100 ug/m ³ (0.05 ppm)	Same as Primary Standards	Proposed: Modified J-H Saltzman (O ₃ corr.) Chemiluminescent
	1 hour	0.25 ppm (470 ug/m ³)		—		
Sulfur Dioxide	Annual Average	—	Conductimetric Method	80 ug/m ³ (0.03 ppm)	—	Pararosaniline Method
	24 hour	0.10 ppm ⁹ (260 ug/m ³)		365 ug/m ³ (0.14 ppm)	—	
	3 hour	—		—	1300 ug/m ³ (0.5 ppm)	
	1 hour	0.5 ppm (1310 ug/m ³)		—	—	
Suspended Particulate Matter	Annual Geometric Mean	60 ug/m ³	High Volume Sampling	75 ug/m ³	60 ug/m ³	High Volume Sampling
	24 hour	100 ug/m ³		260 ug/m ³	150 ug/m ³	
Sulfates	24 hour	25 ug/m ³	AIML Method No. 61	—	—	—
Lead	30 Day Average	1.5 ug/m ³	AIML Method No. 54	—	—	—
	Calendar Quarter	—	—	1.5 ug/m ³	Atomic Absorption	—
Hydrogen Sulfide	1 hour	0.03 ppm (42 ug/m ³)	Cadmium Hydroxide Stratman Method	—	—	—
Hydrocarbons (Corrected for Methane)	3 hour (6-9 a.m.)	—	—	160 ug/m ³ (0.24 ppm)	Same as Primary Standards	Flame Ionization Detection Using Gas Chromatography
Ethylene	8 hour	0.1 ppm	—	—	—	—
	1 hour	0.5 ppm		—	—	—
Visibility Reducing Particles	1 Observation	In sufficient amount to ⁸ reduce the prevailing visi- bility to less than 10 miles when the relative humidity is less than 70%		—	—	—

NOTES:

1. California standards are values that are not to be equaled or exceeded.
2. National standards, other than those based on annual averages or annual geometric means, are not to be exceeded more than once per year..
3. Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25 degrees C and a reference pressure of 760 mm of mercury. All measurements of air quality are to be corrected to a reference temperature of 25 degrees C and a reference pressure of 760 mm of Hg (1,013.2 millibar); ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.
4. Any equivalent procedure which can be shown to the satisfaction of the Air Resources Board to give equivalent results at or near the level of the air quality standard may be used.
5. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health. Each state must attain the primary standards no later than three years after that state's implementation plan is approved by the Environmental Protection Agency (EPA).
6. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a "reasonable time" after implementation plan is approved by the EPA.
7. Reference method as described by the EPA. An "equivalent method" of measurement may be used but must have a "consistent relationship to the reference method" and must be approved by the EPA.
8. Prevailing visibility is defined as the greatest visibility which is attained or surpassed around at least half of the horizon circle, but not necessarily in continuous sectors.
9. Standard applies unless either ozone or particulate levels exceed standards at which time the SO₂ standard becomes 0.05 ppm (130 ug/m³).



3.3 DATA REQUIREMENTS

The first step in a modeling analysis of this type is the collection of required input data. The data consist of three basic types of information: (1) meteorological data, (2) source information, and (3) existing air quality levels. The meteorological data are used in the models to quantify the atmospheric dispersion characteristics of the region. Typically, in short-term air quality impact assessments, meteorological regimes most conducive to degraded air quality are selected for use in the models, in order to present a "worst case" impact analysis. The source information required is a complete inventory of the emission producing equipment and must include size, location, and emission characteristics of each source. Existing air quality levels are required to document current conditions and to calibrate the models so that they can be used to accurately predict existing and projected ground level pollutant concentrations.

3.4 METEOROLOGICAL ANALYSIS

A discussion regarding the regional and local characteristics of key meteorological and climatological parameters is provided in the following sections. This discussion shall provide an insight into climatic variations in the study area, as well as present the subtle particulars of the local meteorological regime. Detailed analyses are presented for meteorological parameters that are related directly to the dispersion and ventilation characteristics of the local atmosphere. These parameters include mixing height, wind speed, wind direction, and atmospheric stability within the mixing layer.

3.4.1 Regional Climatological Summary

The Elk Hills area is situated in the extreme south end of the San Joaquin Valley and is partially surrounded by mountainous terrain on three sides. The NPR-1, as indicated on the regional topographic map in Figure 1, is located in the foothills of the Temblor Range. The peaks of the Tehachapi mountains lie about 30 miles to the south and southeast. The relatively flat plains of the southern San Joaquin Valley separate the Elk Hills Area from the peaks of the Greenhorn mountains which lie due east of the study area. The broad plains of the great Central Valley extend north and northeast of Elk Hills.

The surrounding topography has a significant influence on the regional climate. The Sierra Nevadas, located to the northeast, insulate the central valley from blasts of cold polar air that propagate southward over the continent during the winter. The Tehachapi mountains, forming the southern boundary, force moist air emanating from the northwest and north, to rise, thus promoting heavier precipitation on the windward slopes, as well as a higher frequency of cloudiness over the foothill areas. The coastal ranges, situated due west of the Elk Hills area, tend to shield the local region from the true marine environment that dominates some 50 to 70 miles to the west. Furthermore, because of the nature of the encompassing terrain, large climatic variations can exist within relatively short distances of the Elk Hills study area. These differences become most pronounced in long- and short-term local wind distribution analyses.^(5,6) A site specific wind analysis is provided in later sections.

The general climate of the Elk Hills area is warm and semi-arid. Nearly 90% of all precipitation falls during the

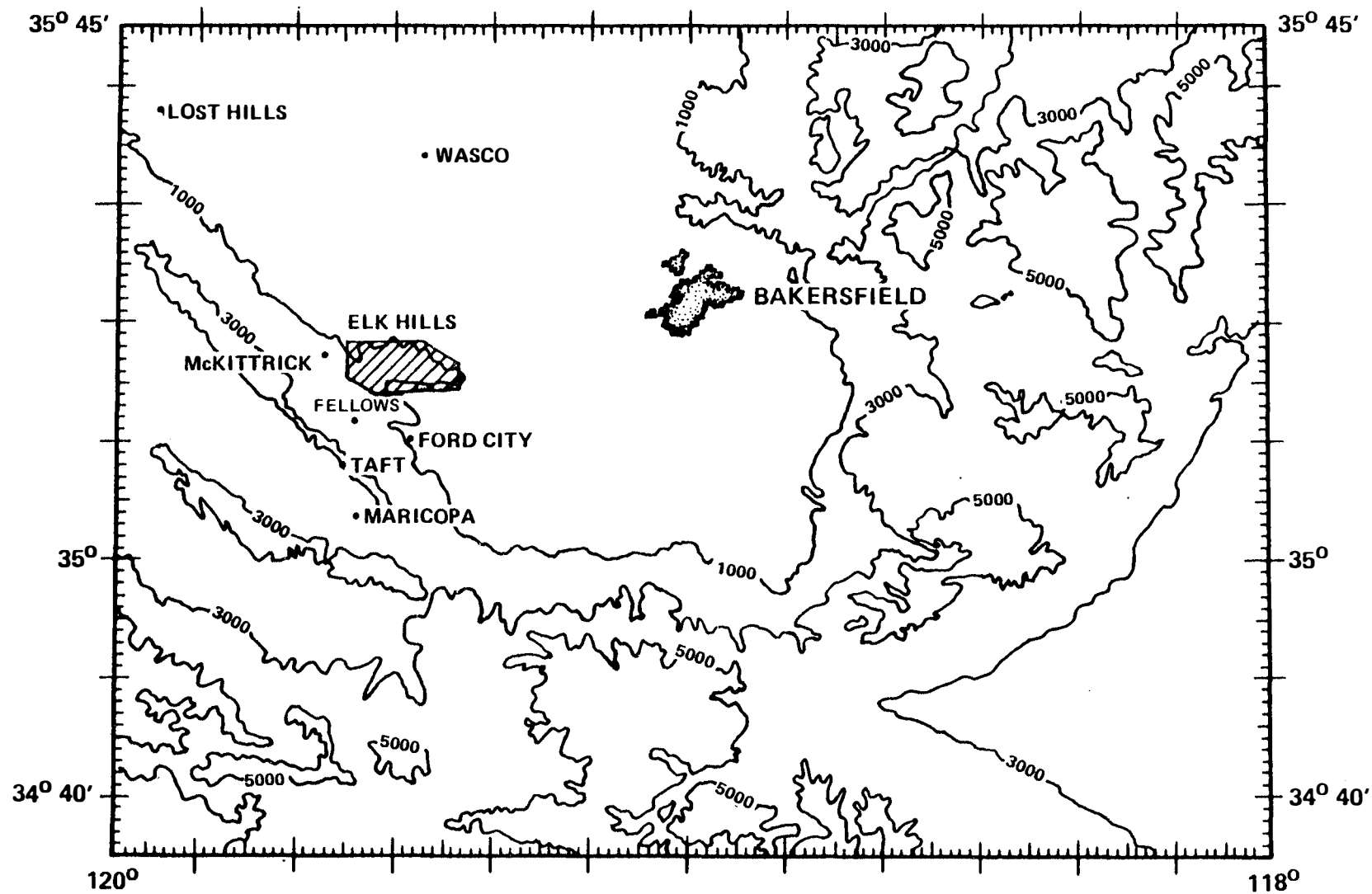


Figure 0-1

Regional Topography Surrounding the Elk Hills Study Region

annual "wet season," which occurs from October through April. Snow in the southern valley region is infrequent, with only a trace occurring in about one year in seven. Thunderstorm and severe weather activity is seldom experienced. Elk Hills receives about 6 inches of precipitation annually.

Monthly normal temperatures range from the mid-40's in January to the mid-80's during July. Record temperatures have been observed to exceed 110 degrees F during the summer months and drop more than 10 degrees F below freezing during the winter season. Figure 2 graphically depicts the long-term, monthly, and annual distribution of mean temperatures and precipitation for Maricopa, California (the nearest recording climatological station to Elk Hills) and Bakersfield, California.

Summer skies are clear and conditions are usually hot and dry. Winters are mild and tend to be fairly humid. As a result, nocturnal fog is frequently experienced during December and January. Dense, foggy conditions can persist for days or weeks as radiational fog (induced by nocturnal cooling) is trapped in the valley regions by large-scale high pressure systems. During the winter season at Elk Hills, warm, dry, south and southwesterly flow is occasionally observed as drainage chinook-style winds emanating from Tehachapi pass area move swiftly into the Central Valley regions.

Ambient atmospheric pressure is generally highest during the winter months. During the relatively cloudless summer season, thermal convection is promoted at the surface, causing the atmosphere to expand and flow laterally. This action tends to decrease the surface pressures as a "thermal" or heat-induced low pressure system develops over the area. In winter, this effect is generally absent and average surface pressures tend to be higher.

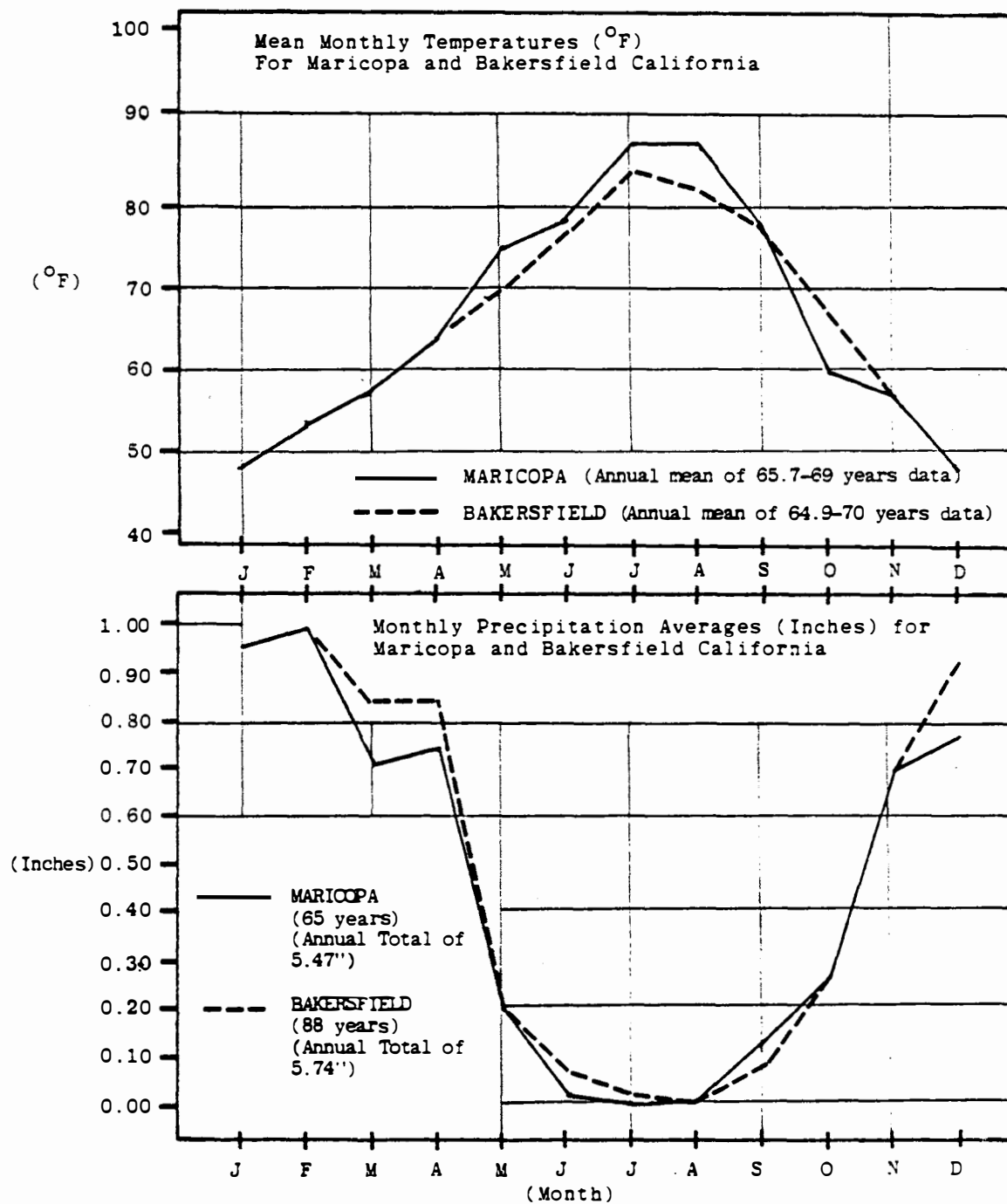


Figure 0-2

Mean Monthly Temperatures and
Precipitation for Maricopa
and Bakersfield, California



Table 2 provides a summary of the long-term normals, means, and extremes for the various climatic parameters in the Bakersfield area. As shown in Figure 2, with the exception of winds, the Bakersfield climatic data are in good agreement with conditions at Elk Hills.

3.4.2 Mixing Height

The entire troposphere, from ground level to the tropopause, is not available for the dilution of pollutants released near the surface. Only the mixing layer, which may be only a few hundred meters thick, serves this function.

The mixing layer defines the extent of vertical circulation in the lower atmosphere. Vigorous convection at the surface due to intense solar heating can be inhibited at higher altitudes by the presence of stable layers or subsiding air from the upper atmosphere. This stable layer, often referred to as an elevated inversion, acts as a "blanket" or barrier which limits pollutant dilution within the mixing layer below.

Upper air data necessary for the determination of morning and afternoon mixing heights are not presently collected in the Elk Hills region. Rawinsonde data were collected at Fresno from April 1970 to March 1971 and October 1971 to June 1973, and at Merced from 1954-1956.⁽⁷⁾ Airplane soundings were taken nearly every morning at Fresno, California for a five year period beginning July 1, 1972 to December 31, 1977. Afternoon mixing heights were compiled from the data base by using a method formulated by Holzworth. Figure 3 graphically summarizes the data base collected by the California Air Resources Board. It is accepted that the mixing layer will be somewhat higher in the Bakersfield/Elk Hills region in comparison to levels measured at Fresno. These data are not sufficient to establish morning and

TABLE 0-2

0-12

(a) Length of record, years, through the current year unless otherwise noted, based on January data.

(b) 70° and above at Alaskan stations.

* Less than one half.

† Trace.



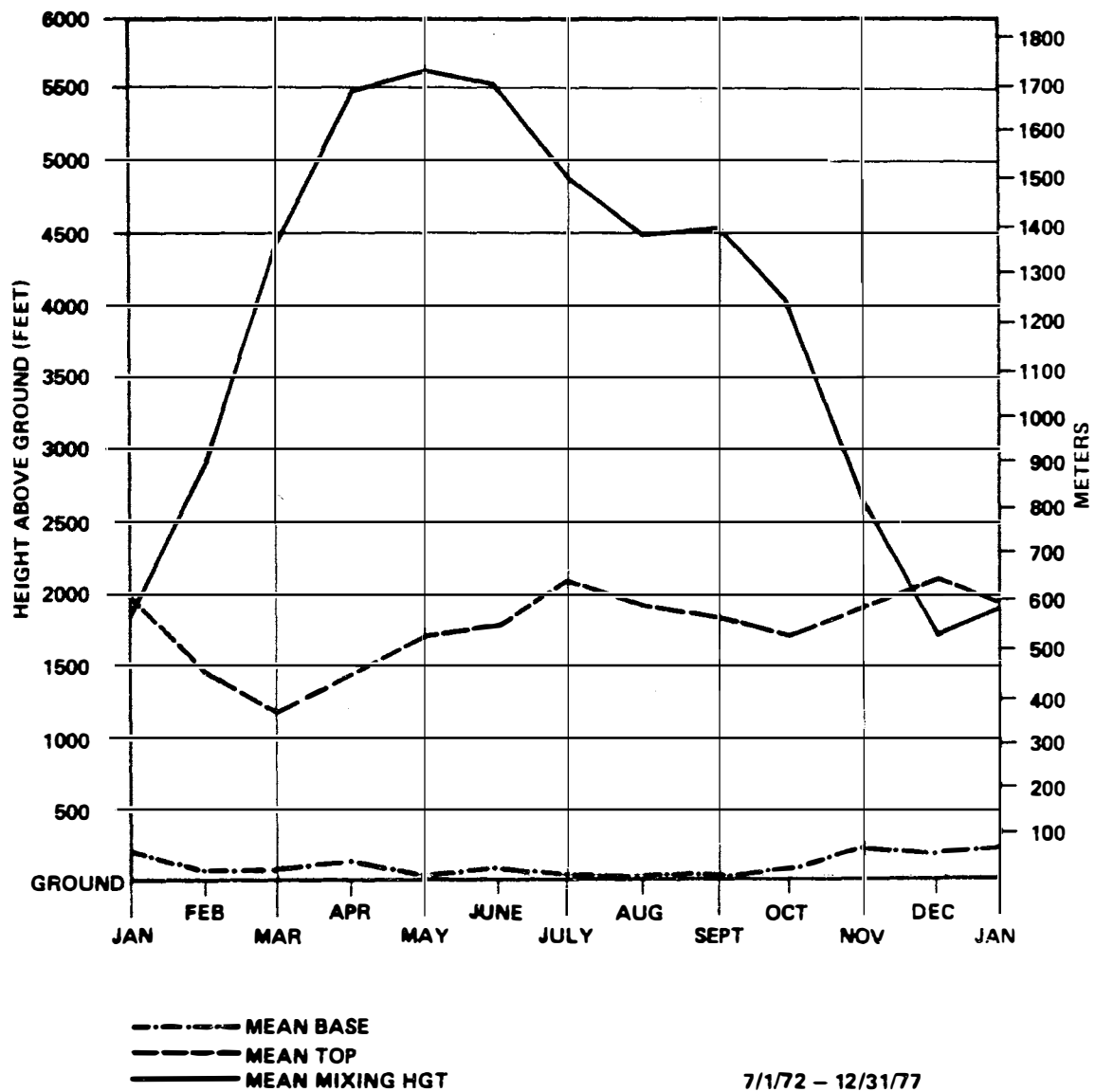


Figure 0-3
Afternoon Mixing Layers for Fresno, California

afternoon mixing depths since they do not cover a climatologically significant period of record; however, they are reasonably well correlated with those data provided by Holzworth⁽⁸⁾ on mixing heights throughout the United States.

The Holzworth analysis uses historical data for the period 1960-1964 at regularly reporting rawinsonde stations in an interpolative scheme. These data are presently felt to constitute the best source for seasonal and annual averages of mixing height in the lower San Joaquin Valley. Figure 4 depicts the morning and afternoon mixing levels for the Elk Hills region on a seasonal basis.

3.4.3 Atmospheric Stability Distribution

Atmospheric stability data is being continuously collected at a monitoring station located approximately 10 miles northwest of McKittrick, California through the measurement of temperature difference (ΔT) in the surface layer. ΔT data can be directly related to atmospheric stability utilizing the guidelines established by the Nuclear Regulatory Commission (NRC)⁽⁹⁾ which are presented in Table 3. The ΔT data collected at this location can be considered representative of conditions at Elk Hills since the two locations are influenced by the same meteorological regimes.^(5,6)

An analysis of the ΔT information indicates that stable atmospheric conditions are more prevalent than neutral or unstable conditions. Figure 5 illustrates the relative distribution of the various atmospheric stability classes experienced at Elk Hills. As shown by this figure, stable conditions are experienced 53 percent of the time, neutral stratification exists 39 percent of the time and unstable conditions occur only 8 percent of the annual period at Elk Hills.

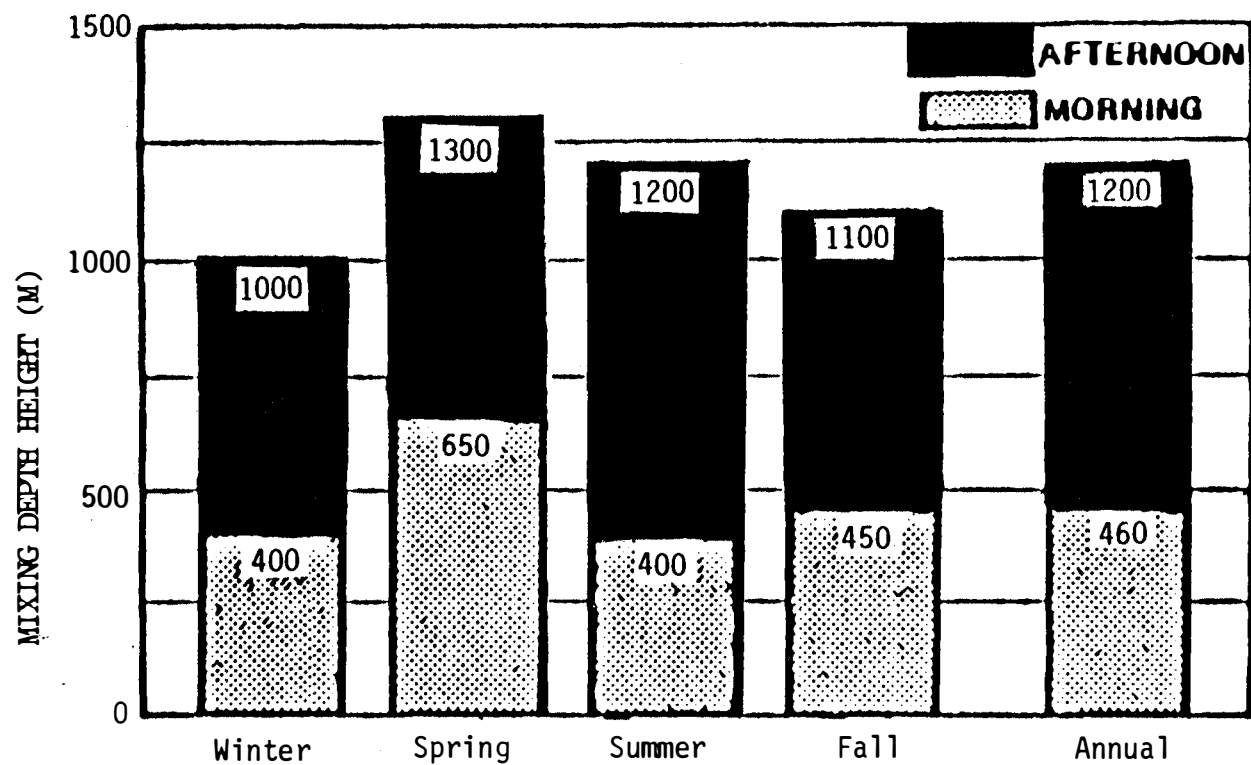


Figure 0-4

Morning and Afternoon Values of Mean Mixing Depth
in Western Kern County

TABLE 0-3
CLASSIFICATION OF ATMOSPHERIC STABILITY

Major Stability Type	STABILITY CLASSIFICATION	PASQUILL CATEGORIES	TEMPERATURE GRADIENT (degrees C/100 m)
Unstable	Extremely Unstable	A	$\Delta T \leq -1.9$
	Moderately Unstable	B	$-1.9 < \Delta T \leq -1.7$
	Slightly Unstable	C	$-1.7 < \Delta T < -1.5$
Neutral	Neutral	D	$-1.5 < \Delta T \leq -0.5$
Stable	Slightly Stable	E	$-0.5 < \Delta T \leq 1.5$
	Moderately Stable	F	$1.5 < \Delta T \leq 4.0$
	Extremely Stable	G	$4.0 < \Delta T$

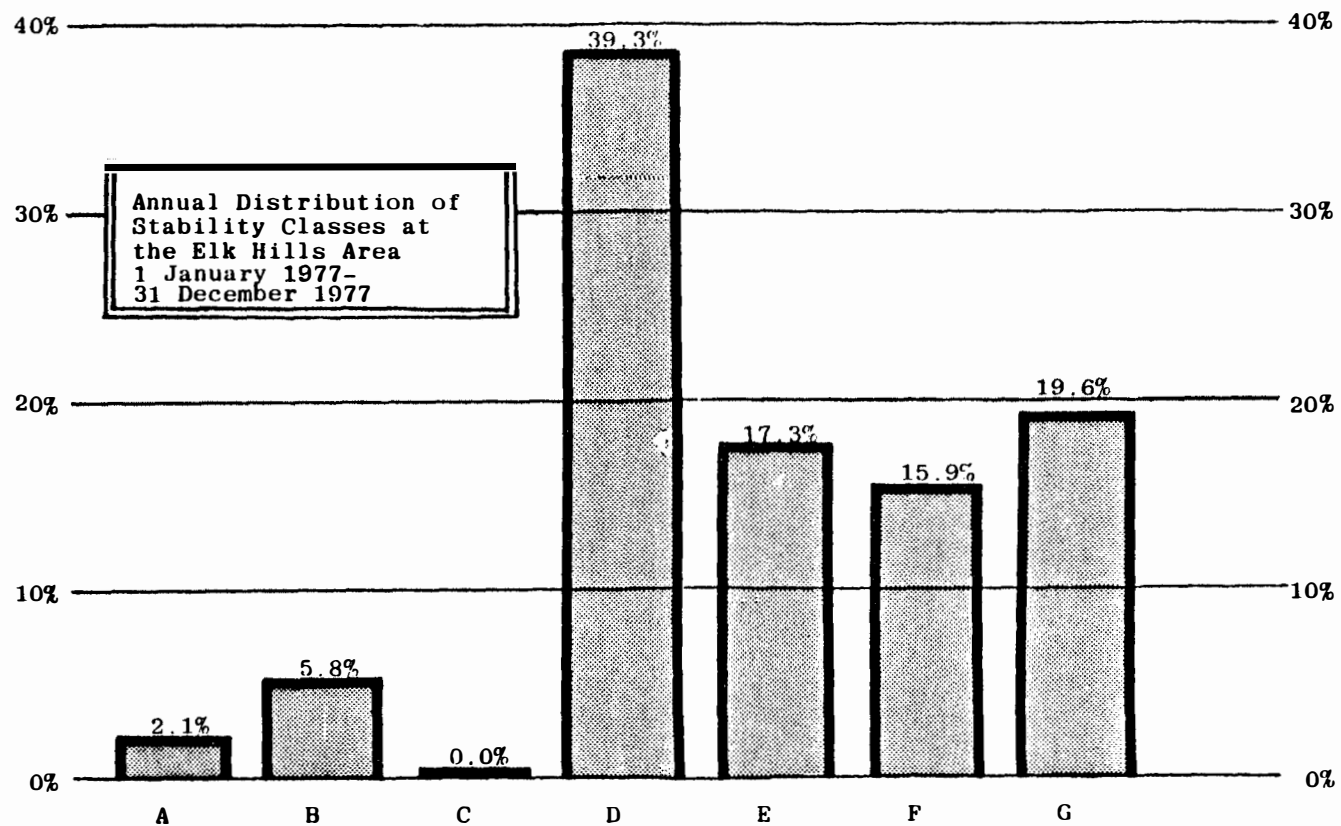


Figure 0-5

Frequency Distribution of Atmospheric Stability Classes
At Belridge, California

A persistence analysis of the stability data for Elk Hills indicates that neutral conditions dominate the persistence distributions for the shorter time periods. Stable conditions dominate the stability persistence distributions for the longer time periods. Neutral stability class D was observed to persist 10 or more continuous hours 5 percent of the time. Table 4 provides the stability persistence analysis for the Elk Hills area during the annual period from 1 January 1977 through to 31 December 1977 based upon data collected at McKittrick, California.

3.4.4 Wind Roses

Annual wind roses for the period 1 January 1977 through 31 December 1977 are provided in Figures 6 through 9. These wind roses include wind direction frequency distributions for the 3 major stability categories (stable, neutral, unstable) as well as the annual wind distribution for all stability classes.

The wind direction distribution for all stability classes (Figure 6) for western Kern County locations are bimodal with primary wind directions corresponding to flow emanating from the southwest and north. At Elk Hills, the winds from the southwest constitute the prevailing direction. Flow from this quadrant is primarily indicative of nocturnal drainage winds originating from higher terrain situated west and southwest of the site location. This is evident from the distribution provided in the stable wind rose (Figure 7). Northerly winds represent the prevailing down-valley flow as noted at most stations in the southern San Joaquin Valley. Unstable and neutral conditions are usually associated with these flow patterns as illustrated by Figures 8 and 9.

TABLE 0-4

STABILITY PERSISTENCE
Mckittrick, California

DATA FROM 1 JAN 1977 THROUGH 31 DEC 1977

ALL STABILITY CLASSES

FREQUENCY OF OCCURRENCE (IN PER CENT OF TOTAL OBSERVATIONS) OF PERSISTENT STABILITY CLASS									
(HOURS)	A	B	C	D/D	D/N	E	F	G	TOTAL
1	2.07	5.01	0.00	31.22	8.04	17.32	15.92	19.61	100.00
2	1.81	3.72	0.00	30.03	7.07	12.39	11.23	17.94	83.09
3	1.16	2.55	0.00	20.21	5.46	9.46	7.32	15.61	69.77
4	0.65	1.27	0.00	24.41	3.04	7.10	4.45	13.12	56.11
5	0.37	0.44	0.00	24.01	2.17	5.60	3.02	11.61	47.31
6	0.14	0.21	0.00	20.96	1.82	4.70	1.69	10.19	39.71
7	0.00	0.00	0.00	16.60	1.60	3.53	1.07	8.53	31.41
8	0.00	0.00	0.00	12.41	1.36	2.56	0.03	7.32	24.47
9	0.00	0.00	0.00	9.09	1.10	1.91	0.65	5.93	18.76
10	0.00	0.00	0.00	4.32	1.07	1.29	0.54	4.79	12.02
11	0.00	0.00	0.00	3.05	0.30	0.94	0.43	3.76	8.56
12	0.00	0.00	0.00	1.91	0.00	0.44	0.30	2.49	5.14
13	0.00	0.00	0.00	0.94	0.00	0.44	0.30	1.52	3.20
14	0.00	0.00	0.00	0.63	0.00	0.29	0.00	1.07	2.00
15	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.75	1.04
16	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.50	0.86
17	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.50	0.86
18	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.50	0.86
19	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.58	0.86
20	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.50	0.86
21	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.50	0.86
22	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.50	0.86
23	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.58	0.86
24	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.58	0.86
25 OR MORE	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.58	0.86

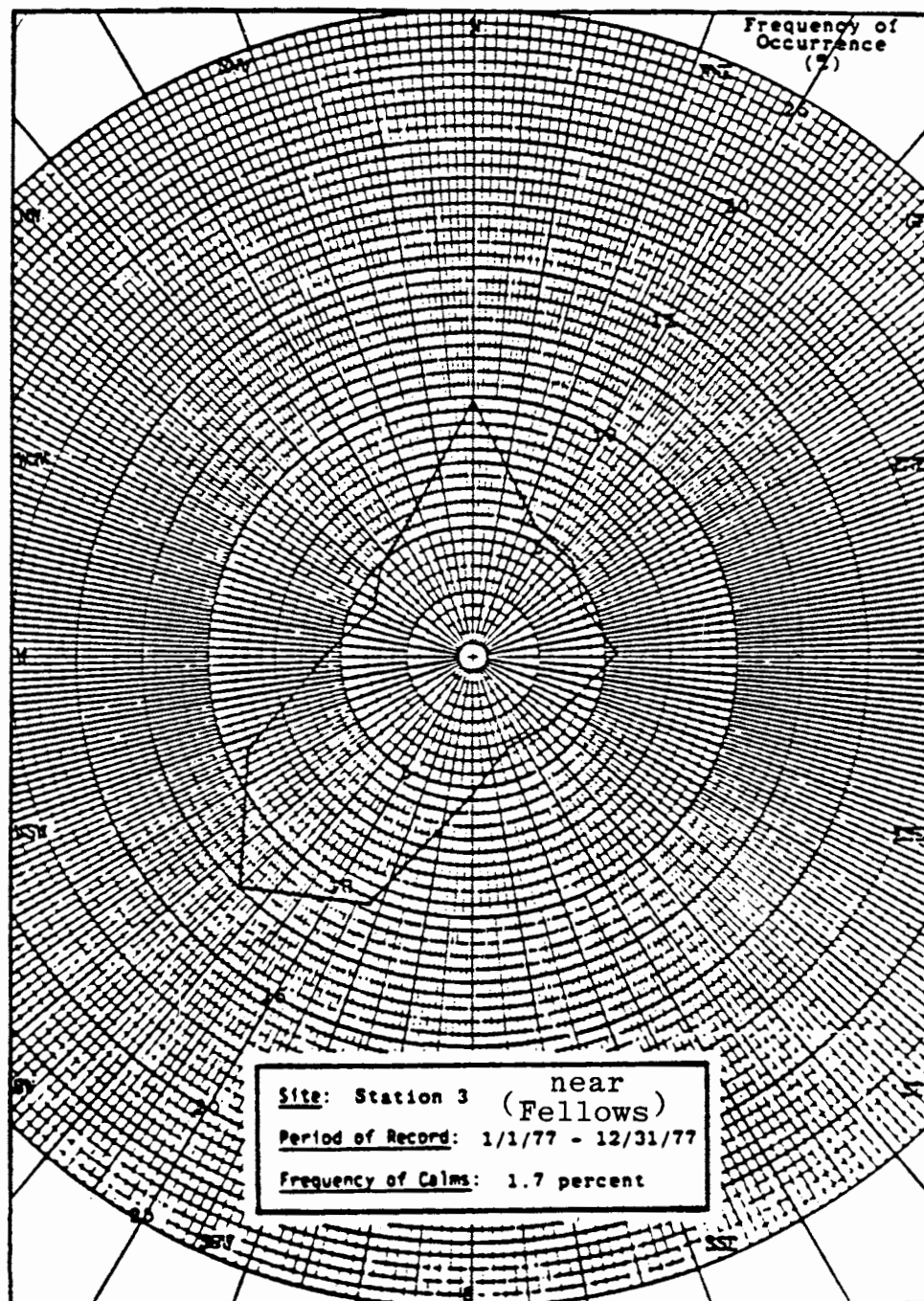


Figure 0-6

Annual Wind Rose Representative of Elk Hills Area for
All Stability Classes for 1977

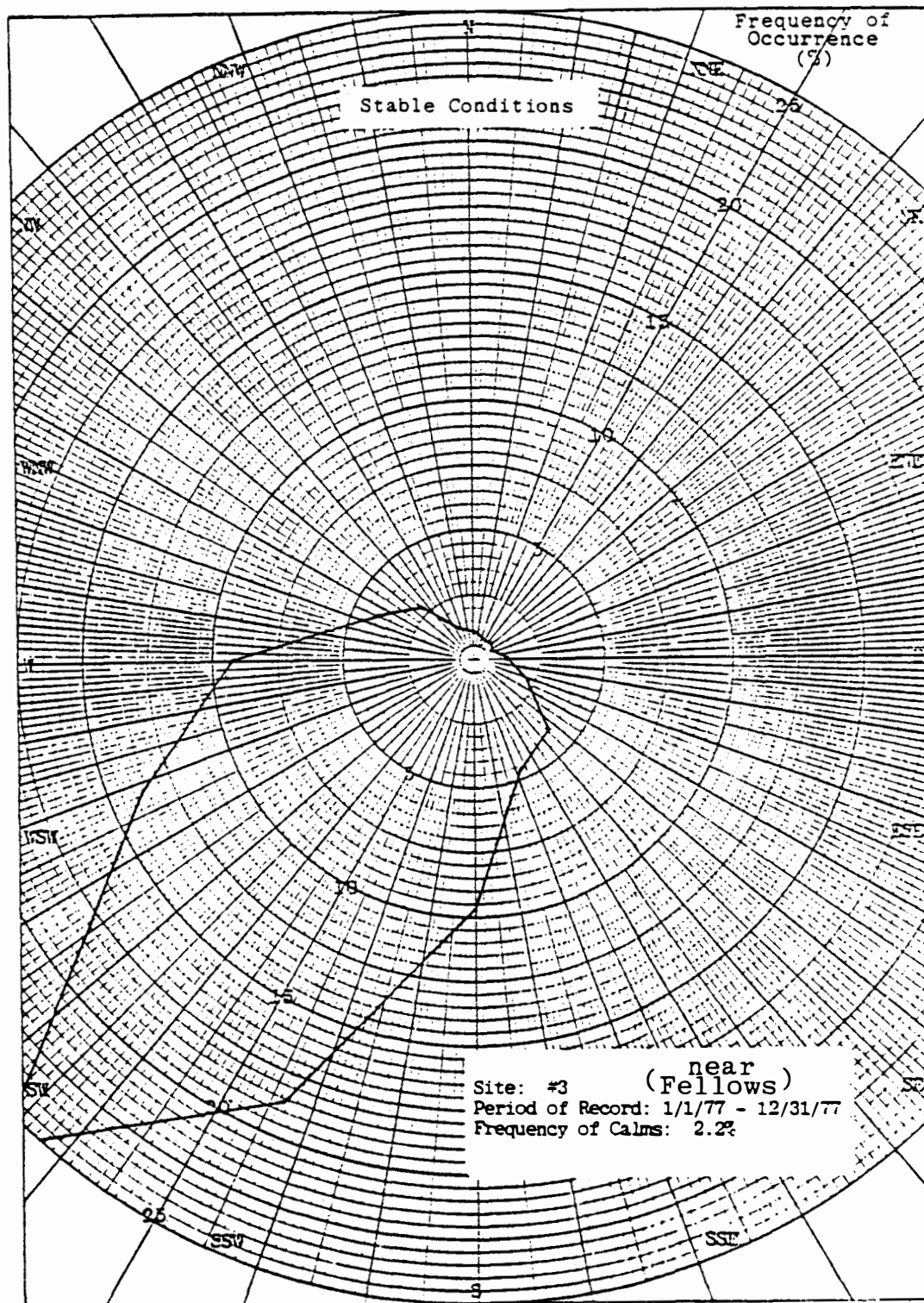


Figure 0-7
 Stable Wind Rose Representative of
 Elk Hills Area



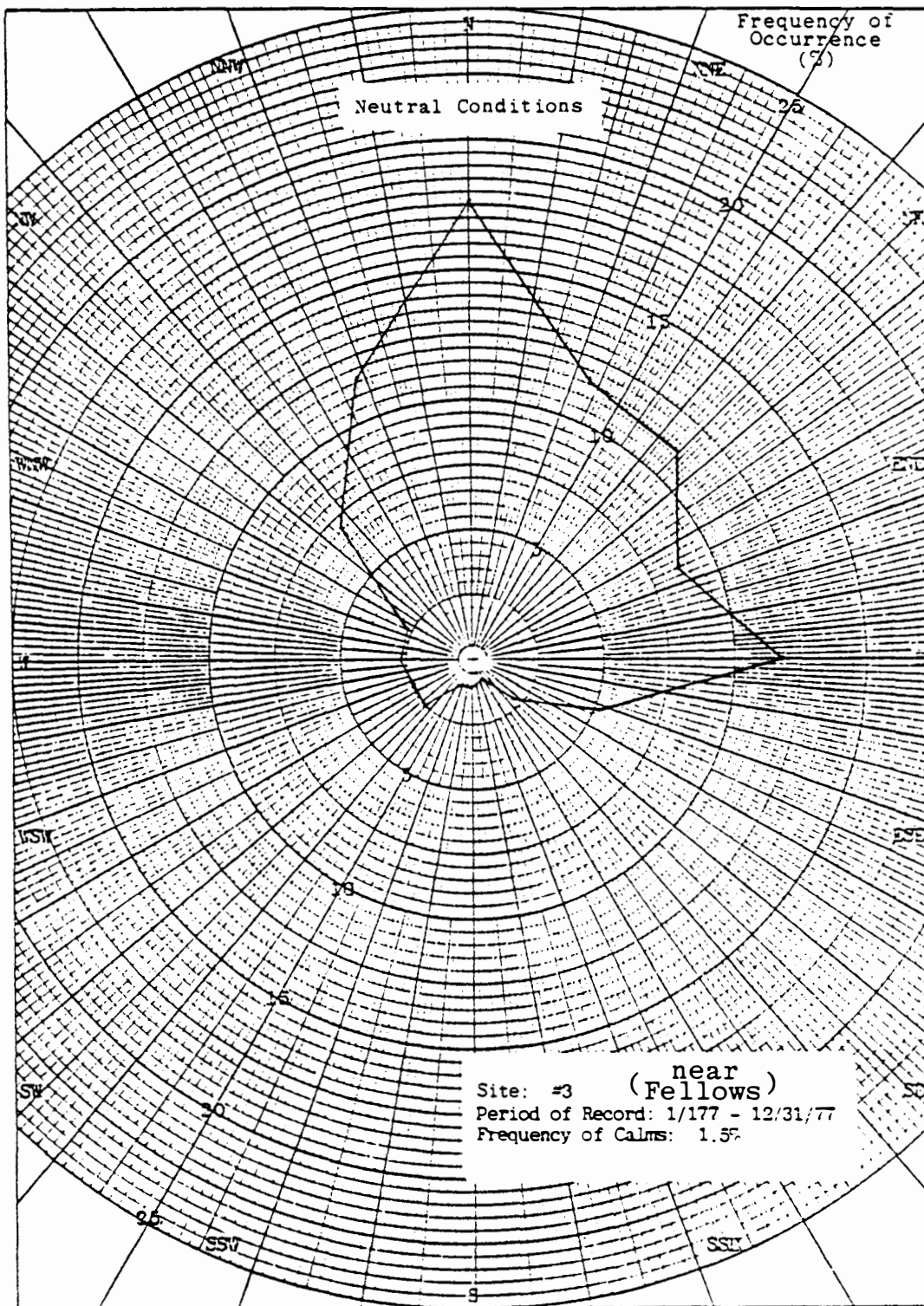


Figure 0-8
 Neutral Wind Rose Representative of
 Elk Hills Area



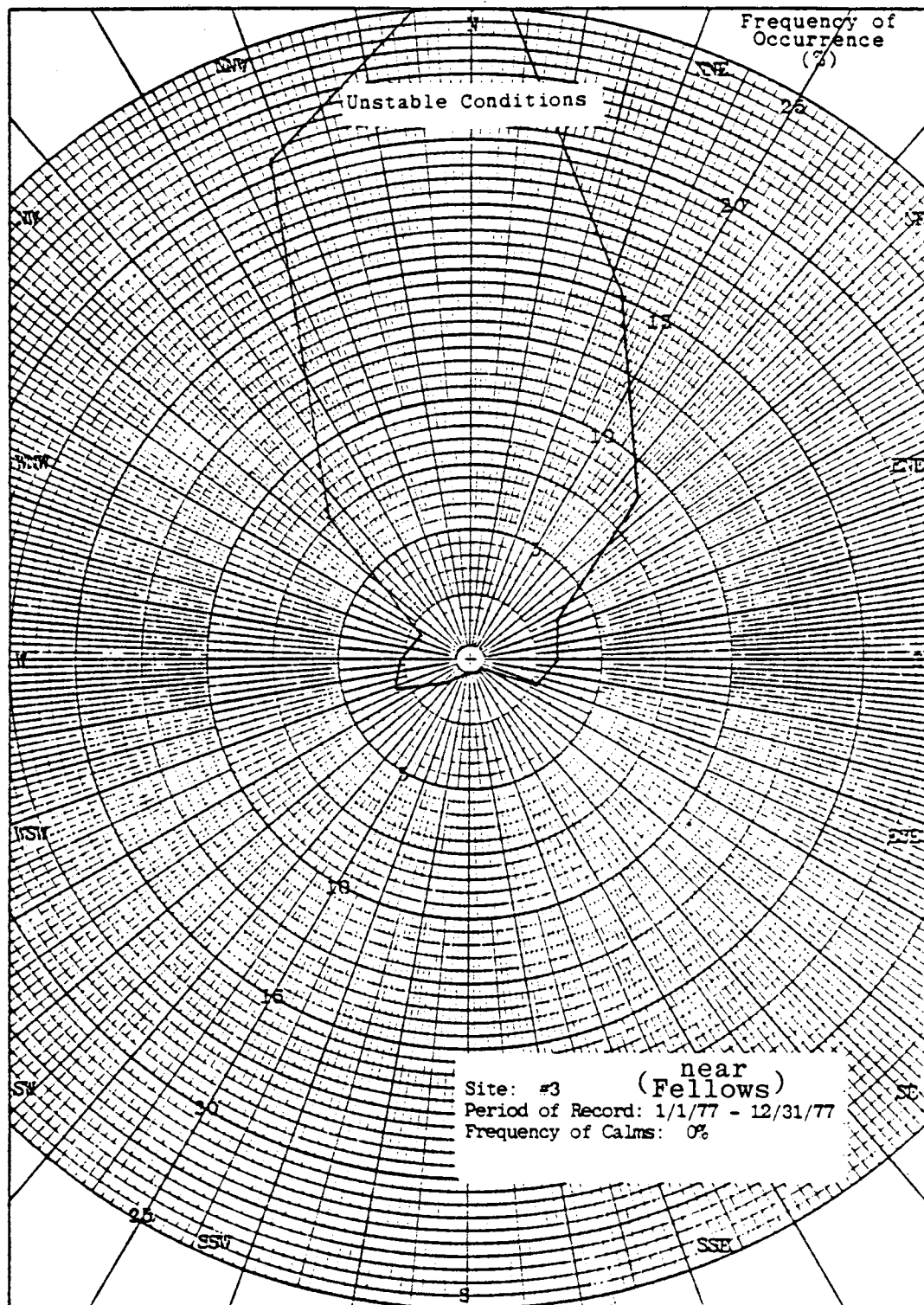


Figure 0-9
 Unstable Wind Rose Representative of
 Elk Hills Area

3.4.5 Wind Direction Persistence

Frequency distributions of wind direction persistence are provided in Table 5. This table indicates that the predominant southwest winds were observed to persist for longer periods of time than any other wind direction. Southwesterly winds persist 2 or more hours 10 percent of the annual period and were observed to persist for as long as 17 consecutive hours. Winds emanating from the north, the secondary maximum, were observed to last 2 or more consecutive hours 6 percent of the time. The maximum persistence time for northerly flow was only 6 hours. East-southeasterly winds as well as south-southwesterly winds were observed to persist as long as 10 consecutive hours.

3.4.6 Wind Speed Persistence

Frequency distributions of wind speed class persistence have been prepared from data obtained near the Elk Hills region. These statistics are provided in Table 6. Wind speeds between 2.07 and 3.60 m/sec are experienced most often at Elk Hills but were not observed to persist for the longest period of time. Wind speeds between 0.52 and 2.06 m/sec have been observed to persist for as long as 23 consecutive hours. These wind speeds persisted for 2 consecutive hours approximately 25 percent of the annual period. Wind speeds in excess of 10.8 m/sec were rarely experienced but have been observed to be sustained for as long as 6 consecutive hours.

3.4.7 Diurnal Trends

In Table 7, diurnal variations of wind speed, wind direction and stability class are averaged over the annual period. It is evident from this table that stable drainage flow from the southwest is most frequently experienced during the nocturnal hours. From 0800 to 1000, wind flow typically exhibits a short



TABLE 0-5

WIND DIRECTION PERSISTENCE

Near Fellows, California

DATA FROM 1 JAN 1977 THROUGH 31 DEC 1977

ALL STABILITY CLASSES

FREQUENCY OF OCCURRENCE (IN PER CENT OF TOTAL OBSERVATIONS) OF PERSISTENT WIND BY DIRECTION																
(HOURS)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	9.78	6.23	5.50	4.03	5.62	3.44	2.94	2.52	5.51	10.20	14.47	0.33	6.13	3.20	5.09	6.91
2	6.01	2.47	1.91	1.40	2.92	1.22	0.07	0.54	2.74	7.04	10.36	4.13	2.66	1.06	2.29	3.65
3	3.28	1.04	0.46	0.50	1.49	0.43	0.30	0.19	1.27	4.41	7.03	1.99	1.10	0.30	1.40	2.10
4	1.04	0.23	0.25	0.15	0.65	0.16	0.09	0.05	0.77	2.55	4.77	1.36	0.40	0.06	0.73	1.22
5	0.81	0.00	0.06	0.06	0.46	0.12	0.00	0.00	0.40	1.33	2.94	0.70	0.06	0.06	0.21	0.56
6	0.28	0.00	0.00	0.00	0.28	0.12	0.00	0.00	0.16	0.80	1.65	0.29	0.00	0.00	0.09	0.15
7	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.09	0.52	1.02	0.00	0.00	0.00	0.09	0.00
8	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.09	0.35	0.69	0.00	0.00	0.00	0.09	0.00
9	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.35	0.41	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.35	0.20	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25 OR MORE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 0-6

WIND SPEED PERSISTENCE

Near Fellows, California

DATA FROM 1 JAN 1977 THROUGH 31 DEC 1977

ALL STABILITY CLASSES

FREQUENCY OF OCCURRENCE (IN PER CENT OF TOTAL OBSERVATIONS) OF PERSISTENT WIND BY SPEED CLASS

(HOURS)	CALM	0.52 TO 2.06	2.07 TO 3.60	3.61 TO 5.66	5.67 TO 8.75	8.76 TO 10.81	10.82 OR MORE	
1	1.70	29.63	47.24	17.25	3.72	0.39	0.07	100.00
2	0.83	25.16	41.37	13.17	3.05	0.23	0.07	83.87
3	0.44	20.37	34.90	9.55	2.20	0.07	0.07	67.60
4	0.09	16.54	28.13	7.27	1.65	0.00	0.07	53.75
5	0.00	13.13	22.61	5.48	1.23	0.00	0.07	42.52
6	0.00	10.20	17.71	3.69	0.94	0.00	0.07	32.62
7	0.00	7.92	14.74	2.59	0.53	0.00	0.00	25.78
8	0.00	6.53	10.55	1.62	0.21	0.00	0.00	18.93
9	0.00	4.89	8.07	1.25	0.12	0.00	0.00	14.33
10	0.00	4.06	6.10	0.74	0.12	0.00	0.00	11.02
11	0.00	3.03	4.49	0.39	0.00	0.00	0.00	7.91
12	0.00	2.01	2.72	0.14	0.00	0.00	0.00	4.67
13	0.00	1.46	1.47	0.00	0.00	0.00	0.00	2.94
14	0.00	1.16	0.87	0.00	0.00	0.00	0.00	2.04
15	0.00	1.00	0.71	0.00	0.00	0.00	0.00	1.72
16	0.00	0.83	0.37	0.00	0.00	0.00	0.00	1.20
17	0.00	0.46	0.00	0.00	0.00	0.00	0.00	0.46
18	0.00	0.26	0.00	0.00	0.00	0.00	0.00	0.26
19	0.00	0.26	0.00	0.00	0.00	0.00	0.00	0.26
20	0.00	0.26	0.00	0.00	0.00	0.00	0.00	0.26
21	0.00	0.26	0.00	0.00	0.00	0.00	0.00	0.26
22	0.00	0.26	0.00	0.00	0.00	0.00	0.00	0.26
23	0.00	0.26	0.00	0.00	0.00	0.00	0.00	0.26
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25 OR MORE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 0-7
DIURNAL TRENDS
OF WIND SPEED, WIND DIRECTION AND STABILITY
Near Fellows, California
1/1/77 - 12/31/77

Local Time	Most Frequent Wind Direction	Averaged Wind Speed (mps)	Most Frequent Stability Class
0000	SW	2.7	extremely stable (G)
0100	SW	2.5	extremely stable (G)
0200	SW	2.3	extremely stable (G)
0300	SW	2.1	extremely stable (G)
0400	SW	2.0	extremely stable (G)
0500	SW	2.0	extremely stable (G)
0600	SW	1.9	extremely stable (G)
0700	SW	1.1	extremely stable (G)
0800	E	0.1	neutral (D)
0900	E	0.9	neutral (D)
1000	N	1.3	neutral (D)
1100	N	1.5	neutral (D)
1200	N	1.6	neutral (D)
1300	N	1.8	neutral (D)
1400	N	1.9	neutral (D)
1500	N	2.1	neutral (D)
1600	N	2.1	neutral (D)
1700	N	1.8	neutral (D)
1800	N	1.0	neutral (D)
1900	SW	0.9	neutral (D)
2000	SW	1.9	stable (F)
2100	SW	2.7	extremely stable (G)
2200	SW	2.9	extremely stable (G)
2300	SW	2.9	extremely stable (G)



transitional period as wind patterns shift counterclockwise from a general southwest direction to a northerly flow. This wind shift is a result of the development of down-valley flow due to surface heating effects along the valley floor. As depicted in the aforementioned table, stability characteristics undergo a transition from extremely stable conditions to neutral conditions during this time period. Concurrently, wind velocities tend to decrease during the course of this directional change.

Late morning and afternoon hours typically experience down-valley air flow (northerly) with moderate wind speeds of 4 to 5 miles per hour. Atmospheric stability during the daylight hours is most frequently neutral in the Elk Hills area.

During the early evening hours, atmospheric conditions undergo another transitional period. Just after sunset, the atmosphere stabilizes and wind direction changes from the down-valley flow into drainage flow, emanating from the southwest and west. Wind speeds are low during this transitional time but gradually increase with time as the drainage winds gain momentum.

3.5 SOURCE DATA

The collection of source data requires three types of information: (1) the number and location of all existing and proposed sources, (2) the physical characteristics of each source, and (3) the emission characteristics of each source.

3.5.1 Size and Number of Sources

The unit operator plans to construct the two gas plants and six compressor stations in five different townships within the reserve. A detailed description of the existing equipment is presented in Table 8, while the new equipment is listed in Table 9.

TABLE 0-8
EXISTING SOURCES
NPR-1 FACILITIES

COMBUSTION SOURCES	SOURCE DESCRIPTION	SOURCE LOCATIONS
35R Gas Plant Process Boilers	3 Boilers - Average Total Natural Gas Consumption of 1.8×10^6 ft ³ /day	Section 35 T30S R23E
35R Gas Plant Compressors	4 Feed Gas Compressors 1200 hp each 1 Feed Gas Compressor 395 hp each 3 Injection Compressors 1528 hp each 2 Injection Compressors 4000 hp each (All reciprocating engines)	Section 35 T30S R23E
3G Compressor Station	9 Compressor Units - total hp = 3260 (All reciprocating engines)	Section 3 T31S R24E
Reciprocating Well Pump engines (Gas driven)	536 Engines (Assume 20 hp)	Scattered throughout Elk Hills Reserve
Other Field Pump Engines (Assume gas driven)	35 Engines (Assume 20 hp)	Scattered throughout Elk Hills Reserve

TABLE 0-9
PROPOSED COMBUSTION SOURCES
NPR-1 FACILITIES

COMBUSTION SOURCES	SOURCE DESCRIPTION	SOURCE LOCATIONS
LTS GAS PLANT #1 Process Heaters	2 heaters - gas consumption per heater will be 33,000 scf/hr	Section 35 T30S R23E
Compressors	3 units - 5,000 Hp each 1 unit - 2,000 Hp (All reciprocating engines)	Section 35 T30S R23E
LTS GAS PLANT #2 Process Heaters	2 heaters - gas consumption per heater will be 33,000 scf/hr	Section 35 T30S R23E
Compressors	3 units - 5,000 Hp each 1 unit - 2,000 Hp (All reciprocating engines)	Section 35 T30S R23E
17 Z Compressor Station	3 units - 4,000 Hp each reciprocating engines	Section 35 T30S R23E
17 R Compressor Station	1 unit - 1,500 Hp reciprocating engine	Section 17 T30S R23E
30 R Compressor Station	7 compressor units total Hp = 7,000 (All reciprocating engines)	Section 30 T30S R23E
33 S Compressor Station	4 units - 2,000 Hp each 1 unit - 1,000 Hp (All reciprocating engines)	Section 33 T30S R23E
15R and 16R Compressor Station	1 unit - 1,000 Hp reciprocating engine	Section 15 and 16 T30S R23E
35 R Compressor Station	3 units - 1,000 Hp each (All reciprocating engines)	Section 35 T30S R23E

A complete inventory of all permitted or proposed units in the Elk Hills and other western Kern County oil fields, as of 1 July 1978, is tabulated in Appendix A. Data for this appendix were provided by the operators and the Kern County Air Pollution Control District (KCAPCD). This appendix represents the complete inventory of oil-fired and gas-fired equipment included in this analysis. An augmented tabulation of the source data, describing physical source characteristics (stack height, diameter) and emission characteristics (emission factors, volume flow rates, gas temperatures and exit velocities) is contained in the CDM output listings presented in Appendix B. This gives the equipment inventory in the format required by the CDM and TEM models.

3.5.2 Location of Sources

Figure 10 depicts the locations of the existing and proposed NPR-1 facilities.

3.5.3 Source Types

Table 10 describes the physical characteristics of the most common existing and proposed Elk Hills area gas-fired equipment. The oil-fired equipment installed in the nearby oil fields have generally similar characteristics and have been extensively discussed in a previous SAI report.⁽⁶⁾

3.5.4 Pollutant Emissions

The emission characteristics of the gas-fired sources under consideration have been determined (1) by using emission rates provided by the unit manufacturers such as Ingersoll-Rand, and (2) by using emission factors provided in EPA's publication AP-42.⁽¹¹⁾ The gas-fired units produce five pollutants of major interest: (1) sulfur dioxide, (2) nitric oxide, (3) unburned

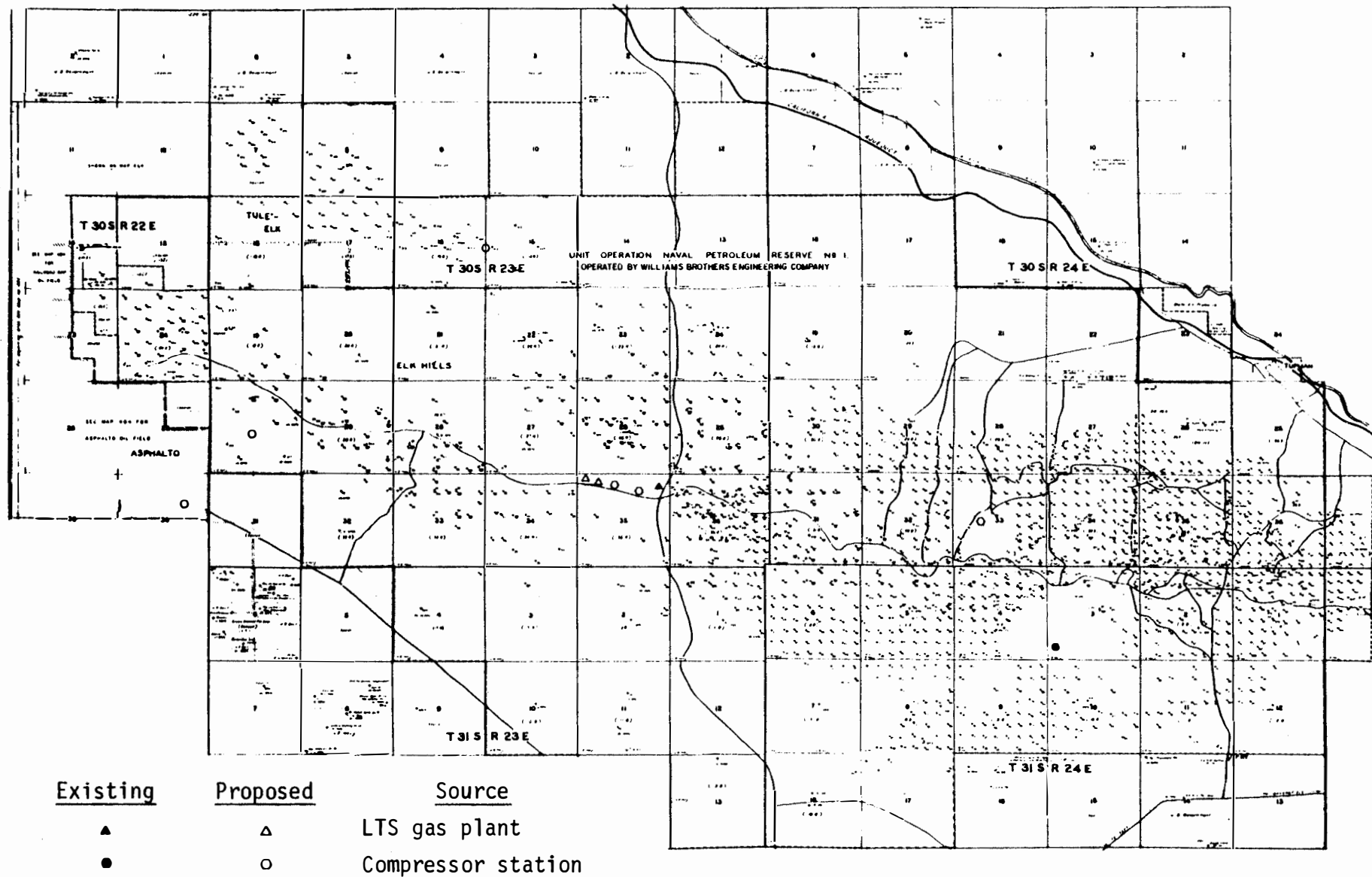


TABLE 0-10
PHYSICAL SOURCE CHARACTERISTICS OF
TYPICAL ELK HILLS OIL FIELD EQUIPMENT

SOURCE TYPE	STACK HEIGHT (m)	EQUIVALENT STACK DIAMETER (m)	EXIT VELOCITY (m/sec)	EXIT TEMPERATURE (C)
Compressor	9.75	1.58	2.39	413
Boiler	16.20	1.07	2.79	316
Process Heater	16.50	1.30	5.40	338

hydrocarbon, (4) particulate material, and (5) carbon monoxide. Tables 11 and 12 summarize the emissions expected from the existing and proposed equipment. Details on the emissions of each constituent are discussed below. Background emissions were obtained as indicated in a previous SAI report.⁽⁵⁾

3.5.4.1 Sulfur Dioxide

Sulfur dioxide (SO_2) is produced by the combustion of fuel containing sulfur and sulfur compounds. For the gas-fired equipment in this study, the SO_2 emission rate is expected to be 3.8 lbs/hr, when the existing emissions are added to the future emissions that are displayed in Tables 11 and 12.

3.5.4.2 Nitric Oxide

Nitric oxide (NO) is produced by the high temperature combustion of the fuel. While there are no standards for NO, there are standards for nitrogen dioxide (NO_2) which is produced by chemical reactions in the atmosphere. The reaction chain is similar to the photochemical reactions which produce "smog." The conversion of NO to NO_2 depends on the concentrations of other primary and secondary pollutants as well as on available sunlight. As discussed in Section 3.2, the 100 percent annual average conversion rate of NO to NO_2 used in this study appears to be overly conservative for the Elk Hills oil field.

For the NPR-1 equipment in this study, the predicted rate for the total NO_2 emissions will be 2506 lbs/hr for the existing and future cases combined.

3.5.4.3 Hydrocarbons

Hydrocarbon (HC) emissions result from not fully burned exhaust from the gas-fired compressors in the Elk Hills Expansion

TABLE 0-11
 EXPECTED COMBUSTION EMISSIONS FROM
 EXISTING NPR-1 FACILITIES

SOURCE	EMISSIONS (LBS/HR)					EMISSIONS (TONS/YR)				
	THC	NO _x	CO	SO ₂	PARTICULATES	THC	NO _x	CO	SO ₂	PARTICULATES
35R Gas Plant Process Boilers	0.2	17	1.3	.045	1.1	0.86	73.4	5.6	.19	4.75
Compressors	147.	363	47.	.06	N/A	635.	1568.	203.	.26	N/A
3G Compressor Station	32.	78	10.	.013	N/A	138.2	337.	43.2	.06	N/A
Reciprocating Well Pump Engines (Gas Driven)	67.	257	33.	.04	N/A	289.4	1110.	143.	.17	N/A
Other Field Pump Engines (Assume Gas Driven)	4.4	17	2.2	.003	N/A	19.	73.4	9.5	.01	N/A
Fugitive Sources	2720.5					11752.6				
TOTALS	2971.	732.	93.5	.161	1.1	12835.	3161.8	404.3	.69	4.75

TABLE 0-12
 EXPECTED COMBUSTION EMISSIONS FROM
 PROPOSED NPR-1 FACILITIES

SOURCE	EMISSIONS (LBS/HR)					EMISSIONS (TONS/YR)				
	THC	NO _x	CO	SO ₂	PARTICULATES	THC	NO _x	CO	SO ₂	PARTICULATES
LTS Gas Plant #1										
Process Heaters	0.4	7.8	0.2	0.2	1.0	1.7	33.7	.86	.86	2.16
Compressors	92.	470.	36.	0.7	N/A	497.4	2030.4	155.5	3.	N/A
LTS Gas Plant #2										
Process Heaters	0.4	7.8	0.2	0.2	0.5	1.7	33.7	.86	.86	2.16
Compressors	92.	470.	36.	0.7	N/A	497.4	2030.4	155.5	3.	N/A
17Z Compressor Station ⁺	58.	288.	23.7	N/A	N/A	254.	1261.4	103.8	N/A	N/A
17R Compressor Station	15.	36.	4.7	0.01	N/A	64.8	155.5	20.3	.04	N/A
30R Compressor Station	67.9	168.	21.7	0.03	N/A	293.3	725.8	93.7	.13	N/A
35R Compressor Station	29.1	72.	9.3	0.01	N/A	125.7	311.	40.2	.04	N/A
15 & 16R Compressor Station	9.7	24.	3.1	0.004	N/A	41.9	103.7	13.4	.02	N/A
33S Compressor Station	87.3	216.	28.	0.04	N/A	377.1	933.1	120.5	.16	N/A
Increase in vehicular traffic ^x										
200 trucks/day*	1.3	5.3	7.4	0.7	0.5	5.6	22.9	32.	3.	2.2
600 automobiles/day*	0.8	.5	4.4	N/A	N/A	3.5	2.2	19.	N/A	N/A
Rail traffic [□]	2.	9.	3.	1.	1.0	8.8	39.42	13.14	4.38	4.38
Fugitive Sources	227.3					2951.4				
TOTALS	683.2	1774.4	177.7	3.59	2.5	5124.3	7683.2	768.7	15.51	10.9

*California Air Resources Board, Emissions and Air Quality Assessment, April 1976

⁺Assume compressors to be supercharged

^xIncrease due to expansions

[□]Kern County

SI

and from fugitive sources such as well heads, well cellars, field relief valves, and field control valves. Table 13 displays the fugitive emissions for the existing equipment while Table 14 shows the fugitive emissions for the proposed equipment. The total hydrocarbon emissions from the existing and future cases have been calculated to be 2038 lbs/hr, due to the fact that, in the future case, the .35R gas plant vent will be flared and 98 percent of the hydrocarbons now emitted will be incinerated.

3.5.4.4 Particulates

Because gas-fired equipment is being proposed for this expansion, particulate matter emitted will be negligible (3.6 lbs/hr), and in this analysis will be considered a minor emission.

3.5.4.5 Carbon Monoxide

Carbon monoxide (CO) results from the exhaust of the gas-fired equipment that is not fully burned. The emission values for the gas-fired sources are shown in Tables 13 and 14 as obtained from AP-42.⁽¹¹⁾ The total maximum emissions from the existing and proposed equipment is expected to be 271 lbs/hr.

3.5.5 Mitigation Methods

Recently all of the San Joaquin Valley portion of Kern County has been designated a non-attainment area for SO₂.⁽¹⁶⁾ The Elk Hills area should be considered a clean sub-area of the non-attainment area for SO₂ and, as such, the proposed sources would be subject to the recently promulgated Prevention of Significant Deterioration (PSD) rules,⁽¹⁷⁾ should SO₂ emissions exceed 250 tons/year. As a result of these rules, all new sources in the Elk Hills area which, uncontrolled, could emit 250 tons/year or more of SO₂ must install BACT unless they can be controlled to less than 50 tons/year. The government's MER project



TABLE 0-13

EXISTING HYDROCARBON FUGITIVE EMISSIONS
NPR-1

Fugitive HC Sources	Source Characteristics	Emissions (lbs/hour)	
		THC	NMHC
Fixed-roof storage tanks (without vapor recovery)	131 storage tanks of various sizes -- Shallow zone only -- breathing and working losses	602	101
Slop tanks	Estimated dimensions - 27 ft diameter x 5 ft high exposed surface area = 38.5 ft ² tank; 54 tanks	8.7	4.4
Well heads (reciprocating pumps wells only)	687 wells	1.4	0.5
Well cellars (all producing wells)	1,048 wells	87	40
Field control valves (gas and oil service)	32,302 valves (including valves at well heads, tank settings, con- densate removal traps, pipelines, field pumps, and LACT facilities	134.6	37
Field relief valves - operational	419 valves (including relief valves on all tank setting separators and along pipelines)	51	15
Field pumps			
Reciprocating	28 pumps, assume 2 seals/pump, packed seals	9.7	9.7
Centrifugal	6 pumps, assume 2 seals/pump, mechanical seals	--	--
35R gas plant			
Control valves (gas service)	841 valves	9	3
Relief valves - operational	59 valves	7.1	1.6
Relief valves - storage	6 valves	.15	0.2
Pumps - reciprocating	6 pumps, assume 2 seals/pump, packed seals	2.0	0.5
Pumps - centrifugal	5 pumps, assume 2 seals/pump, mechanical seals	0.2	0.1
Compressors	10 compressor units	12	2.8
Venting	Average gas vented during upset conditions as of September, 1978	1649	650
Cooling tower	Estimate 5,025 gallons/minute circulation current	1.9	0.4
3G compressor station			
Control valves (gas service)	92 valves	0.6	0.1
Relief valves - operational	9 valves	1.1	0.3
Compressor	9 compressor units	10.5	2.5
Cooling tower	2,600 gallons/minute circulation current	1.0	0.2
Miscellaneous field compressors	2 units	2.3	0.5
Control valves (gas service)	32 units	0.2	0.1
Produced water (settling ponds)	Total surface area of settling ponds = 31,000 ft ²	129	65.2
Total all sources		2720.5	935.1

Source: URS Company, 1978



TABLE 0-14
FUTURE HYDROCARBON FUGITIVE EMISSIONS
NPR-1

Fugitive HC Sources	Source Characteristics	Emissions (lbs/hour)	
		TCH	NMHC
Well heads (reciprocating wells only)	518 wells	1	1
Well cellar (all new producing wells)	248 wells	20.7	4.9
Field control valves (gas and oil service)	4,165 control wells	17	2.7
Field relief valves - operational	196 relief valves	23.7	3.6
LTS Gas Plant #1			
Control valves (gas service)	1,648 valves	17	6
Relief valves - operational	105 valves	12.7	5
Relief valves - storage	22 valves	0.55	0.1
Pumps - reciprocating	7 pumps, assume 2 seals/pump, packed seals	4	0.6
Pumps - centrifugal	22 pumps, assume 2 seals/pump, mechanical seals	0.8	0.2
Compressors	4 units	4.7	1.1
Cooling tower	Assume circulation = 6,700 gallons/minute	2.5	0.6
LTS Gas Plant #2			
Control valves (gas service)	1,648 valves	17	6
Relief valves - operational	105 valves	12.7	5
Relief valves - storage	22 valves	0.55	0.1
Pumps - reciprocating	7 pumps, assume 2 seals/pump, packed seals	4	0.6
Pumps - centrifugal	22 pumps, assume 2 seals/pump, mechanical seals	0.8	0.2
Compressors	4 units	4.7	1.1
Cooling tower	Assume circulation = 6,700 gallons/minute	2.5	0.6
35R Compressor Station			
Control valves (gas service)	Assume 30 valves	0.2	0.1
Relief valves - operational	Assume 3 valves	0.36	0.1
Compressors	3 units	3.5	0.8
17R Compressor Station			
Control valves (gas service)	Assume 10 valves	.06	--
Relief valves - operational	Assume 1 valve	0.1	--
Compressor	1 unit	1.17	0.3
17Z Compressor Station	Valves and compressor	5	1
30R Compressor Station	Valves and compressor	5	1
33S Compressor Station	Valves and compressor	6	1
15 or 16R Compressor Station	Valves and compressor	2	--
Shallow Zone Low Pressure Compressors	Valves and compressor	1	--
35R Low Pressure Compressor	Valves and compressor	1	--
Truck Transport Loading		8	8
Storage Tanks (Crude)	5 - 250,000 gal tanks	10	10
Gasoline Transport		4	4
35R Gas Plant Flare (98% vapor control)		33	13
Total all sources		226.7	78.7

Source: URS Company, 1978



at Elk Hills is not considered a major SO_2 source and therefore is not required by PSD regulations to install BACT on their new and existing gas-fired equipment. Nitrogen dioxide (NO_2) will, however, be a major source and the gas-fired equipment that is proposed must meet EPA's BACT requirements. BACT compliance will be demonstrated with permit applications and was not considered in this study.

The flaring of the 35R gas plant will decrease the existing THC emissions of 1649 lbs/hr by 98 percent, down to 33 lbs/hr. This will result in a net decrease of THC emissions, even when the proposed equipment is considered.

3.5.6 Emission Summary

Table 11 summarizes the net resulting emissions from the Elk Hills existing sources, and Table 12 summarizes the emissions that will result from the proposed expansion. As previously discussed, the values were obtained either from the equipment manufacturers or from the emissions tables for gas-fired equipment in AP-42.⁽¹¹⁾ Table 12 reflects the future emissions when the 35R gas plant vented gases will be flared.

3.6 EXISTING AMBIENT AIR QUALITY DATA

SO_2 and oxidant monitoring in the western Kern County area was begun in February-March 1976, since there was no long-term ambient air quality data available in the area. Subsequently, Getty Oil Company and Circle Oil Company have initiated air quality monitoring in the McKittrick area. Full meteorological monitoring began on 19 April 1976. Details on these monitoring programs are discussed in recent SAI reports. The SAI SO_2 monitor nearest Elk Hills is located at Station 2 in the Cymric oilfield. Even though hydrocarbon emissions are discussed and analyzed in this report, they are not currently monitored in western Kern County.

The maximum 24-hour average SO_2 concentration recorded at Station 2 in 1977 was 0.034 ppm (89 micrograms/ m^3), which is 24 percent of the Federal primary standard and 68 percent of the State combination standard. This measurement occurred on 14-15 December 1977. The maximum 3-hour average recorded through 1977 was 0.062 ppm (161 micrograms/ m^3), which is 12 percent of the Federal secondary standard. This measurement occurred 23 October 1977. The maximum 1-hour average recorded occurred 25 June 1977 and measured 0.135 ppm (352 micrograms/ m^3), which is 27 percent of the State standard. The 1977 annual average SO_2 concentration recorded was 0.006 ppm (16 micrograms/ m^3) or 20 percent of the Federal primary standard.

SO_2 concentrations tended to increase in the early morning hours, reaching a peak at 0800 to 1000 hours. Concentrations slowly dropped to their minimum daily values in the early evening. Wind direction has some effect on measured SO_2 levels; concentrations are maximized for the northwest, north-northwest, and east-southeast wind directions. The highest SO_2 concentrations at Station 2 occur with calm to light wind speeds.

The maximum 1-hour oxidant average measured in 1977 was 0.12 ppm (240 micrograms/ m^3), which meets the new Federal 1-hour standard and is 120 percent of the State 1-hour standard. This value was measured at SAI's station in Taft. Taft is about 10 to 13 miles southwest of Elk Hills. The Federal oxidant standard was not exceeded in 1977 whereas the State standard was met or exceeded only in August and September of 1977. The maximum 1-hour oxidant average ever recorded was 0.14 ppm (280 micrograms/ m^3), which is 117 percent of the new Federal 1-hour standard. The maximum oxidant level recorded in 1977 occurred 12 August 1977; the maximum oxidant level ever recorded occurred 2 November 1976. Daily oxidant concentrations reach peak levels in mid to late afternoon. Northerly winds and moderate wind speeds coincided with maximum ozone concentrations at the Taft station.

The only NO_x/NO_2 measurements available in western Kern County are those taken by Getty Oil Company at their station near McKittrick. The maximum 1-hour NO_2 concentration measured by Getty through June 1978 was 211 micrograms/ m^3 or 45 percent of the State standard. The average annual NO_2 concentration measured by Getty was 13 micrograms/ m^3 or 13 percent of the Federal standard. Insufficient data are available to correlate Getty's NO_2 measurements with meteorological phenomena, however, meteorological data corresponding to worst-case measurements have been provided SAI.⁽¹⁶⁾ Getty's data suggest that an average NO to NO_2 conversion rate of 60 percent can be expected in the area.

The KCAPCD frequently records particulate levels in excess of standards at their station in Taft.⁽¹⁷⁾ More recently CARB has been analyzing the KCAPCD filters for sulfate and also has performed sulfate measurements in McKittrick. The only sulfate exceedance recorded by CARB in western Kern County was a somewhat anomalous value of 30 micrograms/ m^3 in Taft. A sulfate level of 24 micrograms/ m^3 was recorded at McKittrick in January 1978 by CARB.⁽¹⁸⁾ Getty Oil Company is also collecting sulfate data at McKittrick. No exceedances of the sulfate standard have ever been measured by Getty.

4. MODELING ANALYSIS AND RESULTS

Earlier sections have described the necessary data requirements for the projection of air quality levels. After these data have been collected, the projections can be made using appropriate air quality models. This section discusses the models used, the assumptions and techniques utilized in performing the modeling, calibration of the models, and the results obtained. Particular emphasis is given to the SO_2 , HC, and NO_2 predictions.

4.1 THE CDM MODEL

The predicted annual average concentrations were calculated using the EPA-developed Climatological Dispersion Model (CDM). This model has been developed to use input data describing the source in a joint frequency distribution of wind speed, wind direction, and stability (STAR data). From these data the model predicts annual average atmospheric concentrations at ground level throughout the calculational grid.

4.2 CALIBRATION OF THE CDM

An integral feature of the CDM is the ability to "calibrate" the model with measured air quality data. This is done to account for variations caused by unincluded sources, and by meteorological and topographic differences in differing localities. The model results are compared with pollutant measurements for a period when the measured air quality and the source

distribution is known. This comparison results in a linear (constant plus a multiple) correction to the model concentration predictions.

For this study, CDM calibration factors were obtained from previous western Kern County analyses.^(22,23) The calibration factors developed in these earlier studies were based upon an inventory of the sources actually operating during the calibration period. The calibration factor used in this study is 0.18. Details on the sources and measurements used to obtain these factors and a determination of the sensitivity of the factors are contained in the referenced studies.

4.3 ASSUMPTIONS MADE FOR ANALYSIS

All calculations in this study were performed assuming conservation of pollutants, i.e., the pollutants were assumed to be chemically inert throughout the calculation time. This assumption is not strictly true for substances such as SO_2 , but insufficient half-life data are available to utilize the non-conservative provision in the CDM model. Although this assumption is necessary due to the lack of data, it is nevertheless deemed reasonable for the area. In any case, it will provide worst-case values for the primary pollutants of concern. As noted previously, NO_x emissions are taken as equivalent 100 percent NO_2 emissions, a very conservative approach.

4.4 BACKGROUND

Steam generators and related equipment are the principal source of SO_2 in the western Kern County area. To insure that all potential background is included, this study includes calculations for all sources in the surrounding vicinity, as presented in the oil-fired equipment inventory of Appendix A.

Insufficient data are available to adequately determine background sources or values for other pollutants.

Background sources that were not included include equipment that do not have permits to operate and vehicular traffic through that section of Kern County, for which no data are available.

4.5 METEOROLOGICAL DATA BASE

As has been previously discussed, the CDM requires a joint frequency distribution of wind speed, wind direction, and stability class as its meteorological data base. Typically, such data are provided by STAR data provided by the National Climatic Center. In order to utilize the on-site meteorological measurements, it was necessary to digitize and analyze the raw data. The on-site data were "binned" into the wind speed, wind direction, and stability class categories used by the National Climatic Center to prepare the STAR data. The "binned" data were then used to determine the percentage of cases in the combination of wind speed, wind direction, and stability class. These percentages for each possible combination comprise the requisite joint-frequency distribution.

Joint-frequency distributions, based on delta T determined stability classes, were prepared from the on-site data. The on-site data constitutes an annual distribution for the year 1977.

4.6 CALCULATIONAL GRID

For both the CDM and TEM model calculations, the Elk Hills region is simulated by a receptor point grid of one kilometer intervals. It should be noted that the grid size can be varied as required by source configurations. Concentrations are

computed at each of the grid cells in the area of interest. Figures 11a and 11b display a map of the Elk Hills region incorporating major roads and landmarks, and section/township/range information. Figure 11a is the grid that was used for all operators and Figure 11b is the grid used for the NPR-1 facilities only.

4.7 ANALYTICAL APPROACH

To assess the air quality impact of the proposed NPR-1 project, the following approach was employed:

First, calculations were made with the equipment inventory of all permitted oil-fired sources as of 1 March 1978 ("existing" facilities). Next, calculations were made with the existing inventory for NPR-1. Due to the fact that the background and the NPR-1 had different coordinate axes, the two resulting calculations were then overlaid, and a combined figure was obtained. This provides the ambient conditions into which the proposed project is to be implemented. Second, calculations were made with an equipment inventory incorporating the newly proposed sources and all those sources for which applications are on file as of 1 April 1978, together with the proposed NPR-1 sources. This case includes the existing inventory, although some of the operating parameters of existing background equipment were changed to correspond to proposed mitigation plans. The "future" case was handled as in the existing case, in that the background and NPR-1 calculations were combined to give a final resultant figure. This provides an overall assessment of the air quality consequences of all proposed changes dictated by the "future" inventory. Comparison of these results with the "existing" case results provides the net benefit or degradation due to all the proposed changes.



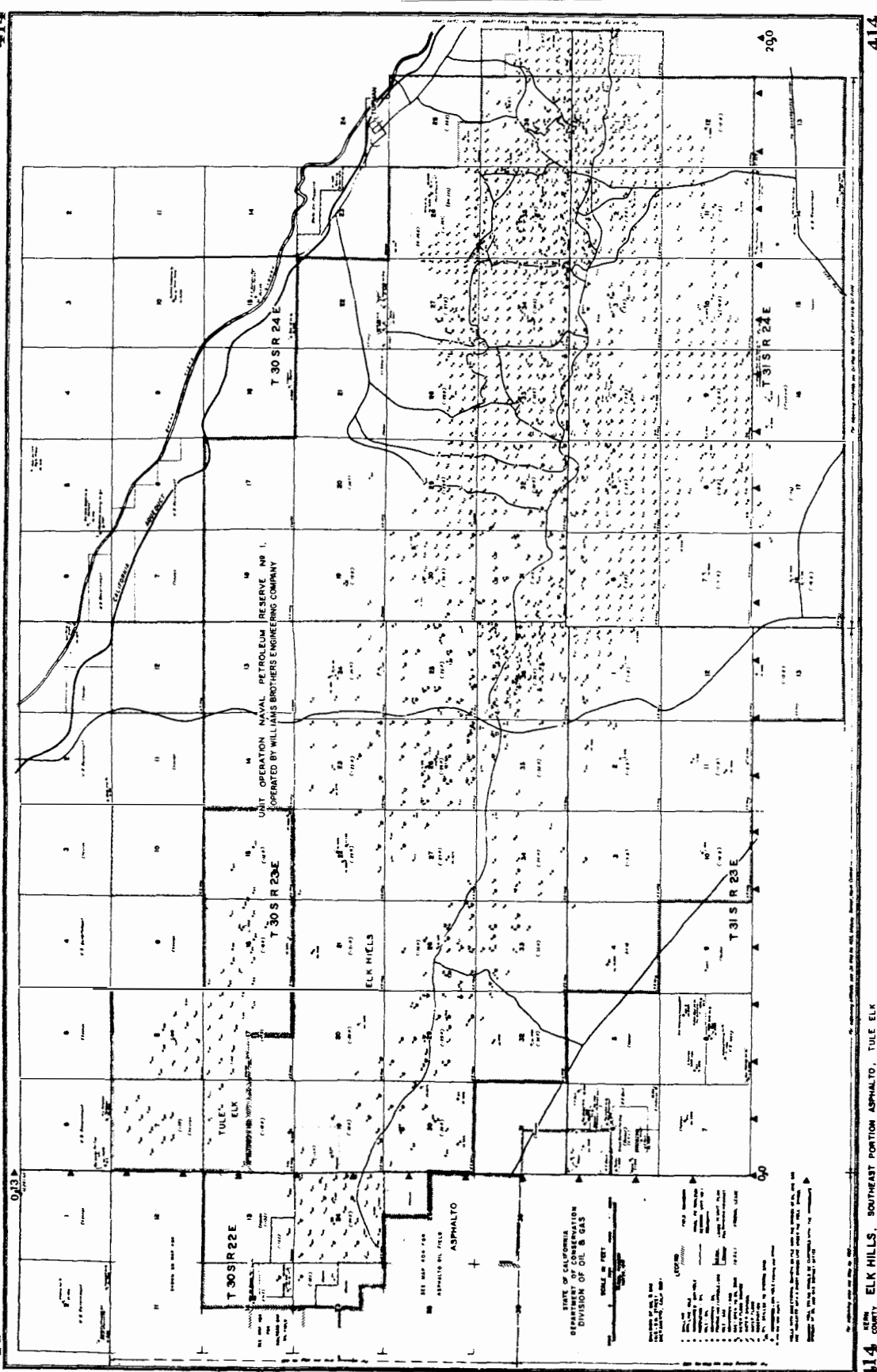


Figure O-11a

Map of the Elk Hills Region with the Computational Grid
Used in the Computer Modeling for the NPR-1 Facilities Only.
Each Grid Cell is 1 Km-by-1-Km.

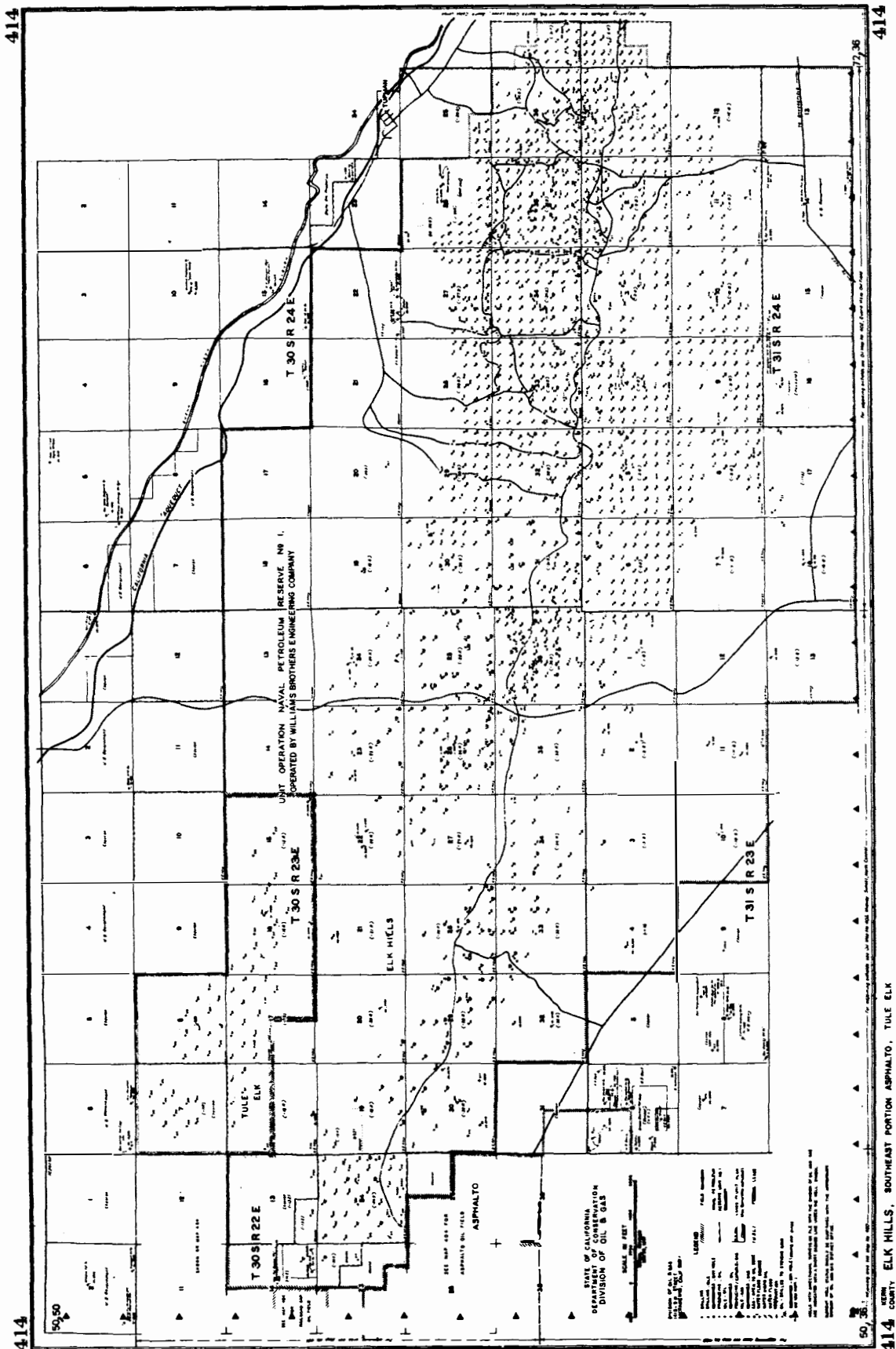


Figure 0-11b

Map of the Elk Hills Region with the Calculational Grid
Used in the Computer Modeling for the Remaining
Southwestern Kern County Operators
Each Grid is 1 Km-by-1 Km.

Further, the NPR-1 project itself is analyzed by looking at it as a separate entity. "Existing" and "future" cases, using only the NPR-1 facilities' inventory, were computed. This provides quantification of the net contribution of NPR-1 to air quality, and also provides a measure of the net change in total emissions due to the proposed project. The combination of the NPR-1 "future" case with the "future" case for all operators results in a total overview of the entire air quality of the Elk Hills area.

4.8 MODELING RESULTS -- ANNUAL AVERAGES

In this section, the predicted annual average SO_2 and NO_2 concentrations from the CDM model are summarized for the various cases analyzed. Copies of the CDM model computer printouts for the "all operators" cases, which display all input data and calculational results, are contained in Appendix B. All calculations were performed using the one kilometer sized rectangular receptor grid described in Section 4.6. All figures depict only the Elk Hills area. A recent SAI report⁽⁵⁾ displays expected concentrations in the oil fields to the west of Elk Hills.

4.8.1 SO_2 Annual Averages

Figures 12 and 13 display the CDM predictions for the annual average concentrations. Due to the fact that the Elk Hills existing equipment and proposed expansion consists of mainly gas-fired equipment, there are no annual average SO_2 predictions for NPR-1 facilities alone. Figures 12 and 13, therefore, show the "all operators" runs for the existing and future cases, respectively.

SO₂
CONCENTRATION
($\mu\text{g}/\text{m}^3$)

LEGEND

ISOPLETHS:

40.0 - - - - -

45.0 -

55.0 ————

X ORIGIN(KM) - 49.0

Y ORIGIN(KM) - 35.0

ZONING(KM) - 1.0

MAXIMUM

CONCENTRATION($\mu\text{g}/\text{m}^3$) - 58.9

LOCATED AT X - 49.0KM

Y - 37.0KM

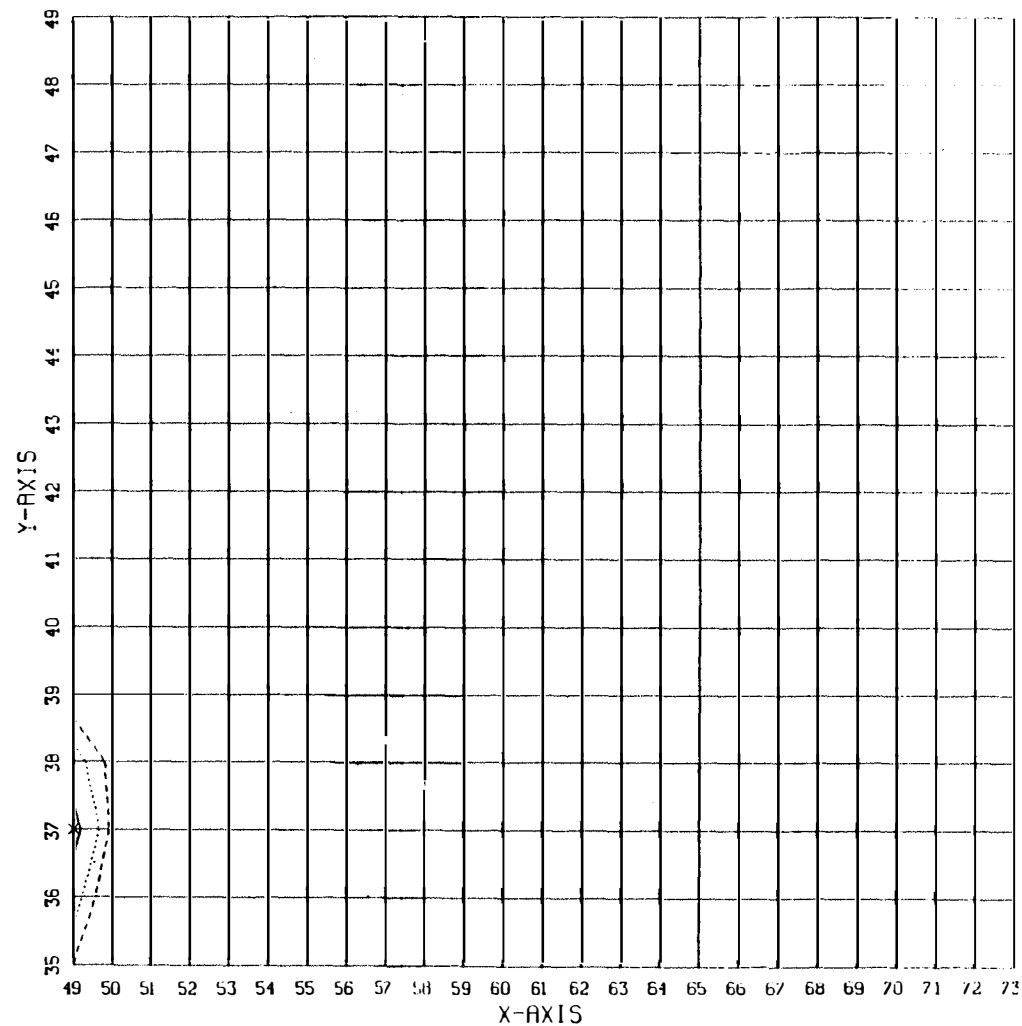
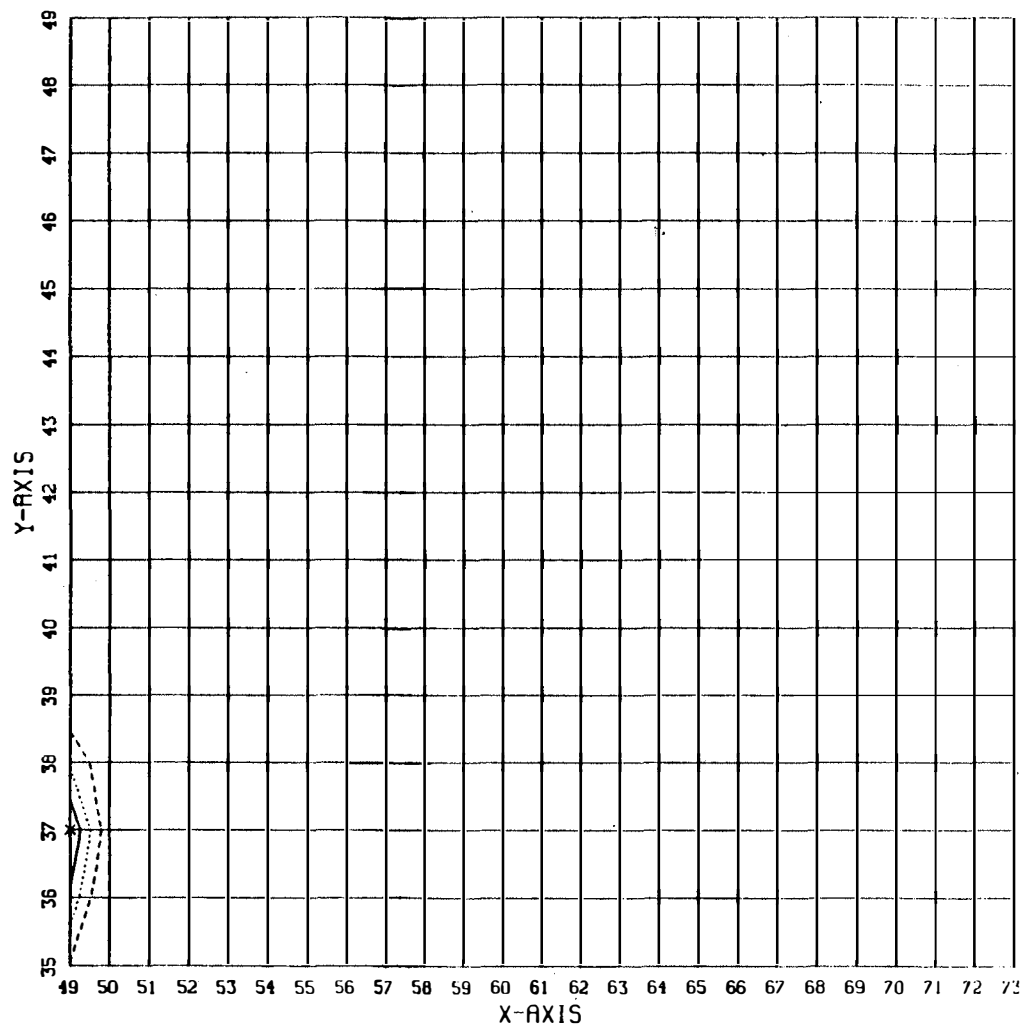


Figure 0-12

Annual Average SO₂ Concentration Contours for
All Existing Southwestern Kern County Background Oil Field Sources
Permitted as of 1 July 1978



SO₂
CONCENTRATION
($\mu\text{g}/\text{m}^3$)

LEGEND

ISOPLETHS:

40.0 -----
45.0
50.0 _____

X ORIGIN(KM)- 49.0

Y ORIGIN(KM)- 35.0

ZONING(KM)- 1.0

MAXIMUM

CONCENTRATION($\mu\text{g}/\text{m}^3$) - 55.1

LOCATED AT X- 49.0KM

Y- 37.0KM

Figure 0-13

Annual Average SO₂ Concentration Contours for
All Future Southwestern Kern County Background Oil Field Sources
Proposed as of 1 July 1978

The highest SO₂ concentration predicted for the Elk Hills area, due exclusively to background, is less than 30 percent of the annual SO₂ standard.

4.8.2 NO₂ Annual Averages

The CDM predictions of annual average NO₂ concentrations are displayed graphically in Figures 14 through 17.

Figure 14 presents the results for the present units at NPR-1, considered exclusively. No exceedances of the NO₂ standard for the existing case are predicted.

Figure 15 presents the CDM predictions of the "existing" NO₂ annual average concentrations when all operators in the central Kern County oil fields are considered. Figure 16 displays the NO₂ isopleths under the conditions of the proposed expansion plans ("future" case) when only NPR-1 facilities are considered, while Figure 17 presents the CDM predictions when all operators are included in the future case. In both cases, it is seen that NO₂ concentrations attributable to the increased oil recovery operations do not approach the Federal NO₂ annual average standard.

4.8.3 Particulate Annual Averages

The Federal primary standard for particulates is 75 micrograms/m³ (annual geometric mean). Particulate emissions are estimated at 0.7 lbs/bbl of oil burned; however, this estimation is very conservative as it does not account for the particulate scrubbing which is occurring in the western Kern County area, because when SO₂ scrubbing occurs, 25 percent of the particulate material is removed.

NO₂
CONCENTRATION
($\mu\text{g}/\text{m}^3$)

LEGEND

ISOPLETHS:

5.0 -----

7.5
 10.0 -----

X ORIGIN(KM)--3.0
Y ORIGIN(KM)--2.0
ZONING(KM)- 1.0

MAXIMUM
CONCENTRATION($\mu\text{g}/\text{m}^3$) - 13.7
LOCATED AT X- 15.0KM
Y- 2.0KM

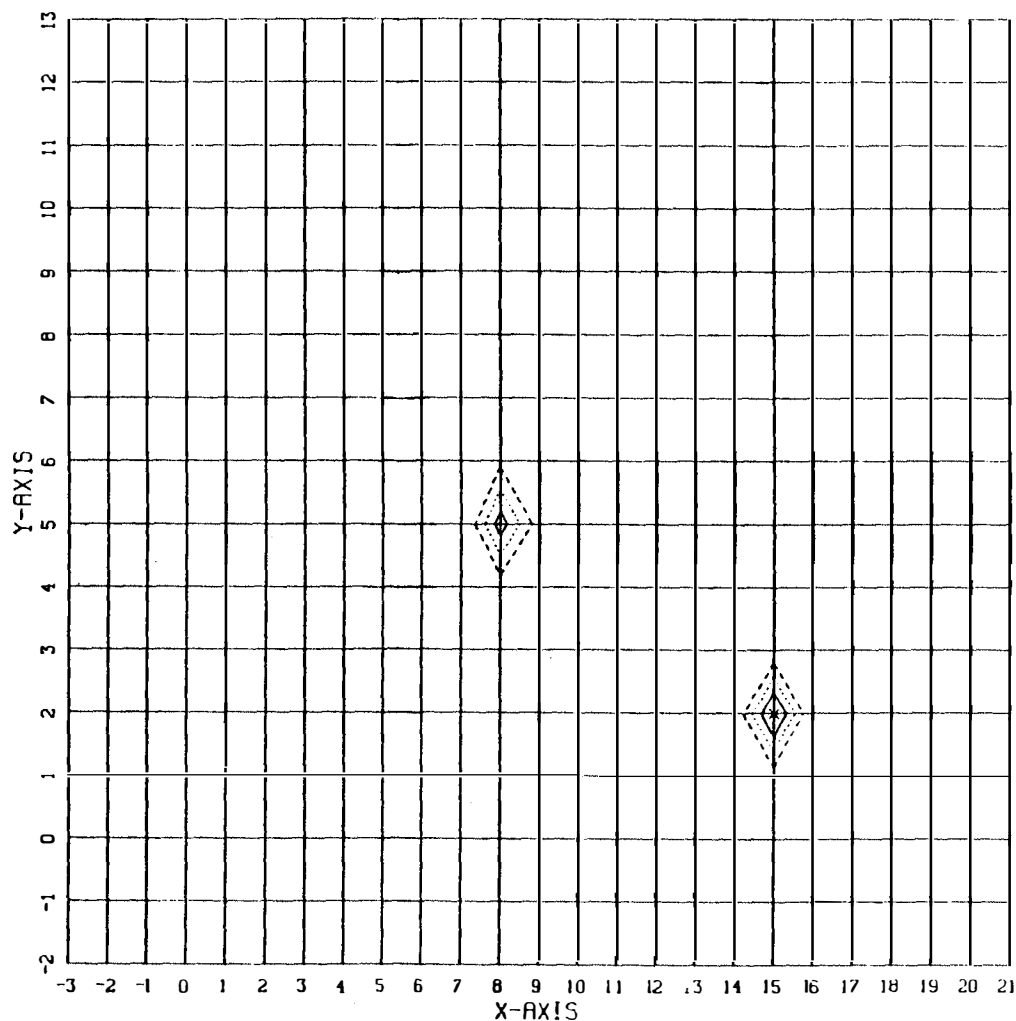


Figure 0-14

Annual Average NO₂ Concentration Contours for Existing Sources,
NPR-1 Facilities Only

NO₂
CONCENTRATION
($\mu\text{g}/\text{m}^3$)

LEGEND

ISOPLETHS:

18.0 - - - - -
20.0 -
22.0 - - - - -

X ORIGIN(KM)- 49.0

Y ORIGIN(KM)- 35.0

ZONING(KM)- 1.0

MAXIMUM
CONCENTRATION($\mu\text{g}/\text{m}^3$)- 23.9
LOCATED AT X- 49.0KM
Y- 37.0KM

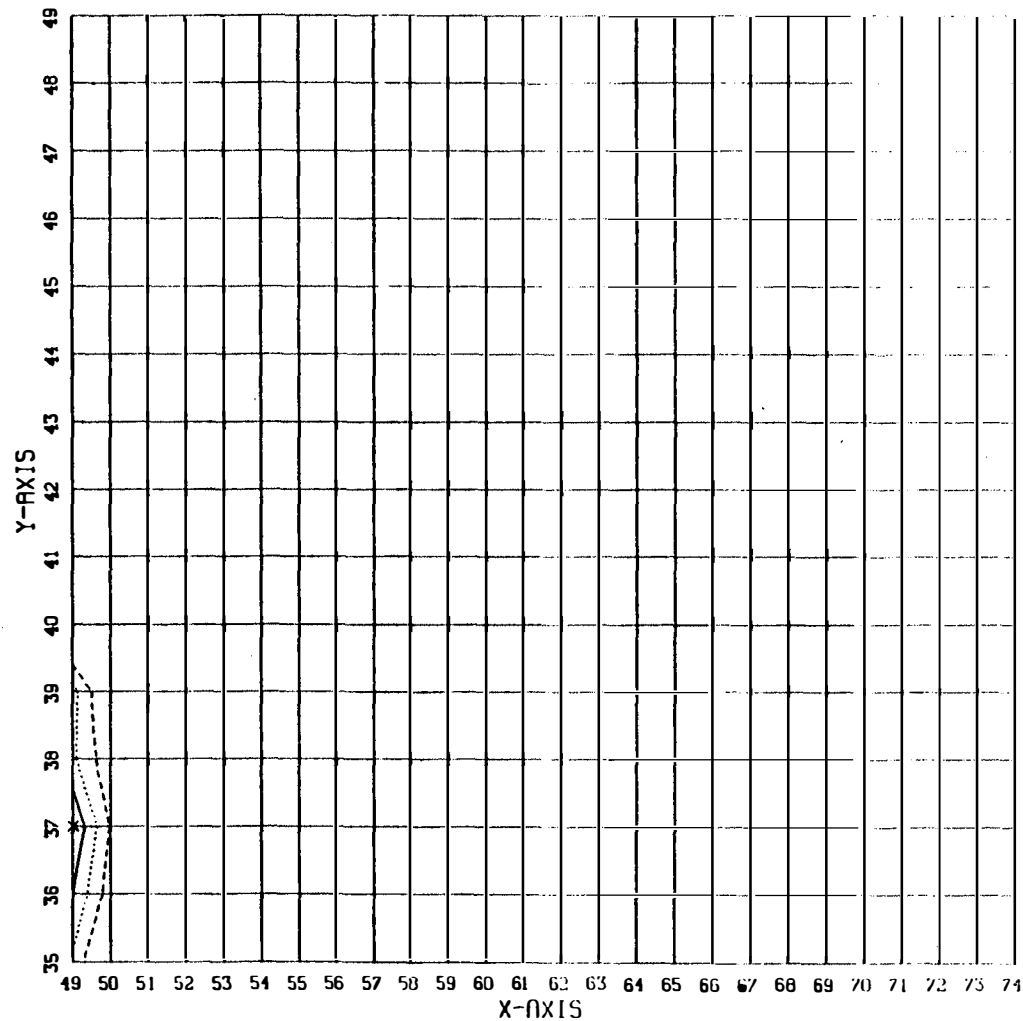


Figure 0-15

Annual Average NO₂ Concentration Contours for
All Existing Southwestern Kern County Background Oil Field Sources
Proposed as of 1 July 1978

NO₂
CONCENTRATION
($\mu\text{g}/\text{m}^3$)

LEGEND

ISOPLETHS:

8.0 - - - - -

12.0 - · - · - ·

16.0 - - - - -

X ORIGIN(KM) - -3.0

Y ORIGIN(KM) - -6.0

ZONING(KM) - 1.0

MAXIMUM

CONCENTRATION($\mu\text{g}/\text{m}^3$) - 23.0

LOCATED AT X- 8.0KM

Y- 5.0KM

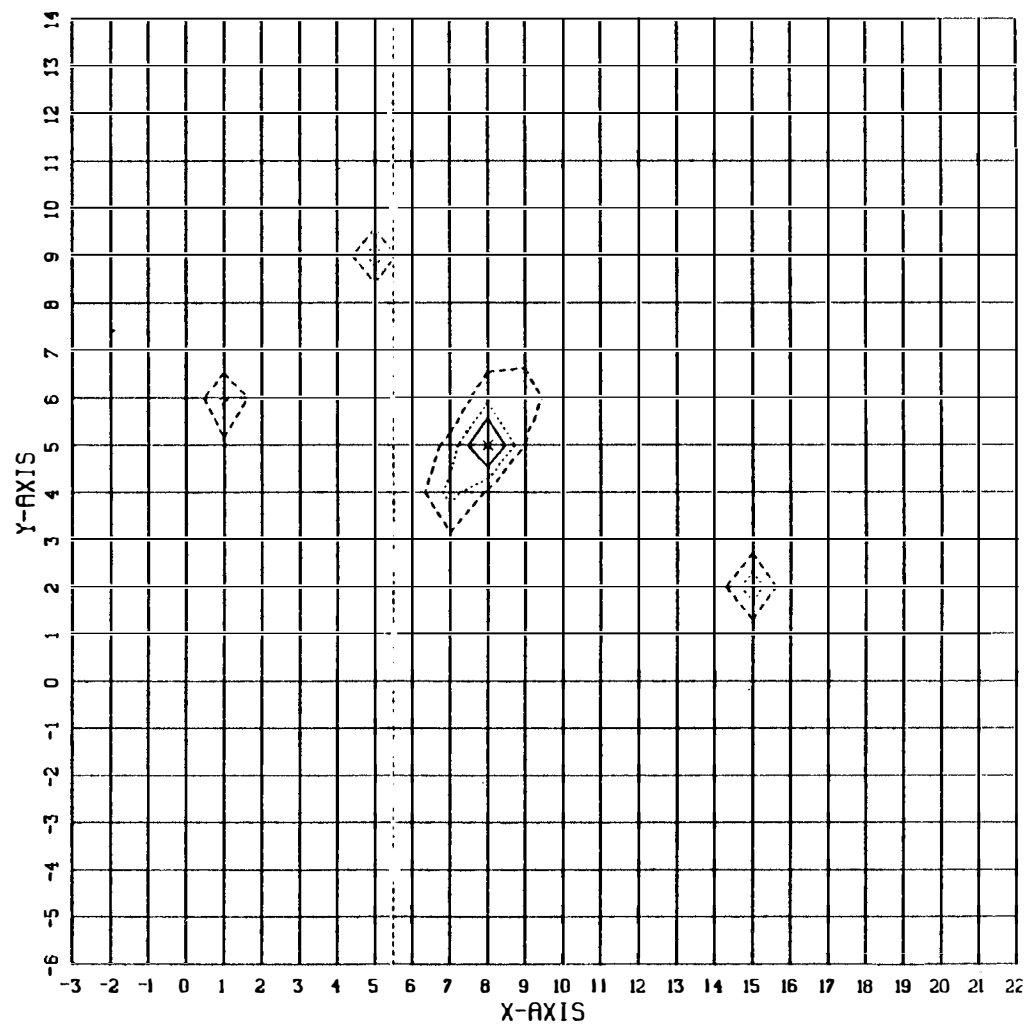


Figure 0-16

Annual Average NO₂ Concentration Contours for Future Case,
NPR-1 Facilities Only

NO₂
CONCENTRATION
($\mu\text{g}/\text{m}^3$)

LEGEND

ISOPLETHS:

10.0 -----

12.0 (dotted)

14.0 ————— (solid)

X ORIGIN(KM) = 49.0

Y ORIGIN(KM) = 35.0

ZONING(KM) = 1.0

MAXIMUM

CONCENTRATION($\mu\text{g}/\text{m}^3$) = 16.3

LOCATED AT X = 49.0KM

Y = 37.0KM

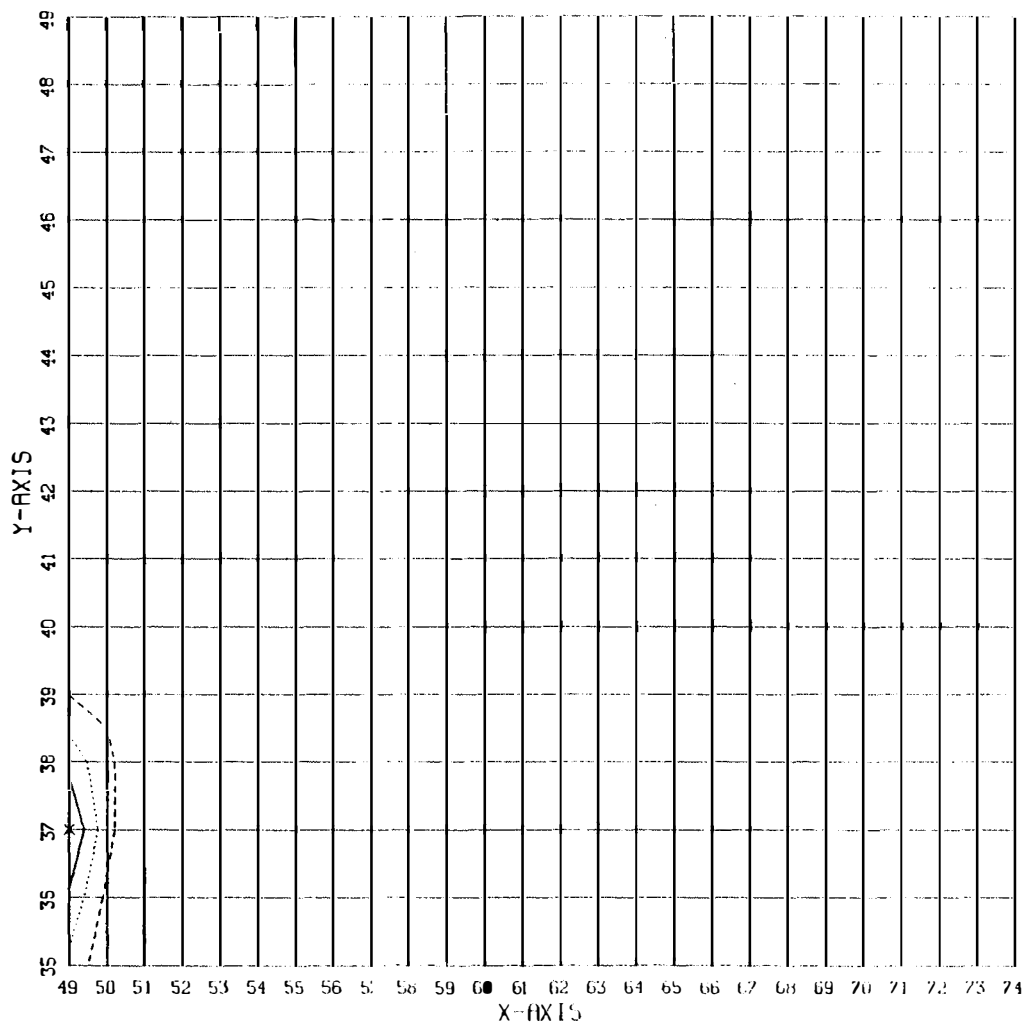


Figure 0-17

Annual Average NO₂ Concentration Contours for
All Future Southwestern Kern County Background Oil Field Sources
Proposed as of 1 July 1978

Scaling the maximum NO₂ isopleth of Figure 17 by 28 percent (0.7 lb particulate per bbl/2.52 lb NO₂ per bbl) to give an equivalent particulate isopleth results in the translation of the 16.3 micrograms/m³ to a 4.6 micrograms/m³ isopleth for particulates. According to the emissions factors in AP-42, for gas-fired equipment, the particulates in this study are less than 0.2 percent of the NO₂ emissions. Scaling the maximum NO₂ isopleth of Figure 16 by 0.002 to give an equivalent particulate isopleth results in the translation of 25.6 micrograms/m³ to 0.05 micrograms/m³, which is inconsequential. The scaled value of 4.6 micrograms/m³, therefore, is less than 7.0 percent of the Federal standard.

4.9 THE TEM MODEL

To compare oil recovery operations from the proposed NPR-1 expansion to short-term air quality standards, the EPA approved Texas Episodic Model (TEM) was employed. This model is a Gaussian dispersion model used for the prediction of concentrations of non-reactive pollutants from multiple point and area sources.

Input requirements for TEM are similar to CDM requirements. The equipment inventory of sources of pollutant emissions used is identical for both models. However, the meteorological data requirements differ. While CDM uses an annual average joint frequency distribution from long-term meteorological measurements, TEM requires data for 1-hour to 24-hour meteorological conditions in which wind speed, wind direction, and atmospheric mixing height are specified in sequential 3-hour periods. TEM employs steady-state bivariate Gaussian plume point source logic and calculates plume rise according to Briggs.

Although TEM has provisions for application of a calibration factor, TEM was applied without calibration in all cases

in this study. Insufficient data are presently available to accurately calibrate the model. Without calibration, TEM can be expected to predict very conservative short-term concentrations.

The TEM calculational grids were the same as the one kilometer sized rectangular receptor grid used in the CDM computations, and are shown graphically in Figures 11a and 11b.

4.10 SHORT-TERM METEOROLOGICAL CONDITIONS

In order to evaluate the various oil company projects in terms of the most severe potential short-term pollutant levels, it is necessary to define worst-case meteorological conditions. The existing SAI field measurement program in western Kern County continuously monitors hourly concentrations of SO₂ and records the associated meteorological parameters. Similar data for NO₂ were collected by Getty Oil Company. From these data "worst-case" episodes have been identified which result in the highest measured pollutant concentrations in the area. The conditions during which the maxima were recorded for each of the short-term averaging periods identified the meteorological parameters at each monitoring site which were utilized for the worst-case calculations. To supplement these calculations, three other secondary worst-case scenarios were developed for each averaging time. The scenarios were developed to particularly include different meteorological conditions which lead to similarly high SO₂ concentrations that were measured. The TEM required meteorological input that was developed from the meteorological monitoring stations with the exception of mixing height data which were obtained from Holzworth.⁽⁸⁾ Through 1977, the four worst 1-hour periods, in terms of SO₂, occurred June 25, 1977 (Scenario 1); November 19, 1976 (Scenario 2); August 10, 1977 (Scenario 3); January 31, 1977 (Scenario 4). A detailed tabulation of the meteorological data used in the TEM runs is presented in Appendix C.

4.11 MODELING RESULTS -- SHORT-TERM AVERAGES

Twenty-four calculations of the short-term consequences of the proposed NPR-1 project were performed. For each of the four meteorological scenarios, calculations were performed for one averaging period (the 1-hour case) and four categories of equipment inventory (NPR-1 only, "existing"; all operators, "future"). Here "existing" and "future" have the same definition as was applied in the CDM calculations. Copies of the computer output of those TEM runs which resulted in the highest concentrations or were the basis of key points in this analysis are presented in Appendix D.

4.11.1 One-Hour Averages: SO₂

Since the Elk Hills MER project will not consist of any oil-fired equipment, the SO₂ emissions are negligible; however, the TEM model was run for background emissions. Table 15 presents the existing and future concentration predictions when all operators in the southwestern Kern County are included. Scenario D yielded the worst SO₂ concentration: 378 micrograms/m³ in the future. This value is about 29 percent of the State 1-hour maximum of 1310 micrograms/m³. Figure 18 shows the isopleths along with the grid used. All of the other worst-case scenarios showed lower maximum concentrations.

4.11.2 One-Hour Averages: NO₂

Table 16 presents the existing and future NO₂ concentration predictions using the one-hour meteorological scenarios for NPR-1 only. As can be seen from the table, the proposed NPR-1 expansion will affect the maximum ground level NO₂ concentrations. Table 17 presents the analogous data for all operators.



TABLE 0-15

SHORT-TERM MODELING RESULTS: SO₂ ELK HILLS REGION
ONE-HOUR WORST CASE METEOROLOGIES

- BACKGROUND SOURCES -

	PREDICTED MAXIMUM -HOUR AVERAGE ($\mu\text{g}/\text{m}^3$)	LOCATION OF MAXIMUM PREDICTED IMPACT					
		X COORDINATE	Y COORDINATE	TOWNSHIP	RANGE	SEC.	QTR.
A. <u>October 5, 1975</u>							
Existing	186	49	35	31S	22E	22	NE
Future	266	49	35	31S	22E	22	NE
B. <u>October 8, 1975</u>							
Existing	61	57	35	31S	24E	21	NE
Future	89	57	35	31S	24E	21	NE
C. <u>December 17, 1975</u>							
Existing	2	50	35	31S	22E	23	NW
Future	3	49	38	31S	22E	10	NE
D. <u>December 25, 1975</u>							
Existing	389	54	36	31S	23E	18	SE
Future	378	50	35	31S	22E	23	NW

SO₂
CONCENTRATION
($\mu\text{g}/\text{m}^3$)

LEGEND

ISOPLETHS:

325.0 -----

350.0
375.0 -----

X ORIGIN(KM)- 49.0

Y ORIGIN(KM)- 35.0

ZONING(KM)- 1.0

MAXIMUM

CONCENTRATION($\mu\text{g}/\text{m}^3$) - 378.2

LOCATED AT X- 50.0KM

Y- 35.0KM

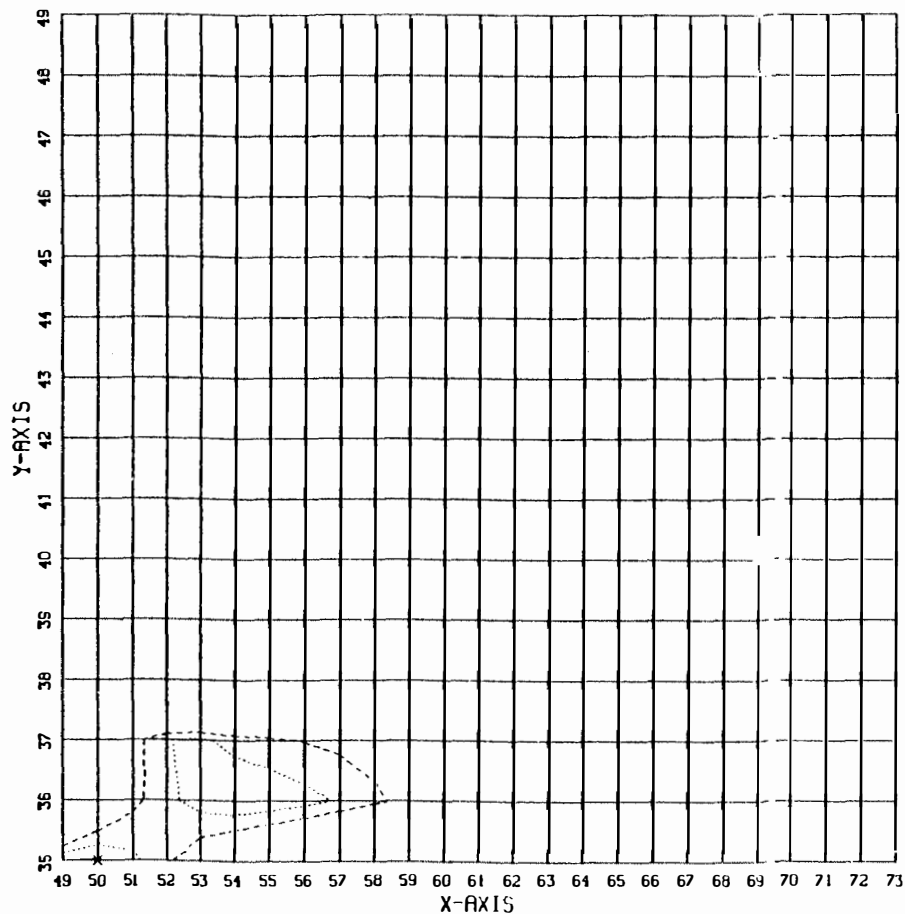


Figure 0-18

TEM Future Case SO₂ Isopleths
for 1-Hour Worst-Case, All Operators
Background Sources

TABLE 0-16
SHORT-TERM MODELING RESULTS: NO₂ ELK HILLS REGION
ONE-HOUR WORST CASE METEOROLOGIES
- NPR-1 FACILITIES ONLY -

	PREDICTED MAXIMUM -HOUR AVERAGE ($\mu\text{g}/\text{m}^3$)	LOCATION OF MAXIMUM PREDICTED IMPACT					
		X COORDINATE	Y COORDINATE	TOWNSHIP	RANGE	SEC.	QTR.
A. <u>January 25, 1977</u>							
Existing	270	9	1	31S	23E	12	SE
Future	461	11	- 1	31S	24E	18	SE
B. <u>November 19, 1976</u>							
Existing	53	7	9	30S	23E	15	NW
Future	178	7	7	30S	23E	22	SW
C. <u>August 10, 1977</u>							
Existing	69	7	- 1	31S	23E	15	SW
Future	158	7	2	31S	23E	2	SW
D. <u>January 31, 1977</u>							
Existing	128	17	2	31S	24E	2	SW
Future	196	14	4	30S	24E	33	NE

TABLE 0-17
 SHORT-TERM MODELING RESULTS: NO₂ ELK HILLS REGION
 ONE-HOUR WORST CASE METEOROLOGIES
 - BACKGROUND ONLY -

	PREDICTED MAXIMUM -HOUR AVERAGE ($\mu\text{g}/\text{m}^3$)	LOCATION OF MAXIMUM PREDICTED IMPACT					
		X COORDINATE	Y COORDINATE	TOWNSHIP	RANGE	SEC.	QTR.
A. <u>January 25, 1977</u>							
Existing	44	49	35	31S	22E	22	NE
Future	111	49	35	31S	22E	22	NE
B. <u>November 19, 1976</u>							
Existing	27	49	37	31S	22E	10	SE
Future	60	57	35	31S	24E	21	NE
C. <u>August 10, 1977</u>							
Existing	--	--	--	--	--	--	--
Future	28	49	38	31S	22E	10	NE
D. <u>January 31, 1977</u>							
Existing	104	54	36	31S	23E	18	SE
Future	170	52	37	31S	22E	12	SE

The State 1-hour standard is 470 micrograms/m³. TEM predicts no exceedance of this standard. Scenario 1 for the future case predicts a maximum of 461 micrograms/m³ or 98 percent of the State standard. The worst case isopleths are shown in Figures 19 and 20. Figure 19 displays the future Elk Hills area when only NPR-1 facilities are considered, and Figure 20 shows the future case when all Westside operators, exclusive of the NPR-1 facilities, are considered.

As discussed previously, when the NPR-1 is overlaid with the background data a resultant figure is obtained. However, when the maximum of 461 micrograms/m³ is reached, the wind direction is such that TEM predicts no NO₂ impingement from the background sources. There is some infringement on the reserve from background sources, but in the "maxima" areas the contribution from background sources is predicted to be zero.

For the NPR-1 project, 100 percent conversion of NO_x to NO₂ was assumed, in accordance with EPA's guidelines,⁽¹⁾ and past indications from Kern County that this was the only acceptable conversion rate. Such assumptions were included to insure consistency with previous work. In this case conservatism leads to predictions of very close approach to the State standards. However, using less stringent, but still conservative assumptions, there would be a much larger margin.

NO₂
CONCENTRATION
($\mu\text{g}/\text{m}^3$)

LEGEND

ISOPLETHS:

325.0 -----

350.0 (dotted line)

400.0 _____ (solid line)

X ORIGIN(KM)--3.0

Y ORIGIN(KM)--12.0

ZONING(KM)- 1.0

MAXIMUM

CONCENTRATION($\mu\text{g}/\text{m}^3$)= 461.4

LOCATED AT X= 11.0KM

Y=-1.0KM

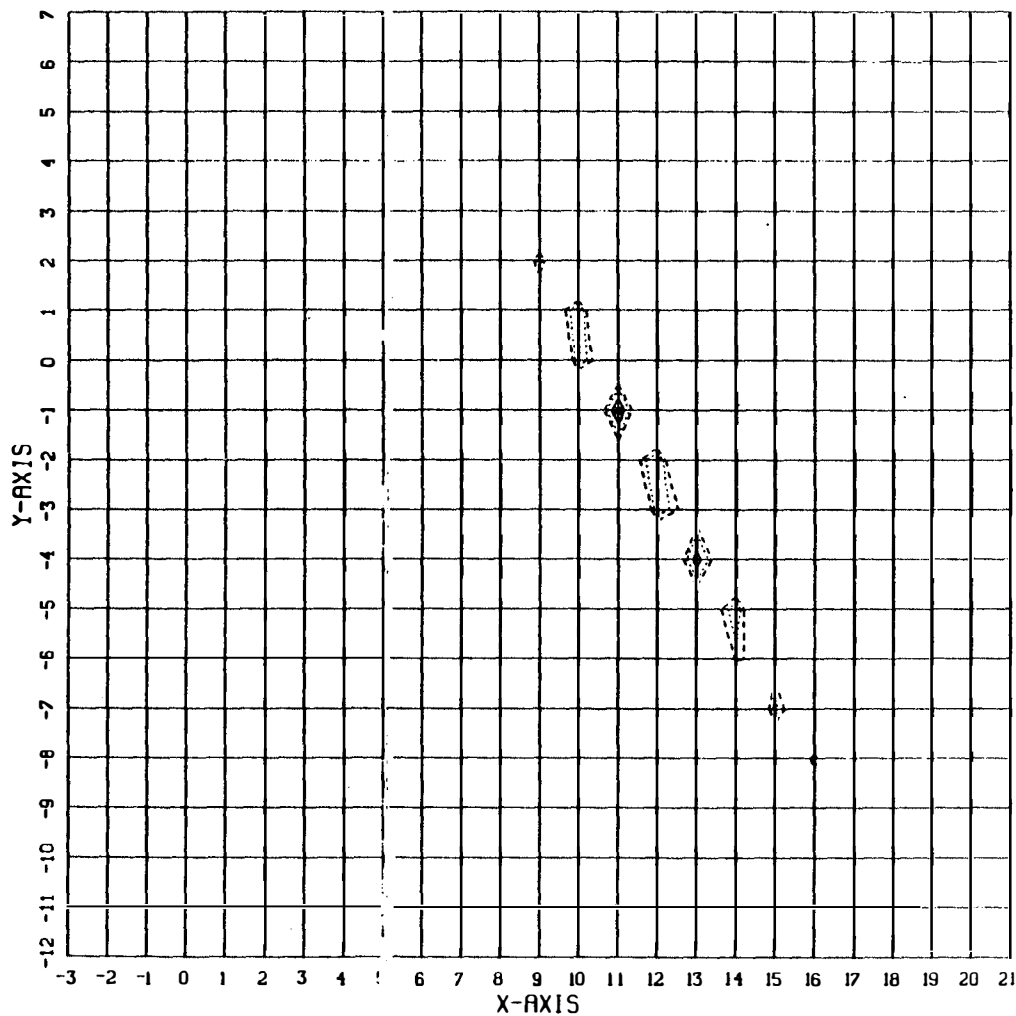


Figure 0-19

TEM Future Case NO₂ Isopleths for
1-Hour Worst-Case, NPR-1 Facilities Only

NO₂
CONCENTRATION
($\mu\text{g}/\text{m}^3$)

LEGEND

ISOPLETHS:

145.0 - - - - -

155.0 ······

165.0 ————

X ORIGIN(KM) - 49.0

Y ORIGIN(KM) - 35.0

ZONING(KM) - 1.0

MAXIMUM

CONCENTRATION($\mu\text{g}/\text{m}^3$) - 170.1

LOCATED AT X- 52.0KM

Y- 37.0KM

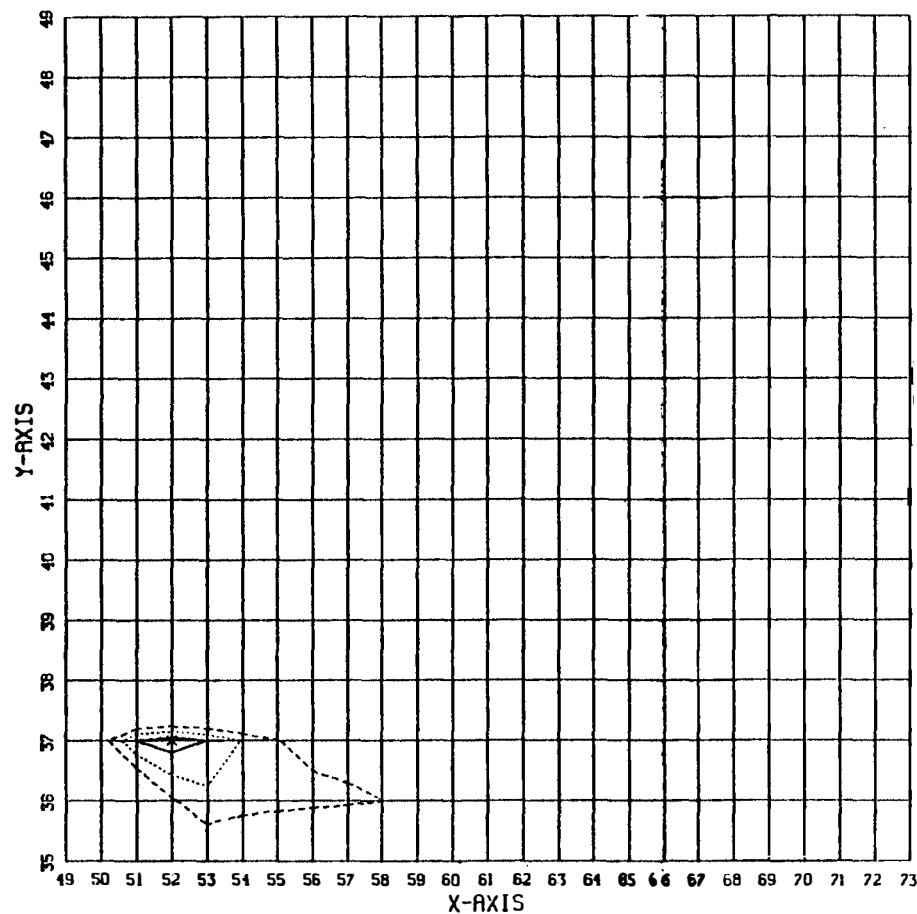


Figure 0-20

TEM Future Case NO₂ Isopleths for
1-Hour Worst-Case, Background Sources Only

5. SUMMARY OF RESULTS

5.1 COMPLIANCE WITH THE CLEAN AIR ACT OF 1977

The Clean Air Act of 1977 has established regulations designed to further prevent significant deterioration of air quality in all areas of the country which presently do not exceed the National Ambient Air Quality Standards (NAAQS). The PSD regulations establish three classifications by which to identify each area of the country. These classifications serve to set limits upon the incremental increase in ambient SO_2 and particulate concentrations over a baseline concentration.

Regulations defining how the Act is interpreted have been published in the June 19, 1978 Federal Register.⁽¹⁴⁾ They establish a "two-tier" criteria for evaluating whether projects must undergo PSD review. In the case of steam generators, uncontrolled (or potential) emissions of greater than 250 tons/yr of any criteria pollutant is subject to PSD. It is important to note that PSD applies only to those pollutants over the 250 ton/yr cut-off, and again only for those pollutants for which attainment status with the NAAQS has been achieved in the locality of the project. Controlled emissions of less than 50 tons/yr, 1000 lbs/day or 100 lbs/hr will be exempted from any further PSD review. Any criteria pollutants exceeding the above values will then be subject to the increment review and BACT review.

The proposed MER project at Elk Hills would emit 16 tons/yr of SO_2 with the inclusion of increased traffic through the area. As Table 12 indicates, however, several pollutant increases will be greater than 250 tons/yr, notably NO_2 , THC, and CO, therefore a PSD review will be required.



5.1.1 Compliance with the EPA's Interpretative Ruling

The January 16, 1979 Federal Register contained an Interpretative Ruling, supplying interpretation to EPA's New Source Review regulation (40 CFR 52.233 (g)), which applies to this source. In essence, the Ruling provides that sources whose allowable emissions are less than 50 tons/yr will be considered to be sources of minor significance. In the case of the proposed project, the pollutants SO₂ and particulate matter have allowable emissions below this cut-off level as will be discussed in more detail below.

For pollutants whose allowable emissions exceed the 50 ton/yr cut-off, the Ruling provides that for non-attainment pollutants, a Lowest Achievable Emission Rate for that pollutant be obtained, and emission offsets secured to represent a net benefit to the air quality. For attainment pollutants below 250 tons/yr (uncontrolled), the Ruling requires that it be demonstrated that major emissions of such pollutants will not cause a violation of any NAAQS.

5.2 POLLUTANT SUMMARY

The model calculations provide predictions of ground level concentrations for pollutants emitted directly by the proposed new NPR-1 expansion, and provide the basis for estimates of the ground level concentrations of secondary pollutants. These predictions are discussed for each pollutant in the following paragraphs.

5.2.1 Sulfur Dioxide

The background oil field equipment included in this study is the principal SO₂ source in the region. Measurements in southwestern Kern County show no levels in excess of any SO₂

air quality standards; and, in fact, the highest they have ever reached through 1977 is 34 percent of any Federal SO₂ standard and 68 percent of the most restrictive State standard. The worst-case maximum predicted by TEM for the Elk Hills area is 332 micrograms/m³, or 25.3 percent of the State 1-hour standard.

SO₂ monitoring in western Kern County will continue and will provide a further measure of the precision of the calculated predictions.

5.2.2 Nitrogen Dioxide

Calculations indicate that the NO emitted by the oil field equipment will not cause any NO₂ standards to be exceeded. The background levels due to contributions from other sources are also expected to be relatively low in the impacted areas. The NO₂ standards are not expected to be exceeded throughout the area, even though they may be predicted to be relatively high.

NO₂ monitoring being conducted by Getty Oil Company has shown that to date only 45 percent of the short-term standard and 13 percent of the annual standard have been preempted in western Kern County. Calculations are based on the conservative assumption that 100 percent of all emitted NO converts to NO₂. Even when the short-term model predictions are not corrected to a more realistic conversion rate, no exceedances of the 1-hour State standard are predicted despite the inherent difficulties with modeling of these sources.

5.2.3 Particulates

Particulate standards are exceeded throughout the San Joaquin Valley portion of Kern County. However, analyses to determine the source of these particulates normally show a large percentage (~55 percent) of inerts (primarily rock minerals such

as silica and silicates) and acid-soluble materials (primarily iron and aluminum oxides) which appear to be derived mainly from wind-blown soil particles. High levels of soil particulates may be unavoidable in a highly developed agricultural area with poor ventilation (mountains on three sides) and very low (~10 in.) annual rainfall (soil is nearly always dry). Analyses also show a significant (~30 percent) water-soluble portion and some (~15 percent) organics which appear to be partly combustion products and partly from activities other than fuel consumption, including soil erosion. Calculations discussed previously indicate that production operations in the Elk Hills area will not cause any exceedance of any Federal standards. In fact, the predicted annual average particulate concentrations from these sources are below Federal standards even when using conservative estimates.

5.2.4 Hydrocarbons

Hydrocarbon (HC) levels in the Elk Hills area are known to be fairly high. The unit operator, however, plans to offset 100 percent of the existing emissions by flaring the vent gas from their 35R gas plant. This will result in an overall decrease of 45 percent, even after the proposed expansion is taken into account.

5.2.5 Carbon Monoxide

Carbon monoxide (CO) emissions from the oil field equipment are approximately ten percent of the NO₂ emissions. Since CO standards are relatively lenient (over 10 times the NO₂ standards), the increase in CO concentrations due to increasing oil recovery operations is an insignificant percentage of the CO standards.

5.2.6 Oxidants

Oxidant levels measured at the Taft monitoring station show levels in excess of the Federal standards on several occasions. It is known that nitric oxide (NO) emissions from the compressors contribute to the photochemical process which results in the formation of oxidants; however, the relationship between NO emissions and oxidant formation is not sufficiently well understood to quantify the effect of these emissions. It is known, however, that oxidant levels in the immediate vicinity of the oil field equipment will be reduced as the NO reacts in part with the available O_3 to create NO_2 . The substantial reduction in HC levels should result in some reduction in oxidant formation due to the role of HC as a prime precursor in oxidant reactions.

5.2.7 Sulfate

No substantiated sulfate level exceedances have been measured in the western Kern County area. During most seasons of the year, the generally low average relative humidity in the area tends to inhibit sulfate formation as most sulfate production mechanisms require humidity in excess of 70 percent. The extent to which sulfate is caused by transformation of generator SO_2 emissions is not fully understood at this time. At any rate, the negligible increase in SO_2 emissions which will occur as a result of the project proposed in this study will result in only a negligible increase in anthropogenic sulfate.

5.2.8 Nitrate

No State or Federal standards exist for nitrate levels; however, they do contribute to particulate levels. Little is known at this time which could quantify their formation. Photochemical processes assist in nitrate formation as does the presence of ammonia. It is possible that some nitrate formation

could occur from the NPR-1 expansion project, but the extent to which the nitrate would change the projected particulate concentrations is unknown.

5.2.9. Conclusions

As a result of this analysis, several conclusions are reached: (1) no Ambient Air Quality standards have been exceeded; (2) the expansion of NPR-1 will not degrade the existing ambient air quality; and (3) the air quality, in some instances, such as the case for hydrocarbons, will actually be beneficial, due to the increased usage of pollution control equipment.

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APPENDIX P

DISCUSSION OF INCREASED PRODUCTION AT NPR-1 AND THE CRUDE OIL SUPPLY AND DEMAND SITUATION IN CALIFORNIA

1. INTRODUCTION

A basic policy objective for increased crude oil production at NPR-1 is to increase overall domestic production of crude oil, the nation's leading source of energy, and thus reduce dependence on foreign supplies. Reduced imports will also favorably impact the nation's balance of payments. After many years as the world leader in oil production, the United States began to import more oil than it exported in 1947. The proportion of imported oil steadily grew to 21% of domestic consumption in 1965, 37% in 1974, and 45% in September 1978, reflecting the affluent lifestyles that emerged in the United States after 1945. However, this level of imports resulted in a vulnerability which was dramatically demonstrated during the embargo of 1973-74.

While an objective of increased Elk Hills production is to decrease United States dependence on foreign sources, the recent arrival of Alaskan North Slope oil on the West Coast and increased California offshore production have raised questions about the impact Elk Hills production will have on the California oil market. Two recent studies have dealt with this issue. The government contracted with the Pace Company to study the impact that NPR-1 crude will have on the competitive market. This study was completed in August 1977, just as Alaskan oil began to reach the West Coast. Another study entitled "Effects of Alaskan North Slope and Continued Crude Oil Production at Elk Hills Naval Petroleum Reserve" was prepared by the General Accounting Office in July 1978.

The purpose of this appendix is to evaluate the impacts of Elk Hills production at maximum efficient rate on the West Coast market, based upon

the two studies cited above and other available data. The petroleum market operates in a highly complex environment. Government regulations, foreign events, the state of the economy, changing lifestyles, and even the weather influence the demand for petroleum products. Given this situation, it is extremely difficult to establish precisely how one particular action, such as increased production at one location, will have on the overall market. Nonetheless, by reviewing available data, it is possible to draw some inferences about the impact of increasing Elk Hills productions.

2. THE CALIFORNIA PETROLEUM MARKET

Until full-scale Alaskan oil production began in 1978, California was the third largest crude oil producing state. Historically, California has operated as a relatively isolated market, consuming the oil it produced. About half the state's production is by independent producers. California crudes tend to be "heavy" and "sour". Elk Hills crude, however, is of better quality, being lighter and lower in sulfur content (0.4 to 0.7 percent). Light crudes are desirable because they yield more gasoline and jet fuel. Heavy crudes yield greater amounts of residual fuel oil. California's air quality standards require a low sulfur content in fuel oil. Indonesian crude, due to its very low sulfur content (.05 to 0.7 percent) is imported into California for the production of residual fuel oil, much of which is used by utility companies to generate electricity. Only two refineries in the state are equipped with desulfurization capability and economic considerations dictate against further installation of desulfurization equipment in the near-term. Thus, Elk Hills production cannot be expected to greatly displace imports of Indonesian crude oil. Most California refiners desire the very low sulfur Indonesian crude to blend with higher sulfur Alaskan North Slope crude to produce a residual fuel which meets California's stringent air quality standards.

3. ALASKAN NORTH SLOPE PRODUCTION

In July, 1977, the first oil produced at Alaska's North Slope reached Valdez, the southern terminus of the Trans Alaskan Pipeline. Production steadily increased after that and reached the pipeline's capacity of 1,150,000 barrels per day in March 1978. Ownership of Alaskan crude is allocated as follows: SOHIO/BP 49%; Atlantic Richfield 21%; Exxon 20%; Mobil 5%; others 6%.* The three major partners, excluding SOHIO/BP, have West Coast refineries to which they ship most of their Alaskan oil. The remainder is being sold to other West Coast refineries or is being shipped through the Panama Canal to Gulf and East Coast refineries. Some of the Alaskan oil used at West Coast refineries has displaced foreign oil.* SOHIO/BP is seeking approval for a pipeline from Long Beach, California to Midland, Texas to transport its Alaskan oil. At the present time, SOHIO/BP is selling its share to other West Coast refineries, or shipping it through the Panama Canal.

4. THE WEST COAST OIL SURPLUS

The advent of Alaskan oil production has resulted in a temporary surplus of oil on the West Coast and calls into question the impact that additional new crude supplies from Elk Hills will have on this surplus situation.

Several east-west pipelines have been proposed to deliver Alaskan crude to the Midwest and Eastern markets where it is needed. However, completion of these pipelines is years away. SOHIO's proposal for a pipeline from Long Beach to Midland, Texas has recently cleared several important hurdles, including (1) an innovative agreement with the State to reduce air emissions for other polluters to compensate for projected emissions from the oil terminal, and (2) support from the citizens of Long Beach in a referendum. Nonetheless, the SOHIO project faces further tests before it can be constructed. The SOHIO pipeline will provide a potential outlet for Elk Hills crude. In the meantime, Elk Hills production must be marketed in California.

*Pacific Oil World, May 1978; GAO Report, July 1978

According to the California Independent Producers Association*, Elk Hills production will have an adverse effect on independent producers.

The government commissioned a study in 1977 by the Pace Company, to assess the effect of Elk Hills crude production on California markets. The study concluded that the surplus situation would lead to price pressure on locally produced crude oil. The Pace study suggested that little California oil would actually be shut in, because the Department of Energy would step in to encourage continued California production (which it has done by way of revisions to the entitlements program). The report recommended that production at Elk Hills be held to a low level until direct crude oil transportation to the Gulf Coast or Midwest is available.

According to the more recent GAO report, no quantifiable evidence was found to show that Elk Hills production was limiting other California production. Much of the concern of California independent producers seems to have been directed at the entitlements program. The Oil and Gas Journal reported recently that adjustments by the Department of Energy in the entitlements program have relieved this concern and "...that virtually all California production now has a market."**

The GAO report concluded that although the Alaskan production is resulting in an excess of oil supply over demand on the West Coast (estimated in April 1978 to be 580,000 barrels per day), benefits still accrue to our national interest from production at Elk Hills including improvements in the balance of payments and displacement of crude oil imports.

*See testimony of Stephan Pehanich at public hearing, Section X.

**Oil and Gas Journal, December 4, 1978, p. 47.

With respect to the oil surplus, three options were identified to resolve this problem:

- (1) an exchange of oil with Japan, an alternative the Administration has decided against;
- (2) shipment of excess crude oil by pipeline to the Midwest and East, an option favored by the GAO, but as noted above, pipelines have not yet been constructed;
- (3) shipment of excess crudes to the Gulf and East coasts by tanker through the Panama Canal, the course being taken at present, at additional transportation costs;

5. USE OF NATURAL GAS AT ELK HILLS

The Naval Petroleum Reserves Production Act of 1976 requires that the petroleum reserves be produced at their maximum efficient rate consistent with sound engineering practices. To do this at Elk Hills, the Government injects residue gas into the reservoir to maintain pressure and to insure maximum recovery of hydrocarbons (oil, liquid petroleum gas products, and natural gas). Thus the proposed method of production, including injection of residue gas, at this time, is in accord with enacted energy legislation. A water-flood program has been initiated at Elk Hills as an eventual replacement of residual dry gas injection in certain reservoirs. If successful, some gas will be available for sale. Although immediate production and sale of the gas would result in a current increase in domestic gas production such premature production prior to a successful water injection program would cause a significant decrease in the ultimate hydrocarbon recovery from Elk Hills and is, therefore, undesirable. When the majority of the Elk Hills oil has been depleted or natural gas is no longer needed to maintain maximum efficient recovery levels, it can be produced and marketed.

6. CONCLUSION

Development of Elk Hills to produce oil at the maximum efficient rate is the result of a Congressional mandate intended to reduce the United States' dependence on foreign oil and aid the balance of payments. However, the large-scale production of Alaskan oil, the need to continue imports of low-sulfur Indonesian crude into California for environmental reasons, and the absence of pipeline transmission eastward have combined to result in a surplus of crude oil on the West Coast. Nonetheless, there is evidence that Alaskan and Elk Hills production are displacing some imports and aiding the nation's balance of payments. Excess production is presently being shipped by tanker to Gulf and East Coast ports. There is no direct evidence of independent producers being shut-in as a result of Elk Hills production. Accordingly, the intent of the Congressional mandate is being met by Elk Hills production.

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